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Assessment of Nurse's Performance Regarding Mechanical Ventilator Troubleshooting

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Abstract
Background: Mechanical ventilation is a critical intervention used to support critically ill patients. Troubleshooting alarms dealing with common problems in mechanical ventilated patients., So it is essential for nurses to be well-informed about how to respond appropriately to the ventilator alarms and which nursing actions are required to maintain the patient's respiratory status. **So, this study aimed to** Assessment of nurses' performance regarding mechanical ventilator troubleshooting . **Research design:** Descriptive research design. **Study setting:** The study was conducted in the Trauma Intensive Care Unit (ICU) at Assiut University Hospital. **Sample:** A total of 40 nurses. **Three tools were used: Tool (1)**: Structured interview questionnaire sheet. **Tool (2)**: Nurses practice observation checklist. **Tool (3):** Checklist for mechanical ventilator troubleshooting. **Results:** 50% of the nurses' ages ranged of 22 to 31 years. Around 75% had 1 to 3 years of experience, 55% were male. 60% lived in urban areas. Majority 95% of nurses demonstrating inadequate knowledge of mechanical ventilation more than half 52.5% of nurses had satisfactory performance in managing mechanically ventilated patient. A statistically significant correlation was found between practice and performance (p=0.005). Conversely, no significant correlation existed between knowledge and practice (r=-0.038). **Conclusion:** Most of nurses had unsatisfactory total level of knowledge regarding the care of patients on mechanical ventilator whereas more than half had good practice. **Recommendation:** It is recommended to Implement training programs aimed at enhancing the knowledge and performance of all intensive care unit nurses in troubleshooting mechanical ventilators."

Keywords: Assessment, Mechanical ventilator, Performance & Troubleshooting.

Introduction
Mechanical ventilation plays a vital role in supporting critically ill patients by promoting oxygenation, enabling gas exchange, and assisting in the elimination of carbon dioxide. While beneficial, it can also lead to complications, which is why early weaning from invasive ventilation is recommended whenever possible **(Sangsari, et al., 2022).**

Ventilators offer adjustable settings for pressure, oxygen levels, respiratory rate, tidal volume, and the timing of inhalation and exhalation. These machines include several alarms designed to enhance patient safety. Nurses must understand how to respond to these alarms appropriately to maintain the patient's respiratory function **(Perry, et al., 2024).**

Troubleshooting the mechanical ventilator involves systematically identifying and addressing potential risks within the patient-ventilator interface. The most reliable way to detect clinical changes is through vigilant monitoring by skilled healthcare providers **(Shanthi, et al., 2017).**

Addressing ventilator alarms begins with assessing the patient. Prompt and effective troubleshooting of alarms is critical, as they may reflect either patient deterioration or technical malfunctions, both of which require immediate attention **(Ali, et al., 2017).**

Nurses play a pivotal role in managing patients who are receiving mechanical ventilation. Through the application of evidence-based practices, they contribute significantly to reducing the length of hospital stays, lowering the risk of complications, and enhancing patient survival. Since mechanical ventilation serves as a supportive rather than a curative treatment, delivering holistic and interdisciplinary care is vital for achieving the best possible outcome **(Hassan et al., 2023).**

Significance of the study:
Mechanical ventilation is a vital life-support method used in emergencies, particularly for patients with breathing difficulties or low oxygen levels. It works by delivering positive pressure breaths and depends on lung compliance and airway resistance. Understanding its effects on patient physiology is essential for safe use. Without it, many critically ill patients would be unable to maintain proper oxygenation, leading to serious outcomes. **(Hickey et al., 2024)**

Hospital records from the Trauma ICU at Assiut University (2022–2023) indicate that approximately 222 patients required mechanical ventilation during their ICU stay **(Assiut University Hospital Records, 2022).**

Given its widespread use, effective ventilator troubleshooting is essential to improve patient outcomes and maintain high standards of care in intensive care units.

Aim of the study: Assessment of nurses' performance regarding mechanical ventilator troubleshooting.

Research questions:

1. What is the current level of knowledge and practical competence among nurses regarding troubleshooting of mechanical ventilators?
2. Is there a statistically significant relationship between nurses' theoretical knowledge and their actual clinical performance in ventilator troubleshooting?

Subjects and Method:

Research design: This study was carried out using a descriptive research approach.

Research setting: Data were collected from the Trauma Intensive Care Unit **(TICU)**, located on the first floor of the main building at Assiut University Hospital. The unit has 15 beds, provides critical care for trauma patients.

Sample: A total of 40 nurses, both male and female, who were caring for mechanically ventilated patients at the time of the study, were selected using a convenient sampling method from the available nursing staff in the Trauma Intensive Care Unit at Assiut University Hospital.

The sample size was determined using Epi Info 2000, based on a formula that considers disease prevalence, with a 95% confidence interval and a 2% level of precision.

Study tools:

Three data collection tools were utilized in this study, all designed by the researcher following an in-depth review of relevant literature **(Perry, et al., 2024).**

Tool (1): Structured Interview Questionnaire Sheet: This tool comprised two parts:

part (1): Focused on gathering demographic details of the nurses, such as age, gender, and years of clinical experience.

part (2): Assessed nurses' knowledge of mechanical ventilation using multiple-choice questions (53 question) . The topics covered included:

- Anatomy and physiology of the respiratory system
- Basic principles of mechanical ventilation
- Complications associated with mechanical ventilation
- Patient care and monitoring during ventilation
- Endotracheal tube management
- Oral and airway hygiene
- Chest physiotherapy techniques
- Suctioning procedures
- Nursing responsibilities in nutritional and fluid management

Scoring system:

Each correct response was awarded 1 point, while incorrect responses received 0. The total score was calculated and converted into a percentage. Scores of 80% or higher were considered satisfactory, whereas scores below 80% were deemed unsatisfactory.

Tool (2): Nurses' Practice Observation Checklist

This tool was used to assess level of nurses' practice in managing patients on mechanical ventilation. It was adapted from **(Perry, et al., 2024)** and included the following key nursing procedures:

Endotracheal tube suctioning, endotracheal tube care, arterial blood gas (ABG) sampling and oral care

Scoring System:

Each correctly performed step was assigned a score of 1, while incorrectly or non-performed steps were scored 0. Results were expressed as frequencies and percentages of correct versus incorrect practices. A total score of 80% or above indicated satisfactory practice, while scores below 80% were classified as unsatisfactory.

Tool (3): Mechanical Ventilator Troubleshooting Checklist

This checklist was designed to assess nurses' performance in managing common mechanical ventilator problems. Adapted from James (2016), it focused on troubleshooting actions in response to various alarms and ventilator conditions, such as:

- Ventilator malfunction
- Power outage
- No gas delivery to the patient
- Low peak inspiratory pressure
- Low tidal volume
- Low minute ventilation
- Low PEEP/CPAP
- Apnea
- Altered inspiratory-to-expiratory (I:E) ratio
- High minute ventilation
- High pressure limit
- Increased respiratory rate
- Abnormal fraction of inspired oxygen (FiO_2), whether too high or too low

Scoring System:

Performance was classified into three categories:

- **Satisfactory** (≥70%)
- **Inadequate** (≥50%)
- **Poor** (<50%)

Each task was rated based on whether it was performed correctly, incorrectly, or not performed at all.

Method: The study was carried out in three main stages: preparation, implementation, and evaluation.

Phase of preparation: The researcher developed and assessed the data collection tools, drawing on recent research for guidance.

Following a clear explanation of the study's purpose and significance, the head of the Trauma Intensive Care Unit approved the study for implementation.

Validity and reliability:

Validity: The validity of the tools was assessed by a panel of four experts, consisting of two professors, an assistant professor, a lecturer in critical nursing from the Nursing Faculty, and a lecturer in Intensive Care and Anesthesia from the Medical Faculty at Assiut University. The evaluation focused on key criteria such as clarity, applicability, comprehensiveness, simplicity, and relevance.

Reliability: The alpha Cronbach test was used to statistically test the suggested tools'

as the following: **tool (1):** Questionnaire was 0.78, **tool (2):** Practice observation checklist was 0.83 and **tool (3):** Troubleshooting checklist was 0.85.

Pilot study: A pilot study was conducted with four nurses, representing 10% of the total sample, to assess the tools' usability, clarity, and application, as well as to estimate the time required for data collection. As the results of the pilot study were satisfactory, the nurses who took part in the pilot were incorporated into the main sample, and no changes were required.

Ethical Considerations:

Approval for the study was obtained from the Ethics Committee of Assiut University's Nursing Department (approval number 1120230734). The study posed no risks to participants. Throughout the research, both anonymity and confidentiality were strictly maintained. After being informed of the study's objectives and procedures, each nurse provided written informed consent. Nurses were assured they could withdraw from the study at any time without any consequences.

Phase of Implementation and evaluation :

1. **Initiation of Data Collection:** Data collection commenced immediately after obtaining the necessary administrative and ethical approvals. The researcher collaborated with staff and head nurses to encourage participation.
2. **Data Collection Responsibility:** The researcher was primarily responsible for data collection, with support from head nurses and department nurses to facilitate the process.
3. **Participant Engagement and Interviews:** The researcher conducted structured interviews with participating healthcare team members using **Tool (1)** (Structured Questionnaire), guiding them through completion.

Interview Process: Each participant was interviewed individually in a one-on-one setting to ensure accurate data collection and privacy.

Knowledge Evaluation: The knowledge level of the healthcare team regarding mechanical ventilation was assessed using the questionnaire.

Time Required for Completion: Each questionnaire took approximately **15 to 20 minutes** to complete.

Questionnaire Content: The questionnaire (Tool 1) included:

- Sociodemographic and clinical data (Parts 1 and 2)
- Anatomy and physiology of the respiratory system
- Principles and complications of mechanical ventilation
- Patient care during ventilation
- Chest physiotherapy
- Endotracheal tube care
- Oral and airway hygiene
- Nursing care during suction, nutrition, and fluid management

Performance Assessment: The researcher used **Tool (2)** (Observational Checklist) to assess nurses' performance in:

- Troubleshooting ventilator alarms
- Managing patients on mechanical ventilation

Researcher Conduct During Assessment: Before observation, the researcher introduced herself and explained the study's purpose. Data collection was tailored to staff work conditions.

Blinding to Evaluation: Participants were not informed of their performance evaluation outcomes to reduce response bias.

Demonstration of Skills (Tool 2 & 3): The healthcare team demonstrated the following procedures while being assessed using Tool (2) and Tool (3):

- Suctioning endotracheal tubes
- Endotracheal tube care
- Arterial blood gas sampling
- Oral hygiene

Troubleshooting scenarios (e.g., apnea, FiO_2 abnormalities, low/high pressures and volumes, ventilator inoperative, power failure, gas delivery failure, etc.)

Timing of Observations: Observations were conducted during various shifts—**morning, afternoon, and night**-to ensure comprehensive evaluation across work conditions.

Study Setting: Data collection took place in the **Trauma Intensive Care Unit (TICU)** at **Assiut University Hospital**.

Analytical statistics

The data was checked for normality and homogeneity variances using the Anderson-Darling test prior to any statistical analysis. Mean and standard deviation (Mean, SD) were used to identify continuous variables, while number and percentage (N, %) were used to identify categorical variables. When utilizing the t-test to compare continuous data, categorical variables are compared using the chi-square and Fisher exact tests. Person correlation is used to show how scores relate to one another. It was considered statistically significant when the two-tailed p-value was less than 0.05. For all analyses, IBM SPSS 20.0 was used.

Results

Table (1): Distribution of Socio-demographic & clinical data for Studied nurses (n=40)

Variables	N	%
Age group		
< 25 years	20	50.0
>25 years	20	50.0
Mean±SD(range)	**25.58±2.26(22-31)**	
Experience		
From 1-3 years	29	72.5
More than 3 years	11	27.5
Mean±SD(range)	**2.82±1.26(1-6)**	

Data described as (n&%) chi-square and(±SD)independent sample t-test

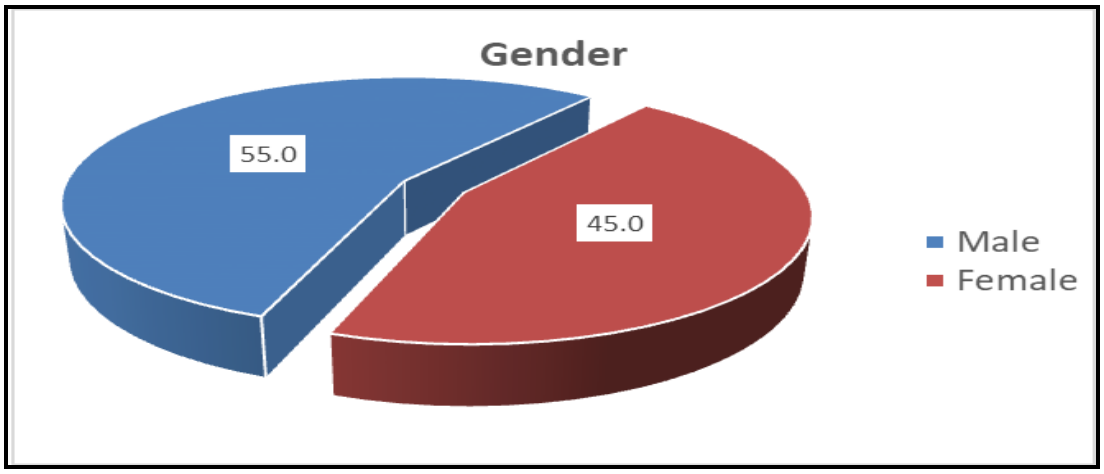

Figure (1): Percentage distribution of nurses according to their gender

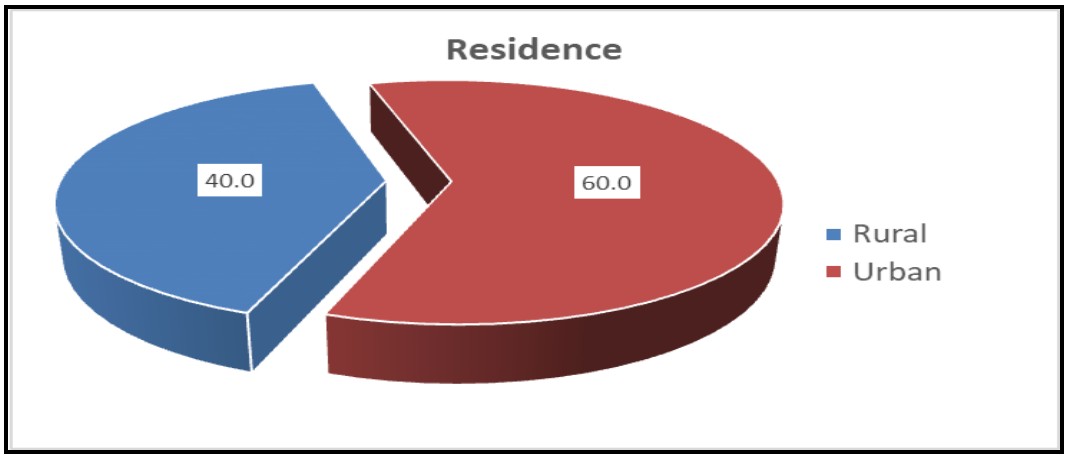

Figure (2): Percentage distribution of nurses according to their residence

Table(2): Distribution of nurses' knowledge Level related to mechanical ventilation (n=40)

Nurses' knowledge	Max Score	No	%
Unsatisfactory	<80%	38	95.0
Satisfactory	≥80%	2	5.0
Mean±SD(range)	**53**	**28.25±11.67(2-48)**	

Data described as (n&%) chi-square and(±SD)independent sample t-test

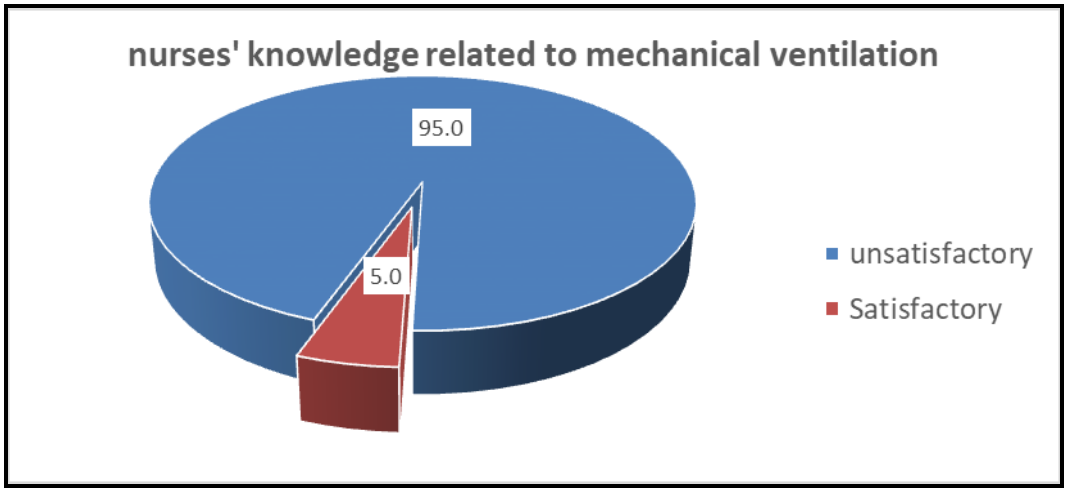

Figure (3): Percentage distribution of nurses according to their knowledge about mechanical ventilation

Table (3): Distribution of nurses' practice Level regarding management of patients on mechanical ventilation (n=40)

Nurses' practice	Max Score	No	%
Unsatisfactory	<80%	19	47.5
Satisfactory	≥80%	21	52.5
Mean±SD(range)	**48**	**38.1±8.81(8-48)**	

Data described as (n&%) chi-square and(±SD)independent sample t-test.

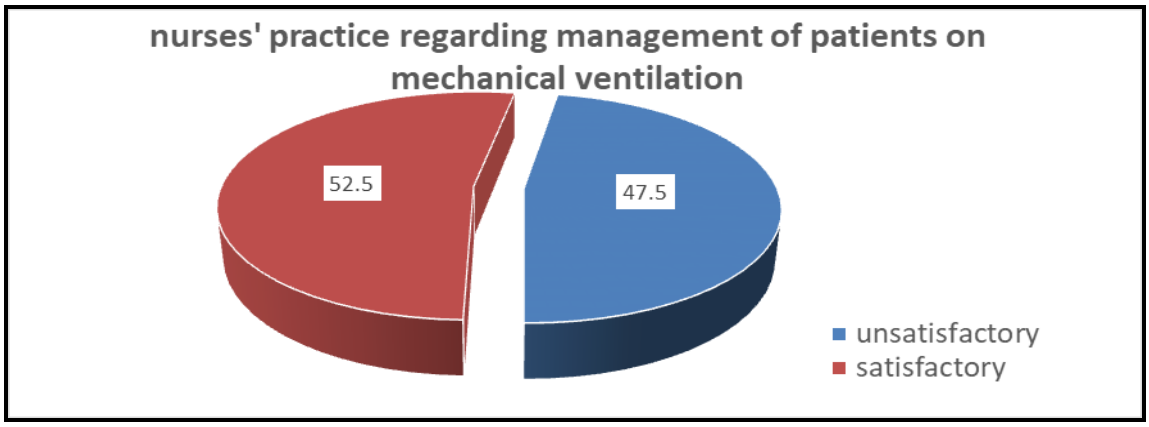

Figure (4): percentage distribution of nurses according to their practice Level regarding management of patients on mechanical ventilation

Table(4): Overall of nurses performance regarding mechanical ventilator troubleshooting (n=40)

Variables	Max Score	Mean±SD	Range	Mean%
Ventilator Inoperative (Vent INOP)	14	10.4±1.61	7-13	74.3
Electricity Failure	8	5.93±1.27	2-8	74.1
No Gas Delivery to the Patient	10	7.75±1.17	6-10	77.5
Low Peak Inspiratory Pressure (PIP)	14	11.05±1.48	6-14	78.9
Low Tidal Volume (VT)	12	9.43±1.39	6-12	78.5
Low Minute Volume (MV)	12	8.48±1.77	4-11	70.6
Low Positive End-Expiratory Pressure/Continuous Positive Airway Pressure (PEEP/CPAP)	14	11.05±1.3	8-14	78.9

Variables	Max Score	Mean±SD	Range	Mean%
Apnea	8	6.23±1.03	4-8	77.8
Inspiratory:Expiratory (I:E) ratio	10	7.5±1.72	4-10	75.0
High Minute Volume (MV)	6	5.2±1.2	1-6	86.7
High-Pressure Limit	16	10.95±3.55	2-16	68.4
High Respiratory Rate	6	5.28±0.82	4-6	87.9
Low or High Fraction of Inspired Oxygen (FIO2)	12	8.23±2.38	2-12	68.5
nurses performance regarding mechanical ventilator troubleshooting	**142**	**107.45±7.56**	**87-121**	**75.7**

Data described as mean±SD independent sample t-test

Table(5): Distribution of nurses performance Level regarding mechanical ventilation troubleshooting (n=40)

Nurses performance	Max Score	No	%
Poor	<50%	0	0.0
Inadequate	50-70%	5	12.5
Good	>70%	35	87.5
Mean±SD(range)	**142**	**107.45±7.56(87-121)**	

Data described as (n&%) chi-square and mean±SD independent sample t-test

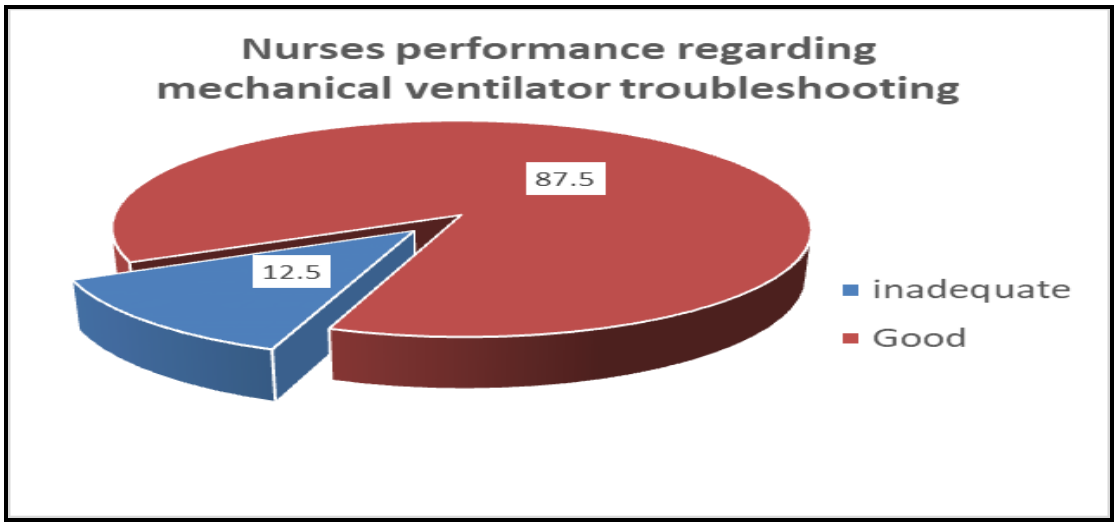

Figure (5): Shows that the majority 87.5 % of nurses had good performance regarding mechanical ventilator troubleshooting, while the minority 12.5% inadequate, and no one of them had poor performance

Table(6): Correlation Co-efficient Between nurses' knowledge related to mechanical ventilation and Their practice (n=40)

Correlations		nurses' knowledge	nurses' practice
nurses' knowledge related to mechanical ventilation	r	1	
	P		
nurses' practice regarding management of patients on mechanical ventilation	r	-0.038	1
	P	0.818	
nurses performance regarding mechanical ventilation troubleshooting	r	-0.018	.432**
	P	0.914	0.005

**Statistically Significant Correlation at P. value <0.05*
***Statistically Significant Correlation at P. value <0.01*

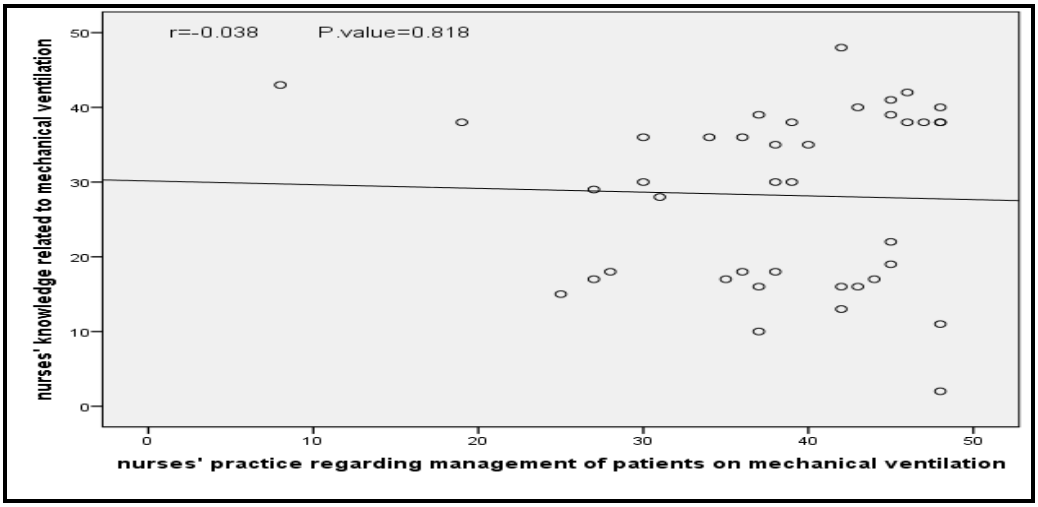

Figure (6): Illustrates the relationship between nurses' knowledge related to mechanical ventilation and nurses' practice regarding management of patients on mechanical ventilation.

Table (1): Showed that almost one half 50% of the nurses in the study were under 25 years old, which range from (22 to 31) years. three quarters of them were from 1: 3 years of experience with range (1-6).

Figure (1): Clarified that fewer than half 45% of the nurses in the study were female, and more than half 55% of them were male.

Figure (2): Showed that less than two-thirds (60%) of the nurses in the study were from cities, and less than half (40%) were from rural areas.

Table (2): Clarified that most of the nurses 95% had inadequate knowledge regarding mechanical ventilation, while the minority of them 5% had satisfactory knowledge, with Mean±SD (range) 28.25±11.67(2-48).

Figure (3): Showed that the majority of the nurses in the study (95%) had inadequate knowledge of mechanical breathing, while only 5% had adequate knowledge.

Table (3): Clarified that less than half of the nurses (47.5%) exhibited unsatisfactory practice in the management of mechanically ventilated patients, whereas slightly more than half (52.5%) achieved a satisfactory level of practice.The practice scores ranged from 8 to 48, with a mean of 38.1 ± 8.81.

Figure (4): Showed that less than half of the nurses in the study (47.5%) had inadequate mechanical ventilation practice, whereas more than half (52.5%) had good practice.

Table (4): Clarified that over three quarters 75.5% of nurses performed satisfactorily in troubleshooting mechanical ventilators, with Mean±SD 107.45±7.56. The majority of nurses in the study—87.9%—performed satisfactorily in terms of high respiratory rate. Additionally 68.4% of respondents performed satisfactorily in terms of the High-Pressure Limit.

Table (5): Showed that the majority of the nurses in the study (87.5%) performed well when it came to troubleshooting mechanical ventilators, while the minority (12.5%) performed inadequately, and none of them performed poorly.

Figure (5): It was found that, when it came to troubleshooting mechanical ventilators, the majority of the nurses in the study (87.5%) performed well, while only 12.5% performed inadequately, and none performed poorly.

Table (6): Revealed correlation between the nurses' performance and their knowledge and practice. It showed that practice and performance had a statistically significant association (p=0.005).

Figure (6): Scatterplot illustrates No Statistically Significant correlation: hypothetical data for the relationship between nurses' practice and knowledge of managing patients on mechanical ventilation (r=-0.038).

Discussion:

Mechanical ventilation remains a crucial intervention in emergency and intensive care settings, especially for patients who have respiratory failure from hypoxia, airway blockage, or inadequate ventilation. Positive pressure breathing is used during this process, which depends on the resistance and compliance of the airway system. (**Hickey et al., 2024).** Mechanical ventilation Troubleshooting is a systematic identification and resolution of potentially dangerous situations in the patient ventilator system **(Perry, et al., 2024).**

The most effective way to identify any deviation in the patient's physiologic state is through clinical observation by a qualified doctor or nurse. **In 2017, Shanthi et al.,**

Because they ensure that patients receive the best care possible, nurses are crucial to patient safety. In order to provide high-quality, patient-centered care, nurses must be knowledgeable with the functions and limitations of ventilators, the causes of respiratory distress, and the appropriate management techniques. **(Km & others, 2020)**

According to the demographic results of the current survey, The finding that nearly half of the nurses fall into the younger age bracket of 22–31 years—is indicative of a workforce trend where early-career professionals dominate clinical roles, particularly in settings like intensive care units or surgical wards. it also raises concerns about clinical experience, critical decision-making. This result was similar to the findings of **Nursalam et al. (2020),** who found that 43.5% of the age group in the data was between 21 and 40. In line with a study by **Hassen et al. (2023),** which discovered that men made up more than half of the nurses in the study, more than half of them were men. The researcher opinion that the predominance of young and relatively inexperienced nurses highlights the urgent need for targeted training and mentorship programs to strengthen clinical competence, especially in high-stakes environments like intensive care. Additionally, the increasing number of male nurses reflects a positive shift toward gender diversity in nursing, which may enhance team dynamics and patient care outcomes. However, ensuring consistent performance across all demographic groups requires ongoing professional development and practical exposure to critical care procedures.

The results of the current study showed that more than half of nurses were from urban areas in terms of residency. **Hassen et al. (2023)** found that less than three-quarters of the nurses in the study were from rural areas, which is in contrast to this conclusion. The findings showed that, three quarters of nurses had one to three years of experience. The researcher view that most nurses had only one to three years of experience underscores the presence of a relatively new workforce, which, while promising in terms of energy and adaptability, may lack the depth of experience needed for managing complex clinical scenarios. This is consistent with the findings of **No, (2021),** who found that "whereas their experience ranges from one to six years; their years of experience are less than half."

According to this survey, the majority of nurses lacked sufficient understanding about how to provide care for patients on mechanical ventilators. Complications of mechanical ventilation and treatment, endotracheal tube care, and oral and airway care were among the areas where expertise was lacking.

As a researcher, believe the evident knowledge gaps among the majority of nurses regarding mechanical ventilation care are concerning, particularly in critical areas such as managing complications, endotracheal tube care, and airway hygiene. These deficiencies may compromise patient safety and outcomes, especially in high-acuity settings. The findings emphasize the urgent need for comprehensive, evidence-based training programs and regular competency assessments to enhance nurses' understanding and skills in mechanical ventilation management. Strengthening these core areas through practical workshops, simulations, and continuing education is essential to ensure high-quality, safe, and effective care for mechanically ventilated patients.

These results were consistent with **Ali et al. (2023),** who discovered that over two-thirds of the research nurses performed badly on the pre-test regarding their level of knowledge regarding the management of patients on mechanical ventilation. The researcher thinks that nurses' misunderstanding of patients on mechanical ventilation may be caused by a lack of post-graduate continuing education programs or courses on the subject, supervision, and regular knowledge testing.

Similarly, the study's statistics aligned with descriptive research conducted by **Abdelsttar et al. (2022),** which verified that more than half of the nurses in the study knew too little about mechanical ventilator systems and gave patients on mechanical ventilation subpar care. This is due to the fact that most nurses concentrated on general knowledge and infection control techniques for patients and mechanical breathing.

When compared to their general practice, the current study found that about half of the nurses in the group had good experience managing patients on mechanical ventilation. The researcher considered that the observation that only around half of the nurses showed strong experience in managing mechanically ventilated patients—despite demonstrating general clinical competence—indicates a clear gap in specialized critical care skills. Although their overall nursing abilities may be sufficient, managing ventilated patients requires advanced expertise and accuracy, which some nurses appear to lack. This highlights the importance of integrating targeted, practical training on mechanical ventilation into both nursing education and continuous professional development to ensure consistent, high-quality care in intensive care environments.

These results were consistent with **Colombage et al. (2020),** who found that "57.8% (N=107) of practices were correct." Only 18% of nurses have practiced good oral hygiene with patients on mechanical

ventilation, despite the fact that half of them possess sufficient knowledge and skills related to ET care.

In a similar vein, **Santos et al., (2020)** "effective nursing practices for patients on invasive mechanical ventilation are related to endotracheal tube, mechanical ventilator and breathing circuit, prevention of bronchoaspiration, infection control and sedation, analgesia/sleep, wakefulness/pain."

The findings of this study are in conflict with those of **Sheta et al. (2022),** who found that only 25% of the nurses in the study had competent levels of practice in all practice items prior to the program's implementation. This immediately improved to competent levels of practice in all practice items related to ETT care and suctioning, oral care for intubated patients, ETT securing or re-taping, and ETT cuff pressure measuring. Additionally, **Botros (2019)** found that approximately 10% of the sample practiced at a higher level, over a quarter practiced at a moderate level, and over two-thirds practiced at a low level overall.

When it came to troubleshooting mechanical ventilators, these studies showed that the majority of nurses under scrutiny functioned satisfactorily. The researcher view that the satisfactory performance of the majority of nurses in troubleshooting mechanical ventilators as a positive indicator of their practical competence in critical care settings. This suggests that, despite potential gaps in theoretical knowledge, many nurses are capable of effectively responding to technical challenges in real-time. However, to maintain and enhance this level of performance, ongoing hands-on training, scenario-based simulations, and regular competency evaluations are essential. Ensuring all nurses are equally skilled in troubleshooting is vital for patient safety and the optimal functioning of intensive care units.

According to **Nursalam et al. (2020),** "competence in handling alarms is by taking action when an alarm occurs." These findings were in line with their findings. These results were consistent with what they found. Among the causes are apnea alarm, low pressure warning, and excessive pressure alarm. Alarm noises, low inspiratory pressure (inspiration), disconnect alarm, vent-inop (absence of ventilation), low exhaled tidal volume, fan failure alarm, and obstruction of the air intake are also present.

In a similar vein, **Ibrahim et al. (2021)** "a third of them have satisfied practices regarding high and low expiratory volume alarm 32(32%) mean 2.32± (.763), but more than half of them lack sufficient information knowledge about the cause of ventilator alarm." Despite their satisfaction with the cause and result of the ventilator alert, over two-thirds of them wear equipment to evaluate the patient (77, or 77%) and determine the cause of the alarm (83, or 83%). Just 3% do not react to the alarm, yet they always do.

Contrary to **Hendrix et al. (2023),** who found that a sizable percentage (44.6%) said they seldom or never took on the responsibility of monitoring patient-ventilator interactions or resolving alarms (48.9%). Of nurses, 60.5% claimed responsibility for resolving oxygenation problems, whereas 58.4% claimed responsibility for resolving ventilation problems. **Hegazy & colleagues (2019)** also found that "more than three-fourths of studied nurses had incompetent practice regarding dealing with ventilator alarms."

There was no statistically significant relationship between nurses' practice and their understanding of ventilated patient care, according to the current study. The researcher suggests that possessing theoretical knowledge does not necessarily translate into effective clinical practice. It highlights the complexity of critical care nursing, where hands-on experience, decision-making skills, and contextual factors may play a more crucial role than knowledge alone. Therefore, nursing education and training programs should emphasize practical skill development and real-world application alongside theoretical learning to bridge this gap and improve patient outcomes.

Hesham et al. (2016) found "No correlation between nurses' practice and knowledge regarding the management of patients on the ventilator." This conclusion is consistent with their findings. Similar findings were made by Mostafa et al. (2019), who found "no statistically significant differences between the total score of the studied nurses' level of knowledge and practice." In contrast, **Hegazy et al. (2019)** found "a highly positive correlation between knowledge and practice of the studied nurses," which runs counter to this conclusion. Furthermore, it runs counter to the results of **Kakoty, (2020)**, who found that "there was a positive correlation' (r=0.655) between the knowledge level and practice level regarding nursing care of patients on mechanical ventilator."

The current study found a positive statistical correlation between nurses' performance and practice in troubleshooting mechanical ventilators. It demonstrates how improved nursing practice raises the bar for care and improves patient outcomes by enabling better performance in managing mechanical ventilator problems. **Mabrouk (2019)** concluded that "the practice and attitude of all the nurses who were studied were highly statistically significant, and the knowledge of all the nurses who were studied and their total practice were highly statistically significant."

Conclusion

The findings of the study indicated that the majority of nurses lacked adequate general knowledge regarding the care of patients on mechanical ventilation. However, over half of the participants demonstrated sufficient practical experience in managing such patients. Most nurses performed satisfactorily in troubleshooting mechanical ventilators, showing the ability to appropriately respond to alarm warnings based on their type, required action, and confirmation processes. Their overall practice in handling ventilator alarms was at an average competency level.

Importantly, the study found **no statistically significant correlation** between nurses' knowledge and their actual performance in mechanical ventilator troubleshooting. However, a **statistically significant positive correlation** was observed between nurses' practical performance and their applied practices in ventilator troubleshooting.

Recommendation:

The study's findings lead to the following suggestions being put forth:

- Conduct regular training for ICU nurses on mechanical ventilation and troubleshooting.
- Use visual aids and instructional videos to enhance practical learning.
- Provide standardized nursing handbooks and clinical guides in ICUs.
- Integrate evidence-based practices into training, especially for alarm management.
- Develop and implement alarm management protocols in collaboration with interdisciplinary teams.
- Encourage further research on alarm response behavior and the impact of training on nurses' performance.

Conflict of interests

None.

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