

Nurses' compliance of evidence-based guidelines for preventing VAP in CCUs

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ABSTRACT

Background: Critically ill patients in critical care units (CCUs) are at high risk for infections associated with increased morbidity, mortality, and health care costs. The overall infection rate in critically ill patients approaches 40% and may be as high as 50% or 60% in patients who remain in the CCU for more than 5 days. Ventilator-associated pneumonia (VAP) in mechanically ventilated patients ranges from 8% to 28%. VAP refers to an infection that develops during mechanical ventilation after 48 hours of intubation. Nurses play a pivotal role in decreasing patients' risk of acquiring VAP. Keeping pace, in this instance, is really about turning focus back to the more basic aspects of critical care nursing. Evidence now demonstrates how important basic nursing care is to the prevention of VAP by using strategies for the prevention of VAP. **Objective:** The aim of this study was to assess nurses' compliance of evidence-based guidelines for preventing VAP in CCUs. **Methods:** The study was conducted at the CCUs of Alexandria Main University Hospital namely, Casualty Intensive Care Unit (unit I) and General Intensive Care Unit (unit III). The sample of this study consisted of 60 nurses working in the previously mentioned CCUs. Two tools were used for data collection VAP Preventive interventions Observation Checklist (VAPPIOC) and VAP knowledge questionnaire (VAPKQ). **Results:** Nurses had different levels of adherence for many non-pharmacologic strategies. All nurses responses to the questionnaire, rates and reasons for non adherence were addressed. **Conclusion:** The most important barriers to implementation were environment-related. Other reasons for non-adherence were patient-related barriers being significantly important for nurses. Overall, the most important barriers to adherence were unavailability of resources. Our findings suggest the need for development of guidelines to reduce variability and the need to include the nursing point of view in these guidelines.

INTRODUCTION

Critical Care Units (CCUs) provide special medical, nursing and other staff with expertise expertise and facilities for the support of vital in the management of problems⁽¹⁾. CCUs also functions, and the utilization of the skills of provide continuous and expert care for

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critically ill patients, including those who require mechanical ventilation (MV) as a form of treatment to support their respiratory efforts. Ventilator-dependent patients, particularly those who require long-term ventilation for 7 days or more, present one of the most complex and challenging aspects of critical care practice.⁽²⁾

VAP is the leading infectious complication in patients under MV, affecting from 8% to 28% of patients admitted to the CCUs. Indeed, in this period, airway management is critical in preventing VAP. From the ventilator to the lungs, all parts and pieces need to be considered when caring for patients on MV.^(3,4)

Risk factors for the development of VAP can be classified into modifiable and non-modifiable risk factors. Modifiable risk factors are of greater value in nursing because of their potential opportunity for intervention. Modifiable risk factors include: supine positioning, enteral nutrition, failed subglottic aspiration, and intra-cuff pressure of < 20 cm H₂O. Non-modifiable patient-related risk

factors include male gender, preexisting pulmonary diseases, coma, head trauma, and multi-organ system failure.^(5,6)

There are several effective measures for VAP prevention. Overall rate of nosocomial infection can be reduced by hand-washing and removal of gloves between patients. Specific measures for VAP reduction include oral endotracheal intubation, non-routine changing of ventilator circuits, use of heat-and-moisture exchangers, and semi-recumbent positioning. Other measures recommended are subglottic secretion drainage (SSD) and strict control of intra-cuff pressure^(7,8).

Nurses in CCUs are responsible for the delivery of excellence in patient care through assessing, formulating nursing diagnosis, establishing goals, planning, implementing intervention and evaluating patient care outcomes. Nurses are responsible for participating in and maintaining quality, safety and cost effectiveness. Critical care nurses rely upon a specialized body of knowledge, skills and experience to monitor and

safeguard the quality of care the patients receive⁽⁹⁾

As one of facts of nurses' role is the promotion of evidence-based care, and the skills necessary to manage change are essential for people with known or suspected infection and infectious diseases. There are many guidelines that focused on prevention of VAP in CCUs. VAP has had a large part of the recommendations for guidance. In fact, the most recent Center for Disease Control and Prevention (CDC) guidelines on preventing hospital-acquired pneumonia contain several nursing interventions specific to VAP.⁽¹⁰⁾

VAP is a significant clinical problem associated with increased CCU and hospital length of stay and substantial increases in delivery cost and associated morbidity and mortality⁽¹⁰⁾. In critical care setting at Main University Hospital of Alexandria a number of studies regarding the compliance to infection control were conducted^(11,12). Also, many studies have been held to examine ways to

prevent VAP and impacts of preventive measures of care to prevent patients' infection in CCUs⁽¹³⁻¹⁶⁾, but no studies were conducted to examine nurses' compliance for VAP preventive measures. So this study was conducted to assess nurses' compliance of evidence-based guidelines (EBG) for preventing VAP in the CCUs of the Main University Hospital of Alexandria, and in order to achieve this aim, the following research questions were addressed:

Do nurses know the evidence-based guidelines for preventing VAP?

Do nurses apply the evidence-based guidelines for preventing VAP?

What are the barriers that hinder critical care nurses from implementing the evidence-based guidelines to prevent VAP?

MATERIALS AND METHODS

Materials

Research design:

The design used in this study is a descriptive design.

Setting:

This study was conducted at the casualty (unit I) and the general (unit III) CCUs of Alexandria Main University Hospital.

Subject:

A convenient sample of all nurses working in the previous CCUs (60 nurses) at the Main University Hospital of Alexandria and providing direct patient care were included in this study.

Tools:**Two tools were used in this study:****Tool one:**

"Ventilator-associated pneumonia Preventive interventions Observation Checklist"(VAPPIOC)

The tool was adopted from Kollef MH. (1999)⁽¹⁷⁾ and was used by the researcher to observe nurse's implementation of evidence-based guidelines for preventing VAP. It contains 21 items describing nursing interventions for preventing VAP, and is divided into four main sections according to VAP causes: Cross contamination, host factors, aspiration and inhalation factors.

Tool two:

"Ventilator-associated pneumonia Knowledge questionnaire" (VAPKQ)

Biancofiore G. (2007)⁽¹⁸⁾ tool was used by the researcher to assess critical care nurses' knowledge regarding evidence-based guidelines for preventing VAP. This tool examines the reasons that hinder nurses from implementing these guidelines; a questionnaire was administered to all nurses working in the previously mentioned settings.

This tool consisted of two parts**Part one:**

It comprised questions of the same items as in tool one. These items were measured on a likert scale by convinced, unsure, and unconvinced. If these prevention strategies were not used, nurses were asked to select the suggested reasons that hinder them from implementing the guidelines such as: unavailability of the necessary material, cost, lack of time, nurse-to-patient ratio, unknown or inactive program of the unit... or other factors that can be reported by nurses.

Part two:

It included the following data: nurses' characteristics and demographic data such as age, type of the critical care unit, level of education, their qualification and their knowledge about VAP and its prevention.

Methods

A written approval to conduct the study was obtained from the responsible authorities of the Alexandria Main University Hospital after providing an explanation of the study aim. Informed consent was obtained from the nurses, the anonymity and confidentiality of responses, voluntary participation and right to refuse to participate in the study was emphasized to subjects. The researcher also explained to the nurses the objectives of the study. The study was conducted during 3 consecutive months from May to July 2009.

Tool II was translated into Arabic before data collection. Jury of five experts in the field of critical care nursing, nursing education, and research assessed the

clarity, feasibility, applicability, and content related validity of the tool. Accordingly, all necessary modifications were done. (Tool one was adopted from Kollef MH where reliability(r) =0.90 and tool two was tested for its reliability using interrater reliability. The reliability coefficients were (r) =0.83).

A pilot study was conducted on 5 nurses not included in the study to test the clarity, applicability and feasibility of the tools. Appropriate modifications were performed prior to data collection for the actual study.

The researcher observed nurses using Tool I, which covers nurses' practices regarding the implementation of guidelines for preventing VAP, and intervention strategies. Each nurse was observed three times regarding implementation of VAP prevention intervention by this checklist tool during 3 consecutive months. Some procedures were observed based on check list.⁽⁸⁾ The interventions were measured using scale of done or not done and the

procedures were done measured as adequate or inadequate, adequate refers to procedures done correctly in every observed time observed and inadequate refers to procedure that was done incorrectly (regarding frequency or technique).

The data was collected by using the questionnaire of Critical care nurses' knowledge for preventing VAP (tool two), and all data were coded and entered in statistical program to be analyzed.

Results of the questionnaire were calculated as follows: The procedures considered as **unsure**, if the nurse's answer were not always or sometimes were combined together, **convinced** if the nurse's answers were always and **unconvinced** if the nurse's answer were not done. If nurses **were unconvinced** with implementation of the procedure, they were asked to check the barriers that hinder them to implement this procedure.

Analysis of the Results

Depending on the analysis of the results, the relationships between variables have been studied, also according to the classification of collected data and depending on the main categories and relation between results of the two tools, results were done and tabulated.

Statistical analysis:

Data was collected and coded, entered into the personal computer (PC). Statistical analysis was performed using the software SPSS (Statistical Package for Social Science), version 15.

Descriptive Statistics:

Numbers and percentage: used for describing and summarizing quantitative data.

Range, arithmetic mean (X) and standard deviation (SD) used for normally distributed quantitative data.

P value of 0.05 was used to assess the

significance of the result.

Statistical test used in the present study was Student t- test which was used for comparing between two means such as relationship between nurses' knowledge and implementation of preventive interventions for VAP.

RESULTS

Table (1): shows distribution of nurses according to their characteristics. This table reveals that only one sixth of nurses were males. Regarding to nurses' age, more than half of nurses were under thirty and the rest of them were above 30 years old. In relation to nurse's qualification, more than one third of nurses had a bachelor degree; also nearly a quarter of nurses held a diploma in nursing, and the remaining 41.7% were from technical schools which was the largest proportion of the total number. Regarding to nurses' experience, more than three quarters of nurses had up to 10 years experience in critical care units and

only 18.3% of nurse's had more than 10 years experience.

Table (2) illustrates distribution of nurses according to their knowledge to prevent VAP; the majority of nurses were convinced of performing hand rub with alcoholic based solution after every patient contact and hand washing with soap and water before and after patient care (75%, 65% respectively). Nearly half of nurses were unsure to wash hands before and after wearing protective gloves, and one third of nurses were unsure to use protective gloves at every approach to a patient, while about half of nurses (46.7%) of nurses were unconvinced of using protective gloves for each procedure.

The highest percentage of nurses were convinced of positioning patients in semi-seated position and nutritional support intake (85%, 76.7% respectively). More than half (58.3%) of nurses were unsure about humidification of respiratory circuit using humidity and heated system, while

half of nurses were unconvinced of maintenance and control of endotracheal cuff pressure once every 4 hours.

In relation to nurses' knowledge to prevent VAP through prevention of aspiration, this table presents high percentage of conviction in removing of oro/nasogastric tube and prevention of gastric distention (100%, 76.7% respectively), and more than half of nurses (55%) were unsure about sterile broncho-aspiration.

Most of nurses were either unconvinced or unsure about performing oral care while all nurses were unconvinced of doing endotracheal tube (ETT) suctioning using sub-glottic aspiration or close circuit suction as they did not use it before.

Regarding their knowledge to prevent VAP through prevention of inhalation, the majority of nurses were convinced of using humidifiers and replacement of ventilator circuit upon disconnecting the patient

(91.7%, 85% respectively), on the other hand all nurses were unconvinced of using anti bacterial filter in ventilator circuit.

Tables (3 a, b): show distribution of nurses' application of measures to prevent VAP. Nurses implementation of preventive intervention for cross contamination. It was evident that in spite of the finding that 98.3% of nurses did hand rubbing with alcoholic based solution, however, only 54.2% of them carried out this intervention adequately. Similar findings were observed regarding washing hands with soap and water before and after each patient contact (93.3% of nurses with adequate procedure in only 21.4% of them) and in wearing gloves in every approach to a patient (96.6% of nurses with adequate procedure in only 39.7% of them).

Regarding nurses' implementation of preventive intervention for host factor.

This table illustrates that all nurses perform nutritional support to patients; however, only 48.3% of them did it

adequately. At the same time, nurses were applying different measures of respiratory hygiene (ranging from 73.3% on monitoring cuff pressure up to 98.3% on performing physiotherapy), however, more than half of them were applying these procedures inadequately.

As for nurses' implementation of preventive intervention for aspiration; it was found that, all nurses (100%) perform gastric distention prevention and removal of nasogastric tube (NGT), while 91.6% of nurses perform sterile ETT suction. However, more than half of nurses were performing these interventions inadequately. At the same time, there was no use of sub-glottic secretion aspiration, or closed suction system. It was found that nurses were performing oral care for patients either once daily (90%) or every 4 hours (78.3%) or by using antiseptics (80%), however, more than 90% of them were performing these procedures inadequately.

Nurses' implementation of preventive intervention for inhalation. It was revealed that the majority of nurses were applying measures to prevent occurrence of VAP through inhalation as replacement of ventilator circuit when disconnecting the patient, water removal from ventilator circuit, using humidifiers, using a sterile suction tube, inhalation device and using sterile syringes for inhalation medications. However, these interventions were performed inadequately in most situations. At the same time, there was no use of antibacterial filters.

Table (4): Illustrates that, statistically significant differences were found between mean percent score of nurses knowledge and their application of measures to prevent VAP in relation to measures that prevent host factors ($T=2.620$, $P=0.010$) and no statistical significant difference was found in relation to cross contamination, aspiration, inhalation. Concerning nurses knowledge about VAP prevention guideline

and nurses application of the guideline, it was found that nurses didn't have enough knowledge (mean score=60.28) and didn't adhere to the guideline to prevent VAP (mean score=57.33) and no statistically significant difference was found between knowledge and application of VAP prevention guidelines ($t=0.007$, $P=0.944$).

Table (5): Barriers that prevent implementation of measures to prevent VAP. As for nursing measures to prevent **cross contamination**, nurses stated that the most common barriers that hinder them from performing measures to prevent cross contamination were unavailability of the necessary material and workload. Concerning nursing measures to prevent **host factors**, some measures were not applied by nurses. Nurses reported that these measures were not foreseen in department protocol. Also, workload and unavailability of the necessary material were the main barriers against the application of preventive measures.

Related to the nursing measures to prevent **aspiration** and **inhalation**, nurses reported that some of these preventive measures are not applied because of the following barriers: not foreseen in departmental protocol, no information about the performance of the procedures, unavailability of the necessary materials, their cost and workload.

DISCUSSION

EBGs aim to improve the quality of care, to decrease costs, and to reduce inappropriate variation in decision making in this setting ⁽¹⁹⁾. The development of EBGs should be based on multidisciplinary participation and should incorporate methods the efficacy and cost-effectiveness of which are supported by evidence-based clinical studies. ^(17, 20)

The prevention and control of VAP are based on the education of CCUs health-care staff towards the problem and on the application of a series of clinical, organizational, and behavioral measures.⁽²¹⁾

The present study reported that there is a deficit in **nurses' knowledge** about VAP risk factors and prevention. This is in line with a study carried out by Biancofiore and coworkers (2007)⁽¹⁸⁾, who found that nearly half of nurses declared that they were poorly informed.

Evidence-based guidelines regarding preventive measures for VAP are increasingly available in literatures. However, the uses of these guidelines in daily practice remain limited. The Canadian Critical Care Trials group surveyed compliance to VAP prevention guidelines across 66 Canadian CCUs. They found significant opportunities for improvement in basic CCU care⁽²²⁾. Rello *et al.*, (2002)⁽²¹⁾ demonstrated in a large, multicenter survey across European CCUs, that non-adherence to published recommendations was about one third. The most commonly cited reason was intensive disagreement with the results, followed by unavailability of resources and costs associated with

implementation of specific intervention.

Although multiple interventions to reduce VAP are available, studies show that these interventions are not being widely implemented. Cook *et al.*, (2000)⁽²³⁾ compared Canadian and French CCUs with regard to the use of seven strategies to control secretions and care for ventilator circuits to prevent VAP and to reduce overall health care costs. Adherence to specific prevention guidelines for VAP was more common among French CCUs, but rates were low in both countries. Investigators also found that, published recommendations did not appear to substantially affect whether preventive interventions were used within individual CCUs. The most common reasons for not applying were adverse effects, cost, lack of convincing benefits, and inconvenience.⁽²³⁾

The present study revealed that critical care nurses did not comply with the EBGs to prevent VAP and the most common barriers for non-compliance were that the

guidelines were not foreseen in departmental protocol, unavailability of the necessary material and workload. Recently, the multicenter, cross-sectional survey to determine the compliance to EBGs for the prevention of VAP among respiratory therapists and registered nurses in academic and nonacademic CCUs, found that the rate of application were more than two-thirds, and the reasons for the lack of compliance to the guidelines were disagreement with the result of randomized trials, unavailability, adverse effect to the patients, high cost and patient discomfort ⁽²⁴⁾.

Ricart et al., (2003) ⁽²⁵⁾ found that the nurses had different levels of compliance than physicians for many non-pharmacologic strategies for prevention of VAP. The most important barriers to compliance were unavailability of resources, followed by patient discomfort, disagreement with the interpretation of reported trials, and fear of potential adverse events. Also, Biancofiore et al., (2007) ⁽¹⁸⁾ reported that the reasons for

non compliance of the proposed strategies were; that they were not in the unit protocols, lack of the necessary resources, disagreement with the proposed strategy, cost, the possibility of causing patient discomfort and side effects on the patient.

To achieve compliance by required procedures, sufficient knowledge must be available for nurses about VAP and preventive measures necessary to adhere, but when the nurses do not have adequate knowledge this will hinder the application, as it was indicated in the current study that, lack of knowledge can be considered the most important barrier that prevents the application of EBG, so, their application was limited to what they know.

Nurses have inadequate knowledge regarding VAP prevention and they do not also apply all measures to prevent VAP because of hospital policy, lack of resources and nurses' workload.

Finally, prevention of VAP requires a collaborative effort, and nurses play an essential role because of their frequent

interactions with patients at the bedside. So that it is important to increase the nurses' knowledge about VAP and prevention strategies through the educational programs to enhance the implementation of EBGs.

CONCLUSION & RECOMMENDATIONS

Conclusion

The present study highlights the nurses' practice regarding the implementation of evidence-base guidelines for preventing VAP, barriers that hinder application and nurses' knowledge about these strategies. *Based on results of the present study it was possible to conclude that:*

In relation to **nurses' knowledge** about VAP, there is a gap in critical care nurses' knowledge regarding VAP, its risk factors, and prevention. This was evident by the deficiency in the application of preventive measures.

Regarding to the implemented **measures to prevent VAP**, there are many measures that were not applied adequately by nurses. Measures to prevent host factors were the most commonly used by the critical care

nurses to prevent VAP followed by the measures to prevent inhalation and cross contamination. Measures to prevent aspiration were less used. The most **common barriers** that hindered nurses from implementing intervention to prevent VAP were workload, lack of resources, and absence of these guidelines in departmental protocol.

Recommendations

On the support of the current study findings, it is recommended that:

Clinical practice:

- The caring of mechanically ventilated patients should be done by well experienced and qualified nurses to minimize occurrence of VAP.
- Team approach should be considered in the care of mechanically ventilated patients. The team should include physicians, critical care nurses and respiratory therapists.
- Nurses caring for patients treated with mechanical ventilation must recognize risk factors and strategies for reducing

these factors as part of their nursing care.

Education:

- Educational programs should be conducted to raise critical care nurses' awareness of VAP risk factors and nursing preventive strategies.
- Regular update about the VAP prevention guidelines should be provided for critical care nurses.
- Further teaching of the EBG principles to nurses to apply these principles is required, for successful implementation of EBG in the daily practice.
- Strategies that prevent VAP should be included in the curricula of the study in undergraduate nursing students.
- Validation of the competency of nurses delivering the care should be carried out for patient's safety.

Administration:

- Local guidelines should be available in a written form at CCUs for the critical care nurses or any other health care providers,

and be applicable for VAP prevention in different CCUs.

- Local guidelines must be emphasized to ensure the quality assurance in the CCUs, by disseminating information on best practices and giving professionals training in risk management through records, periodic reports of occurrence rates, and risk management for patients to ensure the safety of patients.
- Hospital policy should be directed to provide adequate resources which are essential for implementation of VAP prevention guidelines.
- Critical care nurse manager should be ensured that appropriate training and educational programs to prevent VAP are developed and provided to critical care nurses.
- The critical care nurses and intern student nurses should be oriented by preceptors and instructors, about the importance of performing the guidelines and how could respiratory tract infections increase the

morbidity and mortality of critically ill patients

- The administrators should analyze the incidence records of VAP, their causes and how to overcome the barriers that lead to their occurrence.
- The nursing procedures for prevention of VAP should be included in the CCU policies.

Research

Many areas related to VAP have been researched extensively from a medical

perspective; however, prevention and treatment of VAP have had a little attention

from a nursing perspective.

- Further research should be done to develop local nursing standards for VAP prevention and should be translated into tools and templates for use by health care providers.
- Consider further research to explore the effect of implementing of guidelines and their relationship to respiratory infection in patients receiving mechanical ventilation.

Table (1): Distribution of nurses according to their characteristics.

Nurse's characteristics	Total	
	No.	%
Sex		
Male	10	16.7
Female	50	83.3
Age		
<30	31	51.7
30 +	29	48.3
Level of education		
Diploma	14	23.3
Technical school	25	41.7
Bachelor	21	35.0
Experience		
<5	24	40.0
5-10	25	41.7
>10	11	18.3

Table (2): Distribution of nurses according to their knowledge about VAP prevention

Cross contamination	Knowledge N=60					
	Unconvinced		Unsure		Convinced	
	No.	%	No.	%	No.	%
<i>Wearing gloves</i>	12	20.0	20	33.3	28	46.7
• Every approach to a patient.						
• For each procedure.	28	46.7	30	50.0	2	3.3
<i>Hand washing</i>	9	15.0	12	20.0	39	65.0
• Before and after each patient contact.						
• Before and after procedure.	20	33.3	27	45.0	13	21.7
• Hand rub with alcoholic based solution	0	0.0	15	25.0	45	75.0
Host factors	Unconvinced		Unsure		Convinced	
	No.	%	No.	%	No.	%
<i>Nutritional support</i>	0	0.0	14	23.3	46	76.7
<i>Respiratory hygiene</i>	30	50.0	24	40.0	6	10.0
• Cuff pressure.						
• Physiotherapy.	13	21.7	20	33.3	27	45.0
• Humidification.	0	0.0	35	58.3	25	41.7
• Positioning	0	0.0	9	15.0	51	85.0
• Turning	0	0.0	21	35.0	39	65.0
Aspiration	Unconvinced		Unsure		Convinced	
	No.	%	No.	%	No.	%
<i>Gastric distension prevention</i>	0	0.0	14	23.3	46	76.7
<i>Gastric Tube removal</i>	0	0.0	0	0.0	60	100.0
<i>ETT Suctioning</i>	12	20.0	33	55.0	15	25.0
• Sterile.						
• Sub- glottic aspiration.	60	100.0	0	0.0	0	0.0
• Closed- circuit.	60	100.0	0	0.0	0	0.0
<i>Oral care</i>	26	43.3	28	46.7	6	10.0
• Every 4 hours						
• Once	29	48.3	28	46.7	3	5.0
• Using antiseptics	29	48.3	27	45.0	4	6.7
Inhalation	Unconvinced		Unsure		Convinced	
	No.	%	No.	%	No.	%
<i>M.V</i>	0	0.0	9	15.0	51	85.0
• Ventilator circuit						
• Antibacterial filter	60	100.0	0	0.0	0	0.0
• Water removal from ventilator circuits	0	0.0	25	41.7	35	58.3
• Humidifier	0	0.0	5	8.3	55	91.7
• Inhalation device	16	26.7	37	61.7	7	11.7
<i>Suctioning</i>	15	25.0	20	33.3	25	41.7
• Device for each patient						
• A sterile tube	18	30.0	36	60.0	6	10.0
• Sterile syringe of drug	0	0.0	17	28.3	43	71.7
• Amdu bag	18	30.0	34	56.7	8	13.3

Table (3-a): Nurses' application of measures to prevent VAP.

Cross contamination	Application N=60			
	Not done		Done	
	No.	%	No.	%
<i>Wearing gloves</i>				
• Every approach to a patient	2	3.3	58	96.6
• For each procedure.	9	15.0	51	85
<i>Hand washing</i>				
• Before and after each patient contact	4	6.7	56	93.3
• Before and after procedure	7	11.7	53	88.3
• Hand rub with alcoholic based solution	1	1.7	59	98.3
Host factors	Not done		Done	
	No.	%	No.	%
Nutritional support	0	0.0	60	100
Respiratory hygiene	16	26.7	44	73.3
• Cuff pressure				
• Physiotherapy	1	1.7	59	98.3
• Humidification	5	8.3	55	91.6
• Positioning	2	3.3	58	96.6
• Turning	5	8.3	55	91.6
Aspiration	Not done		Done	
	No.	%	No.	%
Gastric distension prevention	0	0.0	60	100
GT Removal	0	0.0	60	100
<i>ETT Suctioning</i>				
• Sterile	5	8.3	55	91.6
• Closed- circuit	60	100.0	0	0.0
• Sub- glottic aspiration	60	100.0	0	0.0
<i>Oral care</i>				
• Once every 4 hours	13	21.7	47	78.3
• Once	6	10.0	54	90
• Using antiseptics	12	20.0	48	80
Inhalation	Not done		Done	
	No.	%	No.	%
<i>M.V</i>				
• Ventilator circuit	0	0.0	60	100
• Antibacterial filter	57	95.0	3	5
• Water removal from ventilator circuits	1	1.7	59	98.3
• Humidifier	1	1.7	59	98.3
• Inhalation device	0	0.0	60	100
<i>Suctioning</i>				
• Device for each patient	4	6.7	56	93.3
• A sterile tube	0	0.0	60	100
• Sterile syringe for drug	0	0.0	60	100
• Amdu bag	3	5.0	57	95

Table (3-b): Nurses' application of measures to prevent VAP.

Cross contamination	N	Application			
		Inadequate		Adequate	
		No.	%	No.	%
<i>Wearing gloves</i>	58	35	60.3	23	39.7
• Every approach to a patient					
• For each procedure	51	45	88.2	6	11.8
<i>Hand washing</i>	56	44	78.6	12	21.4
• Before and after each patient contact					
• Before and after procedure	53	45	85.0	8	15.0
• Hand rub with alcoholic based solution	59	27	45.8	32	54.2
Host factors	N	Inadequate		Adequate	
		No.	%	No.	%
<i>Nutritional support</i>	60	31	51.7	29	48.3
<i>Respiratory hygiene</i>	44	42	95.4	2	4.6
• Cuff pressure					
• Physiotherapy	59	41	69.5	18	30.5
• Humidification	55	39	71.0	16	29.0
• Positioning	58	32	55.2	26	44.8
• Turning	55	38	69.0	17	31.0
Aspiration	N	Inadequate		Adequate	
		No.	%	No.	%
<i>Gastric distension prevention</i>	60	34	56.7	26	43.3
<i>GT Removal</i>	60	14	23.3	46	76.7
<i>ETT Suctioning</i>	55	51	92.8	4	7.2
• Sterile					
• Closed- circuit	0	0	0.0	0	0.0
• Sub- glottic aspiration	0	0	0.0	0	0.0
<i>Oral care</i>	47	44	93.7	3	6.3
• Once every 4 hours					
• Once	54	49	90.8	5	9.2
• Using antiseptics	48	44	91.7	4	8.3
Inhalation	N	Inadequate		Adequate	
		No.	%	No.	%
<i>M.V</i>	60	20	33.3	40	66.7
• Ventilator circuit					
• Antibacterial filter	3	3	100	0	0.0
• Water removal from ventilator circuits	59	30	50.9	29	49.1
• Humidifier	59	19	32.2	40	67.8
• Inhalation device	60	54	90.0	6	10.0
<i>Suctioning</i>	56	24	42.9	32	57.1
• Device for each patient					
• A sterile tube	60	52	86.7	8	13.3
• Sterile syringe drug	60	17	28.3	43	71.7
• Ambu bag	57	53	93.0	4	7.0

Table (4): Comparison between nurses' knowledge and their application of measures to prevent VAP.

Categories	Application		Knowledge		t (p)
	Mean \pm SD	Mean percentage score	Mean \pm SD	Mean percentage score	
Cross contamination	5.9 \pm 1.69	59.7	5.97 \pm 1.94	59.7	0.000 (1.000)
Host factor	8.7 \pm 1.99	62.4	9.67 \pm 1.91	69.1	2.620* (0.010)
Aspiration	6.87 \pm 1.61	42.9	6.63 \pm 2.09	41.4	0.685 (0.495)
Inhalation	12.83 \pm 1.90	64.2	12.67 \pm 2.46	63.4	0.415 (0.679)
Total	34.40 \pm 5.29	57.33 \pm 8.81	39.78 \pm 6.89	60.28 \pm 10.44	0.007 (0.944)

* : Statistically significant at $p \leq 0.05$

Table (5): Barriers that prevent implementation of measures to prevent VAP:

	Interventions	Barriers	No.	%	Total
Cross contamination	Wearing gloves • Every approach to a patient	• Unavailability of the necessary material	12	100.0	12
	• For each procedure.	Unavailability of the necessary material	28	100.0	28
	Hand Washing • Before and after each patient contact	• Workload	9	100.0	9
	• Before and after procedure	• Workload	20	100.0	20
Host factor	Respiratory hygiene • Cuff pressure	• Not foreseen in departmental protocol • Workload	26 27	86.7 90	30
	• Respiratory physiotherapy	• Not foreseen in departmental protocol • Workload	27 26	90 86.7	30
Aspiration	Ett suctioning • sterile	• Unavailability of the necessary material	12	100.0	12
	• Sub-glottic aspiration	• Not foreseen in departmental protocol • I have no information about the procedure • Unavailability of the necessary material • Too expensive	57 21 48 10	95 35 80 6.7	60
	• Closed-circuit .	• Not foreseen in departmental protocol • Unavailability of the necessary material • I have no information about the procedure • Too expensive	37 57 2 32	61.7 95 3.3 53.3	60
	Oral care • Once every 4 hours	• Not foreseen in departmental protocol • Unavailability of the necessary material • Workload	19 12 21	73.1 46.1 80.7	26
	• Once	• Not foreseen in departmental protocol • Unavailability of the necessary material • Workload	22 17 20	75.9 58.7 70.0	29
	• Using antiseptics.	• Not foreseen in departmental protocol • Unavailability of the necessary material • Workload	22 10 26	75.9 34.5 89.7	29

Table (5): con

Inhalation	M.V Equipment • Antibacterial filter.	<ul style="list-style-type: none"> • Not foreseen in departmental protocol • Unavailability of the necessary material • I have no information about the procedure • Too expensive 	46 48 8 16	76.7 80 13.3 26.7	60
	• Inhalation device.	<ul style="list-style-type: none"> • Not foreseen in departmental protocol • Unavailability of the necessary material 	12 14	75 87.5	16
	Suctioning • Device for each patient.	<ul style="list-style-type: none"> • Not foreseen in departmental protocol • Unavailability of the necessary material 	5 10	33.3 66.6	15
	• A sterile tube	<ul style="list-style-type: none"> • Not foreseen in departmental protocol • Unavailability of the necessary material • Too expensive 	2 18 11	33.3 100.0 61.1	18
	• Ambu bag	<ul style="list-style-type: none"> • Not foreseen in departmental protocol • Unavailability of the necessary material 	18 18	100.0 100.0	18

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