

Assessment of Nursing Performance Toward Infection Control Measures for Mechanically Ventilated Patients

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Abstract

Back ground: Nursing care for mechanically ventilated patients is an integral part of changing the rate of ventilator associated infections in the intensive care units, also the time of depending on mechanical ventilator. **Aim:** This study aimed to assess nursing performance toward infection control measures for mechanically ventilated patients. **Design:** A descriptive explorative design was utilized for the conduction of this study. **Setting:** this study was conducted in intensive care units at emergency hospital affiliated to Ain Shams University. **Study subject:** A purposive sample of 60 nurses who provide direct care for mechanically ventilated patients were included. Three tools were used for data collection **Tools: (I)** - Self – administration questionnaire, **(II)** nurses' practice observational checklist, **(III)** nurses' attitude questionnaire. **Results:** revealed that, 47% of studied nurses had satisfactory knowledge, while 58.3% of them had unsatisfactory level of practices. Also, 65% of the studied nurses had positive attitude toward infection control measures for mechanically ventilated patients. **Recommendations:** further researches are recommended to evaluate nurse's performance regarding infection control measures for mechanically ventilated patients.

Keywords: Nurses performance, Infection Control Measures, Mechanically Ventilated Patients.

Introduction

Mechanical ventilation is a life-saving treatment to support patient when they are unable to oxygenate and ventilate on their own (*Mohamed, et al., 2017*). It is refers to any methods to deliver volumes of gas into a patient's lungs over an extended period of time to remove metabolically produced carbon dioxide (*Pham, et al., 2017*).

Mechanical ventilation is indicated in case of inadequate spontaneous ventilation to sustain life, as a measure to control ventilation in critically ill patients and as prophylaxis for impending collapse of other physiologic functions. Physiologic indications include ineffective gas exchange, bradypnea or apnea with respiratory arrest, acute lung injury and the acute respiratory distress syndrome (*Tobin & Manthous, 2017*).

The most common tube used to provide an airway for mechanical ventilation is the endotracheal tube. It is inserted through the nasotracheal or orotracheal cavity. Despite its many advantages, endotracheal intubation has

significant risk to the patient (*Abdelazeem, et al., 2019*).

Endotracheal tube may enter the esophagus or extend into only one of the two main stem bronchi which can lead to hypoxemia and hypoventilation. As the tube passes through the pharynx, the gag reflex is triggered and may cause vomiting and potential aspiration of gastric contents. Prolonged intubation efforts may result in severe hypoxemia (*Tikka & Omar, 2019*).

Practitioners who have demonstrated competency only are allowed to perform intubation procedures to avoid these risks. The bedside nurse may be called upon to assist with intubation and to monitor the patient before, during and after the procedure (*Alghamdi & Urden, 2016*).

Misplacement of an endotracheal tube can lead to complications like trauma of upper airway, nasal trauma, avulsion of the tooth, oral-pharyngeal laceration, vocal cords laceration or/and hematoma, tracheal laceration, perforation, hypoxemia, and intubation of the esophagus. Also, aspiration during intubations

which performed in adults without anesthesia. Sinusitis, tracheal necrosis or stenosis, glottic edema, and ventilator-associated pneumonia may occur with prolonged use of endotracheal tubes (*Evman & Selcuk, 2020*).

Patients who have been treated with mechanical ventilation for 48 hours or longer, with no prior signs or symptoms of lower respiratory infection are being intubated and treated with mechanical ventilation that result in the substantial increase in hospital costs and length of stay (LOS) for the patients. Furthermore, ventilator associated pneumonia (VAP) is also associated with delayed extubation, prolonged stay in the ICU and hospital, increased mortality and morbidity, and increased use of healthcare resources (*Chadani, et al., 2017*).

Also there are other complications can be occurred for mechanically ventilated patients as collapsed lung, pneumothorax, lung damage, lung injury and inability to discontinue ventilator support (*Wolfensberger et al., 2020*).

Infection control measures for mechanically ventilated patients should be followed and applied in order to prevent infection and complications that are expected to be happened. So that, the nurse has major responsibility to focus on the common mechanisms by which infection occurs for mechanically ventilated patients (*Aziz et al., 2020*).

Nurses are the first line of defense in preventing mechanical ventilator associated infections. However, multidisciplinary persons like nurses, physicians, respiratory therapists, dietitians and clinical pharmacists should be a part of the process of mechanical ventilator associated infection prevention for high effectiveness (*Guilhermino, et al., 2018*).

The patient's condition and the functioning of the ventilator, assessing the patient's physiologic condition and his coping with mechanical ventilation are very important to have the nurse attention during the period of mechanical ventilation (*Shehab, et al., 2018*).

Nursing care of the mechanically ventilated patients require special technical and interpersonal skills. Specific interventions used by the nurse are determined by the underlying disease process and the patient's response. The nurse is often the first one to note any changes

in physical assessment findings or significant trends in blood gases that signal the development of a serious problem (e.g. pneumothorax, tube displacement, pulmonary embolus) and early signs of ventilator related infections (*Papathanassoglou et al., 2018*).

Aim of the study

The study aims to assess the nurses' performance toward infection control measures for mechanically ventilated patients through:

1. Assessment of nurses' knowledge toward infection control measures for mechanically ventilated patients.
2. Assessment of nurses' practice toward infection control measures for mechanically ventilated patients.
3. Assessment of nurses' attitude toward infection control measures for mechanically ventilated patients.

Research question

What is the level of nurses' performance toward infection control measures for mechanically ventilated patients?

Subjects and Methods

Technical Design

It included research design, study settings, subject and tools of data collection.

Research Design

A descriptive research design was used to achieve the aim of this study.

It helps the investigator to describe and document aspects of a situation as it naturally occurs. As well, this design helps to establish a database for future research. The investigator attempts to explore and explain while providing additional information about topic, much information is collected instead of making guesses (*Wang, 2015*).

Research Setting

This study was carried out at intensive care units at Eldmerdash hospital affiliated to Ain Shams University. These units are:

- Medical Intensive Care unit 1 in the 1st floor which contain 17 beds with active 5 mechanical ventilators.

- Medical Intensive Care unit 2 in the 1st floor which contains 17 beds with active 7 mechanical ventilators.
- Cardiac Care Unit in the 2nd floor which contains 19 beds with active 3 mechanical ventilators.
- Surgical Intensive Care unit in the 2nd floor which contains 42 beds with active 22 mechanical ventilators.

Subjects:

A purposive sample of 60 nurses was included in the study who provide direct care for mechanically ventilated patients

Tools of data collection:

Three tools were developed by the researcher to collect data pertinent to this study, these tools are:

1- Nurses' self-administrated questionnaire (Appendix I).

It was developed by the researcher after reviewing the related national and international literature. It was written in a simple Arabic language to suit the understanding level of the study subject. It includes two parts as the following:

Part (1):

This part is concerned with demographic characteristics of nurses containing six multiple choice questions (age, gender, Marital Status, level of education, training courses in critical care nursing and years of work in ICUs).

Part (2):

This part is concerned with nurses' knowledge toward infection control measures for mechanically ventilated patients. It was modified by the researcher after reviewing the literatures based on (*Babiker, 2016*) and (*Dhaliwal, et al., 2018*). First, questioner which consisted of 24 closed ended questions in form of multiple choice questions (MCQ) followed by 8 questions in form of True/False question with total questions of (32) it include the following items: nurses' knowledge about mechanical ventilator device (6 questions MCQ), nurses' knowledge about caring for mechanically ventilated patients as general (10 questions MCQ) and nurses' knowledge toward infection control measures for mechanically ventilated patients (16 questions MCQ and true or false).

❖ Scoring system:

A scoring system was followed to assess nurses' knowledge toward infection control measures for mechanically ventilated patients. The Questionnaire contained 32 questions, the total scores was 32degrees, the correct answer was scored as a one degree and the incorrect answer was scored as a zero. These total scores were summed up and were converted into a percentage. It was classified into 2 categories:

- Satisfactory level of knowledge $\geq 85\%$ (27 degrees)
- Unsatisfactory level of knowledge $\leq 85\%$ (27 degrees)

2- Nurses' practices observational checklists (Appendix II).

It was adapted by the researcher after reviewing the literatures based on (*Wilkinson et al., 2015*). In English language and it was revised by supervisors. This checklist was used to assess the nurses' practice toward infection control measures for mechanically ventilated patients by observing them during daily routine care and it include nine checklists as following:

1. Hand washing (17 steps)
2. Doing sterile gloves (12 steps)
3. Gown wearing (11 steps)
4. surgical face mask wearing (10 steps)
5. Chest physiotherapy (15 steps)
6. Endotracheal tube suctioning (30steps)
7. Oral care (15 steps)
8. Endotracheal tube care (27 steps)
9. Care of mechanical ventilator device (16 steps)

❖ Scoring system:

A scoring system was followed to assess nurses' performance toward infection control measures for mechanically ventilated patients; the total checklist contained 153 steps divided as: hand washing (17 steps), donning sterile gloves (12 steps), wearing Gown (11steps), surgical face mask wearing (10 steps), chest physiotherapy (15 steps), endotracheal suction (30 steps), oral care (15 steps), endotracheal tube care (27 steps) and care of ventilator device (16 steps). Each checklist was assigned a score according to sub-items. The total score of nurses' practices were 153 grades, each item was evaluated as "done" was taken one score and "not done" was taken zero score. These

scores were summed up and were converted into a percentage score. The total was classified into 2 categories:

- **Competent level if score \geq 90% (138 degrees).**
- **Incompetent level if score \leq 90% (15 degrees).**

3-Nurses' attitude questionnaire (Appendix III).

It was developed by the researcher after reviewing the recent and related literatures based on *Perceval, et al., (2017)* to assess the nurses' attitude toward infection control measures for mechanically ventilated patient. It include 13 statement (7 positive statements) and (6negative statements) divided in to three categories: first assessment of nursing attitude toward infection control measures related to health care providers (5 points), second, assessment of nursing attitude toward infection control measures during care with mechanically ventilated patients (4 points) and third, assessment of nursing attitude toward mechanical ventilator device care (4 points).

❖ Scoring system:

This tool is consisted of 13 statements. The responses for the positive attitude statements were based on three likert scale 3= agree, 2= neutral and 1= disagree. While, the response for negative attitude statements were 1= agree, 2= neutral and 3= disagree.

The total score of attitude was 39 degrees. The total score for the whole attitude tool was calculated for every nurse and the mean total score for all nurses was calculated.

The total score of attitude was 39 grades. Based on critical care approach. It was considered that:

- Positive nurses' attitude $>$ 60% (23 degrees).
- Negative nurses' attitude $<$ 60% (16 degrees).

Operational Design

It included preparatory phase, ethical considerations, validity and reliability, pilot study, field work and limitation of the study.

Preparatory Phase

This phase included reviewing of literature related to nurses' performance toward infection control measures for mechanically ventilated patient. This served to develop the

study tools for data collection. During this phase, the researcher also visited the selected places to get acquainted with the personnel and the study settings. Development of the tools was under supervisors' guidance and experts' opinions were considered.

Ethical Considerations

The research approval was obtained from the Faculty Ethical Committee before starting the study.

The researcher was clarified the objectives and aim of the study to nurses included in the study before starting. Verbal approval was obtained from the nurses before inclusion in the study; a clear and simple explanation was given according to their level of understanding. They secured that all the gathered data was confidential and used for research purpose only.

The researcher assured maintaining anonymity and confidentiality of subjects' data. The subjects were informed that they are allowed to choose to participate or not in the study and they have the right to withdrawal from the study at any time without any consequences. Also, Ethics, values, culture, and beliefs were respected.

Pilot Study

It was carried out on 6 nurses in medical intensive care unit. In order to test the applicability of the constructed tools and the clarity of the included questions related to nurses' performance toward infection control measures for mechanically ventilated patient. The pilot has also served to estimate the time needed for each subject to fill in the questions. According to the results of the pilot, some corrections and omissions of items were performed so the pilot nurses were not included in the main study sample.

Fieldwork

A letter was issued to them from the faculty of nursing Ain Shams University, explaining the aim of the study in order to obtain their permission and cooperation.

An approval was obtained from the nursing director of Eldmerdash hospital affiliated to Ain Shams University Data were

collected in four months, from the beginning of October 2019 to the end of January 2020.

The researcher first met the nurses at the previously mentioned settings, explained the purpose of the study after introducing herself. The researcher was visiting the study setting 2 days/ week (Saturday and Tuesday) at morning shift (8am to 2pm) and afternoon shift (2pm to 8pm) to collect data. The assessment knowledge sheet was filled out by nurses which take 15-20 minutes, the observational checklist was used for assessing nurses' practice regarding infection control measures for mechanically ventilated patient was filled by the researcher which took from 50 to 60 minutes while nurses given daily routine care and the attitude scale was filled by nurses in 15-20 minutes.

Administrative Design

An approval of ethical committee of faculty of nursing of Ain Shams University was obtained.

An official permission to conduct the study obtained from the nursing director of Eldmerdash hospital affiliated to Ain Shams University. The researcher met the hospital nursing director and explained the purpose and the methods of the data collection.

IV. Statistical Analysis

Data collected from the studied Subjects was revised, coded and entered using Personal Computer (PC). Computerized data entry and statistical analysis were fulfilled using the Statistical Package for Social Sciences (SPSS) version 22. Data were presented using descriptive statistics in the form of frequencies, percentages. Chi-square test (X^2) was used for comparisons between qualitative variables. Spearman correlation measures the strength and

direction of association between three ranked variables.

Results:

Table (1): this table presented that, 58% of the studied nurses their age ranged from 20-<30 years, with the mean (33.21±6.87). As regard to gender and marital status, 58% and 73% of the studied subjects were female and married, respectively. In relation to the educational qualifications of nurses under study, it was found that, 66% of them had nursing institute. Also, 50% of the studied nurses their years of experience ranged from 5-<10 years with mean (7.24±5.29).

Figure (1): this figure showed that 47% of studied nurses had satisfactory level of knowledge toward infection control measures for mechanically ventilated patients. While 53% of them had unsatisfactory level of knowledge toward infection control measures for mechanically ventilated patients, respectively.

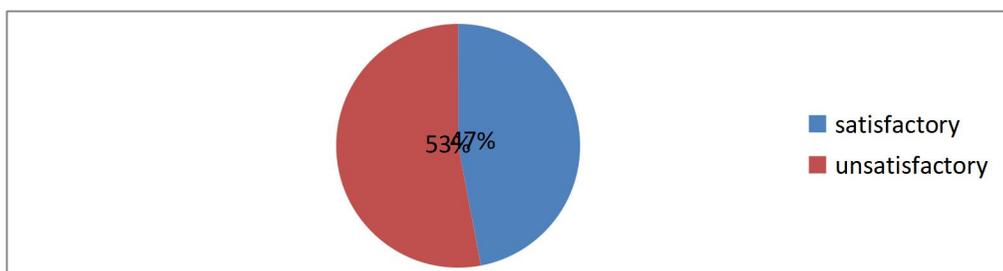
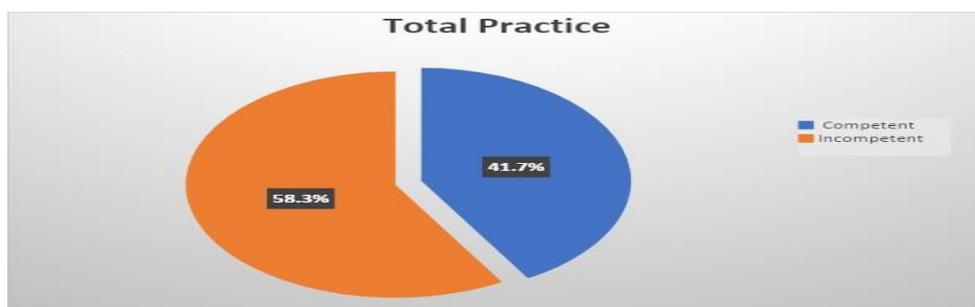
Figure (2): this figure showed that 58.3% of studied nurses were incompetent toward infection control measures for mechanically ventilated patients and only 41.7% of them were competent

Figure (3): this figure showed that 65% of studied nurses had positive attitude toward Infection Control Measures for Mechanically Ventilated Patients and only 35% of them had negative attitude.

Table (2): relation between Characteristics of the Studied Nurses and their Total Attitude toward Infection Control Measures for Mechanically Ventilated Patients.

Table (1): Number and Percentage Distribution of the Studied Nurses According to their demographic Characteristics (N=60).

Characteristics of studied nurses	No	%
Age		
20 - <30	35	58
30 - <40	20	33.4
40 or more	5	8.3
\bar{x} SD	33.21±6.87	
Gender		
Male	25	42
Female	35	58
Marital Status		
Single	12	20
Married	44	73
Divorce	4	7
Educational degree		
School of nursing	0	0
Nursing institute	40	66
Faculty of nursing	16	27
Master degree	4	7
Years of Experience		
< 5 years	25	41.7
5 - <10 years	30	50
>10 years	5	8.3
S.D	7.24±5.29	

**Figure (1):** Percentage Distribution of Studied Nurses' Total knowledge.**Figure (2):** Percentage Distribution of Studied Nurses' Total Practice toward infection control measures for mechanically ventilated patients (N= 60).

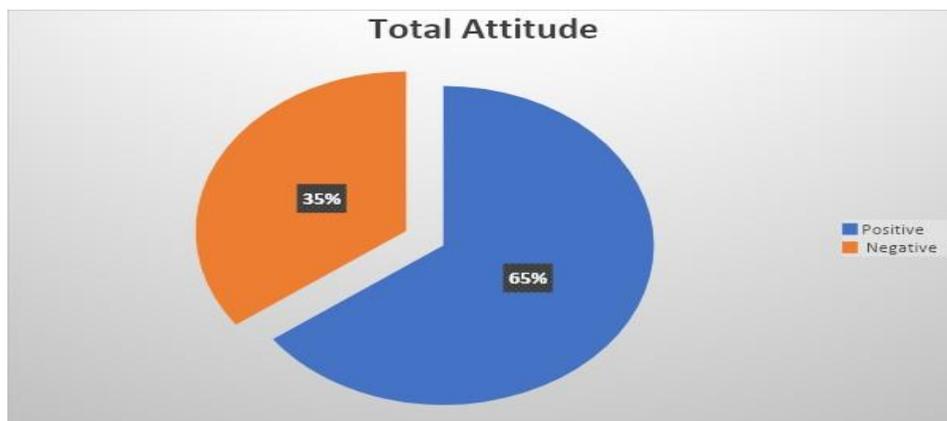


Figure (3): Percentage Distribution of Studied Nurses' Total Attitude toward Infection Control Measures for Mechanically Ventilated Patients (N= 60).

Table (2): Relation between Characteristics of the Studied Nurses and their Total Attitude toward Infection Control Measures for Mechanically Ventilated Patients (N=60).

Items	Total Attitude				X2	P-Value	
	Positive No=39		Negative No=21				
	No	%	No	%			
Age	20 - <30	20	51.3	15	71.4	4.978	.138
	30 - <40	16	41	4	19.1		
	>40	3	7.7	2	9.5		
Gender	Male	14	35.9	11	52.4	5.148	.134
	Female	25	64.1	10	47.6		
Marital Status	Single	10	25.6	2	9.5	6.756	.112
	Married	26	66.7	18	58.7		
	Divorced	3	7.7	1	4.8		
Educational degree	School of nursing	0	0.0	0	0.0	19.36	.000**
	Nursing institute	21	53.8	19	90.5		
	Bachelor	14	35.9	2	9.5		
	Master	4	10.3	0	0.0		
Years of Experience	< 5 years	11	28.2	14	66.7	16.32	.002**
	5 - 10 years	23	59	7	33.3		
	>10 years	5	12.8	0	0.0		
Training Course	Yes	22	56.4	6	28.6	13.25	.01*
	No	17	43.6	15	71.4		

Discussion

Hospital acquired infection is a common problem all over the world especially in ventilated patients. Therefore, up to date knowledge and refined practical nursing skills can play important roles in preventing infection. Nurses should have the opportunity to practice

infection control on a day-to-day basis as an integral part of patients' care. That is why the current study was carried out. Infection control measures consider a key component of practice for all nurses, not only for their health but also to reduce nosocomial infections and thus improve the patient safety (**Perveen, & Habib,**

2017).

The care of the mechanically ventilated patient is at the core of a nurse's clinical practice in the Intensive Care Unit (ICU). The mechanically ventilated patient presents many safety measures for the critical care nurse (Hetland, et al., 2018). Nurses are constantly present at the patient's bedside, so they are the primary healthcare professional responsible for monitoring the patient's respiratory status. They are expected to keep an eye on any equipment required by the patients, including ventilators and monitoring equipment, and to respond to monitor alarms (Osti, et al., 2017).

Demographic characteristics of studied nurses

Regarding the demographic characteristics of the studied nurses the result revealed that above half of the studied nurses their age ranged from 20- < 30 years and female in gender respectively, this study agreed with study done by (Abdelazeem, et al., 2019). Who studied Effect of training program on nurse's knowledge and competence regarding endotracheal tube and tracheostomy care in mechanically ventilated patients. Who revealed that above half of the studied nurses were aged between 20-30 years old and female in gender respectively. This explains that most of those nurses were newly graduated, young and tolerate the nature of the work in the critical care unit. On the other hand, this finding is disagreed with Luna (2015) who measured perception of nursing adherence to the ventilator associated pneumonia bundle interventions in hospital intensive care units and found that the majority of the study nurses were 51 to 55 years of age.

Concerning the educational level, the present study results indicated that two thirds of them had nursing institute, From the investigator point of view this might elaborate the current condition of nursing qualification as bachelor nursing work as administrator more than practitioner. The results agreed with a study done by (Mahmoud et al., 2020) who studied Effect of Educational Program for Nurses Performance Regarding Infection

Control Precautions, toward patient on Mechanical Ventilation. Who showed that about two thirds of the studied nurses have nursing Technician Institute. And contradict with (Bayoumi & Mahmoud, 2017) who studied Effect of education program on nurses' knowledge and practice regarding care of central venous line in hemodialysis: evidence-based practice guidelines. Who reported that about one third of the staff nurses were bachelor degree in nursing.

In regard to level of experience this study revealed that half of studied nurses had experiences from 5 to 10 years. From the investigator point of view these results this could be explained in light that the nature of ICUs as area of specialty necessitates a young qualified nurses. This result agreed with (Botros et al., 2019) who studied Assess Nursing Practice Regarding Safety Measures on Mechanically Ventilated Patients. Who revealed that three fifth of studied nurse had experience > 5 years. And contradict with (Mwakanyanga et al., 2018) who studied Intensive care nurses' knowledge and practice on endotracheal suctioning of the intubated patient: A quantitative cross-sectional observational study. Who showed that about half of the ICU staff nurses had less than five years of experience in the intensive care unit.

Nurses' Knowledge toward infection control measures for mechanically ventilated patients.

The current study revealed that above half of studied nurses had the correct knowledge that the alarm for obstruction inside the circuit is high pressure peak. From the investigator point of view this result due to this checking and response to mechanical ventilators alarms is very important also according to the policy of setting isn't allowing to denial the ventilator alarms. This result agreed with (Blot, et al., 2018) who studied Oral Care of Intubated Patients who showed that the nurses must be aware about the alarms of the ventilator and its management.

In the other hand this results disagreed with (Botros et al., 2019) who studied Assess

Nursing Practice Regarding Safety Measures on Mechanically Ventilated Patients. Who revealed that all of the studied nurses didn't monitor alarm sound and not examine the patient check for mechanical causes of ventilator alarm. And disagree with **(Parker, 2016)** who study ventilator settings and modes. who report that the nurses must check the ventilator mode and parameters.

Based on the results of the current study four fifth of the studied nurses had correct knowledge about the correct position to avoid aspiration during physiotherapy session, this results in the same line with **(Mohammed et al., 2020)** who studied Nurses Knowledge Assessment Concerning Prevention of Ventilator-Associated Pneumonia. Who revealed that above half of the studied nurses had the correct knowledge about the preferred patient position to decrease the risk aspiration. Also this result agreed with **(Mohammed et al., 2017)**. Who studied Assessment of nurses knowledge and Performance regarding prevention of Ventilator associated pneumonia in Intensive Care Unit. Who showed that three fifth of the studied nurses put patient in semi recumbent position.

This current study results revealed that two thirds of the study nurses had the correct knowledge about infection control measures and the precautions to avoid infection during suction and the complications of the suctioning procedure respectively. From the researcher point of view these results might be due to increase the incidence of complication rate that is noticed to nurses during daily care of patients. This result agreed with **(Bano, et al., 2020)**. Who studied Measurement of Knowledge and Performance of Pediatric, who revealed that the majority of ICU nurses know how to prevent a patient from nosocomial infection while frequently suctioning and three quarter of them know correctly which will be the possible complication of suctioning respectively. On the other hand this result contradicts with **El-Sheikh, (2017)** who studied Nurses knowledge regarding care of patients on Mechanical Ventilator. Who revealed that near to three quarter of the studied nurse's had unsatisfied knowledge about importance of wash hands

before endotracheal suctioning and complication of suction from ETT respectively.

Regarding to the nurses general knowledge about tracheostomy care it was found that more than four fifth of nurses had satisfied level of knowledge about single use of suctioning tube for patient decrease infection. This results agreed with **Abdou Eltaib, et al., (2021)**. Who studied Quality of nursing care on Patients with Tracheostomy. Who revealed that three fifth of the studied nurses had the satisfied knowledge about tracheostomy care, its characteristics and suction from tracheostomy tube. Also this result agreed with **(Al-jaradi, 2018)**. Who studied Knowledge and Practice of Intensive Care Unit Nurses toward Prevention of Ventilator-Associated Pneumonia at Public Hospitals in Sana'a City-Yemen who revealed that the majority of the studied nurse had the correct knowledge that is required to dispose of a suction catheter immediately after one single use. On the other hand this study contradict with **Wami, (2014)** who studied Assessment of knowledge practice and associated factors of adult intensive care nurses' on prevention of ventilator associated pneumonia in selected hospitals in Addis Ababa, Ethiopia. Who revealed that only less than half of the studied nurses knew that the nurse is required to dispose a suction catheter immediately after one single use.

Nurses' Practice toward infection control measures for mechanically ventilated patients.

This current study results revealed that four fifth of the studied nurses didn't remove the jewelries and watch and didn't wash hands before donning sterile gloves, respectively. This result agreed with **(Haghighat, & Yazdannik, (2015)**. Who studied the practice of intensive care nurses using the closed suctioning system: An observational study. Who revealed that only near to one fifth of the studied nurses washed their hands, the majority of them did not wear goggles, but all the participants were fully compliant with the best practice in relation to wearing gloves. From the researcher point of view these findings empower the hypothesis that nurses suppose that hand washing can be replaced by wearing gloves and a discrepancy in

eye protection may suggest that nurses underestimate secretion splashing during suction. In the care of a patient, consideration of universal standard precautions, hand washing before and after patient contact and eye protection precautions are essential, in addition to the wearing gloves and regardless of the suctioning method. In the other hand this result contradict with **ABDALLH, (2018)** Who study Assessment of Nurses' knowledge & practice regarding infection control in Endotracheal intubated. Who revealed that less than half of nurses done of Hand hygiene prior procedure.

This current study results revealed the majority of the studied nurses of the studied nurses stand at the right side of the patient and perform suction procedure after percussion. From the researcher point of view that the possible discrepancy might be due to the differences in availability of institutional policies and procedure guidelines, knowledge of nurses, continuing education, equipment and other factors. This result agreed with **(Afenigus, et al., 2021)**. Who studied Skill of suctioning adult patients with an artificial airway and associated factors among nurses working in intensive care units. Who revealed that three fifth of the studied nurses do chest physiotherapy and maintain sterility during endotracheal suctioning practices to prevent the risk of pneumonia in mechanically ventilated patient.

This current study results revealed that all of the studied nurses didn't position the patient so that the affected area is in vertical line to assist in drainage of the secretions with gravity. From the researcher point of view these results might be due to lack of demonstration and re-demonstration of practices related to suctioning. This result agreed with **(Balasooriya, & Seneviratne, (2020)**. Who studied Knowledge and Practices Regarding Open-System Endotracheal Suctioning among Intensive Care Unit Nurses at the National Hospital of Sri Lanka. Who revealed that more than three fifth of the studied nurses did not positioning the patient. This result contradict with **(Haghighat, & Yazdannik, (2015)**. Who studied the practice of intensive care nurses

using the closed suctioning system. Who revealed that more than three fifth of the studied nurses positioned the patients in a semi-fowler position if it was possible.

This current study results revealed that the majority of studied nurses lubricates the catheter tip with sterile water, this results agreed with **(ABDALLH, 2018)**. Who study Assessment of Nurses' knowledge & practice regarding infection control in Endotracheal intubated patient in SHARRG ELNNEEL Hospital between (September-November). Who revealed that the majority of studied nurses lubricate the suction catheter with normal saline. From the investigator point of view this result might due to the transferred of this step from old staff to new staff.

This current study results revealed that four fifth and all of the studied nurses didn't pour 30-50 ml sterile saline into sterile bowl and didn't wear sterile gloves with keeping the dominant hand sterile and other hand clean, respectively.

Attitude of Nurses toward Infection Control Measures for Mechanically Ventilated Patients.

Regarding the total nurses' attitude this current study presented that, four fifth of the studied nurses had positive attitude regarding that using disinfectant solution save recurrent hand washing effort and save the water. While, four fifth of them had negative attitude that wearing personal protective equipment disturbing them and isn't important for them and it is allowed to handle the small procedures without wearing gloves, respectively. This finding could be attributed to many reasons as; lack of knowledge about Infection Control Measures for Mechanically Ventilated Patients. (above two quarters of the studied nurses had unsatisfactory knowledge regarding Infection Control Measures for Mechanically Ventilated Patients.), lack of experience in the critical care unit (more than two fifth of the studied nurses

had experience less than five years), lack of in-service training and educational courses about evidence based guidelines and absence of consistent policies and protocols regarding Infection Control Measures for Mechanically Ventilated Patients.

This current study results revealed that the majority of the studied nurses agreed that shortage in nurses' number affect the infection ratio. This result agreed with (Alkhazali, 2017). Who studied critical care nurses 'knowledge on prevention of ventilator associated pneumonia and barriers of adherence to preventive measures. who revealed that above half of the studied nurses knowledgeable that the barriers nurses to adherence to ventilator associated pneumonia prevention guideline was "Shortage of staff in the ICU". Nursing staff shortage negatively affected the participants' care quality through increasing their workload and the number of their mandatory extra shifts. Mandatory extra shift was referred to by the participants as another barrier to effective VAP management. Such working schedule tired them, disturbed their personal life, broke their concentration, and reduced the quality of care.

This current study results revealed that three thirds of the studied nurses disagreed that oral care for the mechanically ventilated patient is not important and disgusting them. From the researcher point of view these results could be attributed to the satisfactory knowledge of the studied nurses related to importance of oral care in ventilated patients which reflects positively on their attitudes. This result agreed with (Andargie, & Kassahun, (2019). Who studied Knowledge and attitude of nurses' towards patient's oral care at University of Gondar comprehensive specialized hospital. Who revealed that about half of the studied nurses had a positive attitude towards patients' oral care. They disagree that cleaning the oral cavity is unpleasant task.

Relation between the Studied Variable

Based on the results of the current study, it was found that there was highly statistically significant relation between total knowledge of the studied nurses and their educational degree, years of experience and attending training course at. Also, there was statistically significant relation with age at. While, there was statistically insignificant relation with gender and marital status. This result agreed with **Badawy & Abdelgaleil, (2014)** who stated that it was observed that there was an association between knowledge and practice of intensive care nurses regarding prevention of VAP.

The current study showed that there was highly statistically significant relation between total practice of the studied nurses and their educational degree, years of experience and attending training course. Also, there was statistically significant relation with age. While, there was statistically insignificant relation with gender and marital status. This results agreed with (**Botros, et al., 2019**). Who study Assess Nursing Practice Regarding Safety Measures on Mechanically Ventilated Patients. Who revealed that in relation to socio-demographic data and total practice score, there was a statistically significant difference related to training courses and increasing the level of practice.

This current study presented that, there was statistically positive correlation between total knowledge of the studied nurses and their total practice and total attitude toward infection control measures for mechanically ventilated patients. This results in the same line with (**Al-Zaru, et al., 2020**). Who study Knowledge, Attitudes, and Practices of Oral Care in Mechanical Ventilated Patients. Nursing. Who showed that the findings supported positive significant relationships between attitudes and practice.

Conclusion

Based on the findings of the current study, it can be concluded that:

Only less than half of studied nurses had satisfactory level of the total knowledge, more

than half of the studied nurse's had unsatisfactory level of the total practices and more than third fifth of studied nurses had positive attitude toward Infection Control Measures for Mechanically Ventilated Patients. There was statistically positive correlation between total knowledge of the studied nurses and their total practice and total attitude toward infection control measures for mechanically ventilated patients.

Recommendations

The results of this study projected the following recommendation:

1. Continuous evaluation of nurses' knowledge and practice is essential to identify their needs in ICU toward infection control measures for mechanically ventilated patients.
2. Designing nurses' educational program to improve nurses knowledge about toward infection control measures for mechanically ventilated patients.
3. Procedure technique book toward infection control measures for mechanically ventilated patient should be available in ICU as a reference for all nurses.
4. An orientation program should be prepared to help the newly appointment nurse's to revise, acquire and develop the knowledge and practice regarding toward infection control measures for mechanically ventilated patients.
5. Replication of the study on larger subjects selected from different geographical areas of Egypt is recommended.
6. Further research is recommended to evaluate the effect of training program on nurse's performance regarding infection control measures for mechanically ventilated patients.

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