Effect of Implementing Nursing Interventions on Weaning from Mechanical Ventilator Based on Burns Wean Assessment Program (BWAP)

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Abstract

Background: The patients' spent time on the ventilator and its associated difficulties can be minimized through the efficient planning and implementation of nursing interventions to assess the patient's readiness for ventilator weaning. The assessment of nursing interventions' efficacy on weaning from mechanical ventilation has not been adequately performed. This study **aims** to investigate the effect of implementing nursing intervention on weaning from mechanical ventilators based on a burns wean assessment program. **Method**: There are 88 mechanically ventilated patients in this quasi-experimental study (44 patients in each intervention and control group). It was carried out at the Mansoura University Hospital's intensive care unit for anesthesia in Egypt. **Two methods** were used to gather data: an assessment **tool** for patients who were mechanically ventilated, and evaluation tools that were based on the patient's ventilation indicators and the Burns' Wean Assessment Program checklist. **Results**: Compared to the control group, the majority of the intervention group was effectively weaned off of intrusive mechanical ventilation during the trial of spontaneous breathing on the first try. When comparing the intervention group to the control group, the intervention group's length of stay in the critical care unit and ventilation was shorter. **Conclusion**: The intervention group displayed higher weaning scores than the control group. Therefore, integration of the nursing intervention based on the Burns Wean Assessment Program of mechanically ventilated patients is recommended to improve weaning success and reduce the duration of mechanical ventilation.

Keywords: Nursing Interventions, Weaning from Mechanical Ventilator, Burns Wean Assessment Program, Mechanical Ventilation, Weaning

Abbreviations: Critically ill patients (CIPs), intensive care units (ICUs), ventilator-associated pneumonia (VAP), mechanically ventilated patients (MVPs), mechanical ventilation (MV), invasive mechanical ventilation (IMV), Rapid Shallow Breathing Index (RSBI), Burns Wean Assessment Program (BWAP),

Introduction

Critically ill patients (CIPs) are admitted to intensive care units (ICUs) for a variety of factors, such as the need for endotracheal intubation, malnutrition, and fluid loss through fever, diarrhea, and reduced fluid intake which suppose these patients developing oral difficulties quickly (**Atashi et al., 2018**). They frequently require ventilatory support as a lifesaving intervention (**Modrykamien, 2019**). Mechanical ventilation is required for patients who are unable to breathe due to many factors such as trauma, recent surgery, or a medical condition (De Haro et al., 2019). Mechanical ventilation is provided via tracheal intubation which increases the incidence of bacteria colonization and causes many complications such as ventilator-associated pneumonia (VAP) and oral infections **(Anggraeni, Hayati, &Nur'aeni, 2020)**

Ventilator-associated pneumonia is a serious healthcare-associated infection that develops in mechanically ventilated patients (MVPs) for more than 48 hours **(Hellyer, Ewan, Wilson, & Simpson, 2016)**. It causes increased mortality and morbidity, and consequently,

increased health-related costs. VAP is the most common infection in MVPs and the second most common hospital-associated infection associated with higher mortality rates between 20% and 70% and increased hospital lengths of stay from 4-13 days. So, weaning from mechanical ventilation (MV) should be initiated when the patient's condition stabilizes **(Goldsmith, Karotkin, Suresh, & Keszler, 2016, Ahmed, Sobeih, and Abdelsalam, 2019).**

On the other hand, up to 30% of CIPs experience difficulties in weaning from IMV. Successfully weaning patients from ventilatory support is the greatest problem faced by critical care nurses when caring for MVPs **(Shehab, Sadoon, Nasser, & Fathy, 2018).** The first step in weaning a patient from invasive MV is to determine whether they are ready to be weaned. The ability to initiate spontaneous breathing, sufficient gas exchange, and the reversal of the indication for invasive mechanical ventilation (IMV) a stable hemodynamic state, sufficient breathing efforts, the absence of excessive bronchial secretions, and a manageable level of anxiety and nervousness (**Yazdannik, Salmani, Irajpour, & Abbasi, 2012; Zein, Baratloo, Negida, & Safari, 2016, Nickson, 2019**).

Critical care nurses should focus on the interventions that assist the MVPs to reach this readiness point. They should be prepared to use weaning tools and protocols from MV effectively and safely. It is recommended that the use of standard weaning practices decreases the time of MV (**Huaringa, Wang, Haro, & Leyva, 2013; Nitta et al.,2019**). According to the Rapid Shallow Breathing Index (RSBI), if it is low, this is a good indicator of weaning success. However, when the number is close to 105, it is not very useful (**Huaringa et al., 2013, Ward & Fulbrook, 2016)**

Significance of the study

The BWAP is a comprehensive clinical weaning checklist that evaluates the criteria of the patient's weaning from the MV systematically and comprehensively **(Burns. Ryan & Burns, 2000).** This checklist examines the criteria of physiological and psychological status, lung function, and gas change**. Burns et al. (2010)** revealed that the BWAP program is a successful weaning strategy from MV in patients under ventilation for more than three days Additionally, **Burns et al. (2010**) suggested analyzing and more closely examining the BWAP clinical checklist in subsequent research. BWAP can be a useful and efficient approach in determining whether patients are ready to wean. **Furthermore, Keykha, Rahat Dahmardeh**, and **Khoshfetrat (2017)** revealed that assessing the patient's readiness using the BWAP checklist increases successful MV weaning.

There are very few Egyptian studies on this topic. only in this research, the majority of ICUs examine patients' weaning off of the MV device experimentally only on a set of criteria and only with the doctor's orders; no other tool is used to determine the patient's readiness **(Kashefi, Abbasi, Katiraei, & Alikiaii, 2016).** So, the implementation of nursing intervention based on BWAP will reduce the incidence of such complications, improve the quality of patient care, and improve the prognosis of patients' condition and this in turn would decrease the length of ICU stay, and decrease health care costs. The application of BWAP produced positive outcomes. In this way, BWAP is an efficient and effective tool that can be used in assessing patients' readiness for weaning.

Aim of the Study

This study aims to assess the effect of implementing nursing intervention on weaning from mechanical ventilators based on the BWAP program.

Research hypothesis.

To fulfill the aim of this study, the following research hypothesis was formulated:

H1: Patients who received nursing intervention about weaning from a mechanical ventilator based on the BWAP had better successful weaning than those who received routine ICU care.

Method

Study design:

A quasi-experimental research design with a nonequivalent control group was used to conduct the current study. It is an empirical study used to investigate the effect of an independent variable on a dependent variable without randomization (Nestor & Schutt, 2018).

Setting:

The study was conducted at Anesthesia ICU affiliated with Mansoura University Hospital in Egypt. Anesthesia ICU includes 8 beds that provide direct care to CIPs with various disorders. This ICU is well equipped with advanced machines, equipment, and the manpower required for patients' care. The nurse-patient ratio in the ICU is nearly 1:2.

Study sample:

A Purposive sample of 88 patients was admitted to the previously selected ICU during the study period. Patients were assigned randomly and enrolled into two groups: an intervention group and a control group (44 patients in each one) according to the following criteria:

Inclusion criteria

Patients aged >18 years, were orally intubated with a mechanical ventilator. Patients with a Glasgow coma scale more than or equal to 9 and no scheduled surgery in the following 72 hours.

Exclusion criteria

Patients suffering from any disorders that contraindicated implementation of nursing intervention such as brain stem infarction and neuromuscular diseases.

The sample size:

The sample size was calculated based on data from a study by Sepahyar, Molavynejad, Adineh, Savaie, and Maraghi, (2021) using the following formula: $n = [(Z\ \alpha/2 + Z\ \beta) \wedge 2 \times \{2(SD) \wedge 2\}]/$ (mean difference between the two groups) $\wedge 2$, where SD = standard deviation obtained from the previous study; $Z\ \alpha/2$ for a 95% confidence interval is 1.96; and $Z\beta$ for 80% power is 0.84. Therefore, $n = [(1.96 + 0.84) \wedge 2 \times \{2(1.5) \wedge 2\}] / (0.95) \wedge 2 = 40$ for each group. Considering a 10% dropout rate, 4 patients will be added to each group, totaling 44 patients in each group.

Data Collection Tool

Two tools were used to collect the data.

Tool I: Mechanically Ventilated Patients' Assessment Sheet

This tool was developed by the researchers based on reviewing recent relevant literature (Hirzallah, Alkaissi, & do Céu Barbieri-Figueiredo, 2019; Keykha, et al., 2017; Khalafi, Elahi, & Ahmadi, 2016; Yazdannik, Salmani, Irajpour, & Abbasi, 2012). It consisted of two parts as follows:

Part I: Patient's Demographic and Health-Relevant Data

This part highlighted the patient's data as date of admission, age, gender, medical diagnosis, length of ICU stays, past medical history, level of consciousness based on GCS and FOUR scales, and shallow respiratory index. It is used once for both groups.

Part II: Patient Physical Assessment

This part was used for both intervention and control groups, which includes patient physical assessment of body systems that include respiratory, cardiovascular, and neurological systems by using the Glasgow coma scale. It measured the patient's agitation or sedation level using the Richmond Agitation Sedation Scale and laboratory investigations.

Tool II: Mechanically Ventilated Patients' Evaluation Sheet

This tool was used to investigate the effect of implementing nursing intervention on MV successful weaning. It includes two parts:

Part I: Burns Weaning Assessment Program Checklist

It was adopted from S. Burns, et al (1994). It is used to evaluate and monitor the MVPs' weaning process. The two main components of the assessment of weaning are covered by the BWAP score, which consists of (26 elements): a general assessment (12 items) and a respiratory examination (14 items). Use BWAP scores for the two groups under study once daily from the start of the MV for 24 hours until the patient is extubated.

The scoring system: The BWAP checklist required only one of the three responses (yes, no, or not assessed). "Yes" response = 1 (indicating that the factor meets the established threshold definition), while "No" response or "not assessed" = zero (indicating that the factor does not meet that one or inadequate data is available). The patient's assessment using this checklist lasted about 45 minutes. The BWAP score was calculated by dividing the total number of 'yes' responses by 26 thresholds. A BWAP score of ≥ 65% was considered probable weaning, while < 65% was considered improbable weaning (Keykha et al., 2017; Yazdannik et al., 2012).

Part II: Patient's Ventilation outcomes

This part was developed by researchers based on reviewing recent relevant literature (Hirzallah et al., 2019; Keykha, et al., 2017) It is used to evaluate the nursing intervention effect on patients' ventilation status including ventilation duration, length of ICU stays, weaning process outcome, vital signs, and lab investigations.

Tools Validity and reliability

Content validity was conducted to determine the extent to which the tools being used measure what is intended to be measured. The developed tool was evaluated by a panel of experts in the fields of critical care nursing and medicine. Tools items were examined in connection to the research concept and their correlation with one another to determine tool reliability. The first tool's Cronbach's alpha reliability was (0.87), whereas the second tool's part II was (0.74).

Pilot Study

A pilot study was carried out on 10% of the total sample (8 patients), who were excluded from study subjects. It was conducted to test the feasibility and clarity of the tools. Necessary modifications were made accordingly.

Ethical Considerations

Ethical approval was obtained from the research ethics committee (REC) of the Faculty of Nursing - Mansoura University with Ref. No. P. 0529. As well, the administrative authority of the hospital also provided formal acceptance. The patients' families (next of kin) gave their informed consent after being made aware of the study's purpose, methodology, advantages, and disadvantages. They were also reminded of the voluntary nature of involvement and their unassailable right to withdraw at any time.

Data Collection

The study was conducted in three phases: preparation, implementation, and evaluation. The data were collected between September 2023 and April 2024

Preparation phase: During this phase, data collection tools were prepared, ethical approval was obtained, and the study was obtained permission to be conducted by the hospital. An informed consent form was obtained. This phase was completed in two months (September and October 2023).

Implementation phase:

This phase was conducted in six months (November 2023 to April 2024). All patients admitted to the ICU underwent screening daily to determine their eligibility for research participation. Data collection was initiated by the researchers from the control group. Tool I was used to gather the patients' baseline and health-relevant data. The patient's relatives, health team members, and medical records were the sources of these data. The control group's patients received routine ICU care that involved

raising the head of the bed between 30% and 45%, sedation interruption, performing patient hygiene, monitoring patients, giving enteral nutrition, and administering drugs.

Additionally, following 42–48 hours of mechanical ventilation, the doctor evaluated the patient's preparedness for weaning using a set of criteria based on the ICU standard procedure. In the routine weaning method, the patient underwent a weaning process under the guidance of the physician, following certain guidelines based on the standard ICU procedure. The patient needs to be awake or as alert as possible to maintain his airway open, have a good cough and swallow reflex, breathe normally without the need for a ventilator, have a respiration rate of no more than 35, have a Spo2 of no more than 90, and be able to lift his head off the bed and bear a T-tube.

In the intervention group, nurses received face-to-face instruction from the researchers to help them get familiar with the BWAP checklist, and educational pamphlets were distributed about the nursing interventions based on the BWAP program that were adopted from **Sepahyar et al. (2021),** see Figures 1& 2. These interventions included the following: maintaining hemodynamic and metabolic stability, assessment of nutrition, hydration, and electrolytes, providing comfort, adequate sleep and rest, and assessment of anxiety, agitation, and bowel sound. In addition, providing an active and passive range of motions, assessment of breathing rate and pattern, respiratory sounds, chest radiograph, and intervention to prevent abdominal distention. Assessment of the endotracheal and tracheostomy tube size, encouraging the patient to cough, periodic deep breathing, respiratory physiotherapy, and airway clearance, checking swallowing ability, ABG control and proper setting of ventilator parameters, and correct setting of ventilator parameters to correct acid-Acid. The researchers obtained permission from the hospital administrative authority

Before starting the weaning process, the patient's readiness was assessed by the researchers every day during the morning and afternoon shifts (using the BWAP checklist. Throughout the morning and afternoon shifts, the researchers kept an eye on the nursing interventions carried out by the intervention group and documented any changes in the patient's condition for readiness to initiate the weaning process. If the patient received a score >17 on the BWAP checklist, the process of weaning was started. If the patient did not obtain this score, nursing interventions were conducted emphasizing the main problem of difficult weaning identified in BWAP throughout the day.

All patients in both the intervention and control groups were closely monitored during the weaning process. If any of the following conditions were observed, they would indicate that the patient was not tolerant to the intervention; the intervention would end and the patient would be reconnected to the mechanical ventilation device; O2sat <90%; arterial blood partial pressure of carbon dioxide (PaCO2) >50 mmHg; arterial blood partial pressure of oxygen (PaO2) <60 mmHg with FIO2 >40%; arterial blood pH of 7.32 or more; respiratory rate of 38 or more, or a 50% rise in comparison to the baseline for at least five minutes; heart rate of 140 or more, or a continuous increase or reduction >20% compared to the baseline, systolic blood pressure more than 180 mmHg or less than 90 mmHg.

Lastly, the staff member made sure the nursing interventions were carried out correctly via daily monitoring. Competence, willingness to engage in the study, availability in the ICU, and commitment to offer direct patient care were the criteria used to select the assigned staff.

Evaluation phase:

Weaning outcomes, both successful and unsuccessful, were included. Using part 2 of tool II, the length of each patient's ICU stay, and the duration of their ventilation were assessed once their weaning process was complete.

Statistical Analysis of Data

The descriptive statistics of frequency distribution, percentages, means, and standard deviations (SD) were used to summarize, tabulate, and show the data. Because it includes

the significance test provided in conventional statistical books, the Statistical Program for the Social Sciences (SPSS), version (22) was utilized for the data's statistical analysis. The mean and standard deviation were used to express numerical data. Frequency and percentage (%) were the methods used to express qualitative data. The frequencies and correlations between the research variables were compared using the chi-square, The degree of significance of the data was determined by the probability or P-value: a p-value > 0.05 was deemed not significant (NS), and a P-value < 0.05 was deemed significant.

Hemodynamic stability	Stability of heart rate and rhythm and blood pressure without the use of vasoactive drugs or administration of any oral medication, Hct ** >25% (or base)	Cardiac and CVP *** monitoring checking ventilator setting, considering side effects of drugs, skin turgor test for dehydration, and control of hemorrhage and paying attention to gastrointestinal bleeding detected through NG-Tube lavage and presence of melena
Metabolic stability	Absence of sepsis, active infection, thyroid disorders, and seizure	Monitoring body temperature and WBC***** assessment of colour and amount of sputum and using sterile techniques for suctioning airways, control of seizures and administration of anticonvulsant drugs
Hydration & Electrolytes	Assessment of absorption, excretion, and weight	Control of Intake and output, testing skin turgor, peripheral edema, cervical vein dilation and reporting abnormal electrolyte levels
Nutrition	Assessment of serum albumin levels	Skin turgor test, correcting low serum albumin levels, daily sodium, and potassium control, considering muscle weakness and sensitivity, the start of TPN****** if administered, assessment of abdominal distension and bloating, slow gavage, and control of residual volume
Comfort, Adequate sleep and rest	No pain - No sleep disturbance	Assessment of pain symptoms including physiological parameters (e.g., tachycardia, tachypnea, perspiration, and intolerance of ventilator machine), opiate infusion, avoid unnecessary routine patient care, reduce alarms and ringtones, avoid talking loudly at nig
Anxiety and agitation	No anxiety and agitation	Assessment of anxiety and agitation severity based on the (RASS *******), assessment and elimination of causes of anxiety and agitation including hypoxia and hypercapnia, pain and fear, assessment of oxygen uptake, the need for suctioning, checking ventilator setting, offering simple explanations on patient care, and giving the patients enough time to be alone with their families
Bowels	Normal bowel function	Assessment of ileus or abnormal bowel function, daily control of sodium/potassium level, slow gavage to avoid cramps and diarrhea; recording the amount of received food, precise control of absorption and excretion, use of infusion pump in TPN if the patient has difficulty in excreting residuals from the body, abdominal percussion to avoid abdominal distention, changing patients' position every 2 h
Overall body strength/endurance	Moving from a supine position in the bed to hanging from the bed, keeping upright at the bedside, standing up with help, walking at the bedside, etc.	Active and passive range of motions, preventing hip external rotation through proper posture, and preventing foot drop.

Figure 1: Nursing Interventions Based on the BWAP program Adopted from Sepahyar et al. (2021)

Breathing rate and pattern, Respiratory sounds, Chest radiograph	Normal breathing rate and pattern	Assessment of patient compliance with the machine, assessment of abnormal respiratory patterns such as Cheyne-Stokes, Kussmaul and apnea, ABG ******** assessment, suctioning, changing patients' position, and respiratory physiotherapy
Sputum	Small and clear sputum	The use of bronchodilators, the use of aseptic techniques to reduce the risk of infection, ventilator tube replacement every 24 to 48 hours, discharge of the fluid accumulated in ventilator tubes, respiratory physiotherapy, humidification of respiratory gases
Abdominal distension	No abdominal distention	Paying attention to the factors causing abdominal distension and ileus, hypokalaemia and high-potassium diet, slow gavage, paying attention to patient tolerance of a semi-seated position to reduce intra-abdominal pressure and increase chest wall elastance
Endotracheal and tracheostomy tube size	Endotracheal tube ≥7.5 mm Tracheostomy ≥6	Assessment of the tube size, ensuring proper placement of the tip of the tube, and informing the need for tube replacement
Ability to maintain an open airway	Ability to cough and swallow	Encouraging the patient to cough, periodic deep breathing, respiratory physiotherapy, and airway clearance checking swallowing ability
Strength and endurance of respiratory muscles	Negative inspiratory pressure ≤20 cm H_2O Positive inspiratory pressure ≥30 cm H_2O Spontaneous tidal volume >5 ml/kg (VC *********) >10 mL/kg	ABG control and proper setting of ventilator parameters, assessment of hyperventilation causes such as sputum accumulation, hypoxia, pain, fear, and anxiety
Arterial blood gases	ABG ********	Correct setting of ventilator parameters to correct acid-base variations

*Burns Wean Assessment Program, ** Hematocrit, ***Central Vein Pressure, **** Naso -Gastric Tube, ***** White Blood Cell, ******Total Parenteral Nutrition, ******* Richmond Agitation-Sedation scale ******** Atrial Blood Gas *********, Vital Capacity

Figure 2: Nursing Interventions Based on the BWAP program Adopted from Sepahyar et al. (2021)

Results

Regarding the patients' socio-demographic characteristics, table 1 shows that nearly half (45.5%) of the study group, and more than half (54.5%) of the control group were between 40 and 50 years old. More than two-thirds of both studied groups were males (study group, 63.6% & control group 77.3%). Regarding patients' diagnosis, more than one-third of the study and control groups were admitted to the ICU postoperatively (40.9% & 38.6%, respectively). The most common comorbidities among the studied patients were hypertension and Diabetes Mellitus (study group, 43.2% & 36.4%; control group, 50% & 47.7%, respectively).

Concerning the level of consciousness, the results demonstrated that the mean score of the GCS among the study group on the admission time was 9.0 ±1.43 and 11.18 ±1.41 during the weaning time. For the control group, the mean GCS was 8.88 ± 1.52 on admission and 10.15± 1.91 in the weaning time. On admission, the mean scores of the four scales of the study group were 10.18 ±1.35 and 10.13 ±1.40 for the control group. There was a significant difference between the studied groups regarding the four scales in the weaning time (P=0.001). Furthermore, all participating patients had an artificial airway while most of them had a Rapid Shallow Breathing Index (95.5% & 97.7%).

Table 2 illustrates the health-relevant data, all hemodynamic parameters, ventilator parameters, and laboratory data were matched in both groups with no significant difference between the two groups (P>0.05).

Table 3 describes the daily RASS assessment during the study period between the study groups. It was discovered that the intervention group had much higher frequency of optimal RASS scores (-2 to 1) than did the control group. Additionally, on the fourth, fifth, sixth, and seventh days of the trial, there were statistically significant differences (p<.0.05) between the two groups.

Regarding the BWAP for both groups during the study time except the first day of the study, table 4 demonstrates that 95.5%, 68.2%, and 60.5 % of study group patients obtained a BWAP score ≥ 65% on 2nd, 3rd, and 4th day of the study, respectively. For the control group, most of them (97.7%, 84.1%, & 81%) obtained a BWAP score ≥ 65% on the same days. On day 5 of the study,

patients in both groups became weanable (65% for the study group compared to 33.3 % for the control group) with a statistically significant difference. However, the participants in the study group had a score of ≥ 65% on days 6 and 7 (71.4% & 100%, respectively). Additionally, more than half (57.7% & 56.2 %) of the control group had ≥ 65% on days 6 and 7.

Table 5 compares the patients' outcomes in the two studied groups. A statistically significant difference was found between the two groups regarding the weaning process, the MV duration, the length of ICU stays, hemodynamic parameters, and laboratory data except the serum creatinine level and WBCs ($p < 0.05$). Nearly three-quarters (72.7%) of the study group had a successful weaning process compared to 31.8% of the control group. Also, the MV duration and length of ICU stay were less in the study group than in the control group.

Table 1 :Demographic Data of The Patients on Admission.

Items	Study group N= (44)		Control group. N= (44)		P-value of significance test
	No.	%	No.	%	
Age					
18-<30	7	15.9	4	9.1	t= 2.11 P=0.193
30-<40	11	25	12	27.3	
40-<50	20	45.5	24	54.5	
≥50	6	13.6	4	9.1	
□(SD)	41.56(8.51)		39.45(6.46)		
Gender					
Male	28	63.6	34	77.3	X^2=1.95 P=0.161
Female	16	36.4	10	22.7	
Diagnosis (cause of hospitalization)					
Post-operative	18	40.9	17	38.6	X^2=1.78 P=0.619
Internal diseases	10	22.7	8	18.2	
Multiple trauma	12	27.3	17	38.6	
Neurological disease	4	9.1	2	4.5	
Past medical history*					
Diabetes Mellitus	16	36.4	21	47.7	X^2=1.16 P=0.280
Hypertension	19	43.2	22	50	X^2=0.411 P=0.521
Ischemic heart disease	6	13.6	12	27.3	X^2= 2.51 P=0.113
Hepatic impairment	5	11.4	2	4.5	FE=1.39 P=0.434
Renal failure	2	4.5	1	2.3	FE=0.345 P=1.00
Level of consciousness based on the Glasgow Coma Scale at the admission					
□(SD)	9.0(1.43)		8.88(1.52)		t=0.360 P=0.720
Level of consciousness based on the Glasgow Coma Scale at the weaning time					
□(SD)	11.18(1.41)		10.15(1.91)		t=2.84 P=0.006
Level of consciousness based on the FOUR Scale at the admission					
□(SD)	10.18(1.35)		10.13(1.40)		t=0.155 P=0.878
Level of consciousness based on the FOUR Scale at the weaning time					
□(SD)	12.27(1.30)		11.15(1.68)		t=0.3.47 P=0.001
The Artificial airway					
Endotracheal tube	44	100	44	100	NA
Rapid Shallow Breathing Index					
RSBI< 105	42	95.5	43	97.7	FE=0.345 P=0.557
RSBI ≥105	2	4.5	1	2.3	

Multiple response questions, P-value of chi-square, FE: Fisher exact test, NA: Not applicable, t: Independent t-test * Statistically significant at $p < 0.05$.

Table 2. Health-relevant Data of The Studied Patients on Admission.

Items	Study group N= (44)	Control group N= (44)	A P-value of significance test	
	□ (SD)	□ (SD)		
Ventilator parameters				
FiO2	0.44(0.06)	0.42(0.04)	t= 1.51	P=0.134
Set RR (b/pm)	14.64(1.38)	15.09(1.36)	t= 1.55	P=0.124
Vt (ml/Kg)	351.80(21.02)	355.64(14.55)	t=0.996	P=0.322
VE (litre)	6.26(0.88)	6.52(0.93)	t=1.32	P=0.188
PEEP (cm H2O)	5.19(0.72)	5.46(0.78)	t=1.68	P=0.095
I: E ratio	0.322(0.02)	0.329(0.019)	t= 1.27	P=0.205
Hemodynamic parameters				
Temperature	36.86(0.91)	37.25(1.07)	t=1.81	P=0.073
SBP	114.09(14.23)	119.86(17.77)	t= 1.68	P=0.096
DBP	75.27(7.57)	72.81(11.70)	t= 1.16	P=0.24
Heart rate	99.72(10.01)	95.15(21.08)	t= 1.29	P=0.198
Oxygen saturation	94.43(2.58)	95.22(2.64)	t= 1.42	P=0.157
Laboratory data				
Hgb	9.91(1.25)	10.30(0.93)	t=1.64	P=0.104
HCT	31.09(3.381)	32.0(3.24)	t=1.28	P=0.202
WBCs	12.45(0.99)	12.90(1.25)	t=1.88	P=0.063
Blood Urea Nitrogen	17.34(1.37)	17.00(1.29)	t=1.19	P=0.235
Serum Creatinine	1.16(0.25)	1.08(0.23)	t=1.43	P=0.155
Na	134.27(5.86)	135.86(4.50)	t=1.42	P=0.157
K	3.59(0.20)	3.63(0.21)	t=1.01	P=0.312
Ca	7.37(0.42)	7.43(0.44)	t=0.655	P=0.51
Phosphorus	3.61(0.23)	3.54(0.28)	t=1.36	P=0.175
Prothrombin Time	14.17(1.02)	14.02(1.09)	t=0.664	P=0.508
INR	1.25(0.02)	1.23(0.06)	t= 1.80	P=0.075

P-value of chi-square, t*: Independent t-test * Statistically significant at $p < 0.05$.

Table 3. Daily Richmond Agitation Sedation Scale assessment throughout the study period between the studied groups.

Days	Study groups (n)	Richmond Agitation Sedation Scale, n (%)										Significance test	
		Combative N (%)	Very Agitated N (%)	Agitated N (%)	Restless N (%)	Alert N (%)	Drowsy N (%)	Light sedated N (%)	Moderate Sedated N (%)	Deep sedated N (%)	Unarousable N (%)	X^2	P
		4	3	2	1	0	-1	-2	-3	-4	-5		
First day	Study (44)	0 (0.0%)	0 (0.0%)	0 (0.0%)	8(18.2%)	0 (0.0%)	16(36.4%)	17(38.6%)	2(4.5%)	1(2.3%)	0 (0.0%)	7.68	0.175
	Control (44)	0 (0.0%)	0 (0.0%)	0 (0.0%)	8(18.2%)	0 (0.0%)	13(29.5%)	11(25%)	5(11.4%)	4(9.1%)	3(6.8%)		
Second day	Study (44)	0 (0.0%)	0 (0.0%)	5(11.4)	17(38.6%)	0 (0.0%)	11(25%)	11(25%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	6.80	0.147
	Control (44)	0 (0.0%)	2(4.5%)	4(9.1%)	8(18.2%)	0 (0.0%)	13(29.5%)	17(38.6%)	0 (0.0%)	0 (0.0%)	0 (0.0%)		
Third day	Study (44)	0 (0.0%)	0 (0.0%)	5(11.4%)	13(29.5%)	9(20.5%)	10(22.7%)	7(15.9%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	5.16	0.270
	Control (44)	0 (0.0%)	0 (0.0%)	4(9.1%)	8(18.2%)	5(11.4%)	13(29.5%)	14(31.8%)	0 (0.0%)	0 (0.0%)	0 (0.0%)		
Fourth day	Study (38)	0 (0.0%)	0 (0.0%)	1(2.6%)	8(21.1%)	23(60.5%)	6(15.8%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	13.0	0.043
	Control (42)	0 (0.0%)	3(7.1%)	3(7.1%)	3(7.1%)	17(40.5%)	12(28.6%)	1(2.4%)	3(7.1%)	0 (0.0%)	0 (0.0%)		
Fifth day	Study (20)	0 (0.0%)	0 (0.0%)	0 (0.0%)	7(35%)	12(60%)	1(5%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	14.11	0.028
	Control (39)	0 (0.0%)	1(2.6%)	2(5.1%)	3(7.7%)	17(43.6%)	12(30.8%)	1(2.6%)	3(7.7%)	0 (0.0%)	0 (0.0%)		
Sixth day	Study (14)	0 (0.0%)	0 (0.0%)	0 (0.0%)	4(28.6%)	9(64.3%)	0 (0.0%)	1(7.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	8.38	0.039
	Control (26)	0 (0.0%)	0 (0.0%)	0 (0.0%)	3(11.5%)	14(53.8%)	9(34.6%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)		
Seventh day	Study (7)	0 (0.0%)	0 (0.0%)	0 (0.0%)	3(42.9%)	4(57.1%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	6.46	0.039
	Control (16)	0 (0.0%)	0 (0.0%)	0 (0.0%)	3(18.8%)	4(25%)	9(56.2%)	0 (0.0%)	0 (0.0%)	0 (0.0%)	0 (0.0%)		

P-value of chi-square, * Statistically significant at $p < 0.05$

Table 4. Comparison of Burn's Weaning Assessment Program throughout the study period between the studied groups.

Days	BWAP score										Significance test	
	Study group					Control group						
	Patient NO	Improbable weaning (< 65%)		Probable weaning (≥ 65%)		Patient NO	Improbable weaning (< 65%)		Probable weaning (≥ 65%)			
		No.	%	No.	%		No.	%	No.	%		
Second day	44	42	95.5	2	4.5	44	43	97.7	1	2.3	FE	1.00
Third day	44	30	68.2	14	31.8	44	37	84.1	7	15.9	3.06	0.08
Fourth day	38	23	60.5	15	39.5	42	34	81	8	19	4.06	0.44
Fifth day	20	7	35	13	65	39	26	66.7	13	33.3	5.37	0.02
Sixth day	14	10	71.4	4	28.6	26	15	57.7	11	42.3	0.733	0.392
Seventh day	7	7	100	0	0	16	9	56.2	7	43.8	4.40	0.036

P-value of chi-square, t*: Independent t-test * Statistically significant at $p < 0.05$.

Table 5. Comparison between patients' ventilation outcomes in the study and control groups

Items	Study group N= (44)	Control group. N= (44)	A P-value of significance test
Weaning process, n (%)			
Success (simple)	32(72.7%)	14(31.8%)	X^2 =14.75 P<0.001
Failure	12(27.3%)	30(68.2%)	X^2 =15.91 P<0.001
Difficult	8(18.2%)	25(56.8%)	
Prolonged	4(9.1%)	5(11.4%)	
Length of mechanical ventilation, □(SD)	5.73(1.73)	6.93(1.56)	t=3.42 P=0.001
Length of stay in ICU, □(SD)	7.02(1.69)	8.82(2.23)	t=4.25 P<0.001
Hemodynamic parameters			
Temperature	36.09(0.67)	36.65(1.07)	t= 2.92 P=0.004
SBP	108.06(11.57)	126.70(15.78)	t=6.31 P<0.001
DBP	73.06(8.89)	78.43(9.30)	t= 2.76 P<0.001
Heart rate	88.81(11.63)	97.45(17.56)	t=2.73 P=0.008
Oxygen saturation	97.81(2.36)	96.27(2.21)	t= 3.16 P=0.002
Laboratory data			
Hgb	12.02(1.93)	10.95(1.61)	t=2.81 P=0.006
HCT	38.06(4.93)	36.02(4.22)	t=2.08 P=0.04
WBCs	11.72(1.06)	12.20(1.67)	t=1.59 P=0.115
Blood Urea Nitrogen	16.77(2.43)	15.63(2.45)	t= 2.18 P=0.032
Serum Creatinine	0.93(0.31)	1.00(0.26)	t=1.14 P=0.225
Na	130.34(9.89)	134.72(6.98)	t=2.40 P=0.018
K	3.78(0.22)	3.66(0.23)	t= 2.44 P=0.017
Ca	8.16(1.08)	7.74(0.77)	t= 2.06 P=0.042
Phosphorus	3.71(0.20)	3.59(0.29)	t= 2.27 P=0.026
Prothrombin Time	13.08(1.73)	13.82(1.22)	t= 2.32 P=0.023
INR	1.14(0.16)	1.21(0.10)	t=2.18 P=0.032

P-value of chi-square, t*: Independent t-test * Statistically significant at $p < 0.05$.

Discussion

This study aims to assess the effect of implementing nursing intervention on weaning from mechanical ventilators based on the BWAP. The study findings revealed no significant differences between the study and control group regarding patients' demographic characteristics. This finding may be attributed to the selection of homogeneous and matching samples in both groups to minimize the extraneous variation.

The results of the current study found that the dominant of the studied patients in both groups were males in the age group between 40 and 50 years old. This conclusion might be attributed to men's high levels of activity and engagement in high-risk activities that result in ICU admission (**Duran & Uludağ, 2020**). These findings agreed with the results of a retrospective study that was conducted by **Klompas, Kleinman, Szumita, and Massaro (2016)** who reported that the mean participants' age was 61.21 ± 6.1 years. Similarly, our results are aligned with other studies (**Khalil, Mostafa, & Ahmed, 2019; Nafae et al., 2018).**

The present result showed that more than one-third of the study and control groups were admitted to the ICU postoperatively. This could be because the study was conducted at an anesthesia ICU which is concerned with receiving patients with postoperative complications. This finding is supported by another study performed in a postoperative cardiac ICU (**Hassoun-Kheir ET AL., 2020**). On the contrary, other studies reported that respiratory distress was the main cause of ICU **(Khalil et al., 2014; Nafae et al., 2018). This** contradiction could be due to the setting of these studies as they were performed in respiratory ICUs.

The current study found that because of their great incidence in Egypt, diabetes mellitus and hypertension were regarded as the most prevalent medical comorbidities. The International Diabetic Federation (**IDF, 2019**) ranked Egypt as the ninth nation globally with an 8.9 million prevalence rate. The current findings revealed that the majority of the patients were semiconscious on admission according to the GCS with an average of 9.0 ±1.43 for the study group and 8.88 ± 1.52 for the control group. The change in the level of consciousness among postoperative patients is considered one of the important indications for IMV initiation **(Al-Haddad, Petrova, & Kolesov, 2022).** These findings are congruent with Mohamed, Ismail, Elshora, and Elsadek (2013) who found the mean score among studied patients who needed IMV was 10.73 ± 1.49. On the other hand, Puetpaiboon, Chatmongkolchart, and Oofuvong (2022) reported that the postoperative GCS of the studied patients was ≤ 8.

The current results showed that there were no statistically significant changes between the study and control groups during ICU admission about the ventilator and hemodynamic parameters. The outcomes agree with those of **Nafae et al. (2018).** When it came to ventilator parameters like FiO2, tidal volume, respiratory rate, pressure support, and PEEP, the authors could not find a statistically significant difference (P>0.05) between the two groups.

Furthermore, when evaluating the degree of sedation, the results revealed that the study group had higher RASS scores, and on the fourth, fifth, sixth, and seventh days of the study, a statistically significant difference was observed between the two groups. These results may be attributed to the fact that the investigators assessed the patients before discontinuing the sedative, stopped the tranquilizer in the early morning, and monitored the patients' degrees of sedation as part of their nursing duties. These findings corroborate a study's findings, which showed that nurses using RASS prevent ventilated patients from being oversedated, which lowers the amount of ICU ventilation days **(J, Carraway, Carraway, & Truelove, 2021).** Furthermore, sedative infusion pauses resulted in a quicker extubation time and decreased ventilation mortality rates, according to **Klompas et al. (2016).**

Furthermore, compared to the control group, the majority of the study group had a BWAP score of ≥65%, which is better. This is because the BWAP checklist involves many parameters that predict patients' weaning

outcomes (**Yazdannik et al., 2012**). Consequently, early weaning with the intended patient result is facilitated by the identification and treatment of anomalies in these parameters. These results are consistent with research by **Keykha et al. (2017),** which found that the BWAP checklist was an ideal tool for anticipating when patients will wean off of MV. Furthermore, **Jeong and Lee (2018)** noted that once the nursing interventions were applied, the study group experienced more successful weaning.

A highly statistically significant difference was found between the two studied groups regarding the weaning process, the ventilation duration, hemodynamic parameters, the length of ICU stay, and laboratory data except for the serum creatinine level and WBCs. For the hemodynamic parameters, this may be because assessment of these parameters was performed as a part of the daily BWAP checklist monitoring, and the nursing care given to patients in the intervention group. This is in line with **Long, Yue, Peng, Xiong, and Li (2018)** who reported that the intervention group showed stable heart rate and respiratory rate compared with the control group with highly statistically significant differences.

For the weaning process, the findings of the present study found that nearly 75% of the study group had successful MV weaning compared to about one-third only of the control group This may be attributed to the nursing interventions implementation that significantly reduced the incidence of such complications. The results of the present study were in line with a study reported that the intervention group had a weaning score higher than the control group **(Eweas Mohammad, Sayyed, Abd Elbaky, & Bayoumi, 2020).**

The results of this study showed that the study group's mean length of MV was shorter (5.73± 1.73 days) than that of the control group (6.93± 1.56 days), with a statistically significant difference between the two groups. These results were consistent with a study that found that, in comparison to two-fifths of the control group, a larger percentage of the study group experienced a brief mean velocity (MV) duration after adopting nursing interventions **(Eweas et al., 2020). In addition, Khalil et al. (2018)** studied the ventilator bundle and found that compared to the control group (7–12 days), the majority of the study groups had MV for 3-6 days after the bundle was implemented.

Additionally, it was seen that the study group's ICU stay was significantly shorter. The study group's median length of ICU stay was 7.02± 1.69 days, while the control group's was 8.82 ± 2.23 days. This difference may have resulted from the nursing interventions' beneficial impact on the outcomes of MV patients. According to **Karagozoglu et al. (2018),** the intervention group's length of ICU stay was shorter than that of the control group, and these results corroborate their findings.

Conclusion and Recommendations

According to the study's findings, weaning success for MV patients was improved by implementing nursing intervention based on the Burns Wean Assessment Program among the intervention group. Therefore, nursing intervention based on the Burns Wean Assessment Program should be incorporated into mechanically ventilated patients' daily nursing care to improve patient outcomes and highlighted in the undergraduate nursing curriculum.

References

Ahmed, R. Q., Sobeih, H. S., & Abdelsalam, S. N. (2019). Ventilator-associated Pneumonia Bundle among Mechanically Ventilated Patient: Nurses' Perception. (Master Degre, Ain Shams University)

Al-Haddad, H. A., Petrova, M. V., & Kolesov, D. L. (2022). Features of postoperative pain relief in patients with a low level of consciousness: A prospective randomized study. Regional Anesthesia and Acute Pain Management, 16(3), 185-193. https://doi.org/10.17816/RA108501

Anggraeni, D. T., Hayati, A. T., & Nur'aeni, A. (2020). The effect of oral care intervention on oral health status of intubated patients in the

intensive care unit. Belitung Nursing Journal, 6(1), 21-26.

Atashi, V., Yousefi, H., Mahjobipoor, H., Bekhradi, R., & Yazdannik, A. (2018). Effect of oral care program on prevention of ventilator-associated pneumonia in intensive care unit patients: A randomized controlled trial. Iranian Journal of Nursing and Midwifery Research, 23(6), 486-490. DOI: 10.4103/ijnmr.IJNMR_164_17.

Burns, S. M., Burns, J. E., & Truwit, J. D. (1994). Comparison of five clinical weaning indices. American Journal of Critical Care, 3(5), 342-352.

Carraway, J. S., Carraway II, M. W., & Truelove Jr, C. A. (2021). Nursing implementation of a validated agitation and sedation scale: An evaluation of its outcomes on ventilator days and ICU length of stay. Applied Nursing Research, 57, 151357-151372. DOI: 10.1016/j.apnr.2020.151372.

De Haro, C., Ochagavia, A., López-Aguilar, J., Fernandez-Gonzalo, S., Navarra- Ventura, G., Magrans, R., ... & Blanch, L. (2019). Patient-ventilator asynchronies during mechanical ventilation: Current knowledge and research priorities. Intensive Care Medicine Experimental, 7(1), 1-14. Retrieved from: https://doi.org/10.1186/s40635-019-0234-5

Duran, M., & Uludag, Ö. (2020). Mortality analysis of hospitalized trauma patients in the intensive care unit. Journal of Surgery and Medicine, 4 (11), 994-997. DOI: 10.28982/josam.780138

Eweas, A. S., Mohammad, S. Y., Sayyed, J. S. A., Abd Elbaky, M. M., & Bayoumi, M. M. (2020). Application of modified ventilator bundle and its effect on weaning among mechanically ventilated patients. Evidence-Based Nursing Research, 2(4), 193-201 DOI:10.47104/ebnrojs3.v2i4.178

Goldsmith, J. P., Karotkin, E., Suresh, G., & Keszler, M. (2016). Assisted ventilationof an adult E-book. Philadelphia: Elsevier Health Sciences.

Hassoun-Kheir, N., Hussein, K., Abboud, Z., Raderman, Y., Abu-Hanna, L., Darawshe, A., ... & Paul, M. (2020). Risk factors for ventilator-associated pneumonia following cardiac surgery. Journal of Hospital Infection, 105(3), 546-551. https://doi.org/10.1016/j.jhin.2020.04.009

Hellyer, T. P., Ewan, V., Wilson, P., & Simpson, A. J. (2016). The Intensive Care Society recommended bundle of interventions for the prevention of ventilator-associated pneumonia. Journal of the Intensive Care Society, 17(3), 238-243. https://www.elsevier.com/books/assisted-ventilation- /9780323390064

Hirzallah, F. M., Alkaissi, A., & do Céu Barbieri-Figueiredo, M. (2019). A systematic review of nurse-led weaning protocol for mechanically ventilated adult patients. Nursing in critical care, 24(2), 89-96.

Huaringa, A. J., Wang, A., Haro, M. H., & Leyva, F. J. (2013). The weaning index as predictor of weaning success. Journal of Intensive Care Medicine, 28(6), 369-374.

International Diabetes Federation. (2019). IDF Diabetes Atlas (9th Edition). Retrieved from: https://doi. org/10.1289/image. ehp. v119. i03

Jeong, E. S., & Lee, K. (2018). Clinical application of modified burns weans assessment program scores at first spontaneous breathing trial in weaning patients from mechanical ventilation. Acute and Critical Care, 33(4), 260- 268. DOI: 10.4266/acc.2018.00276

Karagözoğlu, Ş., Yildiz, F. T., Gürsoy, S., Gülsoy, Z., Süha, B. K., Koçyiğit, H., ... & Arslan, G. (2018). The effect of bundle adaptation control on VAP speed and length of hospital stays in avoiding the VAP at Anesthesia ICU. International Journal of Nursing Clinical Practice, 5, 295-301.

Retrieved from: https://doi.org/10.15344/23944978/2018.

Kashefi, P., Abbasi, S., Katiraei, F., & Alikiaii, B. (2016). Comparison of the weaning rate in three mechanical ventilation methods, automatic tube compensation and pressure support ventilation with airway pressure of five and eight centimeters of water. Journal of Isfahan Medical School, 34(405), 1297-1303.

Keykha, A., Khoshfetrat, M., Dahmardeh, A. R., Dashipour, A., Dahmardeh, M., & Sarhadi, A. (2017). Success rate of weaning from mechanical ventilation in patients admitted to the intensive care unit with utilization Burn's wean assessment program. Archives of Anesthesiology and Critical Care, 3(2), 319-323. Retrieved from: http://aacc.tums.ac.ir

Keykha, A., Rahat Dahmardeh, A., & Khoshfetrat, M. (2017). Comparison of success rate of weaning from mechanical ventilation using Burn's Wean Assessment Program and routine method. Journal of Critical Care Nursing, 10(3), 0-0.

Khalafi, A., Elahi, N., & Ahmadi, F. (2016). Holistic care for patients during weaning from mechanical ventilation: A qualitative study. Iranian Red Crescent Medical Journal, 18(11).

Khalil, M. M., Abd Elfattah, N. M., & El-Qusy, A. S. (2014). Assessment of the outcome of mechanically ventilated chronic obstructive pulmonary disease patients admitted in the respiratory ICU in Ain Shams University Hospital. Egyptian Journal of Bronchology, 8(2), 138-142. DOI: 10.4103/1687-8426.145708

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. Retrieved from: https://doi.org/10.1016/j.ijans.

Khalil, N., Mostafa, M., & and Ahmed, N, (2019). Sleep quality among patients with chronic obstructive pulmonary disease at a University Hospital in Egypt. Clinical Practice, 16(2), 1085-1092. DOI:10.4172/clinicalpractice.1000451

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. DOI: 10.1001/jamainternmed.2016.2427.

Long, G., Yue, L., Peng, Z., Xiong, G., & Li, Y. (2018). Clinical effects of nursing intervention on severe patients in the respiratory department. Biomedical Research, 29(5), 970-938. Retrieved from: www.biomedres.info

Modrykamien, A. M. (2019). Strategies for communicating with conscious mechanically ventilated critically ill patients. Baylor University Medical Center Proceedings, 4 (32), 534-537.

Mohamed, M. A., Ismail, M. F., Elshora, A. E., & Elsadek, M. E. (2013). Intensive care unit of Chest Department Zagazig University Hospitals' experience in management of acute exacerbations of chronic obstructive pulmonary disease. Egyptian Journal of Chest Diseases and Tuberculosis, 62(2), 229-234. DOI:10.1016/j.ejcdt.2013.04.006

Nafae, R. M., El-Shahat, H. M., Shehata, S. M., & Zaki, L. G. (2018). Effect of multimodal physiotherapy on outcome of mechanically ventilated patients at Zagazig University respiratory intensive care unit in (2014-2015). Zagazig University Medical Journal, 24(3), 178-191. DOI: 10.21608/ZUMJ.2018.13092

Nestor, P. G., & Schutt, R. K. (2018). Research methods in psychology: Investigating human behavior(3rd ed.).Los Angelos: Sage Publication. Retrieved from https://books.google.com.eg/books

Nickson, C. (2019). Weaning from mechanical

ventilation. Retrieved from: https://litfl.com/weaning-from-mechanical-ventilation/

Nitta, K., Okamoto, K., Imamura, H., Mochizuki, K., Takayama, H., Kamijo, H., ... & Satou, T. (2019). A comprehensive protocol for ventilator weaning and extubation: a prospective observational study. Journal of Intensive Care, 7, 1-9.

Puetpaiboon, A., Chatmongkolchart, S., & Oofuvong, M. (2022). The outcomes and predictors associated with prolonged weaning of postoperative patients requiring mechanical ventilation in general wards. Anesthesia, Pain & Intensive Care, 26(2), 161-167. https://doi.org/10.35975/apic.v26i2.1832

Sepahyar, M., Molavynejad, S., Adineh, M., Savaie, M., & Maraghi, E. (2021). The Effect of Nursing Interventions Based on Burns Wean Assessment Program on Successful Weaning from Mechanical Ventilation: A Randomized Controlled Clinical Trial. Iranian Journal of Nursing and Midwifery Research, 26(1), 34–41. https://doi.org/10.4103/ijnmr.IJNMR_45_20

Shehab, M., Sadoon, M., Nasser, H., & Fathy, A. (2018). Nurses' performance about safety weaning from mechanical ventilation of critically ill adults and children. International Journal of Nursing Didactics, 8(11), 11-16. Retrieved from: www.innovativejournal.

Ward, D., & Fulbrook, P. (2016). Nursing Strategies for Effective Weaning of the Critically Ill Mechanically Ventilated Patient. Critical Care Nursing Clinics of North America, 28(4), 499–512. https://doi.org/10.1016/j.cnc.2016.07.008

Yazdannik, A., Salmani, F., Irajpour, A., & Abbasi, S. (2012). Application of Burn's wean assessment program on the duration of mechanical ventilation among patients in intensive care units: A clinical trial. Iranian Journal of Nursing and Midwifery Research, 17(7), 520-523.

Yousefi, H., Toghyani, F., Yazdannik, A. R., & Fazel, K. (2015). Effect of using RASS on duration of mechanical ventilation, type, and dosage of sedation onhospitalized patients in intensive care units. Iranian Journal of Nursing and Midwifery Research, 20(6), 700-704. DOI: 10.4103/1735-9066.170008.

Zein, H., Baratloo, A., Negida, A., & Safari, S. (2016). Ventilator weaning and spontaneous breathing trials; an educational review. Emergency, 4(2), 65.