

T.R.N.C

**NEAR EAST UNIVERSITY
INSTITUTE OF HEALTH SCIENCES**

**CRITICAL CARE NURSES' KNOWLEDGE ON
PREVENTION OF VENTILATOR ASSOCIATED
PNEUMONIA AND BARRIERS OF ADHERENCE TO
PREVENTIVE MEASURES**

MOATH ALKHAZALI

**In Partial Fulfillment of the Requirements for the
Degree of
Master of Nursing (Emergency Nursing)**

NICOSIA 2017

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Master of Nursing (Emergency Nursing)

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APPROVAL

The Directorate of Graduate School of Health Sciences, This study has been accepted by the thesis committee in nursing program as a master of emergency nursing thesis.

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According to the relevant article of the Near East University Postgraduate Study-Education and Examination Regulation, this thesis has been approved by the above-Mentioned members of the thesis committee and the decision of the board of Directors of the Institute.

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DECLARATION

I hereby declare that the work in this thesis entitled “**Critical Care Nurses’ Knowledge on Prevention of Ventilator Associated Pneumonia and Barriers of Adherence to Preventive Measures.**” is the study of my own research efforts undertaken under the supervision of **Prof. Dr. Nurhan Bayraktar**.

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Critical Care Nurses' Knowledge on Prevention of Ventilator Associated Pneumonia and Barriers of Adherence to Preventive Measures

ABSTRACT

Introduction: Ventilator associated pneumonia (VAP) is the most prevalent infection in intensive care units (ICUs), with the highest mortality rate among nosocomial infections. There is a need to increase knowledge and awareness of nurses on VAP risks and prevention to avoid complications.

Objectives: The aim of the study is determination of the knowledge on prevention of ventilator associated pneumonia and barriers of adherence to preventive measures of the critical care nurses.

Methods: The study was performed as descriptive design on critical care nurses ($n = 193$) in two hospitals of Jordan. A questionnaire that was developed by the researchers was used as data collection tool. Data were collected in June-July 2017. Descriptive statistics and Pearson Chi-Square tests were used in analysis of the data.

Results: Results of the present study showed high level of knowledge on general VAP knowledge and VAP prevention. Regarding to barriers of nurses to adherence to VAP prevention guidelines, there were high rates of “sometimes” and “always” and low rates of the “never” answers. The main self-reported barriers towards evidence-based guidelines were Shortage of staff in the ICU, Lack of time and educational programs on VAP.

Conclusions: Continuous educational programs in order to enhance the knowledge and practices of the nurses on VAP, and national and institutional regulations to prevent barriers of VAP prevention were recommended.

Keywords: Critical care nurses, VAP, Prevention, Knowledge, Barriers.

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List of Abbreviations

HAI	Hospital Acquired Infections
CDC	Centers For Disease Control And Prevention
VAP	Ventilator Associated Pneumonia
ICUs	Intensive Care Units
ETT	Endotracheal Tube
MV	Mechanical Ventilator
ARDS	Acute Respiratory Distress Syndrome
IHI	Institute For Healthcare Improvement
NIPPV	Noninvasive Positive Pressure Ventilation
VAE	Ventilator Associated Event
DVT	Deep Vein Thrombosis
SATs	Spontaneous Awakening Trials
SBTs	Spontaneous Breathing Trials
HOB	Head Of Bed
PVC	Polyvinyl Chloride
RAs	Nurse Assistants
RNs	Registered Nurses

1. INTRODUCTION

1.1 Problem Definition

Hospital acquired infections (HAI), also known as nosocomial infections are important problem all over the world. This term is used for any disease acquired by patient under medical care (Krishna, 2014). Recently, a new term, “healthcare associated infections” is used for the type of infections caused by prolonged hospital stay and it accounts for a major risk factor for serious health issues leading to death (Brusaferro et al, 2015). About 75% of the burden of these infections is present in developing countries (Obiero et al, 2015). The U.S.A Centers for Disease Control and Prevention (CDC, 2015) estimates that HAIs in American hospitals account for approximately 1.7 million infections and 99,000 associated deaths each year. Based on a study of a large sample of the U.S.A. acute care hospitals, on any given day, approximately 1 in 25 hospital patients has at least one healthcare-associated infection (CDC, 2015). In the U.S.A. the direct costs associated with HAIs have been estimated at >\$30 billion annually (Cusumano-Towner et al, 2013). In some countries of the Eastern Mediterranean Region (Morocco, Jordan and Tunisia), prevalence studies on the rates of health care-associated infections conducted between 2004 and 2008 have found them to be between 12% and 18% (Allegranzi, 2010). There are many type of hospital acquired infections, but the most common health care associated infections are ventilator associated pneumonia (VAP), urinary tract infection (catheter associated), bloodstream infection (associated with the use of intravascular device) and surgical-site infection.

VAP is the most prevalent infection in intensive care units (ICUs), with the highest mortality rate among nosocomial infections (Albertos et al, 2011). It accounts for 25 % of all types of intensive care unit acquired infections (Balkhy, 2014). In the United States, the incidence is 3-5 cases per 1,000 ventilator-days (Spalding et al, 2017). A recent prospective surveillance study found that VAP prevalence was 15.6% globally (13.5% in the USA, 19.4% in Europe, 13.8% in Latin America and 16.0% in Asia Pacific) (Kollef, 2014).

VAP results in a significant increase in the cost of care (van Oort et al 2017), prolonged hospitalization (Kandeel et al 2012), an extended number of days in need of the mechanical ventilator (Khan et al 2017), and a significant increase in the rate of mortality (Porhomayon et al 2017). The mortality rate of this infection ranges from 20 to 70% (Azab et al 2013, Kandeel et al 2012).

VAP is an infection of the lung that occurs 48 hours after insertion of an endotracheal tube (Rodrigues et al, 2017). The principal factor for the development of VAP is the presence of an endotracheal tube (Zolfaghari et al, 2011). A ventilator is a device that is used to improve patient breathe by giving oxygen via tube placed in the nose or mouth, or through a hole in the front of the neck (tracheostomy). An infection occur when the germs enter via tube and reach to patient`s lung and caused lung infection (alveoli infection). These tubes interfere with the normal protective upper airway reflexes, prevent effective coughing, and encourage micro aspiration of contaminated pharyngeal contents (He et al, 2014).

Many risk factors cause to ventilator associated pneumonia (VAP). The risk factors for VAP can be divided into 3 categories: host related (such as acute respiratory distress syndrome) device related (such as the ventilator circuit) and personnel related (such as failure to wash hands) (Casado et al, 2011). In a study, re-intubation was found as a risk factor for VAP in patients who had ever undergone cardiac surgery (He et al, 2014). It is important to control modifiable factors.

There is no single method to prevent VAP, but multiple non-pharmacological and pharmacological interventions exist that could reduce the incidence and severity of VAP (Lim et al, 2015; Shitrit et al, 2015). CDC (2012) provides guidelines and tools to the healthcare community to help end ventilator-associated pneumonia and resources to help the public understand these infections and take measures to safeguard their own health when possible (CDC, Health Healthcare-associated Infections Update Guideline 2012). There are a lot of recommendations to prevent VAP like head elevated 30-45 and good oral hygiene, selective oral or digestive decontamination (Liberati et al, 2009), and facilitate early mobility (Lord et al, 2013; Needham et al, 2010). According to the previously published studies, the implementation of a VAP prevention bundle had been proven to be efficacious in reduction of VAP rates (Lim et al, 2015; Shitrit et al, 2015).

Quality nursing care based on evidence-based strategies is efficient ways of preventing VAP in intensive care units (ICUs) (Akın, 2014). Nurses play an important role to prevent VAP and improve the patient`s outcome if they are well-educated. The application of knowledge to the care of critically ill patients is a hallmark of professional nursing practice. Many non-pharmacological evidence-based strategies aimed at preventing VAP can be seen as part of basic and routine nursing care, a direct responsibility of the bedside intensive care nurse and can easily be instituted at minimal costs; neglecting any of these could put the patient at risk of infection (Llauradó et al, 2011).

There are many barriers to ventilator associated pneumonia (VAP) prevention and practice among nurses. The most of these barriers is including shortage of resources, insufficient compliance with infection-control standards (AL-Rawajfah et al, 2014) and inadequate knowledge about VAP among health care providers (Hassan et al, 2016). Insufficient knowledge of the nurses ‘about the guidelines results in a lack of competence, and is considered a barrier to adherence (Yeganeh et al, 2016; Ha et al, 2016).

Determination of the knowledge on prevention of ventilator associated pneumonia and barriers of adherence to preventive measures of the critical care nurses may be useful in improving their awareness, practices and preventing this important problem. However a study was not found in the Jordan about this subject and studies.

1.2 Aim of the Study

The aim of the study is determination of the knowledge on prevention of ventilator associated pneumonia and barriers of adherence to preventive measures of the critical care nurses. Study questions include followings:

- What is the knowledge on prevention of ventilator associated pneumonia of critical care nurses?
- What are the barriers of adherence to preventive measures of ventilator associated pneumonia of the critical care nurses?
- Is there any difference between descriptive characteristics, and knowledge on prevention of ventilator associated pneumonia and barriers of adherence to preventive measures of the critical care nurses?

2. BACKGROUND

2.1. Definition

Ventilator associated pneumonia (VAP) is defined as a type of pneumonia that is an acquired from the hospital in a patient who connected to mechanical ventilator support via tracheostomy or endotracheal tube for more than 48 hours with signs and symptoms indicate to pneumonia. VAP is considered the most common hospital acquired infection. VAP characterized by new or progressive pulmonary infiltrate and one or more of the following findings: decrease in oxygen saturation and tidal volume; increase in respiratory rate, white blood cells (leukocytosis) and body temperature (fever); and purulent tracheobronchial secretions. The studies have reported that 27% of intubated patients develop VAP during hospitalization (Spalding et al 2017). Intubation is an invasive procedure, and puts patients at risk in developing a HAI (Mietto et al, 2013). The process of intubation decreases the body's natural response to infection by disrupting the ability to initiate a cough or gag reflex that assists in expelling secretions, as a result, secretions settle around the posterior portion of the pharynx and can eventually lead to micro-aspiration (Sedwick et al, 2012). Proper inflation of the endotracheal tube (ETT) cuff does not prevent micro-aspiration, because there is a small opening that allows leakage of the secretions to travel (Mietto et al, 2013).

2.2. Risk Factors for VAP

There are many risk factors for VAP. Although any patient connected to mechanical ventilator (MV) for more than 48 hours is at risk for VAP; host related, device related, and personnel related factors are considered as categories of VAP risk factors (Casado et al, 2011).

Host related factors include the problems which previously exist such as: immune deficiency, acute respiratory distress syndrome (ARDS), and chronic obstructive lung disease. There are other host-related factors including patients' body positioning, level of consciousness, number of intubations, and medications, including sedative agents and antibiotics (Fathy et al, 2013).

Device related risk factors include, use the nasal route to place endotracheal tubes, un-clean ventilator circuit, and un-cuffed endotracheal tubes. Insufficient cuff pressure leads to aspiration of oropharyngeal contents (Sole et al, 2011).

Lack of staff hand washing due to cross-contamination from patient to another and it is the most personnel-related risk factor for VAP. Failure to wash hands and change gloves between contaminated patients has been associated with an increased incidence of VAP (Labeau et al, 2007).

The risk factors for VAP differ between adults and children. The duration of mechanical ventilation is a risk for both groups, but the results of studies in children have differed somewhat from the results of studies in adults (Casado et al, 2011). Primarily, unlike adults, children have developmental and physiological differences for a wide range of ages. Age is also a factor in immunity, so younger or preterm infants are more likely than older children or adults to experience infection and to have more frequent episodes of infection (Casado et al, 2011).

2.3. Prevention of VAP

VAP prevention is performed through pharmacological and non-pharmacological measures that mainly focus on modifiable risk factors. The Center for Disease Control and Prevention (CDC) and Institute for Healthcare Improvement (IHI) have introduced recommendations (Andrews et al, 2013; Munro et al, 2014). There are many recommendations to prevent VAP:

- Avoiding intubation if possible and use noninvasive positive pressure ventilation (NIPPV) whenever feasible is recommended. NIPPV can be beneficial for patients with acute hypercarbic or hypoxemic respiratory failure secondary to chronic obstructive pulmonary disease or cardiogenic congestive heart failure. NIPPV for these indications may decrease VAP risk, shorten the duration of mechanical ventilation, decrease length of stay, and lower mortality rates compared with invasive ventilation (Klompas et al, 2014).
- Managing ventilated patients without sedatives whenever possible. Preferentially use agents and strategies other than benzodiazepines to manage agitation, such as analgesics for patients in pain, reassurance, antipsychotics, dexmedetomidine and propofol is recommended. Sedation should be interrupted once a day (spontaneous awakening trials) for patients without contraindications. Assessing readiness to extubate once a day (spontaneous breathing trials) in patients without contraindications is recommended. Pairing spontaneous breathing trials with spontaneous awakening trials is necessary (Klompas et al, 2014).
- Minimizing pooling of secretions above the endotracheal tube cuff is recommended (Klompas et al, 2014).
- Changing the ventilator circuit only if visibly soiled or malfunctioning is recommended. Changing the ventilator circuit as needed rather than on a fixed schedule has no impact on VAP rates or patient outcomes but decreases costs (Klompas et al, 2014).

- Elevating the head of the bed to 30–45 degree (Keeley, 2007); Head of bed elevated between 30 to 45 degree is a simple nursing measure to reduce VAP; Keeping the head of bed elevated has been shown to help prevent aspiration of gastric contents and secretions (Klompas et al, 2014; Schallom et al, 2015).
- Providing early exercise and mobilization: Early exercise and mobilization speed extubation, decrease length of stay, and increase the rate of return to independent function (Klompas et al, 2014).
- Prophylactic probiotics: Four meta-analyses of randomized controlled trials have found an association between probiotics and lower VAP rates (Barraud et al, 2013; Siempos et al, 2010).
- Good oral hygiene: Oral care may seem to be a simple task, but it can be challenging to implement. Swabbing a patient's mouth with an antiseptic mouth wash has been recommended for comfort, but recent studies have demonstrated that oral care with an antiseptic has also reduced the risk for Ventilator Associated Event (Garcia et al, 2009). Chlorhexidine is a broad spectrum antiseptic agent (gram-positive, gram-negative, and yeast) which is easy to use, safe, and cost-effective. Additionally, chlorhexidine's slow release properties maintain antimicrobial activity up to 12h (Osman, 2014; Williams al, 2012). Use of mechanical tooth brushing (Alhazzani et al, 2013; Yao et al, 2011).
- Saline instillation before tracheal suctioning (Caruso et al, 2009) is recommended. One randomized trial in oncology patients found that saline instillation before tracheal suctioning lowered the rate of microbiologically confirmed VAP but had no impact on clinical VAP rates or patient outcomes (Klompas et al, 2014).
- Automated control of endotracheal tube cuff pressure between (20 to 30 cm) is recommended (Nseir et al, 2011; Valencia et al, 2007).
- Endotracheal tubes with ultrathin polyurethane cuff membranes of 7 mm only have been introduced to prevent the formation of folds within the cuff and fluid and air leakage. These devices have shown to reduce the frequency of early postoperative pneumonia in cardiac surgical patients (Poelaert et al, 2014).

The development by the Institute of Healthcare Improvement (IHI) of VAP “bundles”—a series of performance measures associated with reducing the incidence of VAP—was an important step in the overall evolution of process measures and accountability for changing clinical behavior and improving the quality of care for critically ill patients (Resar et al, 2012). The VAP prevention bundle includes: head-of-bed elevation to 30 to 45 degrees, oral care with chlorhexidine at 0.12 percent, peptic ulcer disease prophylaxis, deep vein thrombosis (DVT) prophylaxis and ABCDEF bundle elements (i.e. assess, prevent and manage pain — both spontaneous awakening trials and breathing trials, choice of analgesia and sedation, delirium assessment, prevention and management, exercise and early progressive mobility and family engagement and empowerment) (Frimppong et al, 2014; Institute for Healthcare Improvement, 2012).

2.4. Nurses’ Roles and Barriers in VAP Prevention

Nurses are the most contact with patients and they playing a main role to prevent VAP and increase the positive patient`s outcome if the nurse receive well-educated. The nurses’ main practice roles to prevent VAP include:

- Assessing readiness to extubate daily through combined spontaneous awakening trials (SATs: sedation interruption/minimization) and spontaneous breathing trials (SBTs), unless clinically contraindicated (Balas et al, 2014; Yang et al, 2014).
- Elevating the head of bed (HOB) to 30 to 45 degree unless clinically contraindicated in patients receiving mechanical ventilation, as well as patients at high risk for aspiration (Alexiou et al, 2009).
- Utilizing endotracheal tubes with subglottic secretion drainage ports for patients expected to require greater than 48 or 72 hours of mechanical ventilation (Muscedere et al, 2011).
- Collaborating to identify patients where implementation of noninvasive positive pressure ventilation (NIPPV) may be appropriate to prevent the need for intubation (Burns et al, 2013).
- Good hand hygiene and oral care and change gloves between the patients.
- Changing the ventilator circuit only if visibly soiled or malfunctioning (Lorente et al, 2004).
- Using sterilize equipment and aseptic technique.

Adherence the nurses to prevention measures is playing important role to reduce probability of VAP because the nurses is most connected with the patients. However, there are a lot of nursing practice barriers among VAP prevention. In the same line the study conducted by (Jordan et al., 2014) that notices the main barriers to using VAP guidelines are lack of VAP courses and nursing shortages and lack of time was identified as another barrier. In another hand, a survey study revealed poor information provided to nurses regarding current guidelines and the lack of instruction in VAP prevention methods in nursing schools (Jansson et al., 2013). The lack of knowledge may be a barrier towards adherence to evidence-based guidelines (El-Khatib et al., 2010). Study that published in (Aloush, 2017) revealed Jordanian nursing students had poor knowledge.

Several studies implicated that education, guidelines as well as ventilator bundles and instruments should be developed and updated to improve infection control (Jansson et al. 2013). A study that held at Jordan's nursing schools with (Al-Hussami et al 2013) recommended that the nursing curriculum should include additional emphasis on practice as a means to help translate theory into clinical behavior. There are many educational programs that were linked to significant improvements in the overall adherence to VAP evidence-based strategies and a significant decrease in VAP rates. Educational programs consisted of self-study modules (Abbot, 2006), repeated lectures (Bloos, 2009), teaching materials (Morris, 2011), multidisciplinary education meetings (Morris, 2011) and reminders, such as e-mails (Abbot, 2006), posters (Morris, 2011) and visual aids, Also reported that the clinical outcomes of educational programs was decreasing in the incidence of VAP (Morris, 2011).

3. METHODOLOGY

3.1 Study Design:

The study was planned as descriptive design.

3.2 Study Setting:

The study was conducted at the King Abdullah University Hospital and Islamic Hospital Jordan. The King Abdullah University Hospital is the largest and leading university of Jordan which is located in northern part of Jordan in Irbid city. The hospital consists of 15 floors and 683 beds, 12 operating theatres, 78-bed Intensive Care Unit (divided into medical, surgical, pediatric, neonatal, cardiac and burn) and has hospital protocol for prevention the VAP is (bundle VAP protocol). Islamic hospital has 300 beds, 8 operating theatres and 25 intensive care bed, and hospital protocol for prevention the VAP.

3.3 Sample Selection:

The study was performed on the registered nurses who work in ICU departments of the King Abdullah University Hospital and Islamic Hospital. A total of 132 nurses work in ICU in the King Abdullah University Hospital and 61 nurses in ICU in Islamic Hospital (Total 193 nurses). There was no sample selection method. Total 193 voluntary nurses who work in ICU clinics was composed the sample of the study.

3.4 Study Tools:

A questionnaire that was developed by the researchers on the basis of the literature was used as data collection tool in this study (Yaseen et al 2015); (Jansson, et al 2013) (Appendix 1). The first section was regarding to demographics characteristics of the nurses and included 10 questions. The second section consisted 30 questions regarding knowledge of nurses on VAP prevention with “True / False / I don’t know” choices. The last section consisted 8 questions regarding the barriers to adherence to VAP prevention measures with “Always / Sometimes / Never” choices. Since all of the nurses in the hospital can speak English, the questionnaire was prepared as English.

3.5 Pilot Study:

A pilot study was performed on ten nurses after approval from the Near East Institutional Reviews Board (IRB) and King Abdullah University Hospital and Islamic Hospital. After the pilot study, revision was not necessary and the nurses who included in pilot study were added to main sample.

3.6 Data Collection:

Data was collected using a questionnaire from 20th of June to 10th of July 2017. The questionnaires were administered by researchers on nurses while they are on the wards or clinics during duty shift with self-completion method. Completion of the questionnaire took almost 20 minutes.

3.7 Ethical Aspect:

Ethical approval was obtained from the Near East Institutional Reviews Board (IRB) of King Abdullah University Hospital and Islamic Hospital of Jordon (Appendix 2& Appendix 3). In addition, informed consent from the nurses and organizational permission were obtained (Appendix 4).

3.8 Analysis of Data:

Statistical Package of Social Sciences (SPSS) software version 20.0 was used to analyze the collected data. The methods used to analyze the data include an analysis of descriptive statistic variables such as frequency and percentages for the categorical variables. “True / False” variables were used in evaluations of knowledge questions, the comparison were between only always scale and educational degree, years of nurses experience and previous VAP education of the nurses barriers. The person chi-square test was used in comparisons. When finding statistic was significant, the chosen level of significance is $p < 0.05$.

4. Results

Table 4.1 Descriptive Characteristics of the Nurses (N= 193)

Descriptive characteristics	N	%
Age (Mean :28.4)		
<=25 years	44	22.8
26-30 years	109	56.5
>=31	40	20.7
Gender		
Male	77	39.9
Female	116	60.1
Educational degree		
Bachelor`s	173	89.7
Master degree	20	10.3
Working experience in the ICU		
<=5 years	116	60.1
6-10 years	67	34.7
>=11	10	5.2
Number of beds in ICU		
<=12 beds	97	50.3
>=13 beds	96	49.7

Description of characteristics of the nurses is shown in Table 4.1. A total of the nurses of participants in this study 193, the mean of ages of the participants were 28.4 and the 26-30 group of age was the most frequent (56.5%). Females were the majority of the Participants (60.1%). Most of the participants have bachelor's degree (89.7%). Majority of the nurses have experience less than five years as a registered nurses (60.1%). The number of beds were approximately the same for the groups where the percent of participants working in ICU beds <=12 beds was 50.3%.

Table 4. 2 Characteristics of the Nurses on VAP Education (N= 193)

Characteristics on VAP Education	N	%
Previous VAP education		
Yes	137	71.0
No	56	29.0
Educational resource (N=137)*		
School	21	15.4
Courses	47	34.3
Web resources	18	13.1
In-service education	32	23.4
Congress\Conferences	4	2.9
Other	15	10.9
Opinions about quality of the VAP Education (N=137)*		
Excellent	14	10.2
Very good	26	19.0
Good	79	57.7
Fair	15	10.9
Poor	3	2.2
Need for education on VAP		
Yes	154	79.8
No	39	20.2
Using Hospital protocol on prevention of VAP		
Yes	175	90.7
No	18	9.3

***Percentage were calculated based on N=137**

The description of characteristics of the nurses on VAP education is shown in Table 4.2. The majority of the nurses had received VAP education (71.0%). There are six categories of educational recourse which the participants had received VAP education. The highest percent was the courses as educational resource (34.3%). Most frequently stated opinion by the nurses on quality of VAP education was “good” (57.7%). The majority of nurses need for education on VAP (79.8%) and there are hospital protocols on prevention of VAP (90.7%).

Table 4. 3 Nurses General Knowledge on VAP (N=193)

Statements on VAP	T\F	Correct answer		Wrong \I don't know answer	
		N	%	N	%
The Ventilator Associated Pneumonia (VAP) is pneumonia that occurs > or equal 48 hours after endotracheal intubation.	T	157	81.3	36	18.7
VAP is cause of highest mortality rate among nosocomial infections.	T	167	86.5	26	13.5
VAP is the most prevalent infection in intensive care units.	T	145	75.1	48	24.8
Automated control of endotracheal tube cuff pressure is important because it decreases the risk for VAP.	T	103	53.4	90	46.6
Over feeding a ventilated patient is associated with increased the risk for VAP.	T	150	77.7	43	22.3
Continuous education to ICU nurses on prevention of nosocomial infection is associated with decreased rates of VAP.	T	171	88.6	22	11.4

*(T) = **True statement**, (F) = **False statement**

Table 4.3 shows nurses` general knowledge on VAP. It was found that; majority of the nurses had correct answers in majority of the items (5 of 6 items). The most frequently known items were "Continuous education to ICU nurses on prevention of nosocomial infection is associated with decreased rates of VAP" (T) (88.6%), "VAP is cause of highest mortality rate among nosocomial infections" (T) (86.5%) and "The Ventilator Associated Pneumonia (VAP) is pneumonia that occurs > or equal 48 hours after endotracheal intubation" (81.3%) respectively. Percentages of the correct answers of the nurses were close in item "Automated control of endotracheal tube cuff pressure is important because it decrease the risk for VAP" (T) (The correct answers: 53.4% and the wrong\ I don't know answers: 46.6%).

Table 4.4 Nurses' Knowledge on Prevention of VAP (N=193)

Statements on Prevention of VAP	T\F	Correct answer		Wrong /I don't know answer	
		N	%	N	%
If possible, intubation should be avoided to prevent VAP.	T	141	73.1	52	26.9
Whenever feasible, noninvasive positive pressure ventilation should be used to prevent VAP	T	102	52.8	91	47.1
It is necessary to manage patients without sedation whenever possible to prevent VAP	T	121	62.7	72	37.3
Benzodiazepines should always be preferred to manage agitation	F	83	43.0	110	57.0
Sedation should be interrupted daily to prevent VAP	T	124	64.2	69	35.8
It is necessary to assess readiness to extubate of the patient daily to prevent VAP	T	164	85.0	29	15
Pairing spontaneous breathing trials with spontaneous awakening trials is not necessary	F	69	35.8	124	64.3
Minimizing pooling of secretions above the endotracheal tube cuff is necessary to prevent VAP	T	133	68.9	60	31.1
Changing the ventilator circuit regularly is necessary to prevent VAP	F	146	75.6	47	24.3
Elevating the head of the bed to 30–45 is important in prevention of VAP	T	173	89.6	20	10.4
Early exercise and mobilization may increase the possibility of VAP	F	103	53.4	90	46.7
Regular oral care with chlorhexidine is necessary to prevent VAP	T	170	88.1	23	11.9
Proper sterilization and disinfection of respiratory care equipment is important to prevent VAP	T	169	87.6	24	12.4
Oral route is recommended for endotracheal intubation to prevent VAP	T	125	64.8	68	35.2
Prophylactic probiotics may be useful to prevent VAP	T	139	72.0	54	27.9
Ultrathin polyurethane endotracheal tube cuffs may lower VAP rates	T	71	36.8	122	63.2
Saline instillation before tracheal suctioning may cause to VAP	F	120	62.2	73	37.8
Mechanical tooth brushing may be useful in prevention of VAP	T	115	59.6	78	40.4
Closed/in-line endotracheal suctioning reduce the risk of VAP	F	143	74.1	50	25.9
Kinetic beds reduce the risk of VAP and recommended	F	126	65.3	67	34.8
Adequate hand hygiene between patients and change gloves is important to prevent the VAP	T	170	88.1	23	11.9

Prone positioning intermittently may prevent VAP and recommended	F	84	43.5	109	56.5
Using selective oral or digestive decontamination to reduce risk VAP	T	136	70.5	57	29.5
Care bundles may be useful in reducing VAP	T	155	80.3	38	19.7

*(T) = True statement, (F) = False statement

Nurses` knowledge on prevention of VAP is shown in table 4.4 (53.6%) the percentage of total frequency of correct answers and (46.4%) the total of wrong or "I don` t know" answers. The highest correct answers were in “Elevating the head of the bed to 30–45 degree is important in prevention of VAP” (89.6%), “Regular oral care with chlorhexidine is necessary to prevent VAP” (88.1%), “Adequate hand hygiene between patients and change gloves is important to prevent the VAP” (88.1%), "Proper sterilization and disinfection of respiratory care equipment is important to prevent VAP " (T) (87.6%), " It is necessary to assess readiness to extubate of the patient daily to prevent VAP " (T) (85.0%) and “Care bundles may be useful in reducing VAP” (80.3%) items respectively. Most frequent wrong /I don` t know answers were in “Pairing spontaneous breathing trials with spontaneous awakening trials is not necessary (64.3%). “Ultrathin polyurethane endotracheal tube cuffs may lower VAP rates” (63.2%) with wrong answer, and "Prone positioning intermittently may prevent VAP and recommended" (56.5%) items.

Table 4. 5 Barriers of Nurses to Adherence to VAP Prevention Guidelines (N=193)

Statements About Barriers	Always		Sometimes		Never	
	N	%	N	%	N	%
Lack of VAP prevention knowledge	73	37.8	104	53.9	16	8.3
Lack of educational programs on VAP such as in-service education or courses	74	38.3	107	55.4	12	6.2
Shortage of staff in the ICU	107	55.4	72	37.3	14	7.3
Lack of equipment such as gloves and face masks	34	17.6	75	38.9	84	43.5
Lack of written VAP protocol in the hospital	44	22.8	87	45.1	62	32.1
Forgetting to practice the sterile technique	44	22.8	107	55.4	42	21.8
Lack of time to deliver proper infection control	44	22.8	105	54.4	44	22.8
Hospital system insufficiencies	54	28.0	87	45.1	52	26.9

Table 4.5 shows barriers of nurses to adherence to VAP Prevention Guidelines. It was determined that, majority of nurse had "sometimes" answer for the barriers nurses to adherence to VAP prevention guideline. Most frequent "always" answer was "Shortage of staff in the ICU" (55.4%). Highest "sometimes" answers were "Lack of educational programs on VAP such as in-service education or courses", "Lack of time to deliver proper infection control" (55.4%), "Forgetting to practice the sterile technique" (54.4%) and "Lack of VAP prevention knowledge" (53.9%) respectively. Low frequencies in majority of the "never" answers were determined and most frequent "never" answer was "Lack of equipment such as gloves and face masks"(43.5%).

Table 4.6 Comparison of Nurses' Educational Degree, Years of ICU Experience and Previous VAP Education with General Knowledge on VAP (N=193)

General Knowledge on VAP (Statements)	Educational Degree				P value	Years of ICU Experience						P value	Previous VAP Education				P value
	Bachelor		Master			<=5		6-10		>=11			Yes		No		
	Correct answer					Correct answer							Correct answer				
	N	%	N	%		N	%	N	%	N	%		N	%	N	%	
The Ventilator Associated Pneumonia (VAP) is pneumonia that occurs > or equal 48 hours after endotracheal intubation	142	82.1	15	75.0	0.441	93	80.2	55	82.1	9	90.0	0.732	111	81.0	46	82.1	0.856
VAP is cause of highest mortality rate among nosocomial infections	148	85.5	19	95.0	0.241	100	86.2	59	88.1	8	80.0	0.775	120	87.6	47	83.9	0.499
VAP is the most prevalent infection in intensive care units	130	75.1	15	75.0	0.989	83	71.6	52	77.6	10	100.	0.115	111	81.0	34	60.7	0.003
Automated control of endotracheal tube cuff pressure is important because it decreases the risk for VAP	96	55.5	7	35.0	0.082	67	57.8	36	53.7	0	0.0	0.002	84	61.3	19	33.9	0.001
Over feeding a ventilated patient is associated with increased the risk for VAP	134	77.5	16	80.0	0.796	90	77.6	55	82.1	5	50	0.75	103	75.2	47	83.9	0.185
Continuous education to ICU nurses on prevention of nosocomial infection is associated with decreased rates of VAP	152	87.9	19	95.0	0.342	102	87.9	59	88.1	10	100.	0.507	126	92.0	45	80.4	0.021

Table 4.6 shows that there were statistically significant differences between correct answers of some items on general knowledge on VAP and years of ICU experience and previous VAP education. Nurses with <=5 (57.8%) and 6-10 (53.7%) years of experience had higher correct knowledge rates than the >=11 group (0.0) in terms of “Automated control of endotracheal tube cuff pressure is important because it decreases the risk for VAP” item ($P < 0.05$). Nurses who had previous VAP education had higher correct knowledge rates than the other group in terms of “VAP is the most prevalent infection in intensive care units” (81.0%), “Automated control of endotracheal tube cuff pressure is important because it decreases the risk for VAP” (61.3%) and “Continuous education to ICU nurses on prevention of nosocomial infection is associated with decreased rates of VAP” (92.0%) items ($P < 0.05$). However, there wasn't statistically significant differences in terms of majority of the items on general knowledge on VAP and educational degree, years of nursing experience and previous VAP education ($P > 0.05$).

Table 4.7 Comparison of Nurses' Educational Degree, Years of ICU Experience and Previous VAP Education with Knowledge on prevention of VAP (N=193)

Knowledge on prevention of VAP (Statements)	Educational Degree				P value	Years of ICU Experience						P value	Previous VAP Education				P value
	Bachelor		Master			<=5		6-10		>=11			Yes		No		
	Correct answer					Correct answer							Correct answer				
	N	%	N	%		N	%	N	%	N	%		N	%	N	%	
If possible, intubation should be avoided to prevent VAP	124	71.7	17	85.0	0.204	84	72.7	53	79.1	4	40.0	0.033	97	70.8	44	78.6	0.270
Whenever feasible, noninvasive positive pressure ventilation should be used to prevent VAP	90	52.0	12	60.0	0.499	55	47.4	42	62.7	5	50.0	0.135	73	53.3	29	51.8	0.850
It is necessary to manage patients without sedation whenever possible to prevent VAP	109	63.0	12	60.0	0.792	73	62.9	42	62.7	6	60.0	0.983	86	62.8	35	62.5	0.972
Benzodiazepines should always be preferred to manage agitation	79	45.7	4	20.0	0.028	48	41.4	30	44.8	5	50.0	0.814	63	46.0	20	35.7	0.191
Sedation should be interrupted daily to prevent VAP	111	64.2	13	65.0	0.941	58.1	62.1	46	68.7	6	60	0.642	92	67.2	32	57.1	0.188
It is necessary to assess readiness to extubate of the patient daily to prevent VAP	145	83.8	19	95.0	0.185	96	82.8	60	89.6	8	80.0	0.419	119	86.9	27	80.4	0.251
Pairing spontaneous breathing trials with spontaneous awakening trials is not necessary	66	38.2	3	15.0	0.041	39	33.6	27	40.3	3	30.0	0.614	52	38.0	17	30.4	0.317
Minimizing pooling of secretions above the endotracheal tube cuff is necessary to prevent VAP	121	69.9	12	60.0	0.363	74	63.8	52	77.6	7	70.0	0.150	100	73.0	33	58.9	0.055

4.7 Conti, Comparison of Nurses` Educational Degree, Years of ICU Experience and Previous VAP Education with Knowledge on prevention of VAP (N=193).

Knowledge on prevention of VAP (Statements)	Educational Degree				P value	Years of ICU Experience						P value	Previous VAP Education				P value
	Bachelor		Master			<=5		6-10		>=11			Yes		No		
	Correct answer					Correct answer							Correct answer				
	N	%	N	%		N	%	N	%	N	%		N	%	N	%	
Changing the ventilator circuit regularly is necessary to prevent VAP	132	76.3	14	70.0	0.534	83	71.6	57	85.1	6	60.0	0.060	109	79.6	37	66.1	0.048
Elevating the head of the bed to 30–45 is important in prevention of VAP	155	89.6	18	90.0	0.955	98	84.5	65	97.0	10	100.0	0.015	124	90.5	49	87.5	0.533
Early exercise and mobilization may increase the possibility of VAP	97	56.1	6	30.0	0.027	68	58.6	30	44.8	5	50.0	0.190	71	51.8	32	57.1	0.502
Regular oral care with chlorhexidine is necessary to prevent VAP	152	87.9	18	90.0	0.780	102	87.9	59	88.1	9	90.0	0.981	126	92.0	44	78.6	0.009
Proper sterilization and disinfection of respiratory care equipment is important to prevent VAP	151	87.3	18	90.0	0.727	104	89.7	55	82.1	10	100.0	0.155	120	87.6	49	87.5	0.986
Oral route is recommended for endotracheal intubation to prevent VAP	113	65.3	12	60.0	0.637	75	64.7	46	68.7	4	40.0	0.209	88	64.2	37	66.1	0.808
Prophylactic probiotics may be useful to prevent VAP	128	74.0	11	55.0	0.073	84	72.4	48	71.6	7	70.0	0.983	100	73.0	39	69.6	0.638
Ultrathin polyurethane endotracheal tube cuffs may lower VAP rates	59	34.1	12	60.0	0.023	37	31.9	34	50.7	0	0.0	0.02	59	43.1	12	21.4	0.005

4.7 Conti, Comparison of Nurses` Educational Degree, Years of ICU Experience and Previous VAP Education with Knowledge on prevention of VAP (N=193)

Knowledge on prevention of VAP (Statements)	Educational Degree				P value	Years of ICU Experience						P value	Previous VAP Education				P value
	Bachelor		Master			<=5		6-10		>=11			Yes		No		
	Correct answer					Correct answer							Correct answer				
	N	%	N	%		N	%	N	%	N	%		N	%	N	%	
Saline instillation before tracheal suctioning may cause to VAP	107	61.8	13	65.0	0.783	74	63.8	41	61.2	5	50.0	0.675	88	64.2	32	57.1	0.357
Mechanical tooth brushing may be useful in prevention of VAP	105	60.7	10	50.0	0.356	65	56.0	42	62.7	8	80.0	0.272	87	63.3	28	50.0	0.083
Closed in-line endotracheal suctioning reduce the risk of VAP	133	76.9	10	50.0	0.009	85	73.3	52	77.6	6	60.0	0.471	108	78.8	35	62.5	0.019
Kinetic beds reduce the risk of VAP and recommended	111	64.2	15	75.0	0.335	78	67.2	47	70.1	1	10.0	0.001	92	67.2	34	60.7	0.394
Adequate hand hygiene between patients and change gloves is important to prevent the VAP	151	87.3	19	95.0	0.313	99	85.3	62	92.5	9	90.0	.345	123	89.9	47	83.9	0.255
Prone positioning intermittently may prevent VAP and recommended	78	45.1	6	30.0	0.198	45	38.8	36	53.7	3	30.0	0.098	66	48.2	18	32.1	0.041
Using selective oral or digestive decontamination to reduce risk VAP	125	72.3	11	55.0	0.109	79	68.1	51	76.1	6	60.0	0.393	99	72.3	37	66.1	0.392
Care bundles may be useful in reducing VAP	137	79.2	18	90	0.250	92	79.3	57	85.1	6	60.0	0.162	113	82.5	42	75.0	0.236

Comparison of nurses' educational degree, years of ICU experience and previous VAP education with knowledge on prevention of VAP is shown in table 4.7. There were statically insignificant differences in majority of the items ($P > 0.05$). In the present study, results that revealed two there were statistically significant differences only in a few items. Regarding the educational levels; nurses with bachelor degree education had higher knowledge rates on prevention of VAP in terms of "Benzodiazepines should always be preferred to manage agitation" (45.7%), "Pairing spontaneous breathing trials with spontaneous awakening trials is not necessary" (38.2%) and "Closed/in-line endotracheal suctioning reduce the risk of VAP" (76.9%) items than the master degree group ($P < 0.05$). However in "Ultrathin polyurethane endotracheal tube cuffs may lower VAP rates" item, master degree group had higher knowledge rates (60.0%) than the nurses with bachelor degree (34.1%) ($P < 0.05$). It was determined that, there were statistically significant differences between nurses who had ≤ 5 years and 6-10 years of ICU experience, and the nurses who had ≥ 11 years of ICU experience in a few items ($P < 0.05$). Nurses with ≤ 5 and 6-10 years of experience had higher correct knowledge rates than the ≥ 11 group in terms of "If possible, intubation should be avoided to prevent VAP", "Ultrathin polyurethane endotracheal tube cuffs may lower VAP rates" and "Kinetic beds reduce the risk of VAP and recommended" items ($P < 0.05$). However in "Elevating the head of the bed to 30–45 is important in prevention of VAP" item, ≥ 11 group had higher knowledge rates (100 %) than the other groups ($P < 0.05$). There were also statistically significant differences in terms of previous VAP education ($P < 0.05$). Nurses who had previous VAP education had higher correct knowledge rates than the other group in terms of "Regular oral care with chlorhexidine is necessary to prevent VAP" (92.0%), "Ultrathin polyurethane endotracheal tube cuffs may lower VAP rates" (43.1%), "Closed/in-line endotracheal suctioning reduce the risk of VAP" (78.8%) and "Prone positioning intermittently may prevent VAP and recommended" (48.2%) items.

Table 4.8 Comparison of Nurses` Educational Degree, Years of ICU Experience and Previous VAP Education with Nurses ` Barriers to Adherence to VAP Prevention Guidelines (N=193)

Nurses ` Barriers to Adherence to VAP Prevention Guidelines (Statements)	Educational Degree				P value	Years of ICU Experience						P value	Previous VAP Education				P value
	Bachelor		Master			<=5		6-10		>=11			Yes		No		
	Always					Always							Always				
	N	%	N	%		N	%	N	%	N	%		N	%	N	%	
Lack of VAP prevention knowledge	65	37.6	8	40.0	0.832	45	38.8	26	38.8	2	20.0	0.490	47	34.3	26	46.4	0.115
Lack of educational programs on VAP such as in-service education or courses	65	37.6	9	45.0	0.518	41	35.0	30	44.8	3	30.0	0.385	55	40.1	19	33.9	0.420
Shortage of staff in the ICU	94	54.3	13	65.0	0.364	63	54.3	41	61.2	3	30.0	0.167	77	56.2	30	53.6	0.738
Lack of equipment such as gloves and face masks	30	17.3	4	20.0	0.768	17	14.7	15	22.4	2	20.0	0.408	28	20.4	6	10.7	0.108
Lack of written VAP protocol in the hospital	39	22.5	5	25.0	.804	25	21.6	17	25.4	2	20.0	0.819	31	22.6	13	23.2	0.930
Forgetting to practice the sterile technique	40	23.1	4	20.0	0.753	25	21.1	17	25.4	2	20.0	0.819	30	21.9	14	25.0	0.641
Lack of time to deliver proper infection control	37	21.4	7	35.0	.169	25	21.6	17	25.4	2	20.0	0.819	32	23.4	12	21.4	0.772
Hospital system insufficiencies	49	28.3	5	25.0	0.754	26	22.4	24	35.8	4	40.0	0.103	39	28.5	15	26.8	0.813

Comparison of nurses` educational degree, years of ICU experience and previous VAP education with nurses` barriers to adherence to VAP prevention guidelines is shown in table 4.8. It was determined that there were no statically significant differences between items and descriptive characteristics (P >0.05).

5. DISCUSSION

The aim of this study was determination of critical care nurses' knowledge on prevention of ventilator associated pneumonia and barriers of adherence to preventive measures. 193 volunteer nurses with different age, educational level and experience participated in this study.

Regarding to descriptive characteristics of the nurses on VAP education, it was determined that, the majority of the nurses had received VAP education and more than one third of them received the VAP education by courses. Participants rated the quality of the VAP as excellent, very good, good, fair and poor and the most frequent answer was good. However, majority of participants mentioned that they need education on VAP to improve nursing skills and enhance patient's outcomes. This result is satisfying in terms of showing their willingness to improve themselves. Training activities and evidence-based guidelines and protocols in the ICUs improve the quality of nursing care and narrow the gap between scientific knowledge and actual performance and form basis for nurses to make the right decision. In the same line, in our survey more than two third of the participants reported that there are guidelines and or protocols on prevention of VAP in hospital during their work experience.

Examination of general knowledge of the nurses on VAP showed that, a majority of the nurses had correct answers in majority of the items (5 of 6 items). The majority of the nurses had correct answers for "Continuous education to ICU nurses on prevention of nosocomial infection is associated with decreased rates of VAP" (T), "VAP is cause of highest mortality rate among nosocomial infections" (T) and "The Ventilator Associated Pneumonia (VAP) is pneumonia that occurs \geq 48 hours after endotracheal intubation" items. Percentages of the correct answers and wrong/I don't know answers of the nurses were close together in "Automated control of endotracheal tube cuff pressure is important because it decrease the risk for VAP" (T) item. There are same line studies in the relevant literature; VAP is described in the literature as an infection of the lung that occurs 48 hours after insertion of an endotracheal tube (Rodrigues et al, 2017). There is significant increase in the rate of VAP resulted with mortality (Porhomayon et al, 2017). In Jordan, a rate of 29 cases per 1,000 ventilator-days, and the rate of mortality related to VAP as 53% was determined (Samrah et al, 2016).

Another study reported that continuous control of pressure cuff is associated with a decrease of micro aspiration and VAP (Nseir et al, 2011). Zeinab Hassan et al recommended continuous education programs about ventilator-associated pneumonia for nurses in Jordan (Hassan et al, 2016).

In the current study, regarding to nurses` knowledge on prevention of VAP results showed that, majority of the nurses had correct answers in majority of the items (19 of 24 items) and this is satisfying result. The highest correct answers were “Changing the ventilator circuit regularly is necessary to prevent VAP”, “Early exercise and mobilization may increase the possibility of VAP”, “Adequate hand hygiene between patients and change gloves is important to prevent the VAP”, "Proper sterilization and disinfection of respiratory care equipment is important to prevent VAP" (T), "Sedation should be interrupted daily to prevent VAP" (T) and “Care bundles may be useful in reducing VAP” items. There are studies in the relevant literature supporting our results. A descriptive, cross-sectional study conducted with 205 ICU nurses to investigate knowledge, attitudes and practices of nurses about oral care of intubated patients found that, higher scores on oral care knowledge were associated with performing oral care (Lin et al. 2011). Improved oral care is necessary and contributes to reduce the incidence of VAP. An observational study by Llaurodo-Serra et al (2014) concluded that, patients connected with endotracheal tube and without head-of-bed elevation had increased incidence of complications. The Spanish “Zero-VAP” bundle emphasize that the use of gloves does not preclude the obligation of hand-washing before and after management of the artificial airway (Lerma et al. 2013). National Infection Control Guidelines (2016, Singapore) emphasize that patients undergo mechanically ventilated for >48 hours, a daily sedation vacation and assessment for readiness-to-extubate is undertaken, early extubation decreases the time spent on mechanical ventilation and directly reduces the risk of VAP. A study conducted by Mogyoródi et al (2016) showed a reduction in the incidence and risk of VAP after the implementation of the bundle that similar to our results. In the present study, most frequent wrong /I don’t know answers were in “It is necessary to assess readiness to extubate of the patient daily to prevent VAP”, “Ultrathin polyurethane endotracheal tube cuffs may lower VAP rates” and “It is necessary to manage patients without sedation whenever possible to prevent VAP”. However, CDC recommends assessing readiness to extubate once a day (spontaneous breathing trials) in patients without contraindications (CDC, 2014).

Using the endotracheal tube with polyurethane material results in reducing ventilator-associated pneumonia compared to ETT with Polyvinyl Chloride (PVC) cuff (Mahmoodpoor et al 2013). Regarding the barriers of the nurses on adherence to VAP prevention guidelines, present study showed that majority of the nurses had "sometimes" answers for the barriers to adherence to VAP prevention guideline.

Highest "sometimes" answers were "Lack of educational programs on VAP such as in-service education or courses", "Lack of time to deliver proper infection control", "Forgetting to practice the sterile technique" and "Lack of VAP prevention knowledge" respectively. Most frequent "always" answer was "Shortage of staff in the ICU". These results show similarity results of the study of Jordan et al (2014). The authors notice lack of time, probably because of the small number of staff at the ICU, the main barrier. Enough number of nurses in ICUs and professional teamwork reflect nursing performance. Jansson et al (2013) emphasized that, educational programs and guidelines as well as ventilator bundles and instruments should be developed and updated to improve practice and reduce barriers.

Low frequencies in majority of the "never" answers were determined and this result is unsatisfying. Most frequent "never" answer was "Lack of equipment such as gloves and face masks" This result shows similarity with the results of the study conducted in Saudi Arabia. They determined that "Not wearing personal protective equipment" was not considered as a barrier by majority of the nurses (62.4%) (Yaseen et al 2015).

In comparison of nurse's educational degree, years of nursing experience and previous VAP education with general knowledge and VAP prevention, results showed statistically significant differences only in a few items ($P < 0.05$). There wasn't statistically significant differences between descriptive characteristics and items on barriers to adherence to VAP prevention guidelines statements ($P > 0.05$). Results of the current study showed statistically significant differences in terms of educational levels and experiences of the nurses. Nurses who had previous VAP education had higher correct knowledge rates than the other group in terms of "VAP is the most prevalent infection in intensive care units", "Automated control of endotracheal tube cuff pressure is important because it decreases the risk for VAP" and "Continuous education to ICU nurses on prevention of nosocomial infection is associated with decreased rates of VAP" items ($P < 0.05$).

Same line study conducted in Jordan nurses showed significant improvements in mean knowledge scores on ventilator-associated pneumonia and preventive measures after an educational program ($p < 0.05$) (Hassan et al, 2016). Samra et al. (2017) recommend education and periodic training remain a fundamental process of improving health services.

In comparison of knowledge on prevention of VAP with nurses' educational degree that shown bachelor degree nurses' correct knowledge rates were higher than nurses graduated from master degree in items "Benzodiazepines should always be preferred to manage agitation", "Pairing spontaneous breathing trials with spontaneous awakening trials is not necessary", "Ultrathin polyurethane endotracheal tube cuffs may lower VAP rates" and "Closed/in-line endotracheal suctioning reduce the risk of VAP" ($P < 0.05$). This was an unexpected result. In contrast to other study was conducted to objective of evaluation of knowledge, attitude, and adherence of healthcare workers to evidence-based guidelines for prevention of VAP and exploration of the barriers of their implementation in clinical practice that report significantly different between nurse assistants (RAs), nurses (RNs), and shown register nurses higher than assistant nurses with ($P = 0.001$) Mardani et al (2016). Regarding to experiences of the nurses, results showed that, nurses with ≤ 5 and 6-10 years of experience had higher correct knowledge rates than the ≥ 11 group in terms of "Automated control of endotracheal tube cuff pressure is important because it decreases the risk for VAP" items of general knowledge; "If possible, intubation should be avoided to prevent VAP", "Ultrathin polyurethane endotracheal tube cuffs may lower VAP rates" and "Kinetic beds reduce the risk of VAP and recommended" items of prevention knowledge ($P < 0.05$). Nurses with less experience showed higher knowledge rates than the nurses who had more experienced. This result may be resulted from being newly graduated and to remember the knowledge easily. Conversely, Yaseen et al showed that more experienced nurses performed significantly better rates of VAP prevention knowledge than their less experienced colleagues ($p < 0.05$) (Yaseen et al 2015).

6. CONCLUSION

Results of the present study showed that, the majority of the nurses had received VAP education and perceived the quality of the education as “good”; however they have stated that they need education on VAP to improve nursing skills and enhance patient's outcomes. This result may be resulted from weakness of quality of the VAP education and is important in terms of showing the willingness of the nurses for education and development.

Results of the present study showed high level of knowledge on general VAP knowledge and VAP prevention and this is a satisfying result. Regarding to barriers of nurses to adherence to VAP prevention guidelines, there were high rates of “sometimes” and “always” and low rates of the “never” answers. Frequent rated barriers were “Lack of educational programs on VAP such as in-service education or courses”, “Lack of time to deliver proper infection control”, “Forgetting to practice the sterile technique” and “Lack of VAP prevention knowledge” and "Shortage of staff in the ICU". This condition may inhibit for staff improvement and development; also may prevent from motivations and increase incidences of VAP complications. Both national and institutional regulations are necessary to prevent barriers of VAP prevention.

Results of the current study showed statistically significant differences in terms of previous VAP education, educational levels and experiences of the nurses. Education remains as a vital process of improving health services. Professional training programs can affect for well outcome and reflect for inpatients services. It is necessary to give the chance of education to the nurses with higher opportunity to achieve and exposure to professional new in-service education related VAP (Akin et al, 2014). Recommend implementing multifaceted educational programmers comprising information on recent VAP prevention guidelines in the general intensive care unit and promoting nurses' participation to maximize awareness of infection control.

7. FINDINGS AND RECOMMENDATIONS

7.1. Findings

Main findings of the study that was performed with the aim of determination of the knowledge on prevention of ventilator associated pneumonia and barriers of adherence to preventive measures of the critical care nurses were listed as followings:

- A total of the nurses of participants in this study 193, the mean of ages of the participants were 28.4 and the 26-30 group of age was the most frequent (56.5%). Females were the majority of the participants (60.1%). Most of the participants have bachelor's degree (89.7%). Majority of the nurses have experience less than five years as a registered nurses (60.1%). (Table 4.1)
- Regarding to general knowledge of the nurses on VAP it was found that; majority of the nurses had correct answers in majority of the items (5 of 6 items). The most frequently known items were "Continuous education to ICU nurses on prevention of nosocomial infection is associated with decreased rates of VAP" (T) (88.6%), "VAP is cause of highest mortality rate among nosocomial infections" (T) (86.5%) and "The Ventilator Associated Pneumonia (VAP) is pneumonia that occurs > or equal 48 hours after endotracheal intubation" (81.3%) respectively. (Table 4.3)
- About nurses` knowledge on prevention of VAP; the highest correct answers were in "Elevating the head of the bed to 30–45 degree is important in prevention of VAP" (89.6%), "Regular oral care with chlorhexidine is necessary to prevent VAP" (88.1%), "Adequate hand hygiene between patients and change gloves is important to prevent the VAP" (88.1%), "Proper sterilization and disinfection of respiratory care equipment is important to prevent VAP " (T) (87.6%), " It is necessary to assess readiness to extubate of the patient daily to prevent VAP " (T) (85.0%) and "Care bundles may be useful in reducing VAP" (80.3%) items respectively. (Table 4.4)
- It was determined that, majority of nurse had "sometimes" answer for the barriers nurses to adherence to VAP prevention guideline. Most frequent "always" answer was "Shortage of staff in the ICU" (55.4%). Highest "sometimes" answers were "Lack of educational programs on VAP such as in-service education or courses", "Lack of time to deliver proper infection control" (55.4%), "Forgetting to practice the sterile

technique” (54.4%) and “Lack of VAP prevention knowledge” (53.9%) respectively. (Table 4.5)

- There were statistically significant differences between correct answers of some items on general knowledge on VAP and years of ICU experience and previous VAP education. (Table 4.6)
- Regarding the educational levels; there were statically insignificant differences in majority of the items ($P>0.05$). In the present study, results that reveled two there were statistically significant differences only in a few items. (Table 4.7)
- Comparison of nurses` educational degree, years of ICU experience and previous VAP education with nurses` barriers to adherence to VAP prevention guidelines is shown in table 4.8. It was determined that there were no statically significant differences between items and descriptive characteristics ($P >0.05$).

7.2 Recommendations

Based on the result of this study following recommendations were made:

- Continues education programs are necessary to improve nurses` knowledge on VAP prevention.
- Following and implementation the new guidelines and protocols on VAP prevention.
- National and institutional regulations are necessary to prevent barriers of VAP prevention.
- Further experimental studies related to educational interventions for nurses may be useful for evidence-based practices.

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APPENDIX 1 Critical Care Nurses' Knowledge on Prevention of Ventilator Associated Pneumonia (VAP) and Barriers of Adherence to Preventive Measures.






1. Characteristics of Nurse Participants		
Subject Number:		
1.Age		
2.Gender	<input type="checkbox"/> Male	<input type="checkbox"/> Female
3.Education	<input type="checkbox"/> High school <input type="checkbox"/> Master degree	<input type="checkbox"/> Bachelor's <input type="checkbox"/> PhD
4.Working experience in the ICU (As years)		
5.Number of beds in ICU		
6.Previous VAP education	<input type="checkbox"/> Yes	<input type="checkbox"/> No
7. (If you answered the item 6 as "yes") Educational resource	<input type="checkbox"/> School <input type="checkbox"/> Courses <input type="checkbox"/> Web resources	<input type="checkbox"/> In-service education <input type="checkbox"/> Congress/conferences <input type="checkbox"/> Other
8. (If you answered the item 6 as "yes") Perceived quality of the VAP education	<input type="checkbox"/> Excellent	<input type="checkbox"/> Very good
	<input type="checkbox"/> Good	<input type="checkbox"/> Fair
	<input type="checkbox"/> Poor	
9.Need for education on VAP	<input type="checkbox"/> Yes	<input type="checkbox"/> No
10.Is there any protocol in hospital for prevention of VAP	<input type="checkbox"/> Yes	<input type="checkbox"/> No

3. Nurses 'Barriers to Adherence to VAP Prevention Guidelines			
Statements about barriers	Always	Sometimes	Never
1.Lack of VAP prevention knowledge			
2.Lack of educational programs on VAP such as in-service education or courses			
3. Shortage of staff in the ICU			
4. Lack of equipment such as gloves and face masks			
5.Lack of written VAP protocol in the hospital			
6. Forgetting to practice the sterile technique			
7. Lack of time to deliver proper infection control			
8. Hospital system insufficiencies			

2. Nurses' Knowledge on VAP Prevention				
No	Statements about VAP prevention	True	False	I Don't know
1	The Ventilator Associated Pneumonia (VAP) is pneumonia that occurs > or equal 48 hours after endotracheal intubation(T)			
2	VAP is cause of highest mortality rate among nosocomial infections (T)			
3	VAP is the most prevalent infection in intensive care units (T)			
4	If possible, intubation should be avoided to prevent VAP (T)			
5	Whenever feasible, noninvasive positive pressure ventilation should be used to prevent VAP (T)			
6	It is necessary to manage patients without sedation whenever possible to prevent VAP(T)			
7	Benzodiazepines should always be preferred to manage agitation (F)			
8	Sedation should be interrupted daily to prevent VAP(T)			
9	It is necessary to assess readiness to extubate of the patient daily to prevent VAP (T)			
10	Pairing spontaneous breathing trials with spontaneous awakening trials is not necessary (F)			
11	Minimizing pooling of secretions above the endotracheal tube cuff is necessary to prevent VAP(T)			
12	Changing the ventilator circuit regularly is necessary to prevent VAP (F)			
13	Elevating the head of the bed to 30–45 is important in prevention of VAP(T)			
14	Early exercise and mobilization may increase the possibility of VAP(F)			
15	Regular oral care with chlorhexidine is necessary to prevent VAP(T)			

16	Proper sterilization and disinfection of respiratory care equipment is important to prevent VAP (T)			
17	Oral route is recommended for endotracheal intubation to prevent VAP (T)			
18	Prophylactic probiotics may be useful to prevent VAP(T)			
19	Ultrathin polyurethane endotracheal tube cuffs may lower VAP rates (T)			
20	Automated control of endotracheal tube cuff pressure is important because it decrease the risk for VAP (T)			
21	Saline instillation before tracheal suctioning may cause to VAP (F)			
22	Mechanical tooth brushing may be useful in prevention of VAP (T)			
23	Over feeding a ventilated patient is associated with increased the risk for VAP (T)			
24	Closed/in-line endotracheal suctioning reduce the risk of VAP (F)			
25	Kinetic beds reduce the risk of VAP and recommended (F)			
26	Adequate hand hygiene between patients and change gloves is important to prevent the VAP (T)			
27	Prone positioning intermittently may prevent VAP and recommended (F)			
28	Using selective oral or digestive decontamination to reduce risk VAP (T)			
29	Continuous education to ICU nurses on prevention of nosocomial infection is associated with decreased rates of VAP (T)			
30	Care bundles may be useful in reducing VAP (T)			

APPENDIX 2 King Abdullah University Hospital Ethical Approval form

  	
General Director Office	مكتب المدير العام
ص.ب (٦٣٠٠٠١) إربد (٢٢١١٠) الأردن	هاتف : (٩٦٢-٢) ٧٢٠٠٦٠٠ فاكس : (٩٦٢-٢) ٧٠٩٥٧٧٧
Ref: <u>13/13/2268</u>	الرقم : _____
Date: <u>13-6-2017</u>	التاريخ : _____
	الموافق : _____
Dr. Umran DAL YILMAZ, Head the Department of Nursing Near East University Health Sciences Institute Tel.: +90 (392) 223 64 64	
Dear Dr. In reference to your letter, in which you confirmed that Mr. Moath Nayef Alkhazali is a master student at the Department of Nursing/ Near East University, and will be undertaking a project entitled: Clinical Care Nurses' Knowledge on Prevention of Ventilator Associated Pneumonia and Barriers of Adherence to Preventive Measures We would like to inform you that the IRB Committee has granted Mr. Moath Alkhazali the approval to conduct his proposal at King Abdullah University Hospital in coordination with Nursing Department, for the purpose mentioned above, under the following conditions: <ol style="list-style-type: none">1. Commitment to the Scientific Research Policy at Jordan University of Science and Technology and King Abdullah University Hospital.2. Maintaining data confidentiality and using it only for scientific purposes.3. Consent Form is required.4. This approval will be canceled if the principle investigator doesn't provide IRB with the final executive study report about the results of the research after one year.	
Sincerely,  Prof. Ismail Matakah CEO KAUH	
Tel.: (962-2) 7200600 Fax: (962-2) 7095777 P.O.Box: (630001) Irbid (22110) Jordan E-mail : kauh@just.edu.jo	

APPENDIX 3 Islamic Hospital Ethical Approval Form

THE ISLAMIC HOSPITAL
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بسم الله الرحمن الرحيم



المستشفى الإسلامي
عمان - الأردن

تلفون : ٥١٠١٠١٠ - فاكس : ٥٦٦١٧٧٣
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Ref :
Date: **17/06/2017**

الرقم :
التاريخ :
الموافق :

To: Assoc. Professor Umran DAL YILMAZ
Head of the Department of Nursing
Near East University

Kindly be informed that we approved for conduction of the thesis entitled
(Critical Care Nurses 'Knowledge on Prevention of Ventilator Associated
Pneumonia and Barriers of Adherence to Prevention Measures) for Mr.
Moath Nayef Alkhazali.

Respectfully

Mr. Mohammad Subhi Salah

Director of Nursing

The Islamic Hospital

Amman-Jordan

+96265101010



S043D

APPENDIX 4 Ethical Approval Near East institutional Reviews Board



EK: 518-2017

ARAŞTIRMA PROJESİ DEĞERLENDİRME RAPORU

Toplantı Tarihi : 25.05.2017
Toplantı No : 2017/47
Proje No : 420

Yakın Doğu Üniversitesi Sağlık Bilimleri Fakültesi öğretim üyelerinden Prof. Dr. Nurhan Bayraktar'ın sorumlu araştırmacısı olduğu, YDU/2017/47-420 proje numaralı ve **“Critical Care Nurses’ Knowledge on Prevention of Ventilator Associated Pneumonia and Barriers of Adherence to Preventive Measures”** başlıklı proje önerisi kurulumuzca değerlendirilmiş olup, etik olarak uygun bulunmuştur.

1. Prof. Dr. Rüştü Onur

(BAŞKAN)

2. Prof. Dr. Nerin Bahçeciler Önder

(ÜYE)

3. Prof. Dr. Tamer Yılmaz

(ÜYE) KATILMADI

4. Prof. Dr. Şahan Saygı

(ÜYE)

5. Prof. Dr. Şanda Çalı

(ÜYE)

6. Prof. Dr. Nedim Çakır

(ÜYE)

7. Prof. Dr. Kaan Erler

(ÜYE)

8. Doç. Dr. Ümran Dal Yılmaz

(ÜYE) KATILMADI

9. Doç. Dr. Eyüp Yayı

(ÜYE)

10. Doç. Dr. Nilüfer Galip Çelik

(ÜYE)

11. Yrd. Doç. Dr. Emil Mammadov

(ÜYE)

APPENDIX 5 INFORMED CONSENT FORM FOR ADULTS

You are invited to participate in a research study conducted by Prof. Dr. Nurhan Bayraktar and Moath Alkhazali, from the Near East University Faculty of Health Sciences, Nursing Department. This study was planned to determinate the knowledge and prevention and barriers prophylaxis among nurses. You were selected as a possible participant in this study, because findings of the study may be useful in improving nurses' awareness and preventing this important public health problem. If you decide to participate, a questionnaire will be used as data collection tool in this study. The questionnaire contains questions regarding for demographics, knowledge and barriers of nurses on VAP prevention with 3 choices (true,false,i dont know). However, I cannot guarantee that you personally will receive any benefits from this research. Any information that is obtained in connection with this study and that can be identified with you will remain confidential and will be disclosed only with your permission or as required by law. Subject identities will be kept confidential by don't using the name, and using participant coding. Your participation is voluntary. Your decision whether or not to participate will not affect your relationship with Near East Hospital. If you decide to participate, you are free to withdraw your consent and discontinue participation at any time without penalty. If you have any questions about the study, please feel free to contact [05488236500-moath-ke@hotmail.com].[05338398451 nurhan.bayraktar@neu.edu.tr]. If you have questions regarding your rights as a research subject, please contact the Near East Institutional Review Board. You will be offered a copy of this form to keep. Your signature indicates that you have read and understand the information provided above, that you willingly agree to participate, that you may withdraw your consent at any time and discontinue participation without penalty, that you will receive a copy of this form, and that you are not waiving any legal claims.

Participant

Name, Surname:

Address:

Phone:

Signature:

Witness

Name, Surname:

Address:

Phone:

Signature:

Interviewer:

Name, Surname:

Address: