

ADDIS ABABA UNIVERSITY
COLLEGE OF HEALTH SCIENCES
DEPARTMENT OF EMERGENCY MEDICINE



KNOWLEDGE REGARDING MECHANICAL VENTILATION AND
PRACTICE OF VENTILATORY CARE AMONG NURSES
WORKING IN INTENSIVE CARE UNITS IN SELECTED
GOVERNMENTAL HOSPITALS IN ADDIS ABABA, ETHIOPIA
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The board of reviewers approved this thesis by Kedir Abdureman in its present form to meet the proposed prerequisite for a master's degree in emergency medicine and critical care nursing.

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Acronyms

ETT= Endotracheal tube

ICU=Intensive care unit

MV= Mechanical ventilator

PEEP= Positive end-expiratory pressure

TASH=TikurAnbessa Specialized hospital

VAP= Ventilator-associated pneumonia

Table of Contents

Acknowledgment	III
Acronyms	IV
Abstract	VIII
1. Introduction.....	1
1.1 Background	1
1.2 Statement of the problem	3
1.3 Significance of the study	4
2. Literature Review.....	5
2.2. Knowledge	5
2.3 Practice	6
2.4 Associated factors	7
3. Objective	9
3.1 General objective	9
3.1.1 Specific objectives	9
4. Methodology.....	10
4.1 Study Area	10
4.2 Study period	10
4.3 Study Design	10
4.4 Source population	10
4.5 Study subjects	10
4.6 Eligibility criteria	10
4.6.1 Inclusion criteria	10
4.6.2 Exclusion criteria.....	11
4.7 Sample size determination and procedures	11
4.8 Sampling Techniques	11
4.9 Measurement Variables	11
4.9.1 Dependent variables	11

4.9.2 Independent Variables	11
4.10 Operational Definition	11
4.11 Data collections tool and procedures.....	12
4.12 Data entry and analysis procedure	13
4.13 Ethical consideration	13
4.14 Dissemination of the results.....	13
5.Results.....	14
5.1. Socio-demographic characteristic of nurses working in intensive care units of selected governmental hospital.	14
5.2 Knowledge of nurses working in intensive care units regarding mechanical ventilations in selected governmental hospital, Addis Ababa, Ethiopia 2021	15
5.3 Participant Level of knowledge regarding the mechanical ventilator.	17
5.3 Practice of ventilatory care among the nurses working in ICU of selected governmental hospital in Addis Ababa, Ethiopia 2021.	17
5.4 Participant level of practice towards caring of patient on mechanical ventilator	19
5.5 Factors associated with knowledge of nurses working in ICU regarding mechanical ventilation.....	20
5.6 Factors associated with nurse’s level of practice towards caring patient on MV support.....	21
6. Discussions	23
7. Strength and Limitations.....	25
7.1 Strength	25
7.2 Limitations	26
8. Conclusion and Recommendations.....	27
8.1 Conclusions	27
8.2. Recommendations	27
Reference	28
Annexes.....	32
List of Tables	
Table 1: Socio-demographic characteristics of nurses working in ICU of selected governmental hospital at Addis Ababa, Ethiopia 2021 (N= 146).....	15

Table 2: Knowledge of nurses working in ICU regarding mechanical ventilator (N= 146)16

Table 3: Practice among the nurses regarding ventilatory care (N= 146).....20

Table 4: Factors associated with knowledge of nurses working in ICU regarding mechanical ventilator (N=146).....23

List of Figures

Figure 1: Total level of knowledge regarding mechanical ventilator among the nurses working in ICU of selected governmental hospital in Addis Aabab, Ethiopia 2021 (N= 146).....17

Figure 2: Total level of practice towards care of patient on mechanical ventilator support among the nurses working in ICU of selected governmental hospital in Addis Ababa, Ethiopia 2021 (N= 146).....21

Abstract

Mechanical ventilation is a backbone and the major supportive modalities in intensive care units even though it has its own side effects and complications. Nursing care plays a crucial role in the prevention and early recognition of this complication. Knowledge of nurses about mechanical ventilators and good practice of nursing care for the ventilated patient plays a crucial role in improving the effectiveness of mechanical ventilation, preventing harm, and optimizing the patient outcome.

Objective: The objective of this study was to assess the knowledge regarding MV and the practice of ventilatory care among nurses working in ICU at selected governmental Hospitals in Addis Ababa; Ethiopia, 2021

Method: -Descriptive cross-sectional study design was conducted to determine the knowledge and practice of nurses working in intensive care units towards mechanical ventilators at selected governmental hospitals. All nurses working in the intensive care unit of selected governmental hospitals were included in the study. Data was collected from March 1 to 30, 2021 with structured and pretested self-administered questionnaires. The collected data was entered into Epi-data version 4.6 and exported to Statistical Package for the Social Sciences (SPSS) version 26 Software for further analysis. The results were expressed in tables, charts diagrams, and graphs.

Results: A total of 146 nurses participated in the study, the majority (51.4%), were males and (58.9%) within the age group of (20-29) with a mean age of (29.84±4.95). About, 71.4% had a BSc holder in nursing, and (57.5%) had less than 5 years of working experience in ICU and (57.5%) of them had training related to MV. This study showed that (51.4%) and (58.9%) of nurses have poor had poor knowledge and practice regarding MV and ventilatory care respectively. Level of education was significantly associated with the knowledge level of participants with ($P \leq 0.05$).

Conclusions: According to this study finding, it can be concluded that nurses had poor knowledge and practice regarding mechanical ventilators and ventilatory care. Educational level has significantly associated with the knowledge level of participants.

Recommendation: providing special training and continuing educations program to intensive care nurses are important to improve their knowledge and practice regarding mechanical ventilation and ventilatory care.

Keywords: - Mechanical Ventilation, Intensive care unit, Nurse, Knowledge, Practice

1. Introduction

1.1 Background

A mechanical ventilator is a machine that is important to support patients to breathe when they are unable to ventilate and oxygenate on their own due to critical illness or having surgery. The ventilator provides the function of respiratory muscle and patients are connected to the ventilator with a hollow tube (artificial airway) that goes in their mouth and down into their main airway or trachea. They remain on the ventilator until they improve enough to breathe on their own(1,2).

Continuous and development of mechanical ventilators as well as it's clinical use have been key factors for the development and growth of critical care and respiratory professions. The need for mechanical ventilation is also common reason for patient admitted to the intensive care unit(ICU)(3)

In modern intensive care management of a patient with critical problems, mechanical ventilation becomes an essential method of resuscitation and comprehensive treatment. Most of the patients require artificial ventilation during the stage of their critical illness(4). Mechanical ventilator support is important to normalize arterial blood gas levels and acid-base imbalance by providing adequate ventilation and oxygenation(5).In critical care, the indication for mechanical ventilation is for maintenance of oxygenation, management of type I and II reparatory failure, the removal of carbon dioxide, cardiorespiratory arrest, and central nervous system depression(6).

There are various modes of mechanical ventilator such as Controlled Mechanical Ventilation (CMV), Assisted Mechanical Ventilation (AMV), Intermittent Mandatory Ventilation (IMV), Synchronized Intermittent Mandatory Ventilation (SIMV), Pressure-Support Ventilation (PSV), Airway Pressure Release Ventilation (APRV), and Continuous Positive Airway Pressure (CPAP). Mode of ventilation refers to the method of inspiratory support provided by the mechanical ventilator. It is the specific combination of breathing patterns and control variables to deliver inspiration. The selection of mode is based on the clinician's familiarity, experience, and institutional preferences(5,7).

Although mechanical ventilation is a life-saving intervention, it is also known to carry several side-effects and complications(8)like Asynchrony, Auto-PEEP, Barotrauma, Hemodynamic compromise, Nosocomial infection, Anxiety/ Stress/ Sleep deprivation, Ulcers/ Gastritis

/ Malnutrition, Muscle deconditioning/Vent dependence, Increased intrathoracic pressure leading to systemic edema due to decreased venous return(9). This is often with Prolonged mechanical ventilation, increased mortality, prolonged hospital stay, and high cost to the patient(10).In a developed country, 2 to 3 million intensive care unit patients receive invasive mechanical ventilation per year at estimated costs of 15-27 dollars(11).

Ventilator-associated pneumonia (VAP)is one of the most frequent nosocomial infection from ventilated patients in ICUs and continuous to complicate the course of 8% to 28% of patients receiving mechanical ventilator (MV). It is associated with an increase in days of ICU stay, morbidity, and mortality. VAP amongst the most leading cause of death in the developing world among patients on mechanical ventilation/intubation post-hospitalization, and it is 6-20 times higher among patients in critical/intensive care units compared with non-intubated patients. It is related to poor nurses' knowledge and practice of MV for the care of intubated patients. The problem is more severe in Ethiopia which was repetitively reported from public hospitals (12–14)

In every hospital, VAP prevention and other MV-related complications are a major concern. Most interventions and prevention strategies are part of routine nursing care. However, the lack of knowledge and skills related to MV and its complication among nurses may become a barrier to adherence to evidence-based guidelines for the prevention of ventilator-associated complication (13)

The skills and knowledge of health teams regarding the care of a patient on a mechanical ventilator and patients' clinical status are enabled them to fine-tune ventilator settings to maximize the benefits of ventilator support while minimizing complications. The management of critically ill patients has become increasingly important in the modern medical and nursing systems. Critical care nurses play a crucial role in improving the effectiveness of mechanical ventilation, preventing harm, and optimizing patient outcome(2,15,16)

Knowledge of nurses about the functions and limitations of ventilator modes, causes of distress, dyssynchrony with ventilator, and appropriate management enable them to provide high-quality centered care. As nurses are the first line manager challenged with patient's and ventilators problems, it's crucial to recognize the problems such as respiratory distress, dyspnea, increased work of breathing, and the actions to be taken to resolve these problems. So it's essential that nurses who provide care for ventilated patients can understand the basic ventilator supports

including ventilator mode, setting, and alarms. It is also important to be skilled in promptly identifying and managing common patient and ventilator-related problems to provide optimal patient-centered care and prevent complications(5).

Studies normally agree survival of routinely ventilated-affected person within ICU is largely reliant upon the competence of nurse venture which is a very important position, However, an Audit undertaken through Critical-Care-Society of Southern Africa found that-75% of nurses working in ICU were inexperienced and did not have ICU qualification. They did have the required competency to care for a robotically ventilated affected person(17)

In studies investigating the practices of ICU nurses about MV device and care of ventilated patients, the majority of nurses caring for the patients on a mechanical ventilator had unsatisfactory practice and recommended to be trained enough to give effective and safe care to such patients(18)

1.2Statement of the problem

ICU nurses are expected to be highly knowledgeable and skillful health care professionals that work in ICU in association with other teams to provide optimum care. They have to manipulate and adjust MV parameters for intubated patients on daily basis(2). However, the study conducted in India showed that the majority of (66%) intensive care nurses had poor knowledge and only 2% were knowledgeable regarding mechanical ventilation(4)

A study conducted in Australia and New Zealand has revealed that ICU nurses are actively involved in making decisions about ventilator management and frequent adjustment on ventilator settings independently, without input from physicians. However, many of them have limited competence on mechanical ventilation(19)

Studies showed that ICU nurse's knowledge of mechanical ventilation is globally poor. A study done in South Africa has reported that even in high-income countries where nursing education is advanced, the levels of knowledge on mechanical ventilation is not perfect(17)

About eighty percent of the patient in ICU requires mechanical ventilation support. However, ICU nurses' knowledge and practice were poor. A study conducted in Egypt showed that 68.3% of nurses had unsatisfactory knowledge, and;- all nurses in the study (100%) had unsatisfactory practice regarding the management of patients on mechanical ventilation(18). This is likely to

negatively affect the patient who is mechanically ventilated. This may be worse in Ethiopia where advanced nursing education is still growing.

There is a scarcity of data on the ICU nurses' levels of knowledge and practice on mechanical ventilation in Ethiopia. Therefore, the present study is anticipated to be very important, as it will intend to find out more data regarding the levels of knowledge and practice of nurses working in ICU on mechanical ventilator utilization

1.3 Significance of the study

Mechanical ventilation is the major supportive modality in the intensive care units. But it carries a lot of risks and complications. so skilled and knowledgeable nurses are extremely important and needed to make appropriate decisions and minimize risk to the patient.

Continues orientation and periodic in-service training program for nurses in ICU regarding caring of patients on a mechanical ventilator is vital for updating the knowledge and practice of nurses, in turn, improve patient outcomes. Improved outcomes will shorten the patient's ICU length of stay, hospitalization as well as benefit the patient financially with decreased hospital costs(10,18).

This study will provide baseline information on ICU nurses' knowledge and practice level and also identify the factors that affect the knowledge and practice of nurses regarding the caring of a patient on the mechanical ventilator that entail a significant contribution for nursing practice, education, and further research which will contribute to the quality of care and improvement of critical patient's outcome.

Therefore, the result of the study will hopefully provide input for designing appropriate and context-based training, policymakers, public hospitals that have mechanical ventilators, and ICU professionals to contribute to the improvement of quality of care. Also helps for trend analysis for those program efforts working towards improving nurses 'knowledge and practice (nursing care) with an entail to reduce mechanical ventilation-related complication. Lastly, the study finding may also be used as secondary data sources for researchers who want to research on the same inquiry

2. Literature Review.

The intensive-care unit is the section of a hospital where patients' serious illnesses or injuries receive special medical and nursing care. ICU nurses' are expected to be highly knowledgeable and skillful to provide optimum patient care. Because the care of the mechanically ventilated patient is an essential part of a nurses' clinical practice in the intensive-care units (ICU). So, it is natural to train and prepare nurses before allowing them to work with the patient(20).

Research conducted in five hospitals and centers, Baghdad, Iraq demonstrated that most of the respondents (64%) were males; about (58%) of nurses were (20-29) years old, while the lowest percentage (12%) were between(40 – 49) years old. Fifty-two percent were married and (66%) of them had less than five years' experience in the critical care unit with (56%) had got training sessions. A study also showed that nurses' level of knowledge as moderate for endotracheal suctioning (73.6%) and weaning domains(74%) but, high level of knowledge for general information(94%), communication(96%), ventilator setting(89%), and patient education domains(95%)(21).

A study conducted in Iraq showed that (60%) of nurses were between (20-29) years old; most of them (70%) were male and (54%) were from nursing college; thirty-four percent of nurses has less than one year of clinical experience in intensive care unit and (68%) of them have a training session in the intensive care unit(22).

A study conducted on knowledge of critical care nurses on preventions ventilator-associated pneumonia at a selected hospital in Khartoum, in 2017 Sudan on 120 ICU nurses showed that majority of the participants were at the age groups of (23-30) years old, (71.7%) female, (86.7%) had bachelor degree holders and (47.6%) had less 1 years of working experiences(23). In another study conducted on the impact of the special training program in improving the care provided for mechanically ventilated patients on 80 ICU nurses at Al Khartoum teaching hospital and Alshaab teaching hospital in 2018 Sudan showed that almost all of the participants (95%) had Bachelor degree holders(24).

2.2. Knowledge

Nurses play a crucial role in the delivery of the health care system. In modern medical and nursing systems, caring for patients on MV has become an integral part of nursing care in the critical care unit. To provide this care competent nurses are needed. Competency is achieved by gaining theoretical knowledge and practical experience. Improving the nurse's knowledge

regarding the mechanical ventilation function and limitations of modes, causes of respiratory distress, and dyssynchrony with a ventilator is important to provide high-quality patient-centered care(15,18).

The study conducted on knowledge and practice of intensive care nurses on mechanical ventilation at Turgut Ozal Medical Center, Malatya, in 2019 in Turkey on 108 ICU Nurses was suggesting the knowledge scored and their levels were as follows: 24% of the nurses answered correctly the question on the Pao₂ and the respiration type, which are critical value in the MV initiation; 86% answered correctly the question on the modes used in the ventilation process, and 68% answered correctly the question on meaning and function of the term PEEP. While 60% of them did not answer correctly the question on the causes of the MV's high-pressure alarm and 71% did not answer correctly the question on the MV's low-pressure alarm(25).

Survey descriptive study conducted in Yenepoya Medical College Hospital, Deralakatte, India, to evaluate knowledge of nurses regarding mechanical ventilation in a selected government hospital on 50 nurses showed that majority of the subjects 33(66%) had poor knowledge, 16(32%) had average knowledge and only one subject (2%)had good knowledge regarding mechanical ventilation. It was concluded that there is a need for advanced technical education to make the staff nurses highly aware of the care of patients on the ventilator and to further widen their cognitive map to get fruitful results(4).

Another study conducted in Egypt in 2016 showed that more than half of nurses (68.3%) had an unsatisfactory total level of knowledge regarding the care of patients on a mechanical ventilator (18). Although mechanical ventilation is a life-saving intervention, it is also known to have several side effects and risks(8). Complications associated with mechanical ventilation include ventilator-associated pneumonia (VAP), airway complications, gastrointestinal hemorrhage, cardiovascular complications, equipment failure-related complication, ventilator-associated lung injury, and failure of closure of tracheal stoma(ventilator-associated complication) Mechanical ventilation (MV) predisposes patients to numerous complications, which increases with longer durations of treatment(26).

2.3 Practice

The study conducted in Turkey, among 108 ICU nurses: shows that almost all of them performed the ETT care (94%), 85% of them controlled the cuff pressure and 63% did this control by

touching with hand. 57% of the nurses stated that they used the physiological saline solution before aspiration. It was determined that 69% used chlorhexidine in oral care. In the study, it was determined that 47% of the participants got training on VAP.

However, the nurses who received MV and intensive care training did not make any difference in the practices and concluded that the quality of the training provided on the intensive care and mechanical ventilation practices were recommended and provided for all the intensive care nurses (25)

A study conducted in the Intensive Care Units (ICUs) of Mansura University Emergency Hospital in, Egypt, on nurses' Performance Regarding Management of Patients on Mechanical Ventilator; revealed that all nurses (100%) had unsatisfactory practice regarding the care of patients on the mechanical ventilator. Taking into account that incorrect knowledge and practice of these subjects may compromise patient safety and recommended that nurses should be trained enough to give effective and safe care to such patients (18).

Another study conducted in India, among 86 ICU nurses: showed that the majority (93%) of nurses had inadequate practice and none of them had scored for adequate practice regarding the care of the patient on the mechanical ventilator(27).

2.4 Associated factors

Factors associated with knowledge: Continuing education for intensive care unit nurses on invasive mechanical ventilation is fundamental to the acquisition and maintenance of knowledge and skills to optimize patient outcomes and concluded as ICU nurse had experience with limited knowledge of invasive MV. Therefore, education provided within the ICU workplace becomes fundamental to safe and effective practice. However, the majority of ICU nurses (63%) reported that they did not receive education about MV before working in ICU(28).

In Sudan on the analysis of 80 studies conducted on The Effect of a Structured Training Program on Intensive Care Nurses Performance showed that: there is a positive effect of educational program on enhancing nurses' knowledge, about mechanical ventilation in general, and there was a highly statistically significant difference between nurses' knowledge and their performance at pre and post-intervention program, However, there was no correlation between nurses' socio-demographic variables and their knowledge of pre and post-intervention program(20)

According to the study conducted in Sri Lanka 2020, 400 ICU nurses showed that graduate and post-graduate nurses had better knowledge (69.2%) compared with Diploma holders (47.7%). this difference was found to be statistically significant. However, there were no statistically significant associations between knowledge and years of working experiences (P-value > 0.05) (29)

In a study conducted in Ethiopia on, ICU nurses, training and years of experience in ICU and level of education have a significant association with knowledge. Knowledge was associated with ICU training (OR= 1.61, p-value = 0.038, 95%CI (1.02-2.56)) and educational level (OR=1.87,p-value=0.04,95%CI(1.18-4.45))(14)

3. Objective

3.1 General objective

To assess the knowledge regarding mechanical ventilator and the practice of ventilatory care among nurses working in intensive care unit of selected governmental Hospitals in Addis Ababa; Ethiopia, 2021

3.1.1 Specific objectives

1. To determine the level of knowledge of nurses working in intensive care units on a mechanical ventilator at selected governmental hospitals in Addis Ababa, Ethiopia, 2021
2. To assess the practice of nurses working in intensive care units on caring of the patient on a mechanical ventilator at selected governmental hospitals in Addis Ababa, Ethiopia, 2021
3. To identify factors associated with knowledge of nurses working in intensive care units on the mechanical ventilator at selected governmental hospital Addis Ababa, Ethiopia, 2021
4. To identify factors associated with the practice of nurses working in intensive care unit on caring of the patient on a mechanical ventilator at selected governmental hospital Addis Ababa, Ethiopia, 2021

4. Methodology

4.1 Study Area

Addis Ababa is the capital city of Ethiopia, and seat of the African Union. The Economic Commission for Africa is in the heartland of Ethiopia, with a population of 4,793,699 people in an area of 527 square Kilometers. The city comprises 11 sub-cities and 116 woredas. The population pyramid is broad-based, typically of a developing world. People from different regions of Ethiopia populate the city. The city consists of 34 private hospitals, 86 health centers, and 14 public hospitals(30). Among 14 public Hospitals TikurAnbessa, St. Peters, AaBET, Yekatit12, and Minilik II were purposively selected for the study; because they have well-organized ICU services with full mechanical ventilator and other material aids. The study was conducted in these five intensive care units of selected governmental hospitals in Addis Ababa.

4.2 Study period

The study was conducted in five selected governmental hospitals in Addis Ababa from March 1-30, 2021

4.3 Study Design

The institutional-based cross-sectional study design was employed to conduct a study.

4.4 Source population

All nurses who were working in intensive care units of the selected governmental hospitals in Addis Ababa, Ethiopia

4.5 Study subjects

All nurses who fulfilled inclusion criteria and working in ICU of selected governmental hospitals in Addis Ababa during the data collection period.

4.6 Eligibility criteria

4.6.1 Inclusion criteria

- Nurses working in intensive care units for 6 months or more
- Nurses who volunteer to participate in this study during the study period

4.6.2 Exclusion criteria.

- All nurses who were not at the workplace during the data collection period (sick leave, annual leave, and maternity leave)

4.7 Sample size determination and procedures

All nurses working in the ICU of selected hospitals who fulfill the inclusion criteria were taken as the sample size of the study. Because the total number of nurses working in the ICU of selected hospitals were small 173(TAS-52, St,peters-37, AaBET-35, Yekatit12 -31, and Minilik the II- 18).

4.8 Sampling Techniques

A convenient sampling technique was used

4.9 Measurement Variables

4.9.1 Dependent variables

- Knowledge of nurses regarding mechanical ventilator
- The practice of nurses towards caring for a patient on a mechanical ventilator

4.9.2 Independent Variables

- Socio-demographic
- Age
- Sex
- Educational level
- Experience
- Training

4.10 Operational Definition

- 1. Knowledge:** In this study, it refers to the correct level of response of the subject regarding the mechanical ventilation elicited through structured questionnaire participants who selected a correct choice from a certain item and above mean score value was considered to be knowledgeable

- 2. Practices:** In this study, refers to the correct level of response the subject regarding the care of the patient on mechanical ventilators such as ETT care, oral care, eye care, following anxiety of the patient on a mechanical ventilator, and above mean score value was considered to have a good practice on that item
- 3. Experience:** In this study, it refers to the time duration of the nurses working in the ICU which is categorized into 6 month-1yrs, 1-5yrs, 6-10yrs, and >10yrs.
- 4. Educational level,** - In this study refers to the educational level which the nurse currently holds, categorized as Diploma, BSC in nursing, BSc in Emergency and critical care nurse, and MSC nurse.

4.11 Data collections tool and procedures

The self-administered questionnaire was prepared with some of them developed by reviewing literature and most adapted with modification from previous literature. A total of 47 questions were prepared which contains socio-demographic characteristics, knowledge on MV, and practice of nurses towards caring of the patient on MV in previous literature(5,17,25,29,31–36). The questionnaires have three parts; part one socio-demographic factors, part two knowledge assessment consists of 16 items, and part three practice assessment questions consist of 25 items. The study participants were selected from the given option by multiple choices and each correct answer had one point. A questionnaire prepared in the English language was used since all nurses learn (t) and are trained in English. The data collection was conducted by 5 BSc Nurses and trained by the investigator for one day about the content of the questionnaire in detail.

4.12 Data collections and quality control.

Before actual data collection, a pilot study was done in the area outside of the study site(st. Paulos) hospital on 5% of the study population working in the ICU to determine the time taken to complete the questionnaire, to check local acceptability and ambiguity of the questionnaire. Some parts of the tool were revised and adjusted after the pre-test. A good rapport was maintained throughout the whole period of data collection. A questionnaire with an information letter and a consent form attached to it was handed out by data collectors to nurses working in the ICU. Participants were told to sign the written consent form first and then provide them a self-administered Questionnaire. Participants who are not volunteers were allowed not to

participate or stop during a response. If some of the items in the questionnaire were not clear to few participants, questionnaires were filled in the presence of well-trained data collectors, and participants were free to ask questions or clarifications. Data collectors were trained nurses for one day. Questionnaires were filled during working hours; Consent forms and filled questionnaires were placed into sealed envelopes by the data collectors and taken from each unit daily. Data were checked by the supervisor daily for completeness and finally, the principal investigator monitored the overall quality of data collection. The confidentiality of data was maintained throughout the process

4.12 Data entry and analysis procedure

The collected data was entered with Epi-Data version 4.6 and analyzed with SPSS version 26.0 software. Participants' characteristics was examined using frequency, percentage distribution, mean, standard deviation. The binary logistic regression analysis was conducted and all independent variables with a p-value less than 0.25 were included in multivariable logistic regression model to identify factors associated with knowledge regarding MV and practices of ventilatory care. The level of association and statistical significance was measured by using an odds Ratio with its 95% confidence interval. Statistical significance was declared at P- value <0.05.

4.13 Ethical consideration

Permission to carry out the research was obtained from AAU, CHS research standards and ethics committee and Addis Ababa public health and emergency directorate. The research purpose, its benefits, and the procedures were explained for each potential respondent. The respondents signed an informed written and oral consent and any respondent seeking further clarification were assisted. The information that the respondents provide during the study was kept confidential.

4.14 Dissemination of the results

The findings of this study will be communicated to the hospitals where the study was conducted and disseminated in each unit that participated in this study, to the Addis Ababa public health and emergency directorate, and the minister of health to strengthening nurses level of knowledge and practice through training and education, to Addis Ababa University, College of Health

Science, school of medicine, department of emergency medicine through soft and hard copy. Further, the results will be published for access to other users as well.

5.Results

5.1. Socio-demographic characteristic of nurses working in intensive care units of selected governmental hospitals

Of 173 nurses working in ICU, 146 were participated in the study making a response rate of 84.4%.

Out of the total of 146 respondents, the majority 71(51.4%) were males. (58.9%) of nurses were between the age groups of (20-29) years old with a mean age of (29.84); About 104(71.2%) of nurses were BSc holders in nursing. Regarding the training, (57.5%) of respondents were trained related to a mechanical ventilator. The majority of respondents, 84(57.5) had (1-5) years of work experience and most of them were single (56.8%).

Table1: Socio-demographic characteristics of nurses working in ICU of selected hospitals in Addis Ababa, 2021

Variables	Categories	(n=146)	
		Number	Percent (%)
Gender	Male	75	51.4
	Female	71	48.6
Age	20-29 yrs.	86	58.9
	30-39 yrs.	54	37
	≥ 40 yrs	6	4.1
Educational level	Diploma	18	12.3
	BSc nurse	104	71.2
	MSc nurse	12	8.2
	Critical care nurse	12	8.2
Participating in training related mechanical ventilator	Yes	84	57.5
	No	62	42.5
Years of working experiences	<1 yrs.	12	8.2
	1-5 yrs.	84	57.5
	6-10 yrs.	38	26
	>10 yrs.	12	8.2
Marital Status	Single	83	56.8
	Married	61	41.8
	Divorced	2	1.4

5.2 Knowledge of nurses working in intensive care units regarding mechanical ventilation in selected governmental hospitals, Addis Ababa, Ethiopia 2021

When knowledge of nurses working in intensive care units towards mechanical ventilator was assessed, 23.3% answered correctly the question on P_{aO_2} while 34.9% answered correctly the respiratory rate which is a critical value for initiations of MV; 32.2% of the respondents answered correctly the question on volume targeted MV mode while 36.3% did not answer correctly the question on pressure targeted MV mode. The results also showed that the question on the term F_{iO_2} , PEEP, and its functions and tidal volume were answered correctly at the rates of 51.4%, 68.5%, and 46.6% respectively. About 68.5% of respondents answered correctly the question on the cause of MV's high-pressure alarm while 56.8% did not answer correctly the question on the cause of MV's low-pressure alarm.

The questions asked on the ventilator flow rate match with patient inspiratory efforts, inspiratory demand of patient breathing fast, and potential results of alarm silencing were answered correctly at the rate of 37%, 41.1%, and 45.9% respectively. The rate responses on questions on the weaning process were indicated that correct responses had a low percentage of 47.9% and 43.2% respectively compared with incorrect responses. Finally over half of the responses (57.5%) to the questions on preventing aspiration during extubation were correct.

Table2: Knowledge of nurses working in intensive care unit regarding mechanical ventilator at the selected governmental hospitals in Addis Ababa, Ethiopia 2021(N=146)

Knowledge regarding MV	Yes N=146 (%)	No N=146 (%)
Knowing the amount of p_{aO_2} in the initiation of mechanical ventilator	34(23.3)	112(76.7)
Knowing the critical amount of respiratory rate in the initiation of mechanical ventilator	51(34.9)	95(61.5)
Knowing the critical PH values in the indication of mechanical ventilator	71(48.6)	75(51.4)

Knowing volume targeted mechanical ventilator mode	47(32.2)	99(68.8)
Knowing pressures targeted mechanical ventilator mode	93(63.7)	53(36.3)
Knowing the explanation of the term Fio ₂	75(51.4)	71(48.6)
Knowing the term PEEP and its functions	100(68.5)	46(31.5)
Knowing the Term Tidal volume	68(46.6)	78(53.4)
Knowing the cause of high-pressure alarms	96(65.8)	50(34.2)
Knowing the cause of low pressures alarm	63(43.2)	83(56.8)
Knowing the observations that indicate ventilator flow rate setting is matched with patient inspiratory efforts.	54(37.0)	92(63.0)
Knowing the changes should make to match the inspiratory demand of patient breathing fast	60(41.1)	86(58.9)
Knowing the potential results of alarm silencing once or repeatedly	67(45.9)	79(54.1)
Signs and symptoms indicating patient who is not ready to be weaned	70(47.9)	76(52.1)
The correct sequence of weaning	63(43.2)	83(56.8)
Extubation a patient	84(57.5)	62(42.5)

5.3 Participant Level of knowledge regarding the mechanical ventilator.

Out of 146 nurses working in ICU, about 71(48.6%) scores above mean whereas 75(51.4%) scored below mean and have poor knowledge.

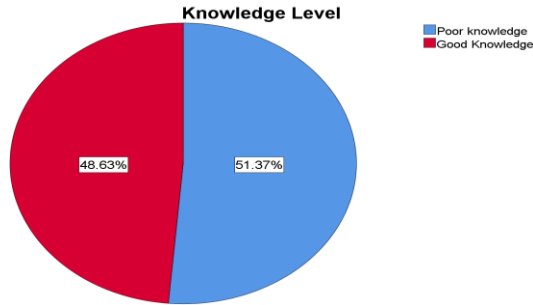


Figure 1: Total level of knowledge regarding mechanical ventilators among nurses working in ICU of selected governmental hospitals in Addis Ababa, Ethiopia 2021(N=146).

5.3 Practice of ventilatory care among the nurses working in ICU of selected governmental hospitals in Addis Ababa, Ethiopia 2021.

When examining the practice of nurses working in ICU on the care of patients on MV supports, it was found that 41.1% performed ETT suctioning, 80.1% checked ETT level when caring for a patient and 37% rotated the positions of ETT. About 37% of respondents performed cuff pressure monitoring and 69.2% of them used the manual (palpation) method for monitoring techniques and 72.6% of the respondents used routine normal saline instillation before suctioning.

Concerning oral care, only 2.7% of respondents performed six times per day and 61.6% of them used chlorhexidine solutions. In the study, it was determined that 30.8% of nurses performed ventilator care bundles practice to prevent VAP.

Table 3: Practice nurses working in ICU regarding ventilatory care at selected governmental hospitals at Addis Ababa, Ethiopia 2021 (N= 146)

Care practice	Yes	%	No	%
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Frequency of endotracheal/Tracheal tube suctioning	61(when required)	41.8	85(Other)	58.2
Checking of Endotracheal tube level	117	80.1	29	19.9
Frequency of rotating Endotracheal tube positions	54(Every 24 hrs.)	37	92(Others)	63
Frequency of checking cuff pressures	54(Every 6-12 hrs.)	37	92(Others)	63
Cuff pressures monitoring methods	CPM(Cuff pressure measurement)= 33(22.6) MLT(Minimal leak test)= 22(15.1) Manual(Palpation) method=101(69.2) Others= 26(17.8)			
Not complication of ETT	74	50.7	72	49.3
Giving of routine normal saline instillation before suctioning	106	72.6	40	27.4
Ventilating patient with 100% oxygen before suctioning	132	90.4	14	9.6
Eye care types (Answered more than one)	Wiping eye from the inner canthus to out= 105(71.9) Closed with tape= 59(40.4) Using teardrop= 46(31.5) Others= 6(4.1)			
Frequency of oral hygiene	One time per day= 79(54.1). Two times per day= 52(35.6). Four times per day= 11(7.5). Six times per day= 4(2.7).			
Solutions used in oral care (Answered more than once)	Sodium bicarbonate= 30(20.5) Chlorhexidine= 90(61.6) Others= 49(33.6)			
Following anxiety of patient on mechanical ventilation	107	73.3	39	26.7

Recognizing the anxiety finding of a patient on mechanical ventilation support	78	53.4	68	46.6
The methods of relieving the anxiety of the patient receiving ventilation support(Multiple options is possible)	Relaxing the patient by talking to him/her=101(69.2)			
	Ensuring that the patient expresses himself/herself by writing=52(35.6)			
	Getting the patient in touch with their relatives=72(49.2)			
Informing the relatives of a ventilated patient	128	87.7	18	12.3
Following ventilator care bundles practice to prevent VAP	45	30.8	101	69.2

5.4 Participant level of practice towards caring of the patient on a mechanical ventilator

Concerning the practice level of nurses working in ICU, 60(41.1%) scored above meanwhile 86(58.9%) of respondents scores below mean and have poor practice.

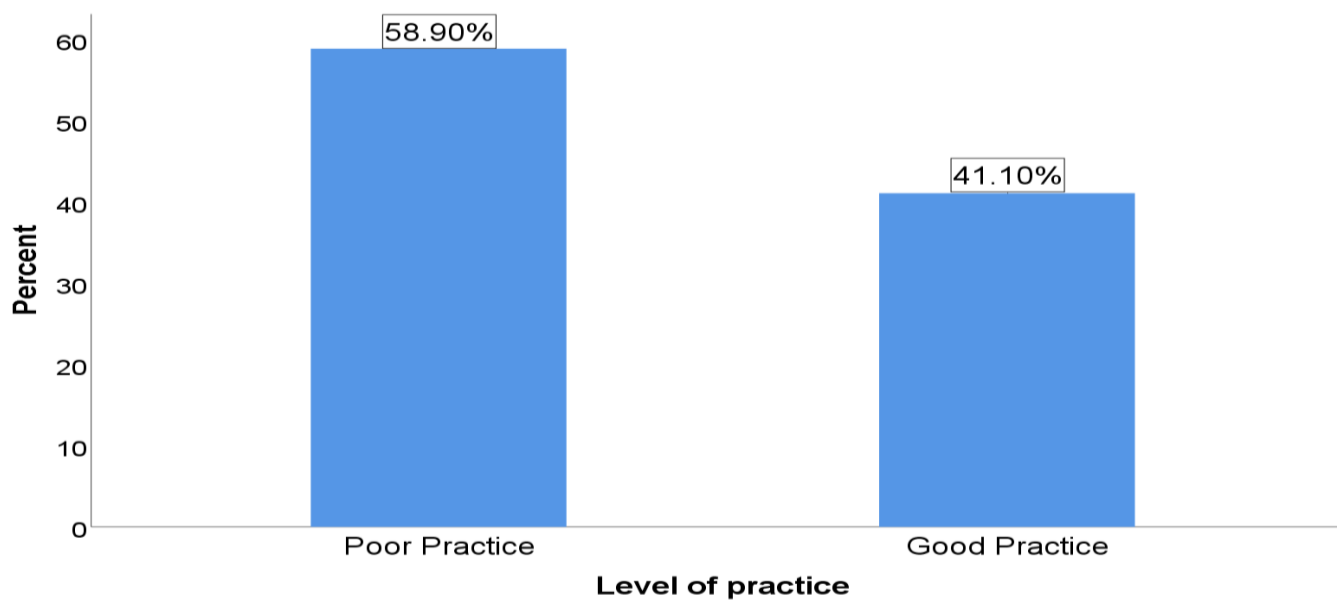


Figure 2: Total level of nurses' practice towards care of the patient on mechanical ventilator support at a selected governmental hospital in Addis Ababa, Ethiopia 2021 (N=146).

5.5 Factors associated with knowledge of nurses working in ICU regarding mechanical ventilation.

In bivariate logistic regressions analysis, the factor found to be associated with knowledge of nurses working in ICU regarding MV were educational level and training related to MV. From multivariate logistic regressions analysis, educational level was found to be statically significant with knowledge (P-Value= 0.016, AOR= 5.268(1.375-20.186)). This implies the knowledge level of Diploma nurses was five times lower than nurses with MSc and post-basic Emergency nurses. There are no significant associations between nurses' knowledge and training related to MV (P-values= 0.197).

Table 4: factors associated with knowledge of nurses working in ICU regarding mechanical ventilator (N= 146).

Variable	Category	Knowledge		COR(95%CI)	P-value	AOR(95% CI)	P-value
		Good	Poor				
Training related MV	Yes	37(44%)	47(56%)	(0.335-1.254)	0.198	1.560(0.794-3.066)	0.197
	No	34(54.8%)	28(45.2%)		1		1
Educational level	Diploma	5(27.8%)	8(72.2%)	(0.051-0.731)	0.016	5.268(1.375-20.186)	0.015
	BSc nurse	50(48.1%)	54(51.9%)	(0.182-1.175)	0.105	2.136(0.837-5.452)	0.112
	MSc nurse and BSc Emergency nurse	16(66.7%)	8(33.3%)		1		1

5.6 Factors associated with nurse's level of practice towards caring patient on MV support.

In bivariate logistic regressions analysis, the factors found to be associated with practices of nurses towards caring patient on the MV support were years of working experiences, educational level, and Training. From the multivariate logistic regressions model, the results were showed no significant differences in practice between the participants with different level of years of experiences, different educational level, and had training related to MV ($PV > 0.05$)

6. Discussions

Nurses play a crucial role in the management of patients on a mechanical ventilator. There is no doubt that nurses knowledge regarding the technical specifications of MV device, recognize and early corrections of practice that causes complications is highly important in a critical care setting. So this study tried to find out the knowledge level of nurses working in ICU regarding the MV and their practice level towards caring of a patient on MV support.

One hundred forty-six nurses working in ICU have participated in this study and the result showed that most of the study participants were males (51.4%) while the remaining were females, and a majority (58.9%) of study participants were between the age group of (20-29) years old. The educational level of respondents showed that most of them (78.1%) were Degree holders.

This finding was in good agreement with a study conducted in Baghdad, Iraq reported that most of the respondents were males (64%), majority of them (58%) between the age groups of (20-29)(21). This finding also comes along with a study done by Majeed HM; who conducted a cross-sectional study for assessment of knowledge and practice of intensive care nurses about endotracheal suctioning and indicated that the majority of study samples were males (70%) and most of them (60%) were between the age groups of (20-29) years(22)

In another study conducted in Khartoum, Sudan 2017 with the title: critical care nurses knowledge of ventilator-associated pneumonia prevention were indicated that the majority of study participants were between the age group of 23-30 years old and most of them (86.7%) had Bachelor degree holder(23). These results were in good agreement with those results reported by other researchers who stated that almost all of them (95%) had Bachelor's degrees as a level of education(24).

In this study majority of study participants (65.8%) were working in ICU for less than five years and most of them (57.5%) had training sessions. This is similar to the results of a study done in Iraq, Baghdad city on ICU nurses showed that (66%) of study participants who worked in ICU had less than five years of work experiences whereas 56% of them had training sessions(21). In contrast to the finding study done in Turkey, Malatya on ICU nurses indicated that less than half of study participants (44%) had training on a mechanical ventilator(25).

In relation to nurses' knowledge regarding the mechanical ventilator, the majority (51.4%) of the study participants were scored below the mean and had poor knowledge. This finding was supported by a study done in Deralakatte, India to evaluate knowledge of nurses regarding mechanical ventilation and reported that the majority (66%) of study participants had poor knowledge(4). Similar results were shown in a study done by Hashem S who reported the majority of study participants (68.3%) had an unsatisfactory level of knowledge on mechanical ventilation(18). According to this study educational level was found to be significantly associated with the knowledge of nurses. Diploma nurses had lower knowledge than MSc and BSc Emergency nurses. This result was congruent with other researchers; results reported that graduate and post-graduate nurses had better knowledge (69.2%) compared to Diploma (47.7%). This difference was found to be statistically significant ($P\text{-value}<0.05$)(29). The current study revealed that there was no statistically significant association between training related to MV and nurses' knowledge ($P\text{-values}> 0.05$). This finding was similar with other researcher results who stated that there is no significant association between nurse's knowledge regarding the management of a patient on MV and getting mechanical ventilator training ($P\text{-value}= 0.348$)(18).

Concerning the total practice of nurses regarding the care of a patient on a mechanical ventilator, this study results showed the majority (58.6%) of respondents scored below the mean and had poor practice. These results agree with other researcher finding who reported that the majority (93%) of study participants had inadequate practice regarding the care of patients on a mechanical ventilator (27). These results also supported by a study done in Mansura, Egypt on ICU with the title: nurse's performance regarding the caring of a patient on a mechanical ventilator and reported that all of the study participants (100%) had unsatisfactory practice regarding the caring of the patient on a mechanical ventilator(25).

The current study revealed that there is no significant difference between practice levels between the participants with different levels of experiences, educational status, and training related to MV. This finding was congruent with a study done by Hesham who evaluate nurses performance regarding the management of a patient on a mechanical ventilator and reported that there are no significant relations between educational qualifications($P\text{-value}=0.154$), years of working experiences($P\text{-value}=0.928$), getting mechanical ventilator training($P\text{-value}=0.611$) and their

practice regarding the management of a patient on MV. However, there is significant associations were found in the area of job positions (P-Value= 0.015)(18). These variations might be due to socio-demographic differences. This is also similar with the study done by Saritas who evaluate ICU nurse's knowledge and practice on a mechanical ventilator and reported that there was no statistically significant association between intensive care certificate, getting mechanical ventilator training, and its practice (P-value> 0.05)(25).

7. Strength and Limitations

7.1 Strength

It's the first study that attempts to assess the level of knowledge regarding the MV and ventilatory care practice among nurses working in the ICU of selected governmental hospitals in Addis Ababa, Ethiopia.

Its multicenter study

Found baseline information for future

7.2 Limitations

It's the first study that is not observational, there is a possible effect of the self-reported practice of nurses rather than actual performed in a clinical setting.

The outcome doesn't include all governmental hospitals.

A cross-sectional study design cannot establish cause and effect relationship.

8. Conclusion and Recommendations.

8.1 Conclusions

From the present study finding, it can be concluded that:

Nurses had poor knowledge and practice regarding mechanical ventilators and ventilatory care. There was no statistically significant relation between the ventilatory care practice of nurses and their socio-demographic characteristics. There was a significant relationship between nurse's knowledge and their socio-demographic characteristics in the area of educational status.

8.2. Recommendations

I would like to recommend

To FMOH and Addis Ababa Health Bureau: Encourage nurses to improve their knowledge regarding the MV and practice of ventilatory care by providing special training, educations, guidelines, different guidebook and strictly follow the nurse's practices for applicability.

To AAU; College of Health Sciences School of Medicine and Critical care to open a specialty track in intensive care and critical care nurses in Bachelor of sciences by formulating its own curriculum because there is no specialty which may contribute to good knowledge and practice of nurses working in the intensive care unit.

To Hospital on which the study was conducted; to make ICU Environment enables nurses to translate their knowledge into practice by providing them special in-service training, refreshment program, adopt and prepare different guidelines and protocol was recommended.

To ICU nurses;

To the researchers; a Similar study is recommended to include a large sample size with an observational checklist and further research on factors affecting nurses' knowledge and practice level was recommend.

To ICU nurses; ICU nurses should update their knowledge through reading different materials and apply accordingly for patient care. Nurses who had better knowledge and skill should share with their colleagues.

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Annexes

Annex I: Information sheet

Title: Knowledge and Practice of nurses working in intensive care unit towards mechanical ventilator utilization in a selected governmental hospital in Addis Ababa, Ethiopia 2021.

Principal Investigator: Kedir Abdureman Hassen.

Name of the institution: Addis Ababa University TikurAnbessa Specialized Hospital.

Dear Colleague,

My name is Kedir Abdureman. I am a master's student at Addis Ababa University, school of medicine. Currently, I am doing research on the knowledge and practice of nurses working in intensive care units towards mechanical ventilation utilization. This information sheet is prepared to enable nurses to understand the purpose of the study, ask for further explanation, and participate voluntarily.

Purpose of study: The purpose of this research is to understand the gaps on mechanical ventilators and the care of mechanically ventilated patients. If you agree to take part in this study, you will be occupying the questionnaire for about 20-30 minutes.

Participation: Participation in this study is voluntary. Participants, who are not interested in participating in this study, are free to refuse and withdraw as they wish, and this does not affect their working relationship at the institution. Those who are willing to participate are asked to sign a consent form as an agreement to participate. But this never results into any immediate benefits. Participants are advised to ask where they do not understand.

Study procedure: The study involves a set of questions in a structured questionnaire. After signing the consent form, participants will be given a self-administered questionnaire to answer.

Risks and Discomforts: There is no risk involved in this research though part of the participants' time is utilized to answer some questions. Participants who need further discussion will be provided to help them understand the topic more.

Benefits: At the moment, this study will not be of direct benefit to you, but I hope that findings from this study may help the policymakers to make decisions in designing appropriate programs, strategies, and policies that will of advantage indirectly to you and others personnel and patients.

Confidentiality: Your name will not be written and provide as sincere answers as you possibly could. The information that you provide during the study will be kept confidential. Only the researchers will have access to the questionnaires and the information that you provide. If you have any questions during filling the questioner you can ask

Contact for additional information: If you need more clarification about this study, you can call or contact the researcher;

Kedir Abdureman, Mobile: 0928116866, Email: kedirabdurehman59@gmail.com

Annex 2: Written consent form

The above information sheet describing the study purpose and procedure, benefits, confidentiality issues, voluntary participation, and rights to withdraw for the research title **“knowledge and practice of nurses working in intensive care unit towards utilization of mechanical ventilation in selected governmental hospitals in Addis Ababa, Ethiopia”** has been read and explained to me. I have been given an opportunity to ask any question for more explanation about the research. I agree to participate as a volunteer

Signature: _____ Date: _____

Participant

Annex III: Questioner

SECTION A: Demographic Information

- 1) Gender A, Male B, Female
- 2) Age _____ years
- 3) Educational level A, Diploma B, BSc nurse C, MSc nurse D, Critical care nurse E, Other(specify).....
- 4) Marital status A, Single B, married C, Divorced
- 5) Years of working in ICU A) < 1 yrs B) 1-5 yrs C) 6-10 yrs D) > 10 yrs
- 6) Have you ever participated in any training program related to a mechanical ventilator while working in this unit? A Yes B, No

SECTION B: knowledge

1. The critical amount of pao_2 in the initiation of mechanical ventilation is.
A) <60% B) 60-70% c) <30% D) >80%
2. Critical respiratory rate in the initiation of a mechanical ventilator is...
(Hint: for Adult).
A) 12-24 B) >30 C) >50 D) I don't know.
3. Mechanical ventilation is indicated when the patient PH value is....
A) 7.25-7.35 B) <7.25 C) 7.35-7.45 D) I don't know
4. Which of the following is a volume-targeted ventilator mode?
 - a. Volume variable
 - b. Fixed inspiratory flow rate
 - c. Preset pressure delivery
 - d. Fixed peak airway pressure
5. Which of the following is a pressure-targeted ventilator mode?
 - a. Assist/control
 - b. Pressure control

- c. Continuous mandatory ventilation
 - d. Controlled mandatory ventilation
6. The amount of oxygen delivered by a ventilator is
 - A) A fraction of inspired oxygen
 - C) positive expiratory volume.
 - A) Inspiratory pressure
 - D) tidal volume.
 7. The pressure given in the expiratory phase to prevent the closure of the alveoli and allow increased time for O₂ exchange is....
 - A) Plateau pressures
 - C) PEEP
 - B) Peak inspiratory pressure
 - D) I don't know.
 8. Which of the following best describes the volume of gas inhaled or exhaled during a breath?
 - A) Minute ventilation
 - C) Peak flow rate
 - B) Tidal volume
 - D) Functional residual capacity
 9. Which of the following alarm problems is caused by a blocked or kinked endotracheal tube?
 - A) Apnea
 - C) Low exhaled tidal volume
 - B) b. Low inspiratory pressure
 - D) High pressure
 10. Which one of the following is not the cause of the low-pressure alarm?
 - A) Cuff leak
 - C) Extubation
 - B) Secretion
 - D) circuit disconnects.
 11. Which of the following observations indicates that the ventilator flow rate setting matches the patient's inspiratory efforts?
 - A) The easy ability of the patient to trigger the breath and delivery of the breath coincides with inspiratory efforts
 - B) The easy ability of the patient to trigger the breath and neck accessory muscle use during inspiration

- C) The effort required to trigger the breath with respiratory muscle contractions during inspiration
 - D) The effort required to trigger the breath with respiratory muscle contractions during inspiration and expiration
12. Which of the following changes should be made to match the inspiratory demands of a patient breathing fast?
- A) Set a lower inspiratory flow rate or a longer inspiratory time to deliver the breath slower on inspiration
 - B) Set a higher inspiratory flow rate or a shorter inspiratory time to deliver the breath faster on inspiration
 - C) Coach the patient to relax and slow down breathing to coincide with the ventilator breath
 - D) Readjust the sensitivity setting on the ventilator to help slow down breathing
13. What is the potential result of alarm silencing once or repeated alarm silencing?
- A) No problem as long as the patient does not exhibit signs and symptoms of respiratory distress
 - B) Severe acute respiratory acidemia, which can lead to cardiovascular decompensation and cardiac arrest
 - C) Severe hypoxemia and acute metabolic alkalosis
 - D) Acute metabolic acidosis
14. Which ONE of the signs and symptoms listed below is NOT indicative of a patient who is ready to be weaned?
- A) The patient still dependent on Inotropic support to maintain hemodynamic stability
 - B) RR rate > 10 and <30 breaths per min
 - C) Temp 36 degrees.

D) PCO₂ 33-35mm/Hg

E) Don't Know

15. With regard to the weaning process which ONE of the following is the correct sequence of weaning?

A) O₂ is reduced to 35-40% followed by a decrease in mandatory respiratory rate, followed by decreasing the pressure support, followed by decreasing CPAP.

B) CPAP /PEEP is decreased first, followed by a reduction in pressure support, followed by a reduction of O₂ % followed by a reduction of mandatory respiratory rate.

C) Pressure support was reduced first, followed by a reduction of mandatory respiratory rate, followed by a reduction in O₂% followed by a reduction in PEEP/CPAP.

D) Rate reduced first, followed by reduction of O₂% followed by reduction of pressure support, followed by reduction of PEEP/CPAP.

E) Don't Know

16. Select the ONE INCORRECT answer below with regard to extubating a patient.

A) The oropharynx must be suctioned and then down the ET tube.

B) The cuff of the ET tube must be inflated to prevent aspiration on Extubation

C) The patient is asked to cough

D) the patient must be sitting up in bed and 40% O₂ administered after extubation

E) Don't Know

C) Using teardrop

D) Other specify.....

10.How frequently do you practice oral hygiene in mechanically ventilated?

A) One time per day C) Two times per day

B) Four times per day D) six times per day

11.Which one of the following solutions do you use for oral care? (Multiple options may be marked)

A) Sodium bicarbonate B) Chlorhexidine C) others (specify.....).

12.Do you follow the anxiety of a patient on the mechanical ventilator?

A) Yes B) No C) I don't know

13.All of the following are the anxiety finding of patient on the patient receiving mechanical ventilation support Except?

A) Hypertension C) Decreased BP

B) Increased HR D) Restlessness

14.Which method do you use to relieve the anxiety of the patient on the ventilation support? (Multiple options may be marked)

A) Relaxing the patient by talking to him/her C) Ensuring that the patient expresses himself/herself by writing

B) Getting the patient in touch with their relatives

15.Do you inform the relatives of the ventilated patient why he/she is admitted to ICU?

A) Yes B) No

16.In intensive care setting, all of the following are ventilator care bundle practice to prevent VAP Except?

A) Hand hygiene. C) Head of a bed elevation.

B) Daily sedation vacation. D) Administration of antibiotics