Effect of Implementing an Educational Intervention on Nurses' Performance regarding Adherence to Infection Control Precautions on Mechanical Ventilation

Mariam Sabry Shehab [(1)], Mostafa Mohamed Zanaty [(2)], Hend Elsayed Mansour [(3)], Asmaa Abouda Abdelhameed [(4)] Soultan, Amal Eid Abdelmonaem Shaanan [(5)]

1. Critical and Emergency Care Nursing, Faculty of Nursing, Damietta University, Egypt
2. Critical Care and Emergency Nursing, Faculty of Nursing, Mansoura University, Egypt. Nursing Sciences Department, College of Applied Medical Sciences in Wadi Alddawasir, Prince Sattam Bin Abdelaziz University, Kingdom of Saudi Arabia
3. Critical Care and Emergency Nursing, Faculty of Nursing, Mansoura University, Egypt
4. Medical–Surgical Nursing Department, Faculty of Nursing, Damietta University, Egypt
5. Medical–Surgical Nursing Department, Faculty of Nursing, Mansoura University, Egypt
*Email: mariam.s.sh98@yahoo.com

Abstract

Background: Critical care nurses provide direct care to patients who require mechanical ventilation and act the key in preventing and development of infections in ventilated patients. **Aim**: Evaluate the effect of implementing an educational intervention on nurses' performance regarding adherence to infection control precautions on mechanical ventilation. **Design**: A quasi-experimental research design was used. Setting: The study was conducted in the ICU unit at Al-Azhar University Hospital. Sample: A convenience sample of all available nurses (40 nurses). **Tools**: Two tools were used, the nurse's knowledge questionnaire and the observational checklist. **Results**: There was a statistically significant difference in overall nurses' knowledge and practice before and after the educational program (P-value = 0.001**). The nurses' knowledge scores increased from 32.5% to 87.5% after the program was implemented, while the observed nurses' practice score increased from 7.5% to 55%. **Conclusion**: Following the educational program, nurses' knowledge and practice about adherence to infection control procedures on mechanical ventilation reach satisfactory levels. **Recommendation**: Providing continual training programs to ICU nurses to improve their performance in terms of infection control precautions during mechanical ventilation.

Keywords: Infection Control, Mechanical Ventilation, Nurses Performance, Program.

Introduction

Artificial breathing (ventilation) refers to the process of replacing or augmenting spontaneous breathing by artificial means. "Breathe for the patient" is the aim till the patient is well enough to respirate spontaneously **(Sole et al., 2020).**

Infections obtained during treatments at different medical wards that weren't present at admission time are defined as infections related to healthcare. This type of infection may occur in a number of locations, including hospitals, ambulatory settings, and facilities that provide long-term care. They can even show up after discharge **(Sikora and Zahra, 2023).**

Implementation of fundamental controlling and prevention of infection measures should be followed at all times for every patient, regardless of their status of infection or medical diagnosis, in

addition to further (transmission-related to safeguards) that are Particular to the transmission types of infection (contact, droplet and airborne) to stop and manage the spread of infections in nursing facilities **(Caeiro & Garzón, 2018).**

Standard precaution is the most fundamental management practice to stay away from infection. It is advised that individuals follow standard precautions for any infection before the disease is diagnosed. These precautions require healthcare professionals to view all patient secretions, consisting of body fluids and blood, as possible sources of infection and to stay away from contact with them in order to stop the spread of pathogens **(WHO, 2020).**

Additionally, according to WHO guidelines, every patient should follow standard precautions, which consist of hygiene care for the hands and respiratory system, using proper personal protective equipment (PPE) and linens according to risk assessment, practicing safe injection and management of waste, and sterilizing patient-care equipment and cleaning the environment **(WHO, 2020).**

Controlling infection is key to training for all persons working at health services, for their well-being and to reduce nosocomial infections, which would enhance safety for both nurses and patients. Healthcare-acquired infections (HAIs) are considered a global problem that raises the death and disability rate among patients who stay a long time in hospitals and increases costs. Updating nurses' information and skills about the application of standard safety measures and strategies for the prevention of infection is considered the cornerstone to reduce hospital-acquired infection burden **(Hattab et al., 2021).**

For all healthcare professions, continuing education is crucial because nurses play an essential part in controlling attitudes and practices and translating knowledge about the avoidance of infection. Furthermore, nurses who participate in-service education obtain the knowledge of both theory and practice required to grow specific skills and practices for continual development **(Belal et al., 2020).**

Significance of the study

Safety of healthcare workers and critically ill patients is significantly endangered by infections related to healthcare; consequently, all organizations and healthcare systems must give priority to preventing them. In the long term, HAIs can lead to significant expenses as well as a low standard of living or even a short life expectancy for the infected individual. According to **AL Humaid et al. (2021),** basic precautions and isolation precautions (droplet, airborne, and contact) may be able to avoid between 55 and 70 percent of HAIs.

The effectiveness of these preventative strategies in lowering the risk of developing a hospital-acquired illness depends heavily on the human element. Due to the significance of obtaining appropriate training and education in these measurements, the study purpose was to evaluate the effect of implementing an educational intervention on nurses' performance regarding adherence to infection control precautions on mechanical ventilation.

Aim of the Study:

Evaluate effect of implementing an educational intervention on nurses' performance regarding adherence to infection control precautions on mechanical ventilation

Hypothesis

H1: Nurses knowledge regarding adherence to infection control precautions on mechanical ventilation will be significantly improved after intervention than before.

H2: Nurses practice regarding adherence to infection control precautions on mechanical ventilation will be significantly improved after intervention than before

H3: There will be significantly positive correlation between nurses' knowledge and practice regarding adherence to infection control precautions on mechanical ventilation.

Subjects & Methods

Subjects and method represented under four primary designs:

I. Technical Design

Includes the research designs description, setting, subjects, and tools for data gathering.

Research design: Quasi-experimental research design had been utilized.

Setting: Al-Azhar University Hospital's intensive care unit served as the study's site.

Subjects

A convenience sample comprising all available nurses (40) who are agreed to take part in the study during the data collecting period while working in the previously specified setting.

Tools:

The researcher created the following two tools:

Tool I: Nurse's knowledge questionnaire

After examining the literature and relatives, the researcher created tool I **(Reynolds et al., 2017),** the tool translated into basic Arabic to evaluate nurses' precise understanding of conventional procedures for infection control in mechanical ventilation. pre-education program's adoption, it was in use. After the standard measures for infection control in mechanical ventilation were put into place, the same tool was utilized right away (immediately post educational program). It included 2 parts:

Part 1: Sociodemographic information (e.g., gender, education, years of experience, age, and training course attendance).

Part 2: Assessment of nurses' knowledge: a questionnaire designed to measure nurses' knowledge with conventional precautions for infection prevention in mechanical ventilation. It contained the following five general items:

1. Five questions in the knowledge part about infection control included the definition, types of infections, mode of transmission, significance and primary goal of controlling infections, and definition of infection acquired by hospitals.
2. Handwashing knowledge included nine questions: why you should wash your hands, how to do it, before you start and stop working, before and after taking a sample, before putting on gloves, before and after doing any procedure, after you take off your

gloves, after you touch your hands with blood or bodily fluids, how to properly rub your hands every time you work, and the supplies you need to wash your hands.

3. Personal protective equipment (PPE) knowledge, which included five questions about preventive precautions and wearing a mask while working at an ICU unit, gloving during tasks and between different care for the patient, and wearing gowns when working in the ICU unit and while providing care for patients in the ICU unit.
4. Seven questions about ventilator bundle care were included: adjusting the head of the bed to a position between 30 and 45 degrees unless otherwise indicated; replacing the ventilator circuit when it becomes solid; filling the humidifiers with sterile water; performing hygiene care orally with an antiseptic agent every 8 to 12 hours; providing subglottic suctioning when necessary; checking the pressure of the endotracheal tube cuff every 2 to 4 hours; and changing the suction after usage.
5. Knowledge about pneumonia related to ventilators: contained freely answering questions such as mechanical ventilation definition, definition of pneumonia related to ventilators, nursing care about pneumonia related to ventilators. The researcher obtained all of the nurses' responses to the structured interview questionnaire, which was then collected during the interview. There were 29 questions altogether.

Scoring system for knowledge

A scoring system was created: a complete, right answer takes 2 marks; an incomplete answer takes 1 mark; and an improper answer takes zero. More than 70% of the questionnaire total score was considered a "satisfactory" knowledge level, and the level of knowledge that was less than 70% was considered "unsatisfactory" **(Onianwa et al., 2017).** The questionnaire about knowledge consisted of two types of questions: statements to which respondents were asked to respond "true" or "false." Questions with open ends were the second type, allowing respondents to freely respond. The model answers were extracted from all responses after they were summarized.

Tool II: Standardize nursing practice (observational checklist)

After reviewing the literature, researchers created the checklist about infection prevention through standard precautions for all procedures for mechanically ventilated patients **(CDC, 2018).** The researchers used the checklist to evaluate nurses' practices in relation to infection control measures. It was employed both before and right after the infection control measures were put into place. It included the handwashing method (9 steps), the personal protection equipment (6 phases), intravenous cannula insertion (12 steps), intravenous line insertion and replacement (12 steps), suction care (11 steps), urinary catheter insertion and removal (11 steps), patient care for intubation (10 steps), the ventilator care package (9 steps), care of wound (11 steps), using sharps and

needles (5 steps), and controlling the environment (11 steps). The total checklist has (107) questions.

Scoring system for practice

The following criteria were used to grade each step: two degrees for correctly completed steps, one degree for steps completed using an improper method, and zero for uncompleted steps. When the overall score for every step fell below 85%, it was deemed to be at an insufficient practical level. At least 85% was considered a sufficient practical level **(Walker et al., 2014)** and is to be the appropriate degree of practice.

II. Operational design:

The Operational design contained a preparatory phase, validity & reliability tests, fieldwork, and a pilot study

Preparatory phase

It comprised a review of associated literature, diverse investigations, and conceptual understanding of many elements of the problems through use of books, research articles, the internet, and monthly publications.

Validity

Five specialists in the fields of critical and emergency nursing evaluated the content validity of each tool to ensure that it was thorough, clear, translated appropriately, and that any necessary changes were made.

Reliability: nurses' knowledge scores increased from 32.5% prior the program to 87.5% following it, according to the Cronbach coefficient alpha, which was used to evaluate the knowledge and practice evaluation methods used in the program. Furthermore, the practice scores of the observed nurses increased from 7.5% prior to the educational session to 55% following it.

Pilot study: It was conducted on seven nurses who worked with patients on mechanical ventilation in October 2023.They were selected at random from intensive care units at Al-Azhar University Hospital in order to assess the tools' usability and visibility and to determine how long the interview would take. A few small adjustments were made to have more appropriate data collection tools based on the pilot study's results. After certain statements were changed, added, or reworded, the final forms were created, and the seven participants chosen for the pilot study were not included in the research.

Field of work:

Data were gathered and carried out in four phases after the researcher has interviewed the nurses to get their agreement and explain the goal of the study:

1. **Phase of preparation**:
   In this stage the researcher created an instructional program **(Moralejo et al., 2018):** after a literature review, the researcher made the educational program based on the needs that the nurses had indicated following the pre-educational program. In order to create the program, the researcher first defined the program's purpose and content.
2. **Phase of planning:**
   The program's content included two parts: 1. Nurses knowledge about standard precautions for controlling infections regarding mechanical ventilation was included: the definition

of infection and the definition of acquired infection; the infection chain, stages, types, routes of transmission, and the significance of controlling infection; the handwashing definition, routine, purpose, and universal precautions of infection control; and defining bundle care of ventilators (putting the head of the bed in 30-45 degrees, performing oral care every 8-12 h, the mechanical ventilator definition, intubation care, and the definition of ventilator-associated pneumonia). 2. Procedures regarding the care of mechanically ventilated patients were included: personal protective equipment applications; intravenous line changing and insertion; hand washing techniques; suction car application; application of urinary catheter care; caring for endotracheal tube (before, during, and following insertion); bundle care of ventilator; care of wound; implementation of needle and sharps handling; and implementation of environmental control.

3. **Phase of implementation**:
During the preliminary session, participants and the program are oriented, and the sheet is distributed and filled up. The second session (40 minutes) covered what the infection is. What is the route of transmission, stage, and type of infection? And what does the infection control mean? The 3rd session involved demonstrating how to put on and take off gloves and how to wear a mask. and how to wear other measures used for protection? (45 minutes). The concept, purpose, and routine of hand washing were covered in session number four, along with an explanation of the worldwide infection control precaution. Session number 5 covered the care of the patient before, during, and after the insertion of an endotracheal tube. Session 6 (30 minutes) covered: how to provide nursing care for ventilated patients. Bundle care for mechanical ventilators: What are the causes of pneumonia linked to ventilators, and how do you prevent occurrence? Group discussions (50 minutes) were motivated with ongoing comments to make sure that the educational program's specific goals were understood and met. The procedures were demonstrated using pictures and videos, and in the final session, the researcher clarified and underlined the significance of the basic precaution for infection prevention in mechanical ventilation.

4. **Phase of evaluation:**
The evaluation step was the final phase of the application of the instructional program. The researcher immediately evaluates both the level of the nurse's knowledge and their practice post program implementation. The program took place in the office of the head nurse at the ICU at Al-Azhar University Hospital.

Administrative Design:

It was approved by Mansoura University's Faculty of Nursing Research Ethics Committee with code number NUR (19/2/2023) (0418). In addition, all ethical issues were considered throughout the investigation, including describing the goal of the study to the director of Al-Azhar University Hospital in New Damietta City to obtain approval to carry

out the research. Furthermore, the researcher explains the study's purpose to each nurse to understand the significance of their involvement. Nurses who participated in the research were given a concise summary of the study and confirmed that any data collected could be kept private and used solely for study purposes. Additionally, participants were instructed by the researcher that they had the option to leave the study at any moment.

Ethical consideration

- The researcher obtained research approval from the Committee on Ethics in the Faculty of Nursing.
- During the research application, the sample used did not face any risk.
- The researcher assured that data would remain confidential and anonymous.
- The study was done according to standardized ethical guidelines for clinical research.
- The study sample had the choice not to take part and discontinue participation in the study at any moment without rationale.
- The researcher took the privacy of the study sample into account during the data collection process.

III. Statistical analysis

The gathered information was recorded and tabulated. The results were analyzed by the researcher using tests and an appropriate statistical method. The researcher analyzed data through the statistical software for programs (SPSS) version 24. For both the demographic and quantitative data from the questionnaire, descriptive statistics were used. Means, percentages, standard deviations, frequencies, and Pearson correlations were among the descriptive statistics (at the P level 0.05, there is a significant correlation). The study's significance level was established at $P < 0$. To detect any changes in the available data, the chi-square test was used to compare categorical variables. P-values below 0.05 were regarded as significant. The inferential statistical test known as the independent t-test was employed to assess if two unrelated groups' means differed in a way that was statistically significant.

Results

Table (1): Showed that the mean ±SD (25.5±4.25) of the nurses in the research was in the range of 18 and 25 years. Of those with a higher degree of schooling, 55% were nursing technicians. According to the training course attendance and experience, 61% of the study sample did not participate in infection control training, and 77.5% of the study sample had fewer than 5 years of experience, respectively.

Table (2): Showed nurses knowledge under the study about controlling infection, personal protective equipment, hygiene care of hands, care of ventilator bundles, and pneumonia associated with ventilators. There was a difference between the pre- and post-educational intervention that is statistically significant (p-value < 0.001).

Table (3): Demonstrated that nurses' satisfaction in adhering to infection control measures on mechanical ventilators differs significantly (P-value 0.001*) in every item of practice prior to and following educational intervention.

Table (4): showed a statistically significant difference between total nurses' knowledge and practice prior to and following the program, utilizing a P-value of 0.001**. Scores of nurses' knowledge increased from 32.5% to 87.5% after the program was implemented, and nurses' practice ratings improved from 7.5% to 55% after the program was implemented.

Table (5): Showed that, before the program was implemented, a statistically significant difference was found between total nurses' knowledge and their ages, educational attainment, and participation in a training course; however, after the program was implemented, there was a statistically insignificant difference between all nurses' demographic characteristics and their level of knowledge at a P-value (> 0.05).

Table (6): Demonstrated that there is a statistically significant difference between the practice of all nurses and their level of education and attendance at a training course prior to the program's implementation; however, a p-value (> 0.05) indicates a statistically insignificant difference between the demographic data and the practice of all nurses following the program's implementation.

Table (7): Demonstrated a positive correlation between the total nurses' practice and their knowledge following the implementation of infection control measures on mechanical ventilation.

Table 1: The frequency and percentage distribution of the nurses' demographic data (n=40).

Items	No.	%
Age		
18<25	20	50
25<30	12	30
>30	8	20
Mean±SD	25.5±4.25	
Education		
Nursing technician	22	55
Bachelor degree in nursing	13	32.5
Post graduate degree	2	5
Others	3	7.5
Experience		
<5	31	77.5
5-10	8	20
>10	1	2.5
Attendance of infection control course		
Yes	14	35
No	26	65
Infection control course duration		
< 5yrs	8	20
>5yrs	6	15

Table 2: Satisfactory knowledge level of nurses before and after educational intervention regarding adherence to infection control precautions on mechanical ventilation (n=40).

Items	Pre intervention		Post intervention		Chi-square	
	Satisfactory %	Unsatisfactory %	Satisfactory %	Unsatisfactory %	X^2	P-value
Control of infection	40	60	95	5	27.578	<0.001*
Wearing Personal protective equipment	42.5	57.5	90	10	20.182	<0.001*
Washing hands	32.5	67.5	92.5	7.5	26.208	<0.001*
Associated pneumonia	37.5	62.5	90	10	23.854	<0.001*
care of ventilator bundle	40	60	95	5	27.578	<0.001*

*Statistically significant difference (P. ≤ 0.05). ** highly statistically significant difference (P. ≤ 0.001)

Table 3: Satisfactory practice level of nurses before and after educational intervention regarding adherence to infection control precautions on mechanical ventilation (n=40).

Practical items	Pre intervention		Post intervention		Chi-square	
	Satisfactory %	Unsatisfactory %	Satisfactory %	Unsatisfactory %	X^2	P-value
Washing hand	30	70	90	10	30.000	<0.001*
Wearing personal protective equipment	37.5	62.5	87.5	12.5	21.333	<0.001*
Intravenous cannulas insertion	47.5	52.5	85	15	12.579	<0.001*
Intravenous lines	50	50	92.5	7.5	17.635	<0.001*
Care of suction	45	55	80	20	10.453	<0.001*
A urinary catheter	32.5	67.5	90	10	27.860	<0.001*
Care for intubated patient	37.5	62.5	90	10	23.854	<0.001*
care of ventilator bundle	30	70	87.5	12.5	27.286	<0.001*
Sharps and needles	45	55	82.5	17.5	12.170	<0.001*
Control of the environment	25	75	90	10	34.578	<0.001*
Wound dressing	42.5	57.5	82.5	17.5	13.653	<0.001*

***Statistically significant difference (P ≤ 0.05) **statistically highly significant difference (P. ≤ 0.001)**

Table (4): Relation between total knowledge and total practice level pre and post an educational intervention (n= 40).

	Pre intervention (n=40)		Post intervention (n=40)		P_1-value
	N.	%	N.	%	
Level of practice					
Inadequate	37	92.5	18	45	<0.001**
Adequate	3	7.5	22	55	
Level of knowledge					
Unsatisfactory	27	67.5	5	12.5	<0.001**
Satisfactory	13	32.5	35	87.5	

***Statistically significant difference (P. ≤ 0.05) **statistically highly significant difference (P. ≤ 0.001)**

Table 5: Relation between total score of nurses' Knowledge and their demographic data pre and post educational intervention (n=40).

Demographic data	Total knowledge			
	Pre		Post	
	Chi-square		Chi-square	
	X^2	P-value	X^2	P-value
Age (years)				
18<25 25<30 >30	8.676	0.013*	2.353	0.308
Education				
Nursing technician Bachelor degree in nursing Post graduate degree Others	15.161	0.002*	5.775	0.123
Experience				
<5yrs. 5-10 yrs. >10 yrs.	0.619	0.734	2.049	0.359
Attendance of infection control course				
Yes No	10.579	<0.001*	3.801	0.051

Statistically insignificant difference P. > 0.05*statistically significant difference P. ≤ 0.05. ** highly statistically significant difference P. ≤ 0.001.

Table 6: Relation between demographic data and total score of nurses' practices pre and post educational intervention (n=40).

Demographic data	Total practice			
	Pre		Post	
	Chi-square		Chi-square	
	X^2	P-value	X^2	P-value
Age				
18<25 25<30 >30	5.584	0.061	2.971	0.226
Education				
Nursing technician Bachelor degree in nursing Post graduate degree Others	10.423	0.015*	4.675	0.197
Experience				
<5yrs. 5-10 yrs. >10 yrs.	0.812	0.666	1.659	0.436
Attendance of infection control course				
Yes No	9.920	0.002*	3.077	0.079

Statistically insignificant difference P. > 0.05 *Statistically significant difference P. ≤ 0.05. ** highly statistically significant difference P. ≤ 0.001.

Table 7: Correlation among total knowledge and practice after educational intervention (n= 40).

Total practice	Total knowledge	
	R	P-value
Pre 0.827 <0.000**		
Post 0.458 <0.001**		

r Pearson correlation *statistically significant difference P. ≤ 0.05. **statistically highly significant difference P. ≤ 0.001.

Discussion:

Patients and healthcare workers safety (HCWs) safety is greatly in danger because of infections acquired in the healthcare sector. Consequently, healthcare organizations and systems should prioritize working on preventing these diseases **(Al-Omari et al., 2020).** Between 5 and 15% of patients who stay a long time in the hospital have infections, and 9–37% of admitted patients in critical care units (ICUs) may have them **(WHO, 2021).**

The following are the main results that will be discussed:

The demographic data of the nurses under study were between the ages of 18 and 25. Of those with a higher degree of schooling, 55% were nursing technicians. In terms of taking part in training courses, 61 percent of the study nurses did not take part in training courses about controlling infection. These findings were disagreed with by **Nour-Eldien and Mohamed (2020),** who made a study about the "Effect of Education Intervention on Prevention of Blood Borne Infections for Healthcare Workers" and mentioned that over 2/3 of their research sample did not participate in any training courses about infection control.

The study found that 77.5% of the study sample had fewer than 5 years of experience. This finding was in accordance with **El Sebaey et al. (2022),** who did research titled "Knowledge, Attitudes, and Practices Related to Standard Precautions among Nurses: A Comparative Study" and reported that most of the nurses who participated in the research had less than 2 years' experience and attributed it to higher education. However, a study by **El Sheikh et al. (2024),** who made a program on nurses' performance in terms of infection prevention and control in wards for chest disease, stated that all of the participants in the sample had over 15 years of experience.

This contrast highlights the significant impact of experience on nursing practice, especially in specialized fields. While newer nurses may benefit from advanced education, seasoned professionals often bring invaluable practical knowledge that enhances patient care and outcomes

From the perspective of the researcher, this outcome might be because most of the nurses that participated in the study were recently graduated and too young to handle the demands of ICU (Intensive Care Unit) work, a specialty that requires an experienced young nurse to provide excellent nursing care and be able to handle the critical care unit's activities. However, due to the demands of the intensive care unit (ICU), including the requirements of patients in critical condition, the workload for the ICU, and stress, the male nurses must be equipped

to handle this type of work. This high level of demand, stemming from the ICU's workload, has contributed to an increase in nurse turnover.

The nurses' knowledge levels pre- and post-program application were shown to differ statistically significantly (p-value < 0.001**). **El Sebaey et al. (2022)** confirmed these findings, reporting a significant improvement in the overall knowledge score following the implementation of the educational program. The results align with those of research by **Al Humaid et al. (2021)** titled "Knowledge of Infection Prevention and Control Among Healthcare Workers and Factors Influencing Compliance. "According to the results of this study, implementation of a proper educational training program improved the general level of knowledge among healthcare workers.

In support of this research, **Tadros et al. (2019),** whose research examined how self-learning packages affected nurses' performance when caring for patients on ventilators, said that nurses' satisfaction with their knowledge had dramatically increased post-test findings.

Findings about the level of nurses' practice: the present research discovered a statistically significant difference among nurses' competency levels pre and post program implementation. In line with the present research, **Ali and Ahmed (2023),** who examined the impact of an in-service training module on the performance of ICU nurses in terms of the skillful handling of patients on mechanical ventilators, showed that most nurses' level of practice was considerably higher after the test than before it came to nurses' practices during ventilator weaning.

This result was consistent with **El-Shafei et al. (2019),** titled "World Health Organization Surgical Safety Checklist with Addition of Infection Control Items: Intervention Study in Egypt," and showed an improvement in both practices and knowledge of all the studied samples toward infection control and patient safety measures after the program implementation. Additionally, **Hassan et al. (2024)** made a program on nurses' performance and compliance regarding infection control measures in isolated departments and found that only 25% of the nurses who participated in the research had a competent level of total practice about infection control measures in isolation departments pre-program implementation. which improved to greater than three-quarters just after the program, then slightly decreased after 3 months post-program implementation.

The lack of leadership and preceptor roles in the critical care unit (CCU), along with the lack of opportunities for continuing education and training, may be the cause of this outcome, according to the study. These factors might also impede the development of new knowledge and skills.

According to the result, before implementation of the program, A difference that was statistically significant was discovered between the total knowledge of nurses' and their ages, level of education, and training courses; however, After the program was implemented, the P-value (> 0.05)

between the overall nurses' knowledge and their demographic characteristics was statistically insignificant.

This result contradicted the findings of a prior study by **Elgazzar & Qalawa (2020)**, titled "Nurses' awareness of infection control measures in operating rooms," which was conducted in the General Hospital of Port Said, Egypt. Who found a highly strong correlation between nurses' sociodemographic characteristics and their knowledge of the fundamentals of infection control and sterilization, primarily in items related to years of experience working in a nursing hospital, marital status, and their education.

The present research agrees with **Tadros et al. (2019),** who examined the impact of a self-learning package on nurses' performance in caring for patients on ventilators. They found a significant strong relationship between nurses' overall knowledge and their demographic traits prior and following the SLP. Also, **Mahmoud et al. (2020)** reported a difference that was statistically significant was noted. between the nurses' knowledge scores with their sociodemographic pre- and post-application of Standard precautions for infection control for mechanical ventilated patients on with the exception of their training and qualifications.

Every organization and profession need to establish guidelines and goals to help practitioners and individuals provide safe and efficient care, according to **Kanki, (2019).**

The finding demonstrates that statistical significance was found among the practice of all nurses and their educational background and attendance at training courses prior to the program's implementation, but there was a statistically insignificant difference between the practice of all nurses and their demographic data after the program's implementation at a p-value (> 0.05). These findings in accord with **Tadros et al. (2019)**, Who said that, pre- and posttest results for age, sex, education, years of experience, and prior training courses were significantly positively correlated with nurses' overall practice. **Hassan et al. (2024)** revealed that there is no statistically significant difference between the total level of practice and all items of demographic data prior to the program and immediately following the program. However, the difference is statistically significant between the total practice and age at post 3 months of program implementation.

Finally, this section discusses the correlation between nurses' satisfactory levels of practice and knowledge. Before and after implementation of the program, the nurses' total knowledge and total practice showed a positive correlation that is statistically significant. The findings of **Ali and Ahmed (2023)** support this conclusion, as they found a strong positive statistical relationship between practice and cumulative total knowledge concerning patient treatment on mechanical ventilation, both prior to and post training module implementation.

These findings agreed with **Rayan & Adam (2021),** who showed that throughout the course of the program, a significant positive association was observed between the overall practice score and the overall

knowledge score concerning occupational health hazards among nurse interns.

Last but not least, the findings of this research confirmed the hypothesis that nurses who worked at critical care units and participated in the program about interventions on nurses' performance regarding adherence to infection control precautions on mechanical ventilation would demonstrate higher knowledge and practice scores in the post-test compared to the pretest.

Conclusions

- Implementation of the program about intervention on nurses' performance regarding adherence to infection control precautions on mechanical ventilation found that nurses had unsatisfactory knowledge preprogram, compared to post program, which was satisfactory.
- The results of implementing an intervention on nurses' performance in terms of following infection control procedures when using mechanical ventilation reveal that nurses' practices were inadequate prior to the program but improved after it.
- Additionally, statistically significant variations were found between the overall nurses' knowledge and practice score following the program, indicating a positive correlation.
- The nursing staff's teaching programs have a significant role in enhancing the standard precautions supplied for mechanical ventilation infection control, even when their level of understanding and practice may indicate a lack of scientific preparedness.

Recommendations

- In order to use the proposed program on a widespread basis and to generalize the results, it is advised that the current study be replicated on a larger sample.
- At Al Azhar University Hospital, continuous nursing education programs are required to be implemented in critical care units.
- Nurses should incorporate regular reading into their daily tasks to improve their effectiveness.
- ICU nurses should consistently receive support to attend conferences and scientific meetings to update their knowledge and skills necessary for effective infection control and adherence to standard precautions.

References

1. **Alhumaid, S., Al Mutair, A., Al Alawi, Z., Alsuliman, M., Ahmed, G. Y., Rabaan, A., Al-Tawfiq, A., & Al-Omari, A. (2021).** Knowledge of infection prevention and control among healthcare workers and factors influencing compliance: a systematic review. Antimicrobial Resistance and Infection Control, 10(1), 1–32. https://doi.org/10.1186/s13756-021-00957-0.
2. **Ali, SH., & Ahmed, R. (2023).** effectiveness of in-service training module on intensive care nurses' performance regarding mechanical ventilator patients' skillful handling, International Egyptian Journal of

Nursing Sciences and Research, 4 (1), P.P.262-287.

3. **Al-Omari, A., Al Mutair, A., Alhumaid, S., Salih, S., Alanazi, A., and Albarsan, H. (2020).** The impact of antimicrobial stewardship program implementation at four tertiary private hospitals: results of a five-years pre-post analysis. Antimicrob Resist Infect Control, 9(1), P.P.1–9.
4. **Belal, S., Ahmed, S., Almessaid, Y., Abobaker, R., Blesilda, B., Llaguno, M., Sanad, H., & Alkahtany, M. (2020).** In-services Education Program for Improving Nurses' Performance Regarding Infection Control Measures in a Rural Hospital. Egyptian Journal of Health Care, 11(2), P.P. 702–718.
5. **Caeiro, M., Garzón, M. (2018).** Controlling infectious disease outbreaks in low-income and middle-income countries. Current Treatment Options in Infectious Diseases, 10(1), P.P.130-138.
6. **Centers for Disease Control and Prevention** (CDC) (2018). National Center for Emerging and Zoonotic Infectious Diseases (NCEZID), Division of Healthcare Quality Promotion (DHQP)
7. **El Sebaey, A., Atlam, M., El Kafas, R., & Zayed, A. (2022).** Effect of infection control training course on knowledge and practices of medical interns in a large academic hospital in Egypt: an intervention study. Environmental Science and Pollution Research, 29(10), P.P.14371–14379. https://doi.org/10.1007/s11356-021-16755-5.
8. **El Sebaey, F., Atlam, M., El Kafas, R., & Zayed, A. (2022).** Effect of infection control training course on knowledge and practices of medical interns in a large academic hospital in Egypt: an intervention study. Environmental Science and Pollution Research, 29(10), P.P.14371–14379. https://doi.org/10.1007/s11356-021-16755-5.
9. **El sheikh, S., Rezian, A., Shaaban, A., Mohamed, M., & Hashem, E. (2024).** Effect of an educational program on improving nurses' performance regarding infection prevention and control in chest disease wards, ASNJ. 9 (3), P.P.73-83.
10. **Elgazzar, E., & Qalawa, A. (2020).** Nurse's awareness of infection control measures in operating room. 0966(3). https:// doi.org/ 10.36349/ EASJNM. 2020.v02i03.029.
11. **El-Shafei, H., Ibrahim, Y., Tawfik, M., & Abd El Fatah, M. (2019).** World health organization surgical safety checklist with addition of infection control items: Intervention study in Egypt. Open Access Macedonian Journal of Medical Sciences, 7(21), P.P. 3691–3697. https:// doi.org/ 10.3889/ oamjms. 2019.593.
12. **Hassan, R., Taha, A., and Fathy, A., (2024).** The effect of educational program on nurses' performance and compliance regarding infection control measures in isolated departments,

Journal of Nursing Science - Benha University,5 (1), P.P. 947-964.

13. **Hattab, W., Kadhim, A., & Abdulwahhab, M. (2021).** Impact of years' experience upon nurses' knowledge and practice concerning infection control at critical care units in Baghdad City. Indian Journal of Forensic Medicine and Toxicology, 15(1), P.P.2564–2568.
14. **Kanki, B., (2019).** Communication and crew resource management. In Crew resource management (pp. 103-137). Academic Press.
15. **Mahmoud, E., EL-shafie, O., Abdel-Aziz, M. (2020).** Effect of Educational Program for Nurses Performance Regarding Infection Control Precautions, toward patient on Mechanical Ventilation. Assiut Scientific Nursing Journal, 8(20), P.P.94-104. doi: 10.21608/asnj.2020. 80502.
16. **Moralejo, M. (2018).** Evaluation of a staff training program to reimplement a comprehensive health assessment.
17. **Nour- Eldein, H., and Mohamed, R. (2020).** Effect of educational intervention on prevention of infection for health care workers in hospitals, Suez Canal University in Ismailia City, Egypt. World Family Medicine, 99 (3177), P.P.1- 10.
18. **Onianwa, P., Aonge, T., Otegbayo, J., Ike, E., Chukura, F., Are, O., Akani, O., Ayorinde, M., Dubi, I., & Yaya, O. (2017)**. Pain as 5th sign, Impact of pain assessment training program on Nigerian nurses' knowledge of pain management, International Nursing and midwifery, vol (9), P.P.129-135.
19. **Rayan, H., & Adam, S. (2021).** Effect of Training Program Regarding Occupational Health Hazards on Nurse Interns' Knowledge and Practice. Medico Legal Update, April 2021.
20. **Reynolds, A., Osborne, T., Waggoner, J., Melton, R., Motarjemi, R., Schulze, J., & Chau, D., (2017).** Advances in Health Education Technology. Using Technology to Improve Care of Older Adults, Springer Publishing Company, ch13, p287.
21. **Sikora, A., Zahra, F. (2023).** Nosocomial Infections. In: Stat Pearls [Internet]. Treasure Island (FL): Stat Pearls Publishing; 2023 Jan-. Available from: https://www.ncbi.nlm.nih.gov /books/ NBK559312.
22. **Sole, M., Klein, D. and Moseley, M. (2020):** Introduction to Critical Care Nursing E- Book. Elsevier Health Sciences. By Mary Lou Sole, Deborah Klein, Marthe Moseley (eds.), 8th Edition, P.P. 564- 571.
23. **Tadros, S., Abd EL Sattar, M., Shehata, H., & Nadr, M., (2019).** effect of self-learning package on nurses' performance caring for patients on ventilators, Egyptian Journal of Health Care, 10(3), P.P.76-88.
24. **Walker, B., Colledge, N., Raston, S., & Peman, I., (2014).** Assessment and management of clinical problem,

chapter (18), principles and practice of medicine, 22nded, Elsevier, P.P. 604.

25. **World Health Organization** (WHO). (2020). Rational use of personal protective equipment (PPE) for coronavirus disease (COVID-19). Geneva: WHO. Available from: https:// apps.who.int /iris/bitstream/ handle/ 10665/331498/ WHO-2019-nCoV-IPCPPE_use-2020.2-eng.

26. **World Health Organization (WHO). (2021).** Rational use of personal protective equipment (PPE) for coronavirus disease (COVID-19). Geneva: WHO. Available from: https://apps. who.int/iris /bitstream / handle/10665/331498/WHO-2019-nCoV-IPCPPE_use-2020.2-eng.pdf.