Effect of Educational Program on Critical Care Nurses' Performance of Cuffed Endotracheal Tube Care Using Blended Method

[1]Basma Badawey Ezzat Badawey, [2] Ibrahim Abbas Youssef, [3]Marwa Mohammad Abdel –baky, [4]Aml A.Mohamed

1. B.Sc. In Nursing - Faculty of Nursing Minia University
2. Professor of and founder of Anesthesia and Intensive Care Departmen - Faculty of Medicine Minia University
3. Assistant professor of Medical Surgical Nursing (Critical Care Nursing) Faculty of Nursing Minia University
4. Lecturer of Medical Surgical Nursing Department (Geriatric Nursing) Faculty of Nursing Minia University

Abstract

Background: Nursing care of intubated patients is a high risk, complex intervention that can lead to several complications. Misconduct of practice and negligence to meet the required standards of care may cause patient harm, elevate treatment costs, and increase patients' ICU stay. **Aim:** Evaluate the effect of educational program on critical care nurses' performance of cuffed endotracheal tube care. **Sampling:** All critical care nurses on duty regardless of their personal data, their total number were 60 nurses. **Tools of Data Collection**: **The First Tool: Socio demographic characteristics of ICU nurses** that include (age, gender, qualification, work place, and years of experience and attendance of training courses**) Second Tool: Nurse Knowledge assessment questionnaire:** Used to assess the nurses' knowledge level about the cuffed ETT care. **Third Tool: Nurses' practice checklist for cuffed endotracheal tube care** used by investigator to assess **ICUs** nurses' practice level while applying the cuffed EET care. **Results:** Reveals that 6.7% of study participants represents a satisfactory knowledge level pre application of the blended learning educational program which improved to 96.7% post 2 weeks followed by slightly decrease 95% Post 3 months. **Conclusion:** The current study concluded that implementing an educational program regarding cuffed endotracheal tube care using the blended method significantly improve the nurses' performance regarding cuffed endotracheal tube care. **Recommendations**: Blended training should be widely used for all nurses in different units and departments to ensure updated knowledge and practices through continuing education center

Keyword: Blended Learning, Critical Care Nurses', Cuffed Endotracheal Tube, Educational Program

Introduction:

Endotracheal intubation is an essential skill performed by multiple medical specialists to secure a patient's airway as well as provide oxygenation and ventilation. There are multiple techniques available, including the visualization of the vocal cords with a laryngoscope or video laryngoscope, direct placement of the endotracheal tube into the trachea via cricothyrotomy and fiberoptic visualization of the vocal cords via the nasal or oral route **Mohamed et al., (2022)**

The use of an endotracheal tube (ETT) can preserve and enhance the natural airway while enabling the administration of mechanical ventilator assistance, hence saving lives. For patients requiring mechanical breathing, it is the most common invasive procedure carried out by critical care nurses. It eliminates secretions from the endotracheal tree, ensures proper tissue ventilation and perfusion, lessens respiratory exertion on the patient, prevents tube clogging, and guards against bronchus infection and atelectasis. It prevents atelectasis and bronchus infection, ensures proper tissue ventilation and perfusion, eases the patient's breathing difficulty, and frees the endotracheal tree from secretions **Mohamed Elmansy (2023)**

Critical care nurses (CCNs) play a crucial role in improving health care that provide comprehensive care and support for patient at ICU from the time of admission till discharge. The performance of health care staff, including professional nurses in ICU, link directly and closely to the productivity and quality of care provision within health care organizations. Caring for patients with ETT is an essential element of nursing practice, such as monitoring respiratory status, providing oral care every 2 hours, repositioning the patient to avoid threats of immobility. In addition, performing ETT suctioning of secretions from the lungs which patients are unable to expel **Sheta & Mohamed (2022)**

Blended learning refers to the systematic integration of online and face-to-face learning in order to facilitate critical, creative, and complex thinking skills. Unlike the passive teaching in the traditional in-class lectures, blended learning shifts the focus of education from teacher-centered to student-centered. It also has the potential to increase student-teacher interaction, leading to improved learning efficiency (**Gong et al., 2021**)

Training by using the BL would help ICU nurses to develop and refine their existing skills and knowledge, which would lead to improve quality of care and its competence. Training sessions through online courses could now be given to nurses in order to continue their education and to save time and effort that related to improve their performance (**Mohammad Abd Elbaky et al., 2023**)

Significance of the Study

Ensuring proper care of the ETT, including monitoring cuff pressure, is crucial to prevent complications associated with its use. Over-inflation of the ETT cuff can lead to severe issues such as mucosal ischemia, paralysis of the vocal cord, and tracheal perforation. Conversely, lower-inflation of the cuff balloon may result in bronchial secretions aspiration of and increase the risk of ventilator-associated pneumonia. Neglecting any aspect of ETT care can result in serious complications and prolonged stays in the ICU (**Turkeli ,et al 2024**).

Nurses are essential in ensuring the proper management of cuffed ETT care, and they are a critical aspect of patient safety. Blended learning (BL) has emerged as a

novel educational approach for nurses, particularly amid the COVID-19 pandemic. This method has become imperative to prevent overcrowding and mitigate the risk of infection transmission among nurses. It allows for education delivery without placing undue pressure on nurses and without compromising patient care time (**Leidl, et al. 2020**).

The investigator noted deficiencies in nursing care related to several aspects of cuffed ETT management, particularly in measuring ETT cuff pressure and ensuring ETT hygiene. Planning educational sessions for all nurses on duty posed challenges due to logistical issues. Consequently, the current study aimed to enhance nurses' understanding and implementation of cuffed ETT care through the utilization of blended education methodologies

Aim of the Study

The current study aimed to evaluate the effect of educational program on critical care nurses 'performance for cuffed endotracheal tube care using blended method

Research Hypothesis:.

- H1- The post-mean knowledge scores of the critical care nurses will be higher after being exposed to the blended educational program than their pre-mean knowledge scores.
- H2- The post-mean educational practices scores of the critical care nurses will be higher after exposure to blended educational program than their pre-mean practices scores
- H3-It will be a positive correlation between knowledge and practice about cuffed endotracheal tube care after the blended education.

Subjects and Methods
Research Design

Quasi-experimental research design (pre and post-test).

Research Setting

This study was carried out at Intensive care units (ICU1, ICU2) and medical intensive care units (MCU) located at Minia Emergency hospital and Intensive care units (ICU) located at the liver hospital in Minia city, Egypt

Subjects

All critical care nurses on duty in previously mentioned setting regardless of their personal data and their total number were 60 nurses. (35 nurses at Minia Emergency Hospital & 25 nurses at Liver Hospital)

Study duration:

Data collection for this study was carried out for eight months, from May 1 to the end of December (1/5/2022 to 31/12/2022)

Data Collection Tools:

Three tools were used for data collection:
Tool I: Socio-Demographic Characteristics of ICU Nurses

Demographic data includes: (age, gender, qualification, work place, years of experience and attendance of training courses …etc.).

Tool II: Nurse Knowledge Assessment Questionnaire:

This tool was developed and modified by investigator based on extensive review of relevant literature (**Soyer, et al. 2019).**
It was filled by the ICU nurses that include: (definition of ETT, indications, complications, frequency of monitoring ETT cuff pressure, methods used to monitor ETT cuff pressure... etc.) total number of questions is 30 questions (15 mcq &15 true or false questions)

Scoring System:

Regarding the scoring system for nurses' knowledge, all knowledge variables were weighted according to the item included in the answer of each question. Correct answers take (1) score and incorrect answer take (0) score. A score of satisfactory level of knowledge equal or more than 75% and unsatisfactory level of knowledge less than 75%.

Tool III: Nurses' Practice Checklist for Cuffed Endotracheal Tube Care:

This tool was developed and modified by investigator based on extensive review of relevant literature (**Wilkinson, et al. 2016)** and (**Arora & Baidya. 2015**). It was used by investigator to assess nurses' practice level while applying the oral suction and ETT suction. ETT suction included 32 items & oral care was included 30 items & re-taping was included 35 items & monitoring endotracheal tube cuff pressure using cuff pressure manometer was included 22 items.

Scoring System:

Scoring system for nurses' practice was weighted according to the steps, done take (1), and not done take (0) score. A score of satisfactory level of practice: equal or more than 75% and unsatisfactory level of practice: less than 75%.

Pilot study:

A pilot study was carried out on 10% of the total nurses' sample (6) to test the feasibility of the study and the applicability of the data collection tool after having the ethical approval and permission from the director of the hospital and intensive care unit. Based on the results of the pilot study, no refinement/ modifications were done for data collection tools; nurses who shared in the pilot study were included in the actual study sample.

Tools Validity and Reliability:-
Tools Validity

To establish validity, the tools were tested by a panel of five experts in the field of medical surgical and critical care nursing at faculty of nursing Minia University and the necessary modifications was done.

Tools Reliability

Reliability was ascertained statistically by using Alpha Cronbach test to ensure that the study tools are reliable as shown in the following table:

Tools	Cronbach's Alpha
Knowledge Assessment	0.756
Practice Observational Checklist	0.653

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Ethical Consideration

Official permission to conduct the study was obtained from Minia University, Faculty of Nursing Dean, ethical committee of the faculty of nursing, research center afflicted to Egypt Ministry of Health, and from the director and head nurse of the critical care units at Minia University Hospital.

Nurses' participation in this study was voluntary; they were informed about the study's importance, aim, nature, and purpose and they had right to withdraw at any time without any rationale. Oral consent was obtained from nurses, and investigator informed them that the obtained data would not be included in any further research without a second consent. All data encoded in order to ensure Confidentiality and anonymity for all participants

Fieldwork of the Research:
Study Procedure

The current study was achieved through three phases: the assessment phase (including the pre-test), the implementation phase (including conducting the blended educational program), and the evaluation phase (including evaluation after ending of the blending education, 1st evaluation was done after 2 weeks and 2nd evaluation was done after 3 months).
Data collection started over three days per week (Saturday, Sunday and Tuesday) on the morning shift and on the evening shift

The Assessment Phase:

Once official permission was granted, the assessment phase includes collected data over four weeks to test nurses' actual level of knowledge and practice about cuffed endotracheal tube care. During the assessment, the researcher held the first meeting with nurses to introduce herself and give an explanation about the nature, purpose, duration, and activities of the study

Through this phase the investigator introduced the tools **I &II** for each nurse and asking them to complete their demographic data and answer the knowledge questionnaire. The duration of this tools for each nurse were about 45 minutes. The observational checklist (tool III) completed by the investigator by observing each nurse during their work and chick their practice to provide baseline date used in comparison at the evaluation phase.

The Implementation Phase

The implementation was covered over a mix of small online and face to face sessions, theoretical and practical,
 During face to face sessions: the total sample (60) was divided into (6) groups each group included ten nurses. The groups divided to sup group according to work needs in the ICU There were (1) group trained in each day during morning and evening shifts according to scheduled and break

time. The nurses were trained in (3) selected days of weeks. The duration of each session was 30 to 45 minutes. On online sessions: the total sample was divided to two what's app group literature was sent as soft content to the ICU nurses via what's app web on recorded lecture, PowerPoint and simulated video to be available for them at any time) .

At the beginning of the session, the investigator made a summary of the previous session to ascertain the extent of the study subject's understanding of the previous content that was discussed and review the content of the session again. During the beginning of the session, the investigator welcomes the investigator study subject and then the researcher explains the pu during the educational program used instructional techniques, such as; group discussion, role-playing, getting participants' feedback, providing corrective feedback has been used. Additionally, at the end of each session, the investigator was given a summary content of the session.

Theoretical part was included four lectures

Introduction for MV and intubation .Endotracheal intubation which includes definition of ETT, indications, complications of intubation and procedure of intubation, Nursing role for intubated patient ,Cuff pressure monitoring and care which includes definition of cuff pressure, normal range of cuff pressure, frequency of monitoring ETT cuff pressure, methods used to monitor ETT cuff pressure, complications of over inflation, complications of under inflation

The first lecture was given face to face to the study sample, the investigator introduce herself, introduction about the program and introduction about MV. Then the other lectures were given online. Practical part was included four recorded online lectures includes the application of the included procedure oral suctioning, ETT suctioning, oral care, monitoring of ETT cuff pressure and re-taping. The nurses of the study provided with another demonstration and re-demonstration by the investigator with same procedure while their work at the ICU face to face to insure competent of practice and allow for discussion and any questions.

Evaluation Phase

Times of evaluation were done for each nurse
The first evaluation was done after 2 weeks after educational program to assess nurses' knowledge and practice regarding the cuffed endotracheal tube care by using blended method using tool II and III .The second evaluation (follow-up) was done after 3 months

Study limitations:
- During data collection, there were a shortage in 3 nurses , but the new alternative nursing was introduced into the study
- There were some nurses who did not respond, but I make another appointment for them. And I used a group discussions according to their work schedules
- Also, nurses who were coming out of the lecture, I used to discuss the lectures with him during the 10 minutes of discussion, and I would give them a rest at the time of application and repeat again. In addition, an audio recordings and PowerPoint was uploaded to these persons whose Internet source was interrupted during the discussion

Statistical Analysis of Data:

The collected Data were summarized, tabulated, and presented using statistical package for the social science (SPSS), version (20) for statistical analysis of the data. Numerical data were expressed as mean & SD. Qualitative data were expressed as frequency and percentage. Chi-square test used as a way to test the association between two categorical variables. The repeated measures ANOVA used to compare means across one or more variables that are based on repeated observations. Friedman test is used to determine whether or not there is a statistically significant difference between 3 or more variables and correlation coefficient was done by using Pearson correlation test. Probability (P-value) is the degree of significance, less than 0.05 was considered significant. The smaller the P-value obtained, the more significant is the result less than 0.001 considered highly significant

Results:

Table (1): Percentage Distribution of the Study Participants Regarding to Their Demographic Characteristics (n=60)

Socio-demographic Characteristics	No.	%
Age / Years		
● 20-29	51	85
● ≥ 30	9	15
Gender		
● Male	20	33.3
● Female	40	66.7
Qualifications		
● Diploma nursing	6	10
● Nursing Institute Degree	39	65
● Bachelor's Degree	15	25
● Post-Graduate Degree	0	0
Type of ICU		
● ICU1	15	25
● MCU	12	20
● ICU2	15	25
● Liver ICU	18	30
Nurses' Experience at ICU		
● ≤ 4 Years	42	70
● ≥ 5 Years	18	30
Attainted Training Courses		
● Yes	14	23.3
● No	46	76.7
Time of working shift		
● Day shift	3	5
● Night shift	3	5
● Day & night	53	88.3
● Long day	1	1.7
Working hours per week		
● ≤ 48hours	18	31.7
● above 48 hours	42	68.3

Table (1) show that 85% of the study's Participants were in the age group of 20-29 years and 65% had an Institute Degree ,and 25% had a bachelor's Degree. Also, the current study revealed that 70% of the studied Participants have ≤ 4 Years of experience at ICU, 76.7% have not attainted any training courses, and 68.3% of the study Participants are working 48 hours per week
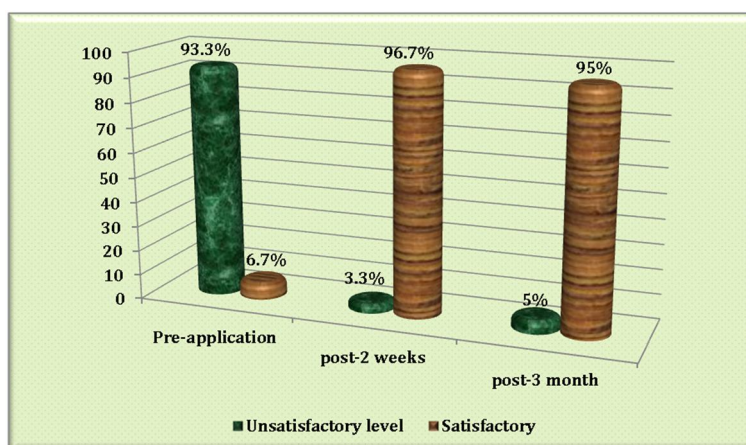

Figure (1): Percentage Distribution of Knowledge Levels among Study Participants at the Pre-Test, Post 2 Weeks and Post 3 Months (N=60)

Figure (1): Reveals that 6.7% of study participants had a satisfactory knowledge level pre application of the blended learning educational program which improved to 96.7% after 2 weeks, followed by a slight decrease of 95% after 3 months.
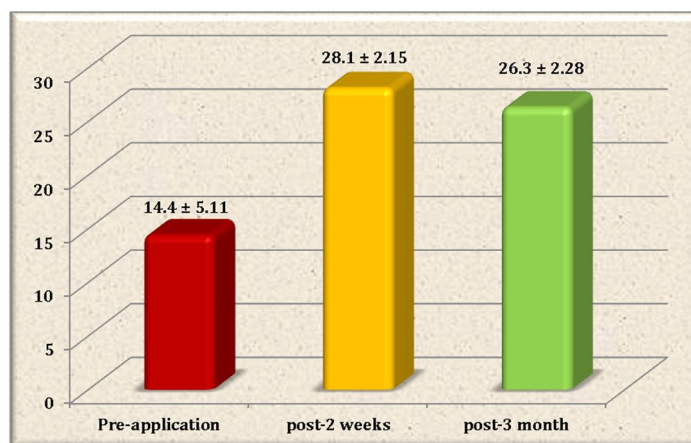
Figure (2): Mean Score of Knowledge Levels According to Total Scores among Study Participants at Pre – Test, Post 2 Weeks and Post 3 Months (N=60)

Figure (2): Illustrated that the mean score of knowledge about cuffed endotracheal tube care among study participants pre application of the educational program was 14.4 ± 5.11 which improved to 28.1±2.15 after 2 weeks, followed by a slight decrease to 26.3 after 3 months

Table (8): Mean Score of the Study Participants' Knowledge and Practice Regarding Care of Cuffed Endotracheal Tube Procedures at Pre, Post 2 Weeks and at Follow Up (n=60):

Procedure	Pre-application	post-2 weeks	post-3 month-	Annova test	P value
	Mean ± SD	Mean ± SD	Mean ± SD		
- Knowledge	14.4 ± 5.11	28.1 ± 2.15	26.3 ± 2.28	283.3	0.001**
- Ett Suction Procedure	20.7 ± 3.47	28.9 ± 1.53	27.6 ± 2.27	211	0.001**
- Oral Care Procedure	18.4 ± 5.25	28.7 ± 1.20	26.6 ± 2.38	157.6	0.001**
- Retabing Procedure	22.6 ± 4.80	32.4 ± 1.57	31.6 ± 1.83	108.4	0.001**
- Ett Cuff Monitoring Procedure	……….	19.3 ± 1.65	19.4 ± 1.76	388	0.001**

Significant test: Annova test *P- value is statistically significant **P- value is highly statistically significant

Table (8): shows that mean score of knowledge about cuffed endotracheal tube care among study participants at pre application was 14.4 ± 5.11 which improved significantly to 28.1±2.15 after 2 weeks and 26.3 ± 2.28 after 3 months.

As regard the mean score of the completely completed steps of the suction procedure, the study findings show that the mean score of study participants at pre application was 20.7 ± 3.47 which improved significantly to 28.9 ± 1.53 post-application, followed by a slight decrease to 27.6 ± 2.27 post-application.

Also, the table shows that the mean score of study participants regarding oral care procedures at pre application was 18.4 ± 5.25 which improved significantly to 28.7 ± 1.20 post-application, followed by a slight decrease to 26.6 ± 2.38 post-application.

In addition, the table shows that the mean score of study participants regarding the retaping procedure at pre application was 22.6 ± 4.80 which improved significantly to 32.4 ± 1.57 after 2 weeks, followed by a slight decrease to 31.6 ± 1.83 after 3 months. Finally, the table shows that the mean score of study participants regarding the ETT cuff pressure monitoring procedure at pre application was zero, which improved significantly to 19.3 ± 1.65 post-application, followed by a slight increase to 19.4 ± 1.76 post-application
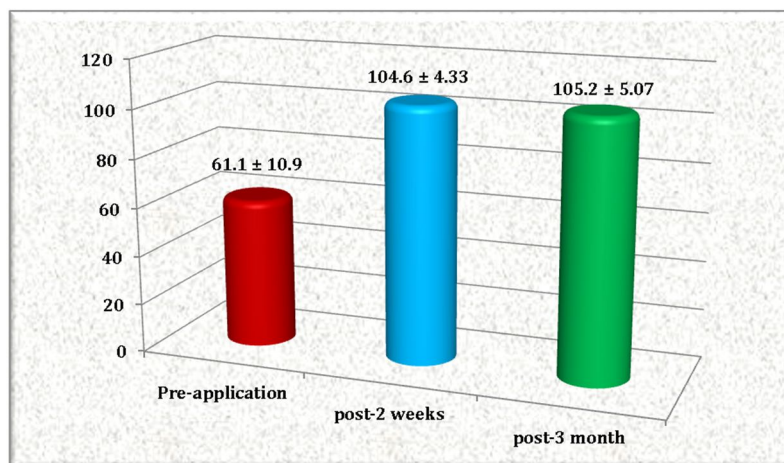

Figure (4): Mean Score of Total Practice Levels Regarding Cuffed Endotracheal Tube Care among Study Participants at Pre – Test, Post 2 Weeks and Post 3 Months (N=60)

Figure (4): Illustrates that Mean mean score among study participants at pre application was 61.1± 10.9and improved to 104.6 ± 4.33, and after 3 months, it became 105.2 ± 5.07

Table (9): Distribution of Study Participants According to Satisfactory Level (≥75%) of Monitoring Endotracheal Tube Cuff Pressure Procedures at Pre – Test, Post 2 Weeks and Post 3 Months among Study Participants (n=60):

Total and Subtotal Items of Practice	Pre-application	post-2 weeks	post-3 month-	Friedman test	P value
	N (%)	N (%)	N (%)		
- Ett Suction Procedure	13 (21.7)	60 (100)	57(95)	88.3	0.001**
- Oral Care Procedure	17 (28.3)	60 (100)	57(95)	80.4	0.001**
- Retabing Procedure	16 (26.7)	60 (100)	60 (100)	88.1	0.001**
- Ett Cuff Pressure Monitoring Procedure	0 (0)	58 (96.7)	56 (93.3)	110.2	0.001**

Significant test: Friedman test   *P- value is statistically significant   **P- value is highly statistically significant

Table (9): ShowsShows that the percentage of study participants who possess a satisfactory level of suction procedure was 21.7% before implementing the educational program which improved significantly after 2 weeks of implementing the educational program 100% followed 95% after 3 months.

Regarding oral care procedure, it was found that 28.3% of study participants who possessed a satisfactory level of suction procedure before implementing the educational program which improved significantly post 2 weeks of implementing the educational program 100% followed 95% post 3 months.

Concerning retabing procedure, it was found that 26.7% of study participants who possess a satisfactory level of suction procedure before implementing the educational program which improved significantly post 2 weeks of implementing the educational program 100% followed 100% post 3 months.

Concerning monitoring procedure, it was found that 26.7% of study participants who possess a satisfactory level of suction procedure before implementing the educational program which improved significantly post 2 weeks of implementing the educational program 100% followed 100% post 3 months
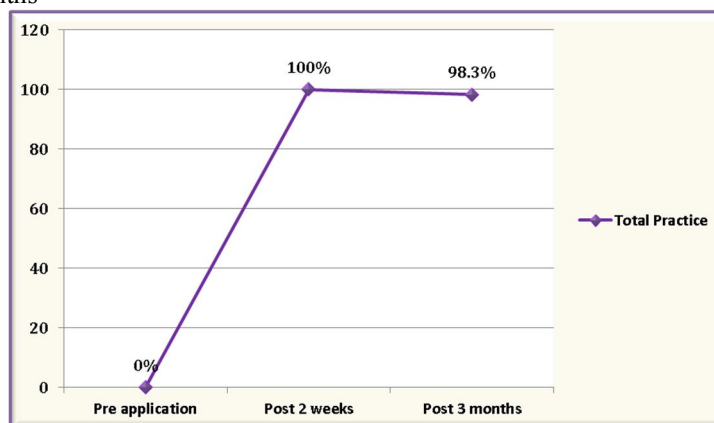

Figure (5): Percentage Distribution of Satisfactory Level (≥75%) of Total Practice Regarding Care of Endotracheal Tube Procedures among Study Participants at the Pre-Test, Post 2 Weeks and Post 3 Months (N=60)

Figure (5): Shows that the percentage of study participants who possess a satisfactory level of cuffed ETT care was zero before implementing the educational program (0%), which improved significantly after 2 weeks of implementing the educational program (100%) and (98.3%) after 3 months.

Section four: support hypothesis number three
Table (12) Correlation between Nurse's Knowledge Level and Practice of Cuffed Endotracheal Tube Care at Pre – Test, Post 2 Weeks and Post 3 Months (n=60)

	Nurses' Knowledge Level					
	Pre-application		Post 2 weeks		Post 3 months	
	r	P	R	p	r	p
Nurses' Practice	0.014	0.915	0.458	0.000**	0.328	0.011*

*P- value is statistically significant   **P- value is highly statistically significant
Table (12): Shows positive statistically significant correlation between nurse's knowledge level and practice level of cuffed endotracheal tube care at post 2 weeks and post 3 months.

Discussion

Endotracheal intubation is a common clinical procedure applied for protecting critically ill patient's airway, and supporting their ventilation needs, endotracheal tube care is an essential nursing practice for maintaining patient safety. The incompetent endotracheal tube care can increase patients' hospital stay, treatment costs, and morbidity and mortality **Saad et al (2022)**

Caring for patients with endotracheal tube (ETT) is an essential element of nursing practice, such as monitoring respiratory status, providing oral care every 2 hours, repositioning the patient to avoid threats of immobility. In addition performing ETT suctioning of secretions from the lungs which patients are unable to expel **Sheta & Mohamed Tantaewy (2022)**

Blended learning refers to courses that are taught both face to face and virtually online. Training through a combined approaches which would assist ICU nurses in enhancing and developing their current skills and knowledge, which would improve the standard of care. Nurses who are unable to attend in-person training sessions could now continue their education through online courses and video-assisted teaching modules. **Mohammed Abd Elbaky et al (2023)**

Recent years, the blended learning strategy has become the most potential teaching strategy in nursing education. It is a student-centered teaching model that combines the advantages of online learning, such as flexibility, extensive educational resources, timely updates and sharing of resources, with the interactivity of traditional teaching. **Du et al., (2022)**

So the present study was implemented to evaluate the effect of educational program on critical care nurses' performance of cuffed endotracheal tube care using blended method

Regarding socio-demographic characteristics, the present study revealed that the highest percentage of study participants' age ranged from 20 to 29 years and more than two third of them were female. This come in the same line with **Colombage & Goonewardena (2020)** who found that more than half of the studied nurses' age ranged from 20 to 30 years and the majority of them were females. This could be explained in light of the known fact that nursing job in Egypt was exclusive on females only till few years ago and the studied sample were recently graduated

As regards to educational level, the present study documented that nearly two third of the study sample have graduated from the technical institute of nursing, this could be due to the increased number of nurses graduated from the technical institute of nursing was higher than bachelor in the recent years, these finding is agreed by **Mohamed & Ahmed (2022)** there study showed that two thirds of studied nurses had graduated from technical institute of nursing.

Corresponding to years of experience the majority of study sample have less than five years of experience this might be related to that most of the studied nurses were young aged and `newly graduated. This result was on the same line with **Sheta & Mohamed Tantaewy (2022)** who clarified that more than one-half of studied nurses reported that they had one to less than five years of experience in the ICU.

Concerning to previous training programs that had been obtained;, the current study revealed that the majority of study sample didn't attain any training courses related to ETT care, this result could be explained in the light of nurses workload in ICU that may prevent them from attendance any training programs in addition to shortage of staff and lack of interest from nurses.

This result was in agreement with **AbdElbaky et al., (2018),** who reported that most of the studied nurses had not attended a training program regarding EET care. Also, **Tembhare & Singh (2021)** a study revealed that majority of the studied nurses had not attended training programs regarding EET care.

Regarding nurses knowledge about ETT care, the current study cleared that, the percentages of correct answers regarding endotracheal tube care were increased in immediate posttest and follow-up test compared to pretest with highly statistically significant difference in most areas of the ETT care items. This result supported the positive effect of the

blended learning educational program in improving nurses' knowledge regarding ETT care

This findings is agreed by **Sayed et al (2023)** whose study revealed a statistically significant difference in nurses' overall level of knowledge and practice with regard to endotracheal tube (ETT) care

Concerning total knowledge score of endotracheal tube care, the current study revealed that the majority of studied nurses possessed a low knowledge level that improved significantly post program implementation, the improvement in these finding from pre to post reflects the good effect of the implemented blended teaching program

The previous findings agreed by Sheta et al (2022) whose study cleared that total nurses' knowledge level regarding care of intubated patients before implementation of the evidence based program was unsatisfactory. While, their level of knowledge was significantly improved to satisfactory level in all knowledge items post program implementation

Abdelazeem (2019) study showed that knowledge of the participant regarding ETT care was intermediate pre intervention then the result improved to becomes good in post intervention

Regarding mean score of total nurses knowledge related to ETT care, the current study showed a significant improvement in the total nurses knowledge pretest to the end of the program this is in the line with **Tembhare & Singh (2021)** who found that the mean overall post-test knowledge score was higher than the mean overall pre-test knowledge score

Regarding oral care, the current study documented that the complete done steps regarding oral care have improved post implementing the blended learning education

This finding come in accordance with Dagnew et al (2020) study depicted that oral care was perceived among caregivers as unessential care practice that might be safely neglected, and they performed it inconsistently and based on ritual care.

Corresponding to retaping procedure, the current study showed that the complete done steps have improved post implementing the blended learning education

This is agreed with **Abdelazeem (2019)** whose study represented a significant improvement in nurses' practice regarding Confirm the placement of the endotracheal tube by listening over the chest of the patient, ongoing ETT assessment and cuff status.

The current study confirmed a statistical significant improvement in nurses' practice regarding all steps of ETT cuff pressure monitoring. This results are in the same line with **Sheta et al (2022)** results who found that only a quarter of the studied nurses had competent level of all practice items regarding ETT cuff measurement pre implementation of the program which significantly improved to competent level of all practice in the same items post intervention

Also, the current study revealed a significant improvement in **total ETT care practice** and the lowest percentage of nurses represented an unsatisfactory level regarding total practice of ETT level pre intervention that improved significantly post intervention which reflects the positive effect of the implemented blended learning method regarding ETT care

The finding of this results supported by **Sayed (2022)** whose study showed that nurses' practice about ETT care improved significantly in the first post-test of educational program. **Also, El-Sayed (2023)** cleared that only a few percent of the

studied nurses had an adequate total practice score before program implementation compared to majority of them who had adequate practice in the post program phase. Statistically significant differences were also found between total nurses' practice through program phases (pre, immediate post and follow up phase). **Sheta & Mohamed Tantaewy (2022)** study showed that percentage of competent practice of the studied nurses in all practice items regarding endotracheal tube care and suction at pre implementation of the program improved post implementation with high statistical significance regarding the overall practice of nurses performed in the previously mentioned procedures items between pre and post program implementation

Adhikari & Subba (2020) found that more than half of the nurses had satisfactory level of practice regarding care of ETT. The reason for this finding might be due to all nurses had attended in-service education regarding care of ETT and availability of standard protocol in the ward.

Finally the current study documented a statistical significant correlation between the nurse's knowledge and practice which means that increasing nurses' knowledge about care of cuffed ETT could improve their practice regarding the same procedure

This is in the same line with **Afandi & Ludin (2020)** whose study documented a significant correlation between the level of knowledge and level of practice were observed.

Also, **Sheta & Mohamed Tantaewy (2022)** illustrated that there was high significant statistical positive correlation between nurses' knowledge and procedural practice at pre, immediate post and three months follow up after implementation of the program about following EBP during procedure of ETT care

In contrast, Hamed et al (2023) found that study participant knowledge and practice are not significantly correlated with each other, and their levels of knowledge better than their levels of practice. This difference in the results could be explained in the light of the use of knowledge gained from continuing professional education programs that could be influenced by many different factors that interact to affect nursing practice like lack of confidence and lack of resources

Conclusion

The current study concluded that the implementation of an educational program for critical care nurses regarding cuffed endotracheal tube care using the blended method had been proven to be significantly more effective in improving nurses' performance regarding cuffed endotracheal tube care, as illustrated by the total knowledge level and total procedural practice level post 2 weeks and after three months follow up of the program implementation than preprogram. Also, there was statistically significant positive relationship was found between total nurses' knowledge and practice mean scores post 2 weeks and after three months follow up of program implementation

Finally, blended training was a successful strategy for raising ICU nurses' performance levels regarding cuffed endotracheal tube care

Recommendations

Based on the findings of the present study, the investigator suggested that;
Recommendations for the nurses;

- There is a need for an ongoing planned education and training program offered on a regular basis to critical care nurses to improve their knowledge and practice, regarding cuffed endotracheal tube care to execute the procedure correctly in the intensive care unit to achieve high quality nursing care for intubated patients
- Blended training should be widely used for all nurses in different units and departments to ensure updated knowledge and practices through continuing education center

Recommendations for Further Researches:-
Replication of the current study on a larger sample size to achieve generalizable results

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