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## Effect of Implementing Ventilator Care Bundle on Mechanically Ventilated Patients Outcomes

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### Abstract

Trauma patients require mechanical ventilation for variety of reasons. Despite its benefits, it may increase the risk of deadly consequences. This can be minimized or prevented. Therefore, a series of evidence-based interventions called ventilator care bundle **VCB** when applied with each other will achieve positive outcomes of patients on mechanical ventilation. **Aim of study:** this study aimed to investigate the effect of implementing ventilator care bundle on mechanically ventilated patient outcomes. **Design:** Quasi experimental research design was used to conduct this research. **Setting:** This study was carried out at trauma ICU at Assiut University Hospitals. **Sample** consisted of 60 patients, divided into study and control groups equally. **Tools** included three tools. **Tool I:** - Ventilator Care Bundle audit form, **Tool II:** - Weaning Trial and Extubation Assessment, **Tool III:** - Mechanically ventilated patient Outcomes Indicators. **Results:** - Findings of the present study revealed that study group had lower incidence of ventilator-associated pneumonia VAP 30% compared to 73.3% for control group. As regard to oral cavity assessment the majority of study patients 80 % had no oral dysfunction compared with 0% for control group. Also study group had a significantly shorter time of mechanical ventilation connection  $6.97 \pm 3.00$  days for study group and  $13.63 \pm 6.26$  for control group that resulting in shorter ICU stay for study group  $11.37 \pm 3.48$  days compared to control group  $17.50 \pm 6.03$  days. **Conclusion:** Implementing ventilator care bundle is an effective approach to reduce the incidence of VAP and oral cavity dysfunction in mechanically ventilated patients and it has lower ICU stay period, lower mortality rate and duration on ventilator. **Recommendation:** Further study focuses on intervention to improve care of patient- centered outcome. Replication of population from different geographical locations in Egypt for generalization.

**Key words:** *Mechanically Ventilated Patient, Ventilator Care Bundle, Patient's Outcomes.*

### Introduction:

Traumatic injury is a leading cause of death in young people and the majority of them require mechanical ventilation (MV) for variety of reasons including regulating the patient's respiration, oxygenating the lung when the ventilator efforts are insufficient. Despite its benefits, MV. may increase the risk of deadly consequences such as barotraumas, aspiration, ventilator-associated pneumonia (VAP), stress ulcer, gastrointestinal bleeding, deep venous thrombosis (DVT) and weaning failure (Prakash et al., 2017).

Ventilator-associated pneumonia (VAP) is one of the most severe complications for a patient on a ventilator. Such complications increases medical costs and extends the hospital length of stay (LOS) of patients in ICU. While the length of ventilator use is a risk factor for infection. VAP is the most common

type of healthcare-associated infections (HAI). It accounts for 36–60% of all of HAI cases. Furthermore, 9–27% of mechanically ventilated patients have VAP. Moreover, VAP infections can lengthen LOS by 7–9 days (Batra et al., 2020).

One of the important safety issue in mechanically ventilated patients is VAP prevention. The American Association of Critical-Care Nurses (AACCN) recommended steps for reducing the incidence of VAP; these steps are based on the best practice guidelines for patients receiving MV. Called the “ventilator care bundle” (Kao et al., 2019).

Care bundle approach is an effective method for reducing complication related to MV. Care bundles are interventions that are supported by research; they include 3-5 evidence- base interventions that have been shown to improve patient outcomes. Ventilator care bundle is an important component of patient

safety. Implementation of bundles can support and improve the quality and delivery of care in ICUs (Prakash et al., 2017).

**The ventilator care bundle** is a series of evidence-based interventions, that when implemented together will achieve outcomes improvement in patients on mechanical ventilation. components of the ventilator bundle are; Elevation of head of the bed to between 30 and 45 degrees, sedation vacation and daily assessment of readiness to extubate, Peptic ulcer disease prophylaxis, Deep venous thrombosis (DVT) prophylaxis, and daily oral care with chlorhexidine 0.12% (Alcan et al, 2016 ) & (Klompas et al., 2016).

### Significance of the study

Ventilator-associated pneumonia occurrence in Egyptian ICUs ranged from 16% to 75%. In comparison with its incidence World Wide, 10–28%, it is about 2.5 times more. The mortality rate of ventilator patients who develop VAP is 46%, compared to 32% for ventilator patients who do not develop VAP. Therefore, application of VCB is considered a standard of care for ventilated patients for saving their live and improves outcomes (Moustaf et al., 2016).

Traumatic patients require MV. for variety of reasons. The number of patients admitted to trauma ICU and connected to MV was about 475 patients at 2019 (Assuit University Hospital records, 2019). Clinical observation of the researcher revealed that most of those patients were suffering from a lot of respiratory problems (50% to 66% had respiratory infection) and hemodynamic deteriorates, which might endanger their life, increase hospital stay and the period of connection to the mechanical ventilator and reduce rate of turnover and burden hospital resources. Despite these complications most of them can be minimized or prevented.

### Aim of the study:

This study aimed to investigate the effect of implementing ventilator care bundle on mechanically ventilated patients outcomes.

### Specific objectives:

positive outcomes post implementation of ventilator care bundle are

- Reduce incidence of VAP.
- Lower rate of oral cavity dysfunction.
- Reduce time of mechanical ventilation connection.
- Lower ICU stay period.
- Lower mortality rate.

### Research hypothesis:

- **H<sub>1</sub>** VAP occurrence of trauma patients on mechanical ventilation who receive a bundle protocol will be less than that of control group.

- **H<sub>2</sub>** Developing of oral cavity dysfunction in study patients whom were received oral care with chlorhexidine 0.12% less than those receiving routine oral care.

**H<sub>3</sub>** patients who were received the ventilator care bundle have a positive outcomes more than those receiving usual care.

### Patients and Method

#### Research design:

Quasi experimental (study and control) research design was utilized to carry out present study.

#### Setting:

The study was executed at trauma intensive care units of Assuit university hospitals. This is the largest teaching hospital in Assuit City, Egypt. The trauma intensive care unit of the hospital contains twelve beds. The patient/ nurses ratio of the unit is 1:1. The unit provides care for all types of trauma patients, including those with head, chest trauma and spinal cord injuries. This setting was selected for this study because of its high flow of injuries with about 160 patients admitted to the trauma ICU every year and connected with MV. (Assuit university hospital records). The unit contains the necessary resources such as advanced therapeutic and diagnostic machines (MV, X-rays, and laboratory investigator), infection control system and qualified health care team to implement the ventilator care bundle.

#### Sample:

A sample of sixty patients admitted to trauma ICU. They were sequentially recruited equally into two groups; control and study (30 patients each).

#### Sample size:

$$n = \frac{N Z^2 \sigma^2}{Z^2 \sigma^2 + N e^2}$$

$$n = \frac{615 \times (1.96)^2 \times (0.221)^2}{(1.96)^2 \times (0.221)^2 + 615 \times (0.05)^2} = 60$$

Where:

$Z = 1.96$  [standard scores],

$e = 0.05$  [error],

$\sigma = 0.221$  [SD]

$N = 615$  [population],

$n = 60$  [sample]

#### Inclusion criteria

- Age: 20- 60 years old.
- Recent admission to trauma ICU within 24 hrs.
- Recent connected to MV.
- Receive continuous sedation.

**Exclusion criteria were:** Severe head injury; Spinal cord injury; Chest infection or Cardiac disease; COPD or Asthma, Ventilator support less than 72 hours; Autoimmune diseases or sepsis; (h) GCS <8.

**Tools of data collection:-**

Data were collected using three tools in order to achieve the aim of this study.

**First tool : Ventilator Care Bundle audit form:**

**Part I :** Demographic and clinical data

This part included socio- demographic data (code, age, sex), past medical history, current diagnosis and causes of trauma.

**Part II: Ventilator Care Bundle items**

It was developed by the researcher after reviewing the relevant literature (Cutler & Sluman, 2014). It was developed primary to investigate the Bundle Compliance in trauma ICU. It covered five main items of the VCB ; Elevated head of bed position in 30°- 45° if not contraindicated, Oral care with Chlorhexidine 0.12%, Weaning trials and assessment of extubation, Peptic ulcer prophylaxis and DVT prophylaxis,

**Second tool: Wakening Trial and Extubation assessment**

This tool was compiled by the researcher to assess sedation level and patient's readiness to extubation based on the relevant literature (Diaz, 2020 and Bazan, 2020). This tool consisted of two parts.

**Part I: Sedation Scale Assessment:**

Using Richmond Agitation-Sedation Scale (RASS). It was adopted from Almgren et al., (2010) . It was used to assess the degree of sedation and it used to define the patient's agitation during the time of study (sedation vacation).

**Sedation scoring system** containing 5 levels by negative score: **Drowsy** scored as -1, A score of -2 indicated **Light sedation**, A score of -3 indicated **Moderate sedation** , A score of -4 indicates **Deep sedation**, A score of -5 indicated **Unarousable**. To assess level of Agitation, using scoring system containing 5 levels by positive score: **Alert** and **calm** scored as 0, **Restless** is scored as +1, **Agitated** scored as +2, **Very agitated** scored as +3, **Combative** scored as +4.

**Part II: Extubation Readiness test:**

It adopted from (Epstein 2002). It was used to assess the patient's readiness to extubation. It consisted of five items (patient raises his arm and leave in air for 15 seconds, patient raises his head off the bed, pressure support = 5 cm H<sub>2</sub>O, ables to generate a strong cough, absence of intolerance signs (oxygen saturation <90%, heart rate > 140, SBP>180, severe anxiety or decrease in LOC).

**The scoring system:** This part scored “yes” or “no” depending on whether the patient met the each item. A score of “yes” on all items is required to be considered ready for extubation. If one of these items was “no” continued mechanical ventilation and reassessed in 24 hours.

**Third tool : Mechanically ventilated patient Outcomes Indicators:**

This tool was developed by the researcher after reviewing the relevant literature to investigate patient outcomes post implementation of the VCB. It incorporated the modified Beck oral assessment scale (BOAS) adopted from (Ames et al. 2011) to assess oral cavity of both groups , BOAS has 5 sub-scales and examines lips, gums, oral mucosa, tongue, teeth and saliva, while each was scored on a four-point Likert scale.

**The scoring system:** The total score ranged 5–20 while score 5 indicated no dysfunction and 20 score indicated severe dysfunction. Therefore, scores 6–10, 11–15, and 16–20 indicated presence of mild, moderate, and severe dysfunction, respectively.

In this study VAP was determined by using the Clinical Pulmonary Infection Score (CPIS) adopted from (Gaudet et al 2020). It based on six criteria which include body temperature, leukocytes, volume of respiratory secretions, secretion culture results, chest radiograph.

**The scoring system:** The total score of this tool ranged from 0–10 and According to this tool, score of six or higher indicated incidence of VAP. The validity and reliability of this tool had been confirmed in several studies.

In this study DVT was determined clinically by presences of manifestation as (Calf pain, Calf tenderness, Calf edema, Skin color changes, superficial vein distension, and Warm calf). patient outcomes additionally included time which patient spent connected with MV, length of ICU stay, mortality rate.

**Methods****The study was carried out on three phases:****1-Preparatory phase:**

Study tools were developed by the researcher based on review of related literature.

After explanation the aim and nature of the study, researcher granted an official Permission from the head of Trauma ICU at Assuit university hospitals.

**Content validity:** The tools of the study were tested for content validity by five jury experts. Three assistant professors of critical care nursing staff at faculty of nursing, Assuit University and two professors of anesthesia and intensive care medicine faculty of medicine, Assuit University and modifications were done.

**Pilot study:** was conducted on 10% of the study patients to test the feasibility and applicability of the tools and time needed to collect the data. The tools were applicable, and the pilot study subjects were excluded from the actual study.

An approval was obtained from the local ethical committee and the study followed the common ethical principles in clinical research.

**Protection of human rights:** The researcher obtained an informed consent from each patient. The researcher emphasized that patients' participation was voluntary and the confidentiality and anonymity of patients were assured through data coding.

## **2-Implementation phase**

Data collection began from January 2020 to September 2020 .Patients were randomly assigned to the study group or the control group.

**Implementation phase for both groups:** During this phase the researcher evaluated patients of the studied groups from day one of ICU admission and record patient's demographic and base line clinical data from his/her sheet.

**Ventilator Care Bundle :** were applied on Each patient of the study group subjects as : **Elevated Head of Bed;** maintained continuously patient's position in 30°- 45°. The researcher changed patient position every 2 - 4 hours, either side lying or supine while the required HOB angle was maintained. **Oral care with chlorhexidine;** performing oral care by Chlorhexidine 0,12%, and decontaminated oral cavity by antiseptic agents topically.

**Sedation interruption;** a process in which patient sedation interrupted until the patient follows commands and then assessed for discontinuation of MV. using second tool named Weaning trials and extubation assessment.

**Peptic ulcer prophylaxis;** It began within 24 hours of start of MV.

- **DVT prophylaxis;** It is a combination of pharmacological prophylaxis application of sequential compression device .

Outcomes of patients are ICU staying period, period of time which patient spend connected with mechanical ventilation and mortality rate by using tool 3.

## **Evaluation phase:**

This phase was performed to assess effect of VCB implementation on reducing complication of mechanical ventilation through evaluate the studied patients' outcomes according to their clinical data (Length of ICU stay, VAP, oral cavity dysfunction , patients' mortality rate, and the development of deep venous thrombosis).

## **Statistical analysis**

Data were wrote down in a designed chart for each patient. The collected data were coded, analyzed and tabulated . SPSS 20.0 statistical software package were used for entering data and analysis . Data were presented using descriptive statistics in form of frequencies and percentages for qualitative variables, means and standard deviations for quantitative

variables. Data were compared using analysis of variance test in case of comparisons between two independent groups. Using independent T-test and chi-square test to determine significant, it is considered significant when  $P \leq 0.05$  significant.

## Results

Table (1): Distribution of personal &amp; Clinical data of the studied groups

Patients' Characteristics	Study (n= 30)		Control (n= 30)		P-value
	No.	%	No.	%	
<b>Sex:</b>					0.222
Male	21	70.0	25	83.3	
Female	9	30.0	5	16.7	
<b>Age: (years)</b>					0.078
Mean $\pm$ SD	32.73 $\pm$ 12.54		38.37 $\pm$ 13.78		
Range	18.0-58.0		20.0-59.0		
<b>Diagnosis on admission</b>					0.243
Head injury	24	80.0	20	66.7	
Chest trauma	4	13.3	6	20.0	
Abdominal trauma	2	6.7	4	13.3	
<b>Comorbidity:</b>					0.559
Diabetes mellitus	7	23.3	9	30.0	
Hypertension	0	0.0	0	0.0	
None	23	76.7	21	70.0	
<b>GCS on admission:</b>					0.062
Mean $\pm$ SD	9.03 $\pm$ 1.38		9.93 $\pm$ 2.59		
<b>APACH II score:</b>					0.596
Mean $\pm$ SD	21.33 $\pm$ 3.01		20.77 $\pm$ 2.46		
Range	17.0 - 30.0		17.0 - 27.0		
<b>Injury severity score:</b>					0.653
Mean $\pm$ SD	19.3 $\pm$ 7.4		18.5 $\pm$ 6.4		

APACHE II score: Acute Physiologic Assessment & Chronic Health Evaluation

GCS: Glasgow Coma Scale

Table (2): Comparison between the studied groups in relation to VAP occurrence

CPIS	Study (n= 30)		Control (n= 30)		P-value
	Mean $\pm$ SD		Mean $\pm$ SD		
<b>2<sup>nd</sup> day:</b>	3.33 $\pm$ 1.79		4.90 $\pm$ 1.58		0.007*
No VAP	27	90.0	18	60.0	
VAP	3	10.0	12	40.0	
<b>5<sup>th</sup> day:</b>	4.33 $\pm$ 1.31		7.73 $\pm$ 1.89		0.001*
No VAP	21	70.0	8	26.7	
VAP	9	30.0	22	73.3	

\*P<0.05 significant

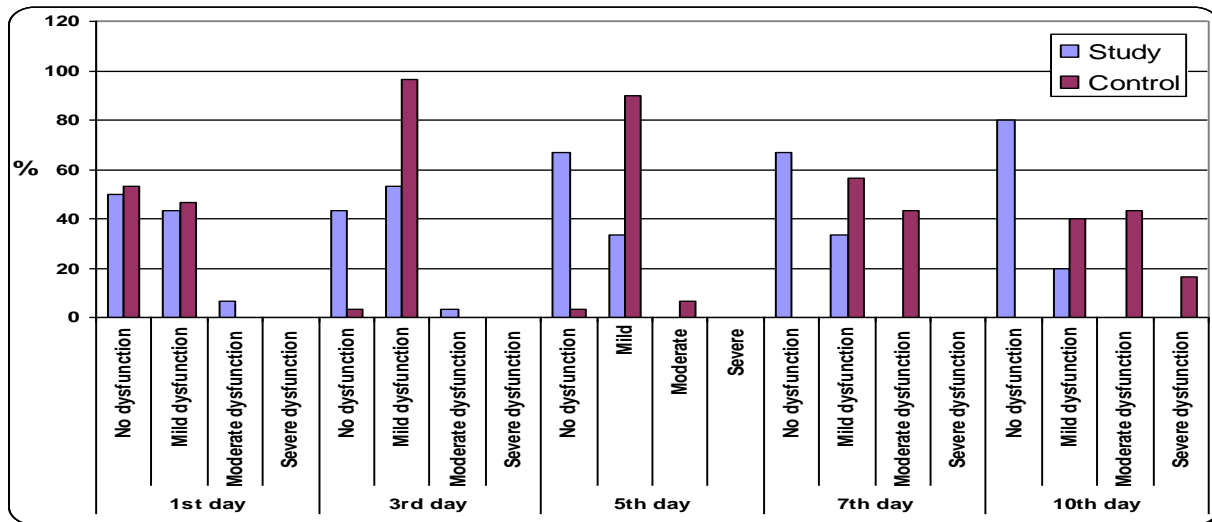


Figure (1) Percent distribution of the studied groups in relation to oral dysfunction assessment

Table (3): distribution of patients in both groups in relation to awakening trials

Causes of Re-sedation	Study(n= 30)		Control(n= 30)		P-value
	No.	%	No.	%	
Passed sedation trial	13	43.3	4	13.3	0.010*
Failed	17	56.7	26	86.7	
RR 35/min or above, this rate lasts for more than 5min.	7	23.3	2	6.7	0.145
Hypoxemia	7	23.3	3	10.0	0.166
HR 140/min or above.	9	30.0	3	10.0	0.053
HR either increases or decreases 20% from original.	1	3.3	3	10.0	0.612
Systolic blood pressure is 180 mmHg or above.	0	0.0	2	6.7	0.492
Systolic blood pressure is 90 mm Hg or below.	1	3.3	1	3.3	1.000
Sedation Period(day)	4.40 ± 1.94		7.33 ± 3.23		0.000*
Sedation free (days)	6.90 ± 2.64		9.17 ± 2.91		0.007*

Table (4): distribution of patients in both groups in relation to sedatives administered during total period of ICU stay

Sedatives	Study(n= 30)		Control(n= 30)		P-value
	No.	%	No.	%	
Midazolam	30	100.0	30	100.0	--
<b>Total dose:</b>					0.000*
Mean ± SD	264.17 ± 133.79		458.37 ± 161.71		
Median (Range)	237.5 (90.0-725.0)		450.0 (150.0-753.0)		
Propofol	6	20.0	15	50.0	0.015*
<b>Total dose:</b>					0.201
Mean ± SD	875.00 ± 1189.43		1790.00 ± 1239.84		
Median (Range)	500.0 (50.0-3200.0)		1500 (50.0-3000.0)		
Tracurium	0	0.0	1	3.3	1.000

\*P<0.05 significant

P >0.05 not significant

**Table (5): Distribution of patients in both groups regards to clinical outcomes**

Clinical outcomes	Study (n= 30)		Control (n= 30)		P-value
	No.	%	No.	%	
VAP incidence	9	30.0	22	73.3	0.001*
Successful extubation	26	83.3	15	50.0	0.002*
Delirium	9	30.0	24	80.0	0.000*
DVT	2	6.7	9	30.0	0.043*
Pulmonary embolism	0	0.0	2	6.7	0.472
ICU mortality	7	23.3	8	26.7	0.766
MV Duration(days)	6.97 ± 3.00		13.63 ± 6.26		0.000*
ICU length of stay: (days)					0.000*
Mean ± SD	11.37 ± 3.48		17.50 ± 6.03		
Range	9-18		14-25		

\* $P < 0.05$  significant $P > 0.05$  not significant (NS)

MV = Mechanical ventilation

**Table (1)** Shows that two third of the studied groups were male, Regards to the clinical data, it observed that the most common medical diagnosis was head injury follow by chest trauma of both groups. Also, Majority of both groups with no comorbidity (76.7% vs. 70% respectively). In addition, the table illustrated the higher mean of APACHEII score in study group.

**Table (2)** presents a comparison between studied groups in relation to presence of VAP, It was observed that 90% study group patients had No VAP compared with 60% for control group at the 2<sup>nd</sup> day of this study. Significant differences were found between both groups presented by p value 0.007, with respect to the 5<sup>th</sup> day of study it was observed that a lower percent of study patients group (30%) had VAP than control group (73.3 %) had VAP with statistically significant differences presented by p value 0.001.

**Figure (1)** shows that Assessment of oral cavity dysfunction by using Beck oral assessment scale (BOAS) at the 5<sup>th</sup> day of study it was observed that a higher percent of study patients (66.7 %) had no oral dysfunction than control group. As regard to the 10<sup>th</sup> day the majority of study patients (80 %) had no oral dysfunction compared with 0% for control group. There were significant differences between studied groups regarding the mean of BOAS during the study days.

**Table (3):** currently available when the studied groups were compared in terms of awakening trials, it was shown that 43.3 % of the study group and 13.3 % of the control group passed the sedation vacation trial. The most prevalent reasons for trial failure were tachypnea, hypoxemia, and dysrhythmia (23.3% & 6.7%), (23.5% & 10%) and (30% & 10%) respectively.

**Table (4):** shows comparison between the studied groups in relation to sedatives consumption. The

result revealed that all studied patients (100%) received Midazolam while use of Propofol (20%) of study group compared to (50%) for control group. There were a statistical significant differences p value (0.015). Regarding to total dose of Midazolam, it was observed that were a statistical significant differences presented by P value (0.000). The Mean dose ± SD was (264.17 ± 133.79 & 458.37 ± 161.71) for study group and control group respectively with range (90 mg -725 mg) for study group and (150mg -753mg) for control group.

**Table (5):** represents clinical outcomes after ventilator care bundle implementation. It was discovered that the study group with ventilator care bundle implementation had a significantly shorter ICU stay, lower VAP, and a lower rate of delirium, while the control group had higher mortality, incidence of DVT, and Pulmonary embolism.

### Discussion:

Ventilator care bundles are standardized techniques based on differing levels of evidence that when used together, produce better results than used separately. it includes essential techniques including semi-recumbent positioning (HOB elevated between 30 and 45 degrees), oral care, daily sedation interruptions and spontaneous breathing trials, subglottic suctioning in addition to prophylaxis of stress ulcers and DVT. (Alsoda et al., 2019)

Findings of the present study shows that two third of the studied sample in both group were males, where study group aged from 18- 58 years old and observational group aged from 20- 59 years old. This results were accepted with the quasi experimental study of Khalil et al., 2018 who showed that the mean age of ventilated patients in both groups ranged between 45 and 48 years. Males represented 70% of patients in both groups. So no significant differences

were found between them.

Regarding to medical diagnosis of patients on admission to ICU, the current study revealed that head injury was identified in the majority of both groups, followed by chest trauma. Furthermore, there were no comorbidities in the majority of the study and control groups. In addition, the control group had a higher mean APACHE II score. This findings contrast those of **Mavinga et al., 2018** who claimed that hypertension was the most common prior medical history in their study "Implementation and evaluation of the impact of a ventilator-bundle at Kinshasa University Clinics."

The current study's mean APACHE II score was lower than that of **Gaspard, et al (2015)**, who compared deferent venous thromboembolism prevention in patients received MV . Hypertension was the most prevalent past medical history, followed by diabetes mellitus, according to the same study. This contradicts this study's findings, which suggested that diabetes was the most common past medical history. Also, (**Arabi 2016**) informed that the mean APACHE II score among ICU patients which receiving pharmacologic prophylaxis and IPC was lower than that of control patients.

In dimension of the Glasgow Coma Scale(GCS), there was no significant difference between the two groups in this study. This contradicts the findings of (**Lim et al. 2018** ) who found that the GCS scores were lower in the post-VAP bundle phase ( $p = 0.001$ ).

**According to VAP incidence** the current study found that in the second and fifth days of the study, the mean Clinical Pulmonary Infection Score(CPIS) was lower in the study group compared to the control group, with a statistical significant difference. It is in consistence with (**Haghighi et al., 2017**) who reported that the observational group receiving routine dental wash had a higher mean of CPIS than study group but without statistical significant difference. Furthermore, The effect of mouth care by chlorhexidine on critically ill patients evaluated by (**Andersen 2019**); (**Lavigne and Lavig, 2019**) The most important conclusion of these studies was that using oral care with chlorhexidine on mechanically ventilated patients reduced the occurrence of VAP considerably when compared to regular oral care.

**Atashi et al. 2018** stated that throughout the trial day, the frequency of VAP in the control group increased more than in the study group, but there was no significant difference between the two groups. On days 1, 3, and 5 of the same trial, there was no significant difference in mean CPIS between both groups ( $p > 0.05$ ). Also, in study titled "The effect of daily sedation interruption protocol on early incidence of ventilator-associated pneumonia among patients hospitalized in critical care units receiving

mechanical ventilation". **Shahabi, et al. (2016)** discovered that the mean CPIS score in the study group was lower than the control group with statistically significant, this suggested that occurrence of VAP was decreased in the study group.

**As regarded to assessment of oral cavity condition by using** Beck oral assessment scale. the results revealed that BOAS was higher in control group during the trial days compared with study group. **According to( Kord et al. 2021) & (Estaji et al. 2015)** use a toothbrush and chlorhexidine can help intubated patients in ICUs improve their dental health. The present study findings corroborated the findings of the research conducted by. (**Haghighi et al. 2017**) who reported that the observational group receiving routine dental wash had a lower BOAS score on day one compared to day 5 of the study, indicating that oral health deteriorated during hospitalization. During the trial days, however, the BOAS score for patients in the intervention group decreased significantly.

The findings of (**Abd Elbaky et al. 2015**) stated that a combined brush and chlorhexidine program plays a significant role in improving the oral health of intubated patients. Also, The similarity was discovered in a study titled "The Impact of Systematic Mouth Care on Oral Health Status in Patients in Intensive Care Units", in which( **Atashi et al., 2018**)

Researcher think that oral health improvement is linked to a systematic oral care program in addition Chlorhexidine that reduces the amount of dental plaque therefore enhance the oral health of intubated patients.

**Ali et al. 2019** in the study titled "Effect of Daily Interruption of Sedation on Level of Consciousness among Mechanically Ventilated Patient". Was noticed that there was a statistical significant difference between study and control groups regarding RASS score in second, third , fourth and fifth days. On the other hand, according to (**Aliye et al. 2017**) daily sedation interruption had little impact on the sedation level of ICU patients.

Because of a variety of factors, such as device noises, loss of contact with the outside environment, little contrast between day and night, intubation, MV., underlying difficulties, and discomfort, ICU patients are restless and require sedation. The ideal level of sedation is neither too profound nor too light. The medical team's planning and intervention are critical in this regard. The most common form of sedative employed in the current study was midazolam, which was readily available in the study's conducted by **Patel et al.(2014)** Who claimed midazolam is a well-known sedative for mechanically ventilated patients in ICU. additionally to that findings this study



revealed that the study group was received lower dose of Midazolam compared with the control group. This is consistent with (Ren et al. 2017) who found that the pre-ABCDE bundle group received a higher total dose of Midazolam than the post-ABCDE bundle group, which was statistically significant.

The majority of study group subjects and a small percentage of control group subjects passed the sedation test, according to the present study findings. Tachypnea, hypoxemia, and dysrhythmia were the most common three causes of trial failure. This is in line with (Girard, et al. 2008) study findings which stated that the most prevalent reasons for weaning trial failure were tachypnea, hypoxemia, and dysrhythmia.

As regarded to clinical outcomes, this study findings revealed that the study group had shorter time to successful extubation and a higher percentage of successful extubation starting on the seventh study day.

This is in line with (Mehta,2012) who cleared that trauma patients randomized to daily interruption had a significantly shorter time to successful extubation, a shorter ICU stay, a lower hospital mortality rate, a lower rate of unintentional device removal, delirium, tracheostomy, and physical restraint than those randomised to protocolized sedation alone, but there was no differences between groups. Also, It supported by the study of (Gaber et al., 2018) who presented that the number of patients who improved after being exposed to the proposed nursing guide line for sedated critically ill patient protocol was higher in the study group than in the control group. This is in line with the findings of (Ahmed et al., 2015) who discovered that interrupting sedation on a daily basis is a safe and practical way to manage patients who are on MV.

The present study showed that a combination of mechanical and pharmacological prophylaxis of DVT had lower rate of Venous thromboembolism VTE among study group than control group. This study is supported by the study of (Ley et al. 2020) who using of sequential compression devices with traumatic patients in ICU which reduced DVT incidence when no pharmacologic prophylaxis used. Also, (Ibrahim ,2015) informed that DVT incidence reduced after applying of SCDs in traumatic patient. (Sakai et al. , 2016). and studies of (Dhakal et al., 2019) stated that PE occurrence was higher in the control group versus the intervention group which receiving mechanical combined with pharmacological DVT prophylaxis.

This study is agreed with finding of (Sang et al., 2018) who stated that combination prophylaxis is superior to monoprophylaxis in decreasing VTE. and, (Wang et al., 2020) who reported reducing

incidence of venous thrombosis when used pneumatic compression as thromboprophylaxis in critically ill patients. Furthermore, (Kakkos et al., 2016) mentioned that intermittent pneumatic compression and anticoagulants prophylaxis were found to be effective in reducing rate of pulmonary embolism and DVT than using pharmacological prophylaxis only.

Regarding to secondary outcomes after VCB application on the study. The present research discovered that patients of bundle(intervention group) had a significantly shorter ICU stay, lower VAP, and a lower rate of delirium while the control group had higher mortality, incidence of DVT, and pulmonary embolism. This is finding supported by (Gaspard et al., 2015) who reported that the mean LOS on ICU & NO. Of days on MV among patient receiving mechanical Prophylaxis were lower than that in chemical Prophylaxis group. Also, The present study is in agreement with the study done by (Eweas et al., 2021), who reported that after ventilator bundle implementation, more than half of the study group had a shorter period of mechanical breathing support compared to only (40.0 percent) of the control group.

Ren et al., 2017 discovered that the incidence of delirium was lower in the bundle group than in the control group, and that the mean of MV duration and length of ICU stay were also lower in the study group when compared to the control group.

According to (Mavinga, et al., 2018) the study findings showed that implementing a prevention regimen of the kind «bundle» efficiently reduced VAP occurrence , on the other hand, found no evidence of a substantial influence on MV days or death on individuals on MV.

The Ventilator bundle's implementation is a practical reality that leads to improvements in microbiological measurements and nosocomial infection rates, as well as lower mortality, shorter hospital stays, and cheaper medical care expenditures (Samra et al., 2017).

This study revealed that the mean of ICU stay and MV duration were lower in study group. The researcher think this could relate to the improvement in oxygenation achieved post implementation of ventilator bundle , resulting in speedy recovery and discharge. In addition, the lower incidence of Delirium during the introduction of the VAP bundle could be related to strong adherence to daily sedation interruption . Also, researcher guesses that VAP was higher in the control group, as increase rate of reintubation which was one of the risk factors for VAP.

The present study is supported with (El-Sharkawy et al., 2017) who found that there was a significant statistical difference between the study group and the control group in terms of compliance with individual

ventilator bundle elements such as head-of-bed elevation, sedation interruption, and assessment of extubation readiness.

### Conclusion

Based on the results of the current study it can be concluded that the Ventilator care bundle (VCB) protocol which applied in the present study is an effective approach to reduce the incidence of VAP in mechanically ventilated patients. In addition, it was important in reducing the ICU length of stay although it did not affect the incidence of mortality significantly.

### Recommendations

Based on the finding of the current study, the following recommendations are suggested; The hospital administration should assign a respiratory team for caring with mechanically ventilated patients, Further studies are needed to test the effectiveness of ventilator care bundle implementation on specific patients (e.g severe head trauma, neurological patients,.....etc), Further studies were recommended by using a larger sample size and Further studies are needed to test the implementation and compliance of ventilator care bundle by nurses.

### References

- Abd Elbaky, M. M., Youssef, I. A., El-Soussi, A. H., El-Aziz, A., & Anwar, M. (2015): Effect of Two Standardized Oral Hygiene Methods on Bacterial Colonization in Mechanically Ventilated Patients. *Assiut Scientific Nursing Journal*, 3(5.0), 1-11.
- Ahmed S., Eiman A., Nuha A., Awad H., (2015): The success rate of split-night polysomnography and its impact on continuous positive airway pressure compliance, *Annals of Thoracic Medicine* | Published by Wolters Kluwer, 10(4): 274-278.
- Alcan, A. O., Korkmaz, F. D., & Uyar, M. (2016): Prevention of ventilator-associated pneumonia: Use of the care bundle approach. *American journal of infection control*, 44(10), e173-e176
- Ali SA, Abdel El-Aziz MA, Morsy KM & Ahmed MA, (2019): Effect of Daily Interruption of Sedation on Level of Consciousness Among Mechanically Ventilated Patients *Assiut Scientific Nursing Journal* Vol , (7) No, (16) March, 2019.
- Aliye O., Meryem Y., Gulin D., Ziyne H., Erdem K., & Mehmet U., (2017): Effect of patient position on endotracheal cuff pressure in mechanically ventilated critically ill patients, *Australian Critical Care*, Australian College of Critical Care Nurses, 30(5): 267-272.
- Almgren M. ,M. Lundmark and K. Samuelson,(2010) The Richmond Agitation-Sedation Scale: translation and reliability testing in a Swedish intensive care unit, *Acta Anaesthesiol Scand. journal* vol 54: p.p729–735.
- Alsoda MF, Al-Shahat MM, K. Reda SM, Alsawah AY, M. Abboud MA, Elgendy, (2019): Implementation of ventilator bundle for prevention of ventilator-associated pneumonia in pediatric intensive care unit. *J Med Sci Res*;2:265-72
- Ames NJ, Sulima P, Yates JM, McCullagh L, Gollins SL, Soeken K, et al.,( 2011): Effects of systematic oral care in critically ill patients; a multicenter study. *Am J Crit Care*;20(5):e103–114.
- -Andersen B.M. (2019) Oral Hygiene. In: *Prevention and Control of Infections in Hospitals*. Springer, Cham pp 265-272.
- Arabi, Y. M. (2016). The impact of implementing multifaceted interventions on the prevention of ventilator-associated pneumonia, *American journal of infection control*, 44(3), 320-326.
- Assuit University Hospital records (2019).
- Atashi V, Yazdannik A, Mahjobipoor H, Yousefi H, Bekhradi R.,(2018) The Impact of Systematic Oral Care on Oral Health Status in Patients of Intensive Care Units. *J Health Care.*;20(3):244-51.
- Batra, P., Soni, K. D., & Mathur, P. (2020). Efficacy of probiotics in the prevention of VAP in critically ill ICU patients. *Journal of Intensive Care*, 8(1), 1-14.
- Bazan, G., Ewing, B., Grissman, C., Marpa, A., Montgomery, A., & Overman, T. (2020). Effects of Sedation Vacations and Sedation Level Quality Improvement Project.
- Cutler, L. R., & Sluman, P., (2014). Reducing ventilator associated pneumonia in adult patients through high standards of oral care: a historical control study. *Intensive and Critical Care Nursing*, 30(2), 61-68.
- Dhakal, P., Wang, L., Gardiner, J., Shrotriya, S., Sharma, M., & Rayamajhi, S. (2019): Effectiveness of Sequential Compression Devices in Prevention of Venous Thromboembolism in Medically Ill Hospitalized Patients, *Turkish journal of haematology*, 36(3), 193–198.
- Diaz, L. B. (2020). Paired Spontaneous Awakening Trial and Spontaneous Breathing Trial Protocol Implementation.
- El-Sharkawy MA, Mohamed WY, Ali NS.,( 2017): Effect of ventilator bundle implementation on weaning indicator among mechanically

- ventilated patients at a selected private healthcare sector. *Egypt Nurs J* 14:50-7.
- **Epstein SK (2002):**Endotracheal extubation, *Respiratory care clinic N Am* 6:321- 360.
  - **Estaji Z, Alinejad M, Hassan Rakhshani M, Rad M.,( . 2015 )** The Comparison of Chlorhexidine Solution and Swab With Toothbrush and Toothpaste Effect on Preventing Oral Lesions of Patients in Intensive Care Unit. *Glob J Health Sci.*8(5):211-6.
  - **Eweas, A., Mohammad, S., Sayyed, J., Abd Elbaky, M., & Bayoumi, M., (2021):** Application of Modified Ventilator Bundle and Its Effect on Weaning and Ventilation Days among Critical Ill Patients. *Evidence-Based Nursing Research*, 2(4), 9.
  - **Gaber HH, Ahmed AM, Mehany MM & Mahgoub AA.( 2018):** Effect of Implementing Nursing Guideline on Critically Patients Outcomes' Regarding Sedation. *Assiut Scientific Nursing Journal Vol , (6) No, (15).*
  - **Gaspard, D., Vito, K., Schorr, C., Hunter, K., & Gerber, D. (2015):** Comparison of Chemical and Mechanical Prophylaxis of Venous Thromboembolism in Nonsurgical Mechanically Ventilated Patients, *Thrombosis*, 2015, 1–6.
  - **Gaudet, A., Martin-Loeches, I., Povoas, P., Rodriguez, A., Salluh, J., Duhamel, A., (2020).** Accuracy of the clinical pulmonary infection score to differentiate ventilator-associated tracheobronchitis from ventilator-associated pneumonia. *Annals of Intensive Care*, 10, 1-10.
  - **Girard, T. D., Kress, J. P., Fuchs, B. D., Thomason, J. W., Schweickert, W. D., Pun, B. T., ... & Ely, E. W. (2008):** Efficacy and safety of a paired sedation and ventilator weaning protocol for mechanically ventilated patients in intensive care (Awakening and Breathing Controlled trial): a randomised controlled trial. *The Lancet*, 371(9607), 126-134.
  - **Haghighi, Shafipour, Bagheri-Nesami, M., Gholipour Baradari, A., & Yazdani Charati, J., (2017):**The impact of oral care on oral health status and prevention of ventilator-associated pneumonia in critically ill patients. *Australian Critical Care*, 30(2), 69–73.
  - **Ibrahim, M., Ahmed, A., Mohamed, W. Y., & El-Sayed Abu Abduo, S. (2015):** Effect of Compression Devices on Preventing Deep Vein Thrombosis Among Adult Trauma Patients. *Dimensions of Critical Care Nursing*, 34(5), 289–300.
  - **Kakkos SK, Caprini JA, Geroulakos G, Nicolaides AN, Stansby G, Reddy DJ, Ntouvas I. (2016):**Combined intermittent pneumatic leg compression and pharmacological prophylaxis for prevention of venous thromboembolism, Issue 9.
  - **Kao, C. C., Chiang, H. T., Chen, C. Y., Hung, C. T., Chen, Y. C., Su, L. H. & Hsueh, P. R., (2019).** National bundle care program implementation to reduce ventilator-associated pneumonia in intensive care units in Taiwan. *Journal of Microbiology, Immunology and Infection*, 52(4), 592-597.
  - **Klompas, M., Li, L., Kleinman, K., Szumita, P. M., & Massaro, A. F. (2016):** Associations between ventilator bundle components and outcomes. *JAMA internal medicine*, 176(9), 1277-1283.
  - **Khalil, N. S., Mohamed, W. Y., & Sharkawy, M. A. M. (2018).** Patients' weaning from mechanical ventilation: Complete versus incomplete ventilator bundle implementation. *International Journal of Africa Nursing Sciences*, 8, 28–32.
  - **Kord Salarzahi F , Rahat Dahmardeh A , Nasiodin Tabatabaei S M, Yaghoubinia F.,( 2021):** Effects of a Comprehensive Oral Care Program and a Combined Toothbrush and Mouthwash Program with 0.2% Chlorhexidine on Oral Health in Mechanically Ventilated Intubated Patients: A Clinical Trial, *Med Surg Nurs J.* 9(4):e114194.
  - **Lavigne PS and Lavig MC (2019):** Performance Summary of Agents Used in Oral Care for Non-Ventilated and Mechanically-Ventilated Patients. *Anna Pul and Crit Car Med.*; 2(2): 01-34.
  - **Ley, E. J., Brown, C., Moore, E. E., Sava, J. A., Peck, K., Ciesla, D. J., Sperry, J. L., Rizzo, A. G., Rosen, N. G., Brasel, K. J., Kozar, R., Inaba, K., & Martin, M. J. (2020):**Updated guidelines to reduce venous thromboembolism in trauma patients: A Western Trauma Association critical decisions algorithm, *Journal of trauma and acute care surgery*, 89(5), 971.
  - **Mehta, S. (2012).** Daily Sedation Interruption in Mechanically Ventilated Critically Ill Patients Cared for With a Sedation Protocol. *JAMA*, 308(19)
  - **Moustafa, M. F., Tantawey, N. M., El-Soussi, A. H., & Ramadan, F. A. (2016):** The effect of oral care intervention on the occurrence of ventilator-associated pneumonia. *Gynecol Obstet (Sunnyvale)*, 6(383), 2161-0932.
  - **Patel, S., Poston, J., Pohlman, A., Hall, J., & Kress, J., (2014):** Rapidly reversible, sedation related delirium versus persistent delirium in the intensive care unit. *American journal of respiratory and critical care medicine*, 189 (6), 658-665

- **Prakash, S. S., Rajshekar, D., Cherian, A., & Sastry, A. S. (2017).** Care bundle approach to reduce device-associated infections in a tertiary care teaching hospital, South India. *Journal of laboratory physicians*, 9(04), 273-278.
- **Ren, X. L., Li, J. H., Peng, C., Chen, H., Wang, H. X., Wei, X. L., & Cheng, Q. H. (2017).** Effects of ABCDE Bundle on Hemodynamics in Patients on Mechanical Ventilation. *Medical science monitor: international medical journal of experimental and clinical research*, 23, 4650–4656.
- **Sakai T, Izumi M, Kumagai K, Kidera K, Yamaguchi T, Asahara T, Kozuru H, Jiuchi Y, Mawatari M, Osaki M, Motokawa S, Migita K (2016):**Effects of a foot pump on the incidence of DVT after total knee arthroplasty in patients given edoxaban: a *Medicine (Baltimore)*; 95(1):e2247.
- **Samra, S. R., Sherif, D. M., & Elokda, S. A. (2017).** Impact of VAP bundle adherence among ventilated critically ill patients and its effectiveness in adult ICU. *Egyptian Journal of Chest Diseases and Tuberculosis*, 66(1), 81–86.
- **Sang, C. Q., Zhao, N., Zhang, J., Wang, S. Z., Guo, S. L., Li, S. H., Jiang, Y., Li, B., Wang, J. L., Song, L., Zhai, J. J., & Zhang, Z. Y. (2018):**Different combination strategies for prophylaxis of venous thromboembolism in patients: A prospective multicenter randomized controlled study, *Scientific reports*, 8(1), 8277.
- **Shahabi, M., Yousefi, H., Yazdannik, A. R., & Alikiaii, B. (2016).** The effect of daily sedation interruption protocol on early incidence of ventilator-associated pneumonia among patients hospitalized in critical care units receiving mechanical ventilation. *Iranian journal of nursing and midwifery research*, 21(5), 541–546.
- **Wang, Y., Huang, D., Wang, M., & Liang, Z. (2020):** Can Intermittent Pneumatic Compression Reduce the Incidence of Venous Thrombosis in Critically Ill Patients: A Systematic Review & Meta-Analysis. *Clinical & Applied Thrombosis/Hemostasis*, 26, 10.