Efficacy of Implementing Nursing Care Protocol on the Incidence of Ventilator Associated Pneumonia in Intensive Care Unit at Tanta Emergency Hospital

Zeinab Mohammed Shaban Aysha[1], Sanaa Mohamed Alaa El-Din[2], Nagwa Ragab Attia[2], and Mohammad Ibrahim Akab[3]

[1]Medical Surgical Nursing (Critical Care) Department, Faculty of Nursing, Tanta University, Tanta, Egypt
[2]Medical Surgical Nursing Department, Faculty of Nursing, Alexandria University, Alexandria, Egypt
[3]Anesthesia and Critical Care Department, Faculty of Medicine, Tanta University, Tanta, Egypt
Email: ngawagad@Rocketmail.com

Abstract: Utilization of protocols of care in the ICU can potentially improve the care of the critically ill patient, by improve patients' outcomes. ***Aim*:** This study aimed to evaluate the efficacy of implementing nursing care protocol on the incidence of ventilator-associated pneumonia in the Intensive Care Unit at Tanta Emergency hospital. ***Materials and Method*:** The study was conducted in anesthesia and Emergency ICU at Tanta University Hospital, Tanta, Egypt. Data collection was extended from June 2009 to the end of March 2010. The sample of the study was consisted of two subjects (patients and nurses) A convenience sample of 60 adult mechanical ventilated patient for longer than 24 hours and fulfilling the inclusive criteria were included, and divided into three equal groups: ***Group I:* (Control group)** pre intervention group. **Group II Studied group** and **group III** Follow up group. **Four tools** were used for the collection of data as follows: **Tool (I) Mechanical-Ventilated Assessment tool**: **Tool (II) Ventilator-associated- pneumonia assessment tool: Tool (III): Nurse's Knowledge questionnaire Tool (IV) Observational checklist** for nurses was practicing ventilator associated pneumonia protocol of care. **Results:** ***The main results revealed that:*** there were a highly significant difference among mean scores of nurse's knowledge and performance at three phases (phase I versus II) and between (phase I and phase III) and between (phase II and III) at p value, equal (0.0001, 0.0001, 0.001) respectively. on the other hand It was found that there was a significant decrease in the incidence rate of VAP infection among the three studied groups three quarter (75%) of patients within group I had developed VAP infection versus to more than one third (35%) in-group II patients and 20% group III patients. ***Conclusion and recommendations*:** Protocol of care education was effective and successfully enhancing ICU nurses' competencies improving in clinical outcomes and reduction of VAP rate among mechanically ventilated patients. It was recommended that provision of institutional written policies and guidelines regarding application of protocol of care in daily routine care for mechanically ventilated patients.

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1. Introduction

Best practice and preventive measures are important aspects of nursing care for patients' who receive mechanical ventilation (MV) [(1)]. Nurses' have taken an aggressive role in developing best practice standards in an attempt to prevent ventilator-associated pneumonia (VAP) [(2)]. Protocols, which standardize care of patients' with similar diseases, represent a potential solution to managing multiple simultaneous problems in critically ill patients. The use of protocols in the ICU has become increasingly common. Protocol of care (POC) are one method to more quickly adapt new information to bedside care, therefore the utilization of these protocols in the ICU can potentially improve the care of the critically ill patients because of the complexities of caring for those patients[(3)].

The Center for Disease Control and Prevention (CDC) [(4)] defined VAP by the criteria of National Healthcare Safety Network (NHSN) (2011) [(5)] as "Pneumonia in persons who had a device to assist or control respiration continuously through a tracheostomy or by endotracheal intubation within the 48hours period before the onset of infection, inclusive of the weaning period.

Incidence:

Ventilator associated pneumonia is the most common worldwide problem and lethal form of hospital-acquired (nosocomial) pneumonia, which occurs in 8%–28% of all patients' who receive mechanical ventilation. The incidence of nosocomial pneumonia (NP) is markedly higher about (3–10)-fold among those patients than others not receiving mechanical ventilation[(6-12)].

Most studies on VAP have come from the United States and Europe where there are active VAP surveillance programs but these figures did not necessarily reflect the situation in other countries [13-16].VAP rate, in USA as reported by the CDC and NHSN hospitals (2011) [5] ranged from zero to 4.9 / 1.000 ventilator days. According to unit type the report also illustrated a mean VAP rate in US medical-surgical ICUs of 3.6 per 1000 ventilator-days, in neurosurgical ICUs of 7.0 per 1000 ventilator-days, and in trauma ICUs of 10.2 per 1000 ventilator-days [17, 18].

In Egypt, Surveillance programs for (HAIs) or antimicrobial resistance (AMR), the United States Agency for International Development (USAID) in Egypt in June 2011 until January 2012. [15] a surveillance project examining HAI and AMR in 11 hospitals in Egypt, including 43 intensive care units (ICUs) representing both the Ministry of Health and University Hospitals. The result was 50% of the HAIs were pneumonia 20% bloodstream infections, and 15% urinary tract infections. A high proportion of the overall infections (64%) were device-associated infection (DAI), where VAP constituted 92% of the overall hospital-acquired pneumonia. Also, a study conducted in (2008) [16] at Tanta university emergency Hospital, proved that incidence rate of VAP was 47.5% of patients on mechanical ventilators with an associated mortality of 22.5%.

Center for disease control and prevention established recommended guidelines to decrease the risk of VAP. Nurses have taken an aggressive role in developing the best practice standards in an attempt to prevent VAP. Therefore, nurses' education and reinforcement is considered as the cornerstone and the first step in preventing VAP [5, 18, 19, and 20].

Nursing care protocol for mechanical ventilated patients will include four main strategies as follows: Standard precaution techniques**,** Airway management techniques**,** Entral feeding and prevent aspiration, Sedation vocation and test the patient readiness to wean from MV.

Aim of the study

To evaluate the efficacy of implementing nursing care protocol on the incidence of ventilator associated pneumonia in the Intensive Care Unit at Tanta Emergency hospital.

Hypothesis:

1. The application of nursing care protocol effective and has an impact on reducing incidence rate of VAP among mechanically ventilated patient in the Intensive Care Unit at Tanta Emergency hospital.

2. The intensive care unit nurses will have higher knowledge and performance score related to different protocol of care strategies post the application of the protocol than before and will affect the patient outcomes.

3. The application of nursing care protocol not effective and has no impact on the incidence rate of VAP among mechanically ventilated patient in the Intensive Care Unit at Tanta Emergency hospital.

2. Materials and method:

Research design:

The present study was utilized A quasi-experimental research design it designed to evaluate the efficacy of implementing nursing care protocol on the incidence of ventilator-associated pneumonia in the Intensive Care Unit at Tanta Emergency hospital.

Setting:

This study was conduct at the ICU of Tanta Main University hospital namely:

Emergency Anesthetic Intensive Care Unit**,** which receives patients have life threatening problems, transferred from emergency and all hospital departments which include medical, surgical, and post-operative….etc. It consists of 24 beds

Subjects: The sample of this study was consists of all nurses (40) working in previously mentioned setting and 60 patients**.**

A) Patients: A convenience sample of 60 adults, mechanically ventilated patients of both sexes, fulfilling the inclusive criteria randomly divided into three groups as follows: **Group(I)** (Control group) pre intervention group consisted of 20 adult MV patients received routine care of intensive care unit. This routine did not include endotracheal cuff pressure monitoring, weaning protocol, sedation score, standardized airway management protocol, and caring with mechanically ventilated patient without consideration to evidence based practices or center of disease control and prevention (CDC) guidelines**. Group (II)** (immediately post intervention group) this group was consisted of 20 adult mechanically ventilated patients, fulfilling the same inclusive criteria which receiving nursing care protocol by the ICU nurses after receiving protocol of care regarding incidence of ventilator-associated pneumonia. **Group III** Follow up group: it was consisted of 20 adult fulfilling the same inclusive criteria. This group was followed up after two months from implementing the nursing care protocol to evaluate the efficacy of implementing nursing care protocol on the incidence of ventilator associated pneumonia. **Inclusion Criteria** includes adult patient from both sexes, newly admitted and 24-48 hours of intubation, needs mechanical ventilator for more than 72 hours, using invasive mechanical ventilation via artificial airway either endotracheal or tracheostomy tube, haemodynamically stable i.e. all physiologic parameters within normal levels such as pulse, blood

pressure, blood gases analysis, & central venous pressure and free from infection as evidenced by clinical manifestation or microbiological analysis and chest X ray.

B) Nurses: All nurses (40) have bachelor degree of nursing who are working in intensive care unit and directly contact and caring with those ventilated patients regardless of their age, years of experience, and level of education were included in the study.

Data collection Tools: Four tools were used for data collection they accomplished after reviewing the related literature. **Tool (1) "Mechanical ventilation assessment tool'** this tool was developed, and used by the researcher after reviewing the relevant literature [1-27] for collection of baseline data regarding mechanical ventilation. It comprised ***five parts***: part one, four & five were developed by the researchers while part two & part three was adopted from Sesseler & Gosnell (2002) [21] Richmond Agitation Sedation Scale and Burn Weaning Assessment Program adopted from **Burns SM et al** (1994) [22] ***Part one:*** Sociodemographic and medical clinical baseline data. ***Part two*****: It concerns data about** Level of consciousness, New Simplified Acute Physiological Score (SAPS II) on admission**,** Richmond Agitation Sedation Scale (RASS), ***Part three*****: includes data related to:** Intubation, ventilator profile, Nutritional variables**,** Burn Weaning Assessment Program (BWAP)**,** ***Part four***: It was concerned data about buccal cavity status. ***Part five****:* It was concerned data about medication as: duration of previous antibiotics, type of current antibiotics used, antacids, vasopressin, muscle relaxant, and sedative. **Tool (2) Ventilator-Associated-Pneumonia Assessment Tool.** This tool adopted from Pugin et al (1991). [22] Using a Modified Clinical Pulmonary Infection Score (CPIS) it used by the researcher for accurate and early clinical diagnosis of pneumonia infection. **Tool (3) Nurses knowledge questionnaire regarding ventilator- associated pneumonia protocol of care tool.** It was developed by researcher after revising related literature to assess nurses' knowledge regarding ventilator associated pneumonia protocol of care. It includes **two parts** as the followings **Part one** sociodemographic data such as age, level of education, and years of experience in ICUs, attending previous in-service training courses or program about VAP prevention**. Part two:** it comprises 70 questions about nurses knowledge concerned with ventilator associated pneumonia protocol of care which includes nurses knowledge about a. mechanical ventilation 20 multiple choice questions, b eleven multiple choice questions about ventilator associated pneumonia, c. sixteen questions about hand washing and standard infection control precaution, d. eight questions about airway management strategy, e. three questions about enteral feeding protocol and f. twelve questions about sedation vocation and testing patient readiness to e weaned from ventilator. Scoring system of the nurse 's knowledge questionnaire: the incorrect answer and no response was allocated sore zero and the correct answer was scored one. Grades of total knowledge of the nurses in relation to different protocol technique was as the following: fair = equal or more than 50%, Good = > %50- 65%, very good = > 64%- <85 %**,** excellent = >_ 85%.

Tool (4): Observational checklist for nurses practicing ventilator associated pneumonia protocol of care. It was developed by the researcher as monitoring and an evaluative tool for nurses' performance regarding protocol of care application according to evidence based practices and center for disease control CDC. This protocol was including 1. Educational hand washing and precaution techniques, 2. Airway management strategies, 3. Sedation assessment by using Richmond Agitation Sedation Scale and 4 prevention of aspiration and gastric translocation. Scoring system of nurses' performance of protocol of care.

Method:

1. A Written approval to conduct the study was obtained from the responsible authority of Emergency Anesthetic ICU before conducting this study through official letters from Faculty of Nursing explaining the purpose of the study.
2. Tool development: Four tools were used in this study as follows:
3. ***Tool development for patients***. Two tools were used for ventilated patients, as following:

Tool(I)"Mechanical ventilation assessment tool was constructed by the researcher after review of the relevant literature, except in Part two Glasgow coma scale (GCS) to test Level of consciousness using this scale, adapted from Teasdale and Jennett, (1974).[23], and New Simplified Acute Physiological Score (SAPS II) on admission: it adapted from Le Gall, et al (1993). [24] The score aimed to measure the severity of disease and predicting mortality rate for all patients. Richmond Agitation Sedation Scale (RASS). This scale, adapted from Sessler CN et al (2002). [21] It is used in sedation evaluation (assess level of sedation and evaluate agitated behavior of adult ICU patient**.** Part three Burn Weaning Assessment Program (BWAP) this sheet was adopted from **Burns SM et al** (1994) [22] which used to test patient readiness to wean **Tool II Ventilator-Associated-Pneumonia Assessment Tool.** It is used by the researcher for early clinical diagnosis of pneumonia infection using a Modified Clinical Pulmonary Infection Score (CPIS) which was adopted from Pugin et al (1991) [25]. **Tool development for nurses** two tool were developed, it is tool III & IV as the following: **Tool III** (Nurses

knowledge questionnaire sheet regarding protocol of care**.** This tool was developed by the researcher to assess and evaluate the nurses' knowledge on three phases of protocol application. Phase I pre intervention, phase II Immediately post intervention and phase III follow up phase two months after the application of the protocol of care. **Tool IV:** Observational checklist for nurses practicing ventilator associated pneumonia protocol of care. The researcher also developed this tool to assess and evaluate the nurse's performance three times among three phases of protocol application.

3. Content validity: The tools of the study were tested for content validity by nine jury experts in the field of medical surgical nursing, critical care nursing, anesthesiologists and medical biostatistics. Modifications were carried out accordingly.

Tool reliability: tools reliability were tested through test retest method

Informed consent:

Patient's Informed consent was obtained from patients and /or their families. Also Nurse's **informed consent** to participate in the study was obtained.

Pilot study was conducted before the actual study, on 5 patients and 5 nurses from ICU, in order to test the clarity, feasibility and the applicability, and content related validity of the different items of the determent tools. Data collection extended from June 2009 to the end of March 2010.The study was conducted on 3 phases

A) Assessment phase: During this phase: **I) for patients:** Initial assessment was carried out by the researcher for all ventilated patient, to assess the patients who met the inclusive criteria of this study. Twenty adults, mechanically ventilated patients, fulfilling the inclusive criteria were selected and assigned randomly into three groups according to the phase of the protocol implementation as follows: **Group I:** (pre intervention group) consisted of 20 MV patients who received routine care from the nurses before educational protocol of care. **Group II:** (post intervention group) consist of other 20 adult MV patients fulfilling the same inclusive criteria, receiving nursing care protocol. **Group III:** it consisted of 20 adult mechanically ventilated fulfilling the same inclusive criteria. This group was a follow up after two months after implementing the nursing care protocol. The researcher used tool (I, II) firstly at the time of patients admission for collection of the baseline data within the first 24 hours of intubation and continued daily for 10 days of ICU stay and tool II, was estimated on admission to exclude the patients who had infection at the time of admission this through estimation of Clinical pulmonary infection score (CPIS) as follows:

At the first 24-48 hour of patients' intubation, throat swap and a blind endotracheal aspirate specimen for gram stain and culture will firstly obtained accompanied by newly chest X- ray.1. Calculate pretest baseline probability test estimation of baseline data for the incidence of VAP. It calculated firstly based on the first five clinical variable only (temperature, oxygenation index Pao_2/Fio_2, leukocytes count/mm3, chest x-ray infiltrate and tracheal secretion.). The result of this score revealed the probability of the infection either positive or negative. 2. If it **less than 6** those were included on the sample and categorized as low likelihood of infection and randomized to receive either standard therapy with reevaluation after 3 days later. 3. If the result of this score was, **more than 6** it considered as high likelihood of pneumonia and those patients treated as they had pneumonia, and excluded from the study subjects. 4. Calculation of (CPIS) at the baseline as a pretest for the probability of the incidence of ventilator-associated pneumonia based on the clinical variable only, 4. When chest proliferation and endotracheal aspirate was available, aspirate a blind non-bronchoscopic endotracheal aspirate specimen The collection of the sample conducted under strict aseptic technique and was sent to the lab immediately, the results were calculated from both clinical and laboratory variables. If the CPIS result more than 6 it represented a highly likelihood of (VAP) and if the result was equal or less than 6 it indicated a low probability of the ventilator associated pneumonia. 5. after that, the selected patients randomly assigned into the studied group 6. The microbial processing follow up were carried out after three days, and after one week from admission for diagnose early and late onset pneumonia.

SAPS II score was used to assess the severity of illness for both groups in the first 24 hours of admission to the critical care unit. It estimated once on admission only and the calculation method is optimized for paper schemas.8. The Glasgow coma score (GCS) was used on admission and daily along the period of 24 hour. 9. 10.Richmond assessment sedation score was used on admission and daily along the period of admission until the patients weaned from mechanical ventilation. 11. Burn Weaning Assessment Program (BWAP) which used to test patient readiness to wean by daily assessing and evaluate factors related to weaning, to track progress over time, and test the patient's readiness to weaning from mechanical ventilation.

Two tools for Nurses were used in the study as the following:

Tool III (Nurses knowledge questionnaire sheet regarding protocol of care). (This tool was used to assess and evaluate the nurses' knowledge on three

phases as follows: phase I pre intervention phase), Phase II (immediately post intervention) and Phase III (follow up phase) two months after the application of the protocol of care.

Tool IV: Observational checklist for nurses this tool to assess and evaluate the nurse's performance related to protocol of care strategies at three times by the same manner on three phases.

A) The implementation phase for the protocol of care:

The protocol of care was presented by the researcher to all nurses as follow: Preparation of the suitable educational aids used to cover the three domains of education it was included the following: Power point presentation about the protocol of care techniques used and a soft copy of the presentation, poster presentation for ventilator-associated pneumonia protocols, video presentation, simulation, performance equipments, and self learning handout about mechanical ventilation basics and protocol of care for VAP. Grouping the nurses, 8 nurses in each group according they endorsement shifts distribution. Sessions were given to 5 groups (8) nurses in each group. Eight sessions were given for those nurses for duration of two hours /week. In each session, the group of nurses that was contained 8 nurses divided to "sub group" 4 in each one. The session total duration was one hour for each sub group as follows the researcher started the implementation of the techniques of the protocol through (explanation and demonstrate) the techniques one by one. A theoretical part was given using power point slide presentation for 15 minute followed by video presentation for 10 minute after that demonstration for 35 minute by researcher and the nurses according to the workload of the unit, the number of the patient assigned to each nurse and the patient critical condition. The second hour was by the same manner to the other sub group.

The content of the sessions was divided as follows:

Session 1: Hand washing and standard precautions**, Session 2-5:** Airway management practices**, Session 6** Sedation vocation and weaning protocol to test the daily readiness to extubate and weaning**, Session 7***:* measurements to prevent aspiration and gastric reflux through entral feeding protocol of care**, Session 8:** open discussion and re demonstration for the previous Protocol of care techniques**.**

B) The evaluation phase: For patients:

Evaluation was carried out by the researcher using tool (I mechanical ventilated assessment tool) and tool II (CPIS) to evaluate the incidence of VAP as an impact of nurses' performance. At three phases (before the application of the protocol of care by the ICU nurses, immediately post intervention and two months after the nurses application of the protocol of care techniques, as an evaluation for nurses practices outcome on the incidence of ventilator associated pneumonia among those mechanically ventilated patients in the study. **For the nurses:** Knowledge of the nurses regarding different protocol techniques was evaluated by using (Tool III) and each item was evaluated as follow: Incorrect and no response answer scored (0), Correct answer scored (1) Nurses performance regarding protocol of care techniques was evaluated using (Tool IV) and each item was evaluated as follow: Not done or bad (scored 0), Need improvement (scored 1), Competent (scored 2), Proficient (scored 3). Finally a comparison was made between the results of both study subjects at all phases (pre, post test and follow up after two months) to evaluate the efficacy of implementing nursing care protocol on the incidence of ventilator-associated pneumonia in intensive care unit at Tanta Emergency Hospital**.**

Limitation of the study: Workload on nurses were high, No infection control committee inside ICU & Unavailability of some necessary equipment as cuff pressure

4. Results:

Table (1): Distribution of studied nurses according to their demographic data.

It reveals that all studied nurses (100%) had a bachelor degree in nursing science, and they were in early adulthood stage since the mean age of (27.37±3.21) years, moreover**,** their years of experience in nursing ranging from (1-13) with mean (5.42±2.88) years, the mean years of experience in ICU was 4.90±2.46 years with a range of (1-10) years. Furthermore, the findings revealed that, none of the nurses had previous educational courses about infection control practice in ICU, mechanical ventilation, nosocomial pneumonia infection in ICU, educational rotation about VAP and its association with mechanical ventilation**.**

Table (2) Comparison between total knowledge grades of the studied nurses among three phases of protocol of care application

The findings revealed that the majority (100%) of nurses total knowledge before intervention (phase I), was fair and enhanced in phase II in which, three quarter of them (75%) was excellent, and (25%) was very good, compared with phase III the total knowledge grades of nurses slightly changed, three quarter (75%) of them was very good and only 12.5% was excellent but still higher than phase one total grade of knowledge.

Figure (1): Mean total scores of performance of the studied nurses related to protocol of care different strategies.

The figure revealed that, the mean scores of nurse's performance of protocol of care strategies, in

(phase I) were 223.57±41.42 and increased to 629.20±11.21 in phase II while, the mean performance score decreased slightly to 567.65±8.86 in phase III but, still higher than score of pre intervention phase.

Table (3): Comparison levels and grades of total performance of the studied nurses among phases of protocol of care application

In phase I near three quarter (72.5%) of nurses their total performance grades of protocol of care different techniques badly done and no one of nurses' application was competent or proficient. While in phase II their total grades of performance was enhanced as the majority of them (82.5%) was proficient and (17.5%) was competent in application of different protocol of care techniques. Compared with phase III, the majority of the nurses(100%) was competent in their practices.

Table (4) Correlation between knowledge and performance of the studied nurses during three phases of protocol application It shows statistically significant positive correlation between nurses knowledge and performance in phase II, and phase III of protocol of care application with r = 0.524, 0.658 respectively.

Table (5) Demographic data of the studied mechanically ventilated patients (control and study groups). As regards sex: it was found that more than half of the three studied groups (I, II, III) (65.0), (65.0%), (60.0%) respectively were males and more than one-third in-group I, II and III respectively (0.35%) (0.35%) and (40.0%) were females. **Concerning age**: it was presented that more than half of group I, and group II, 55%, and 55%, respectively were within middle age stage of adulthood from 31-40 years, and in group III there were more than one third 40% were within the same age group. **In addition, this table shows that**, more than one-third 35% of three patient's groups (I, II, III) were admitted from post neurosurgery department. **In relation to smoking history**: it was observed that, in group I and II respectively more than half 60%,55% were smokers while, in group III two thirds of them 65% were non smokers.

Table (6): Effect of weaning protocol on weaning outcome among the three studied groups of mechanically ventilated patients. Concerning weaning attempts outcome and state of weaning it was found that three quarter of patients (75%) in group III and half (50%) of the patients in group II weaning attempts were succeed, and the patients completely weaned from mechanical ventilators. Compared with group I patients, three quarter (75%) of them weaning from mechanical ventilation did not succeed, and majority (70%) of them did not weaned from ventilator. Moreover, it was observed that there were statistically significant differences between the study groups in relation to duration of mechanical ventilation/days with p value equal 0.020. Results revealed that the duration of mechanical ventilation/days of studied subject (I, II, III) ranged between 6-30 day with a Mean 15.65±6.77 for group I and 5-30 day with a Mean 13.15±8.14 for patients within group II while it ranged from 7-15 with a Mean 9.90±2.57 for studied patients in-group III.

Figure (2) Incidence of VAP according to clinical pulmonary infection score Regarding total VAP infection cases among mechanically ventilated patients in three studied groups (I, II, III) it was found that the majority of patients in group I (75%) developed ventilator associated pneumonia compared with 35% and 20% in group II and group III respectively. Moreover, there were a significant differences between three studied groups (I, II, III) regarding all CPIS parameters as P = 0.001.

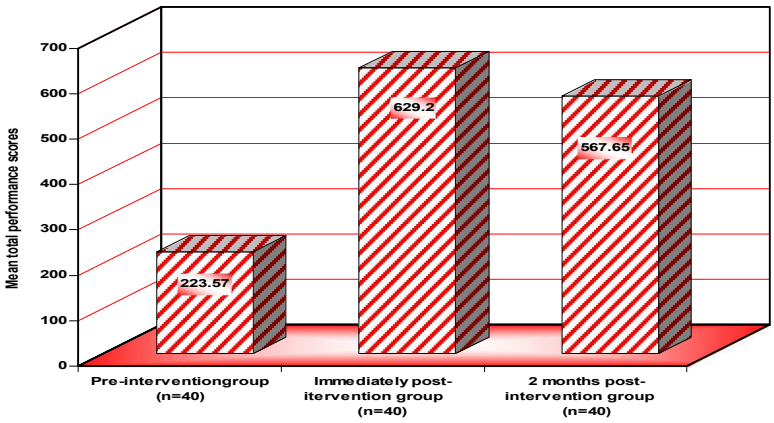

Figure (1): Mean total scores of performance of the studied nurses related to protocol of care different strategies.

Table (1): Distribution of studied nurses according to their demographic data.

Sociodemographic data	The studied nurses	(n=40)
	No	%
•Age: Range Mean±SD	22-35 27.37±3.21	
•Education level: ▪ Baccalaureate degree	100	40
•Years of experience in nursing:		
Range Mean±SD	1-13 5.42±2.88	
•Years of experience in ICU:		
Range Mean±SD	1-10 4.90±2.46	
•Previous ICU work Yes	40	100
• In service training programs in ICU:		
▪ No ▪ Yes	40 0	100 0
• Courses about infection control practice in ICU:		
▪ No ▪ Yes	40 0	100 0
•Previous education related to mechanical ventilation:		
▪ No ▪ Yes	40 0	100 0
•Educational program about VAP and its association with mechanical ventilation ▪ No	40	100
• Procedural guidelines for prevention of VAP in ICU ▪ No	40	100

Table (2): Comparison between total knowledge grades of the studied nurses among three phases of protocol of care application.

Grades of total knowledge	Total knowledge of the studied nurses (n=40)						χ^2	F-test P
	Pre-intervention (phase I)		post-intervention (phase II)		2 months post-intervention (phase III)			
	No	%	No	%	No	%		
Fair	40	100	0	0	0	0	169.286	0.0001*
Good	0	0	0	0	5	12.5		
V. good	0	0	10	25.0	30	75.0		
Excellent	0	0	30	75.0	5	12.5		

*Significant (P=0.05)

Fair= ≤ 50%, Good= >50%-65%,Very good= >65 %-< 85%, Excellent= ≥85%

Table (3): Comparison levels and grades of total performance of the studied nurses among phases of protocol of care application

Grades of total performance	Total performance of the studied nurses (n=40)						χ^2
	Pre-intervention (n=40)		Immediately post-intervention (n=40)		2 months post-intervention (n=40)		P
	No	%	No	%	No	%	
Not done or bad	29	72.5	0	0	0	0	204.225 0.0001*
Needs improvement	11	27.5	0	0	0	0	
Competent	0	0	7	17.5	40	100	
Proficient	0	0	33	82.5	0	0	

Not done or bad	(≤30%)	= the step or task not performed
Needs improvement	(>30%-65%)	=the step is performed incorrectly or out of sequence or sequence is completely omitted
Competently performed	(>65 %-< 80%)	= step or task is performed correctly and in proper sequence but participant does not progress from step to step efficiently
Proficiently performed	(≥ 80%)	= step or task performed efficiently, precisely and in proper sequence

*Significant (P=0.05)

Table (4): Correlation between knowledge and performance of the studied nurses during three phases of protocol application.

Phases of protocol of care	Correlation between knowledge and performance of the studied nurses (n=40)	
	R	P
Pre-intervention	0.203	0.208
Immediately post-intervention	0.524	0.001*
2 months post-intervention	0.658	0.0001*

r=Correlation coefficient

Table (5): Demographic data of the studied mechanically ventilated patients (control and study groups).

Sociodemographic data	The studied mechanically ventilated adult patients (N=60)						$\chi 2$	P
	Group I (Pre-intervention) (n=20)		Group II (Immediately post-intervention) (n=20)		Group III (2 months post-intervention) (n=20)			
	No	%	No	%	No	%		
Sex:								
▪ Females	7	35.0	7	35.0	8	40.0	0.144	0.931
▪ Males	13	65.0	13	65.0	12	60.0		
Age:								
▪ 20-	6	30.0	2	10.0	7	35.0	8.138	0.189
▪ 31-	11	55.0	11	55.0	8	40.0		
▪ 41-60	3	15.0	7	35.0	5	25.0		
Range Mean±SD	20-50 29.5±10.12		20-60 34.12±9.78		20-60 31.41±8.45			
Occupation ▪ Workers ▪ Not worker	 13 7	 65.0 35.0	 12 8	 60.0 40.0	 12 8	 55.0 40.0	0.14	0.932
Level of education ▪ Illiterate ▪ Read and write ▪ Primary ▪ Preparatory ▪ Secondary ▪ High	 5 3 3 4 4 1	 25.0 15.0 15.0 20.0 20.0 5.0	 3 3 4 3 3 4	 15.0 15.0 20.0 15.0 15.0 20.0	 2 5 4 3 3 3	 10.0 25.0 20.0 15.0 15.0 15.0	4.459	0.924
Patients referred from:							0.00	1.000
▪ Post neurosurgery	7	35.0	7	35.0	7	35.0		
▪ Cardiology	3	15.0	3	15.0	3	15.0		
▪ Cardiothoracic surgery	4	20.0	4	20.0	4	20.0		
▪ Medical ICU	1	5.0	1	5.0	1	5.0		
▪ Emergency	5	25.0	5	25.00	5	25.0		
Smoking history:								
▪ Smoker	12	60.0	11	55.0	7	35.0	2.800	0.247
▪ Non smoker	8	40.0	9	45.0	13	65.0		

***Group I*: Pre-intervention, *Group II* Immediately post-intervention, *Group III*: two months post-intervention (follow-up group)**

Table (6): Effect of weaning protocol on weaning outcome among the three studied groups of mechanically ventilated patients.

Weaning protocol	The studied mechanically ventilated adult patients (n=60)						χ^2	P
	Group I (Pre-intervention) (n=20)		Group II (Immediately post-intervention) (n=20)		Group III (2 months post-intervention) (n=20)			
	No	%	No	%	No	%		
•Weaning protocol utilization:								
▪ Yes	0	0	20	100	20	100	60.000	0.0001*
▪ No	20	100	0	0	0	0		
• weaning attempts: Rapid shallow breathing index (RSBI) was calculated:								
▪ Yes	0	0	20	100	20	100	60.000	0.0001*
▪ No	20	100	0	0	0	0		
•Burns weaning assessment program (BWAP) /26*100:								

Range Mean±SD	3.00-95.00 28.37±33.76		6.00-96.00 60.70±34.26		19.00-96.00 72.72±24.09			
Kruskal-Wallis (χ2) test P	14.00 0.001*							
•Richmond Agitation Sedation Scale (RASS)								
Range Mean±SD	-5.00-4.00 -2.05±3.35		-5.00-2.00 -0.90±2.69		-5.0-1.00 -1.15±1.78			
Kruskal-Wallis (χ2)test P	2.696 0.260							
▪ Ventilator circuit type: ▪ Disposable ▪ Reusable	20 0	100 0	20 0	100 0	13 7	65.0 35.0	15.849	0.0001*
▪ The circuit was changed: ▪ Yes ▪ No	19 1	95.0 5.0	20 0	100 0	2 18	10.0 90.0	47.291	0.0001*

***Significant (P<0.05)**

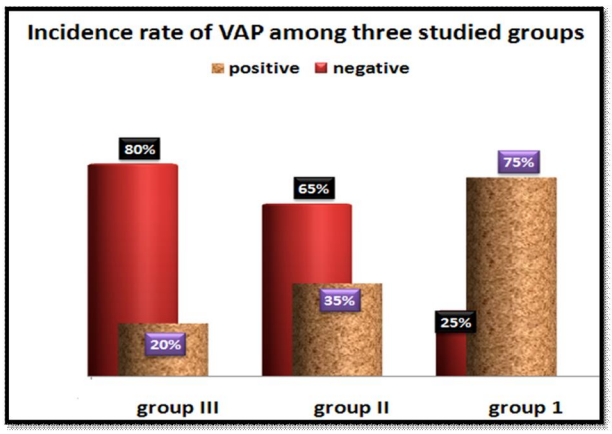

Figure (2): Incidence rate of VAP among the three studied groups.

4. Discussion:

There is no doubt that nurse's competences play a crucial role in critical care settings. Best practices and preventive measures are the important aspects of nursing care for patients who receive MV and experience a life threatening illness. They commonly contract VAP that is considered as one of the most significant and common infection in ICU**. Concerning demographic profiles and general characteristics of the studied nurses'** the findings showed that all ICU nurses had a Bachelor Degree in nursing science, and their mean age was (27.37±3.21) years and the mean years of experience in ICU ranged between (1-10) years. These results were in agreement with **Arlene et. al (2007) [28] Blot et. al, (2007) [29] and Subramanian et. al, (2013)[30]** who reported that the mean age of the participant nurses' ranged from (21-41) years and their educational level was Bachelor of Science Degree in nursing and most of them had hospital experience more than five years.

Regarding previous educational courses the findings revealed that none of the nurses' had previous educational in-service training courses about infection control practice, MV, and VAP infection in ICU, and its association with MV.

The same findings showed by **El Azzazy (2007) [31] Subramanian et. al, (2013) [30] & Ali (2013) [32]** whose findings reported that critical care nurses in ICU had no structured guidelines prior to the educational program.

Concerning comparison of nurses' knowledge and performance among the three phases (pre, post, and follow up phase) of protocol of care application. **Regarding phase I (pre intervention phase)**, the findings of the present study highlighted that the majority of nurses had significantly exhibited the lowest scores in knowledge and performance scores regarding the protocol of care strategies and their total knowledge grades were fair and their performance was badly done.

Moreover, the current findings revealed that there was a negative correlation between nurse's knowledge and their performance in this phase. These results could be **contributed to** the majority of nurses who acquire their knowledge of care for critically ill patients (CIP) from their basic educational programs, or from hospital policies and procedures and the nurses usually have lack of the updated researches knowledge and evidence regarding the prevention of VAP. **Furthermore,** it may be interpreted in the light of lack of training courses, updating pre-existing knowledge, lack of time, and inadequate institutional commitment to good hygiene practice, and lack of accountability. The previous barriers mentioned above adversely affected the nurses' knowledge and subsequent poor performance and poor patient's out come.

These findings were in agreement with **Gomes (2010)** *[33]* & *Ali (2013)* *[32]* and many authors [1, 4, 6, 36] who examined critical care nurses' knowledge and compliance in ICU, the study results revealed that all CCN had unsatisfactory, poor knowledge scores during baseline phase before the implementation of educational module. In addition, **El Azzazy (2007)** *[31]* mentioned that the initial baseline assessment in the pretest of nurse's knowledge and performance in Tanta ICU about infection control practices was extremely poor and substandard.

Concerning nurses' knowledge and performance in phase II of the protocol of care application, the present study findings highlighted that the nurses had a sharply significant increase and enhancement of their knowledge and performance scores regarding the protocol of care strategies. Moreover, the current findings revealed that there was a significant positive correlation between nurse's knowledge and their performance in phase II of protocol of care application. Furthermore, the majority of CCN performance was the most proficiently regarding all protocol of care strategies. The possible *attributed reasons* for this phenomenon returned to the implementation of the educational program and nurse's demonstration and re-demonstration techniques of the protocol of care strategies. **The present study** is consistent with **Ali (2013) [32], Gomes (2010) [33] Meherali (2011) [35],** & other studies [32, & 36-39] they conducted a study about the impact of education on VAP in the intensive care unit. Their results revealed that overall knowledge results in pretest phase was poor and Enhanced after education. On the other hand, the study findings were contradicting with **Bingham et. al, (2010)** (40) who revealed that no difference was observed in hand hygiene behavior even after the implementation of unit level interventions to reduce VAP.

As regard phase III (follow up after two months from the protocol of care application), the study findings showed that the majority of nurses' knowledge scores were very good and their performance scores were competent. The nurses' knowledge and performance scores were slightly decreased in phase II. Nevertheless, it is still overall better than the scores of the pre test (pre intervention phase). In addition, there was a significant positive correlation between nurses' knowledge and performance of protocol of care application. **Thus,** there were significant differences amo1ng CCN knowledge and performance scores in three phases of protocol of care application (Phase I versus II), (Phase II versus III) and (Phase III versus I). **The possible interpretation** for this finding could be due to the knowledge interval between the second post-test and follow up the third test was eight weeks and the knowledge retention generally falls to (75-89%) of its original level after a relatively short two to three weeks time and the absence of in-service training program or continuing education inside the ICU.

The present study findings were in congruence with **Subramanian et. al, (2013) [30]** who reported that there were significant differences among the phases of educational program intervention, and the nurse-led education on VAP significantly increased knowledge and was associated with a reduction in the incidence of VAP among intubated and mechanically ventilated ICU patients. ***Meherali et. al, (2011)*** [35], ***Ali (2013)*** [32] & ***Jansson et. al***,(2013) [41] reported that nurses' knowledge for prevention of VAP in critical care areas increased significantly after the educational intervention in the first post-test; however, there was a decline in the score in follow up the phase, but still higher than pre test.

Regarding the demographic and clinical characteristics of studied MV patients, the present study findings showed that more than half of the study samples were males and more than one third were females. These results were in accordance with **many studies** [21, 22, 42, and 36] that reported the same results. **Hunter(2006) [43] Hyllienmark et,al.(2007) [44] & Ahmed (2008) [45]** reported that majority of the study sample were males and emphasized that male sex is considered as an independent risk factor of VAP development in the ICU **with regards to the patient's age,** it was found that more than half of the studied subjects were within age group of (31-40 year), while minority were in age group of (41-60 year) this finding was in line with **Chastre et. al, (2006) [10], Kollef (2007) [46] and Aysha (2008) [16]** they stated that most patients with VAP within age group of (15-55). This result was stand in contradiction with **El Solha et. al, (2002)[47] & Michalopoulos et. al, (2003) [48]** they found that most patients with VAP are elderly and emphasized that age more than sixty act as independent risk factor for the development of VAP infection.

Concerning smoking history, the present study findings showed that there were no significant differences among the three studied groups. These findings were in agreement with **Aysha (2008) [15] & Fatehy et. al,(2013) [49]** who stated that there were no significant differences among mechanically ventilated patients regarding smoking history. On the other hand, the study findings contradicted with **Chaster et. al, (2006) [50]** they mentioned that there were significant differences among the studied mechanically ventilated patients related to smoking history and added that smoking is a contributed risk factor for VAP infection among those ventilated patients.

The effect of protocol of care on mechanically ventilated patient's outcomes. Concerning weaning attempts outcome and state of weaning, it was found that the majority of group II and group III attempts of weaning success; the patients were improved and completely weaned from MV. Compared with group I patients, the majority of them weaning attempts did not succeed, and did not wean from ventilator. The possible reasons for these findings may contribute to excessive manipulations of airways and extreme use of, sedatives, muscle relaxant, and antibiotics, and reinsertion of endotracheal tube lead to delayed weaning from MV. These findings were in agreements

with several studies [51-53] **& Carolyn (2007)[54] Ali (2013)[32] and Mohamed (2013)** [55] they reported that the development of VAP leads to delayed weaning from MV and increased ICU length of stay.

Regarding incidence rate of VAP among the three studied patients groups (I, II and III) in the three phases of protocol of care application, the present study found that three quarters of group I patients developed VAP infection and more than half of them had early onset infection, and more than one third of infection was caused by pseudomonas. Conversely for group II, the VAP rate dropped to more than one third, minority of them with early onset VAP compared to group III the minority of them developed VAP infection, 5% of them were early onset VAP indicating a reduction in the incidence of VAP following intervention in phase II and phase III of protocol application compared with phase I.

Finally, the present study showed that the protocol of care had been shown to play an essential role in the improvement of ICU nurse's knowledge and performance associated with a sustained improvement in clinical outcomes and reduction of ventilator associated pneumonia rate among the studied mechanically ventilated patients. Consequently, the hypotheses of the present study were realized.

Conclusion &Recommendations

Protocol of care education was effective and successfully enhancing ICU nurses' competencies improving in clinical outcomes and reduction of VAP rate among mechanically ventilated patients. It was recommended that provision of institutional written policies and guidelines regarding application of protocol of care in daily routine care for mechanically ventilated patients.

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