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Original Article

The Effect of Implementing Ventilator Bundle Training Sessions on Critical Care Nurses' Practice

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1.ABSTRACT

A ventilator bundle is a straightforward set of three to five evidence-based practices that should be done collectively and reliably to improve the quality of care and patient outcomes. Most ventilator bundle measures are closely related to nursing interventions. Hence, critical care nurses must have ongoing and periodical training programs on ventilator bundle. **Aim**: The study aimed to evaluate the effect of implementing ventilator bundle training sessions on critical care nurses' practice. **Method**: A quasi-experimental one-group (pre-post-test) design was used on 30 nurses who were working in the intensive care units allocated in a University hospital in Egypt. Data were collected by using one tool: Nurses' practice of ventilator bundle observational checklist. **Results**: The mean nurses' practice scores were improved post-implementation of the training sessions compared with pre-training with highly statistically significant differences (P <0.001). **Conclusion:** The implementation of the ventilator bundle training sessions can improve critical care nurses' practice of mechanically ventilated patient care. **Recommendations:** Continuous in-service training programs on ventilator bundle should be organized for critical care nurses to enhance their performance and keep them up-to-date and competent.

Keywords: Ventilator Bundle, Training Sessions, Critical Care Nurses, Practice

2.Introduction:

Critically ill patients (CIPs) admitted to intensive care units (ICUs) frequently require ventilatory support and airway protection as life-saving therapies **(D. Wu, Wu, Zhang, & Zhong, 2019; Popat & Jones, 2016)**. Mechanical ventilation (MV) is a fundamental therapeutic measure required for patients with acute respiratory failure to ensure sufficient gas exchange **(Fichtner et al., 2019)**. Although invasive MV is often a lifesaving procedure for CIPs, its application is associated with significant complications **(Haribhai & Mahboobi, 2021)**.

Ventilator-associated pneumonia (VAP) is a serious healthcare-associated infection and is one of the most common complications among mechanically ventilated patients (**Núñez, Roveda, Zárate, Emmerich, & Verón, 2021**). The **National Healthcare Safety Network of the Centers for Disease Control and Prevention (NHSN/ CDC, 2021, P. 3)** defined VAP as ‘‘pneumonia that develops in a patient who is on MV for more than 48 hours’’. It is a problematic ICU issue as it can cause increased mortality and morbidity, and consequently, increased health-related costs **(D. Wu et al., 2019)**. A study conducted by **Othman and Abdelazim (2017)** revealed that the patients with VAP have significantly higher ventilation duration and ICU length of stay than those without VAP.

Additionally, the most common complications associated with invasive MV are weaning failure and ventilator-induced lung injury, which appears to be induced via three major mechanisms including volutrauma, atelectrauma, and biotrauma **(Markle, 2014).** Patients on MV are also more likely to develop venous thromboembolism (**Zhang et al., 2019**) and gastric colonization which can lead to peptic ulcers and upper gastrointestinal hemorrhage **(Haribhai & Mahboobi, 2021)**. Therefore, the ventilator bundle (VB) was introduced to prevent ventilator-related complications.

The ventilator bundle is one of the most preventive strategies used to control VAP at the bedside (**Liu et al., 2020**). According to the **Institute for Health Care Improvement (IHI, 2021)**, the bundle of care is an organized approach to improving care processes and patient outcomes that includes a small, straightforward set of three to five evidence-based practices that should be performed cooperatively and continually. The main VB involves 6 domains, including elevation of the

patient's head to 30°–45°, oral care with Chlorhexidine, daily sedation vacation, assessing the weaning readiness, stress ulcer prophylaxis, and deep vein thrombosis (DVT) prophylaxis (**IHI, 2012**). Recent evidence added subglottic suctioning to the main VB to improve patient outcomes **(Baldwin, Gray, Chequers, & Dyos, 2016; DeLuca et al., 2017; Khan et al., 2016)**.

Most of the ventilator bundle measures are closely related to nursing interventions (**Osti, Wosti, Pandey, & Zhao, 2017**). Therefore, critical care nurses (CCNs) are particularly responsible for taking the lead of the healthcare team in implementing the VB (**Boltey, Yakusheva, & Costa, 2017**). They are the cornerstones of overall patient care from admission until discharge. They play a variety of important roles in preventing ventilator complications including, caregivers, educators, evaluators, coordinators, and managers **(Osti et al., 2017)**.

The knowledge, experience, and skills of CCNs are the foundation of safe, competent care for mechanically ventilated patients **(Osman, Ibrahim, & Diab, 2019)**. Additionally, nurses' knowledge and practice can directly affect the quality of patients' care, and consequently clinical outcomes **(Oyira, Ella, Chukwudi, & Paulina, 2016)**. Despite the significant impact of implementing the VB on improving patients' outcomes, it continues to be a challenge for CCNs. This is supported by an Egyptian study which showed that the majority of the studied nurses had an incompetent practice with a negative perception regarding the VB (**Sobeih, Abd-Elsalam & Ahmed, 2018**).

Another investigation showed that the mean practice score established by CCNs was unsatisfactory and did not meet the VB standard criteria (**Aziz et al., 2020**). Furthermore, **Dumbre (2019)** found that the improvement of patient outcomes, including VAP incidence and the mortality rate was dependent on CCNs' adherence to the VB. Evidence indicates that CCNs' training on VB had a significant impact on reducing VAP occurrence and improving their practices (**Elbilgahy, Ouda, Hashem, & Elassmy, 2015; Ismail & Zahran, 2015**).

From our clinical experience and empirical observations, we found that there are no available protocols or standards of care for mechanically ventilated patients in the study setting. Additionally, CCNs believe that the VB interventions such as assessing the patients' readiness to wean, implementing sedation vacation, and performing DVT prophylaxis are the responsibility of the physician. Furthermore, they are unaware of the significance of implementing the VB practices for patients on MV, which necessitates the need for organizing training programs for CCNs.

Aim of the Study:

This study aimed to evaluate the effect of implementing ventilator bundle training sessions on critical care nurses' practice.

Research Hypothesis

To achieve the aim of this study, we hypothesized that CCNs' practice will be improved after implementing the VB training sessions.

3. Subjects and Method

Research Design

A quasi-experimental one-group (pre-post-test) design was used in this study. The pre-post-test is probably the most common experimental research design in clinical nursing studies (**Knapp, 2016**). It looks at how an independent variable (VB training or educational sessions) affects a dependent variable (CCNs' practices) in a certain population before and after intervention (**Stratton, 2019**).

Setting

The present study was conducted at two chest ICUs allocated in one University Hospital in Egypt. One ICU has seven beds and the other has six beds. These units are well stocked with supplies, equipment, and innovative technology, as well as the manpower needed for CIPs' care. Chronic obstructive pulmonary disease, pneumonia, and obstructive sleep apnea are the most common diseases in these units. The nurse-patient ratio in these units is 1:2 in the morning shifts and 1:3 in other shifts.

Subjects

The study involved a convenience sample of 30 nurses working at chest ICUs who had more than one year of working experience, were involved in direct patient care, and voluntarily agreed to take part this research.

Tools of Data Collections

Data were collected using one tool: nurses' practice of VB. The main domains of the VB were adopted from **IHI, (2012)**. We added the airway care domain to the main VB which is a highly performed procedure in the study setting. Thus, the VB was used in the present study covered seven domains. The practices under each domain were developed by a principal researcher (PR) after reviewing related literature (**Aysha, El-Din, Attia,**

& Ibrahim, 2016; Baldwin et al., 2016; DeLuca et al., 2017; Khan et al., 2016; Mercene, 2016; NHSN/ CDC, 2021). This tool included two parts as follows:

Part 1: Nurses' Demographic Characteristics

This part contained participant nurses' gender, age, qualifications, years of ICU work experience, and attended previous workshops or programs on care of patients on MV.

Part 2: Nurses' Practice of* Ventilator Bundle *Observation Checklist

This part involved an observation checklist to assess and evaluate nurses' practice of the VB.

1. Elevating the patient's head of the bed (HOB) to approximately 30°–45° (7 practices).
2. Performing oral care using 2% Chlorhexidine (15 practices).
3. Assessing the patient's sedation level (8 practices) by using the Richmond Agitation Sedation Scale **(Sesseler et al., 2002)**.
4. Assessing the patient's readiness to wean (18 practices).
5. Performing airway care which includes:

- Tracheal and oral suctioning (17 practices)
- Ventilator circuit care (3 practices)
- Chest physiotherapy (5 practices)

6. Implementing stress ulcer prophylaxis (3 practices).
7. Implementing DVT prophylaxis (6 items).

The scoring system:

Each intervention was scored based on competent practice (done correctly) = 1, and incompetent practice (done incorrectly or not done) = 0. Based on the scores received for each step, the total maximum score for CCNs' practice was 82. The overall scoring system was classified into two categories: satisfactory practice: ≥ 85% and unsatisfactory practice: < 85%.

Validity and Reliability of the Tools

The validity of the tool was evaluated by a group of seven experts in the fields of Critical Care and Emergency Nursing and Medicine. Their opinions were elicited regarding the layout, relevancy, accuracy, and consistency of the tool. Cronbach's alpha test was used to determine the tool's reliability, and the result was 0.923, indicating a high-reliability tool.

Pilot Study

A pilot study was conducted before the main study in June 2019 on 3 nurses to evaluate the objectivity, probability, and applicability of the data collection tool. The participants in the pilot study were excluded from the main study group, and the necessary modifications were made accordingly.

Field Work

Data were collected between June 2019 and January 2020. The current study was carried out in four phases:

Phase 1: Assessment

- The PR introduced herself to the participant nurses, described to them the details of the study, and encouraged them to take part in it.
- Nurses who agreed to participate in the study were asked to express their expectations about the VB training sessions.
- Each participant nurse was interviewed individually to gather the demographic data using part I of the tool. Nurses' practices regarding the VB were observed once in one of the three shifts using the VB observational checklist.

Phase II: Preparation of the booklet

- The PR prepared the VB educational booklet based on the empirical observation of nurses' practices and the most recent evidence-based nursing guidelines. It covered the practical and theoretical components of the VB. It was prepared in the Arabic language as it is the mother tongue of the participants and reviewed by a panel of specialists in critical care and medicine. Consequently, their recommendations were considered.

Phase III: Implementation of the training sessions

- During this phase, the PR coordinated and implemented the VB training sessions in the selected ICUs.
- The educational training included sessions covering the practical and theoretical components of the VB. The theoretical sessions contained detailed information about the definition, purpose, and indications of invasive MV, the ventilation modes, settings, troubleshooting, and weaning from the ventilator. The practical sessions focused on the demonstration of the nursing practice of VB and the role of the CCN before, during, and after weaning.

- The PR implemented the VB training in twenty-four teaching sessions in addition to an orientation session for the participant nurses. Three sessions were given every week for eight consecutive weeks (each nurse attained three sessions to fulfill the training). The nurses were distributed into small groups. Each group involved four nurses according to their availability in the shift.
- The educational sessions were organized between the morning and afternoon shifts or throughout the morning shift after the patients received the routine care. Each session lasted from 30 to 45 minutes considering nurses' attention span and the unit workload.
- The PR utilized different teaching methods including lectures, group activities, brainstorming, demonstration, and re-demonstration.
- By the end of each session, the PR provided a summary and emphasized the most important points.

Phase IV: Evaluation of nurses' practice

- All participant nurses were evaluated for their practice before and immediately after implementing the VB educational sessions. A comparison between nurses' scores pre and post training sessions was calculated.

Ethical Considerations

Ethical approval was obtained from the Research Ethics Committee of the Faculty of Nursing at Mansoura University, Egypt (Ref. No. 182). The administrative authorities of the chosen hospital granted permission to conduct the study. Written informed consent was obtained from the nurses who agreed to participate in the study after providing them with a comprehensive explanation of the details of the study. All nurses were assured that their participation in the study was voluntary and that they could withdraw at any stage without responsibility. The participants' confidentiality and anonymity were assured. It was emphasized to the nurses that the observed practices were not considered a part of their annual performance evaluation.

Statistical analysis

Statistical Package for the Social Sciences (Chicago, IL, USA), version 20 was used to code, compute, and statistically analyze the obtained data. All continuous data were normally distributed and were expressed in mean ± standard deviation (SD). Numbers and percentages were used to express categorical data. To compare continuous quantitative and categorical data, the student's t-test and the chi-square (2) test were utilized. The statistical significance level was set at $p \leq 0.05$.

Study Limitations

The study was conducted in a small group of CCNs in one selected hospital which limits the generalizability of the research findings. Furthermore, there were difficulties to stick with the educational session schedule due to participant nurses' heavy work schedule in the study setting.

4. Results

Table 1 depicts participant nurses' demographic data. It showed that female nurses represented more than half (56.7%) of the participants. The majority of them (86.7%) were less than 30 years old with a mean age of 27.3 ±2.1. In addition, 66.7% of the participants were graduated from the Technical Nursing Institute. More than half of the participant nurses (56.7%) had from 5 to 10 years of ICU work experience with a mean of 7.3 ± 2.9. Additionally, 60% reported that they did not attend any training programs or workshops on mechanically ventilated patient care.

Figure 1 illustrated that the most incompetent practice in pre-educational sessions was related to airway care (10%). However, post the training sessions, 86.7% of the participant nurses performed this intervention competently. Only 13.3% of the participants were competent in assessing the patients' sedation level using the RASS and assessing the patients' readiness to wean before the training. Nevertheless, after the training sessions, most of the nurses performed these practices competently (90% & 86.7%, respectively). Moreover, participant nurses' practice of oral care with 2% Chlorhexidine/8 hours and the implementation of the DVT prophylaxis improved after the training sessions. However, the vast majority of the participant nurses (90%) elevated the HOB to 30-45 degrees and implemented stress ulcer prophylaxis competently before the training sessions. Following training, all nurses performed these interventions competently.

Table2 compares participants' total mean practice scores of VB pre-and post-training. Significant differences were noted in participant nurses' practice of the VB pre-and post-training sessions (P <0.001). There was a marked improvement in the total mean practice scores post-implementation of the training sessions. These results support the study's research hypothesis.

Table 3 depicts the relationship between the participant nurses' practice scores pre and post the

training sessions, as well as their demographic data. In pre-training sessions, no statistically significant relationship was noted between the participant nurses' practice scores and their demographic data including age and gender (P = 0.552 & 0.177 respectively). Conversely, a statistically significant relationship was observed between the participant nurses' practice scores, and their educational level and years of ICU work experience (P = 0.012 for both). In addition, there was a highly statistically significant relation between the participant nurses' practice scores and their attendance of previous in-service training programs on care of patients on MV (P <0.001). In post-training sessions, no statistically significant relation was noted between participant nurses' practice and their demographic data (P >0.05).

Table 1.Participant Nurses' Demographic Data

Demographic Data	Participant Nurses (n=30)	
	n	%
Gender		
○ Male	13	43.3
○ Female	17	**56.7**
Age (years)		
○ < 30	26	**86.7**
○ ≥ 30	4	13.3
Mean ± SD = 27.3 ±2.1		
Qualifications		
○ Technical Institute of Nursing	20	**66.7**
○ Bachelor of Nursing	7	23.3
○ Postgraduate study	3	10.0
Years of work experience in ICU		
○ < 5 years	10	33.3
○ 5 - 10 years	17	**56.7**
○ >10 years	3	10.0
Mean ± SD = 7.3 ±2.9		
Attended training programs or workshops on care of patients on MV		
○ Yes	12	40.0
○ No	18	**60.0**

ICU: Intensive Care Unit MV: Mechanical Ventilation

Data are expressed as numbers (n) and frequency (%), SD= Standard Deviation

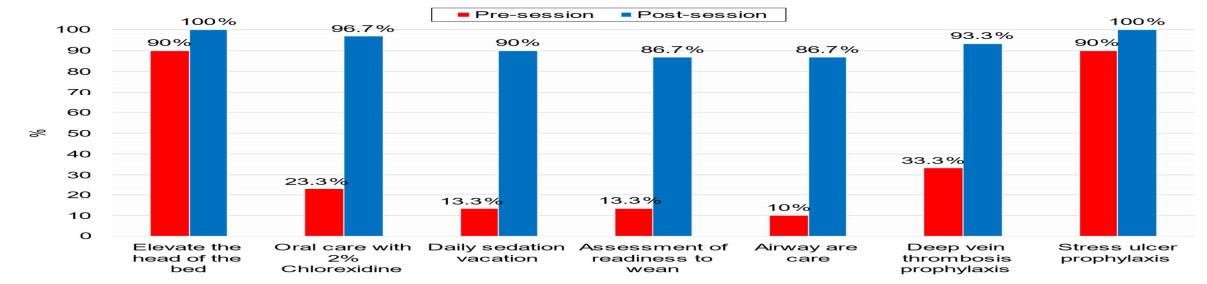

Figure 1: Nurses' Practice of the VB Domains Pre-and Post-Training Sessions

Table 2.Comparing Participants' Total Mean Practice Scores of VB Pre-and Post-Training Sessions

Statistic	Participant Nurses' Practice Score (n=30)			
			Significance Test	
	Pre-sessions	Post- sessions	*T*	*P*
Mean ± SD	49.5 ± 14.9	76.1 ± 5.9	9.054	**<0.001**

SD= Standard Deviation; P by student's t-test (t), ** refers to high significance if P value less than 0.001

Table 3.Relation between the Participant Nurses' Practice Score and Their Demographic Data Pre-Post Training Sessions

Nurses' Demographic Data	Pre-training Sessions		Post-training Sessions	
	Unsatisfactory (n=١٩)	Satisfactory (n=١1)	Unsatisfactory (n=٣)	Satisfactory (n=٢٧)
	n(%)	n(%)	n(%)	n(%)
Age (years)				
▪ < 30	17(89.5%)	9(81.8%)	3(100.0%)	23(85.2%)
▪ > 30	2(10.5%)	2(18.2%)	0(0.0%)	4(14.8%)
χ^2 (*P* - value)	χ^2=0.353 (*P* =0.552)		χ^2=0.513 (*P* =0.474)	
Gender				
▪ Male	10(52.6%)	3(27.3%)	2(66.7%)	11(40.7%)
▪ Female	9(47.4%)	8(72.7%)	1(33.3%)	16(59.3%)
χ^2 (*P* - value)	χ^2=1.824 (*P* =0.177)		χ^2=0.739 (*P* =0.390)	
Qualifications				
▪ Technical Institute of Nursing	16(84.2%)	4(36.4%)	2(66.7%)	18(66.7%)
▪ Bachelor of Nursing	3(15.8%)	4(36.4%)	1(33.3%)	6(22.2%)
▪ Postgraduate's study	0(0.0%)	3(27.3%)	0(0.0%)	3(11.1%)
χ^2 (*P* - value)	χ^2=8.838 (***P* =0.012)***		χ^2=0.476 (*P* =0.788)	
Years of work experience in ICU				
▪ < 5 years	10(52.6%)	0(0.0%)	1(33.3%)	9(33.3%)
▪ 5 - 10 years	8(42.1%)	9(81.8%)	2(66.7%)	15(55.6%)
▪ >10 years	1(5.3%)	2(18.2%)	0(0.0%)	3(11.1%)
χ^2 (*P* - value)	χ^2=8.891 (***P* =0.012)***		χ^2=0.392 (*P* =0.822)	
Training programs or workshops on care of patients on MV				
▪ No	18(94.7%)	0(0.0%)	3(100.0%)	15(55.6%)
▪ Yes	1(5.3%)	11(100.0%)	0(0.0%)	12(44.4%)
χ^2 (*P* - value)	χ^2=26.053 (***P* =<0.001)****		χ^2=2.222 (*P* =0.136)	

MV: Mechanical Ventilation

Data are presented as frequency (%) and n (numbers), *P* by Chi square test (χ2), * refers to significance if *P* value ≤ 0.05, **refers to high significance if *P* value less than 0.001

5. Discussion

In ICUs, caring for patients who need MV has become an important aspect of nursing care. Nurses, physicians, and respiratory therapists must be aware of the specific needs of each patient and collaborate to set realistic caring goals (**Abdelgadir, Mohamed, Abuzeid, Zeen, & El-rufai, 2018**). Thus, the **IHI (2012)** developed and implemented an evidence-based VB practice to prevent infections related to MV and improve patient outcomes. Therefore, it is important to train CCNs on the VB practices before allowing them to care for mechanically ventilated patients.

Participant Nurses' Demographic Data

According to the current findings, more than half of the participating nurses were young females and were less than 30 years old. This is to be expected, given female nurses typically outnumber male nurses (**Mohamed, Kandeel, Abosaeda, & Ali, 2020**). Additionally, males joined the nursing profession in growing numbers lately. These results are consistent with other studies (**Aysha et al., 2016; Oner Cengiz & Kanan,** 2019).

Two-thirds of the participant nurses were graduates of the Technical Nursing Institute. This is consistent with the finding of **Hassan, Abd El-Aziz, Hassan, and El-Hosany (2018)**. In contrast, other studies found that the studied nurses were predominantly holding Bachelor's degrees in nursing (**Elbilgahy et al., 2015; Ismail & Zahran, 2015; Mohamed & Elhanafy, 2019)**. Furthermore, **Shehab, Sadoon, Nasser, and Fathy (2018)** noticed that nearly two-thirds of enrolled nurses had diploma degrees. This discrepancy may be due to the availability of different nursing educational programs in Egypt.

The study findings showed that nearly two-thirds of the participant nurses did not attend any training courses or workshops on care of patients on MV. This may be due to the unattainability of staff development plans or training funds. This is harmonious with other investigations which reported that the majority of the studied nurses did not participate in any training courses on the evidence-based VB (**Dipanjali, Shivananda, & Yashoda, 2020; Oner Cengiz & Kanan, 2019)**. On the contrary, **Hassan et al. (2018)** revealed that nearly two-thirds of the studied nurses had received

previous training programs on endotracheal tube care. This may be due to organizing continuing education training programs for nurses as a part of the hospital policy.

The Effect of Educational Training Sessions on Nurses' Practice of the VB

The current study findings depicted that nurses' total mean practice scores of the VB were unsatisfactory before the training sessions compared with the scores after training. This could be due to shortage of nursing staff, or an increased nurses' workload in the ICUs. The shortage of nurses is one of the significant problems in the healthcare setting, which is a worldwide phenomenon (**Haddad, Annamaraju, & Toney-Butler, 2020**). It limits the nurses' time available for each patient and hinders their ability to develop competencies. Moreover, increasing patient flow rates in the study setting could be another reason for incompetent nurses' practice. Most importantly, nursing practice is based primarily on nurses' individual experiences and the guidance of senior nurses.

A marked improvement was noted in the total mean practice scores post-implementation of the VB training sessions. This improvement might be attributed to the educational sessions' content and process, which were fitted to the particular needs of the participating nurses. This corresponds with findings of an Egyptian study by **Khalifa and Seif Eldin (2020)** who found that nurses' knowledge and performance concerning the VB preventive guidelines improved after implementation of the educational program.

Branco et al. (2020) found that nurses' adherence to VAP bundle domains was significantly increased following the educational training. Also, the same findings were reported in other studies (**Elbilgahy et al., 2015; Dipanjali et al., 2020; Subramanian, Choy, Gobal, Mansor, & Ng, 2013**). Moreover, **Agarwal, Kakati, Mahalingam, and Rana (2019)** highlighted the importance of training programs for healthcare workers in improving their performance and patients' outcomes. Indeed, CCNs must be prepared, up-to-date, and highly competent to provide evidence-based care for mechanically ventilated patients and enhance their recovery **(Mohamed & Elhanafy 2019)**.

The findings of the current study showed that the majority of participant nurses' practices of oral care using 2% chlorhexidine every 8 hours, assessment of the patients' sedation level using RASS, assessment of the patients' readiness to wean, performance airway care, and implementation of DVT prophylaxis were incompetent before the training. This could be due to nurses' workload, inadequate learning resources for nurses, and unavailability of Arabic nursing management books or guidelines.

After the training, nurses' practices improved, and they became more competent. This improvement could be attributed to that the educational sessions fulfilled nurses' interests and the training requirements for properly managing patients on MV. Additionally, during the training sessions, the PR emphasized the significant role of CCNs in implementing the VB. These findings are compatible with **Ismail and Zahran (2015)** who found that the participant nurses were significantly more competent in performing these interventions after training than before the training.

The results of the current study showed that the majority of participant nurses' practices of elevating the patient's HOB to 30°–45°degrees and implementing stress ulcer prophylaxis were satisfactory before the training. After the training, their performance improved by 100%. Supporting our findings, **Khalil, Mohamed, and Sharkawy, (2018)** reported no statistically significant differences in nurses' compliance with applying stress ulcer prophylaxis between the study groups pre-and post-training. Furthermore, **Yilmaz et al. (2016)** noticed that the majority of staff performances including elevating the patient's head to a semi-seated position were performed appropriately prior to the training and no statistically significant differences were noted after the training.

In contrast, **Ismail and Zahran (2015)** found that the nurses' adherence to elevating the patient's HOB to 30-45 degrees and implementing stress ulcer prophylaxis was significantly increased after the training than before training. This contradiction could be attributed to the fact that adjusting the HOB elevation and administering stress ulcer prophylaxis is part of the routine nursing care in the study setting. Hence, nurses are competent in performing these interventions.

The current study illustrated a statistically significant relationship between the nurses' total practice scores, and their educational level, years of ICU work experience, and attendance of previous in-service training programs on care of patients on MV before the training sessions. This means that nurses with more experience and proper ICU training had better practice of VB than other nurses.

These results are consistent with **Ibrahim, Al-Rafay, and Tantawi (2021)** who found a significant relation between the studied nurses' total level of the bundle of care practices and their personal data including qualifications, years of work experience, and training courses. However, this finding contradicts the results of **Hassan et al. (2018)** who found no statistically significant relation between participant nurses' practice and their demographic data pre and post program implementation. This discrepancy may be due to the nature of the studied nurses, health care institutions' services, availability of in-service training programs, and funds.

Overall, the current study showed a significant improvement in nurses' total practices score of the VB post-educational sessions. This reflects the effectiveness of the training that was based on evidence-based practices. This improvement should be continued, supported, and audited by the health care team in the ICUs. In addition, continuous educational programs on the VB for CCNs can improve patient outcomes.

6.Conclusion and Recommendations

Based on the study findings, it can be concluded that the implementation of VB training sessions improved CCNs' practice. There is a need for periodic appraisal of nurses' practices of VB. Continuous in-service training programs are required for CCNs to update their knowledge and practices in caring for patients on MV. Further research is needed to investigate the effect of integrating the VB into care on patients' clinical outcomes.

7.Acknowledgment

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8.Declaration of Conflicting Interests

The authors state that there are no potential conflicts of interest in this article's research, authorship, or publishing.

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