**An-Najah National University**

**Faculty of Graduate Studies**

# THE IMPACT OF ABCDE BUNDLE IMPLEMENTATION ON MECHANICALLY VENTILATED PATIENTS' OUTCOMES AT ICU IN HEBRON GOVERNMENTAL HOSPITAL

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# Dedication

وإني وفي ظل النوائب التي يمر بها وطني ... وفي ظل الإجرام الذي يحدث بحق أبناء قضيتي في بقعة باتت من أشرف بقاع الأرض .... في التي أراها الآن جنة أخرى تبنى لهم في ظل عرش الرحمن ...إلى الذين ظلموا ظلما لم تستطع شريعة الغاب أن تشرعه....إلى أبناء شعبي في غزة الشرفاء الذين فدوا وطننا بدمائهم ..... إلى تلك الأعين التي ما عرفت معنى النوم لقرابة ما أوشك على العام .... إلى الذين أدركوا معنى الحياة فأحسنوا التقديرا... إلى شهداء عقيدتي وقضيتي ...إلى كل أحرار العالم...إلى الذين ضحوا لهذا الدين بكل غال ونفيس...إلى من دافعوا عن دينهم ووطنهم ...إلى الذين رابطوا على ثغور هذه الأمة ...إلى الذين لم يرضوا لأقذر عدو مر على هذا الكوكب أن يعيث فسادا في الأرض.... إلى الذين حملوا أمانة أمة كاملة ...إلى الذين لو تخلوا لبغى هذا المحتل في كل بلد من هذه الأمة ... إلى الذين صدقوا قول الله: (انفروا خفافا وثقالا وجاهدوا بأموالكم وأنفسكم في سبيل الله ذلكم خير لكم إن كنتم تعلمون)

.....أهديكم ثمرة سنوات من العمل الدؤوب ...وأستحي أن أهدي هذا

لغيركم.....

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# Declaration

I, the undersigned, declare that I submitted the thesis entitled:

**THE IMPACT OF ABCDE BUNDLE IMPLEMENTATION ON MECHANICALLY VENTILATED PATIENTS' OUTCOMES AT ICU IN HEBRON GOVERNMENTAL HOSPITAL**

I declare that the work provided in this thesis, unless otherwise referenced, is the researcher's own work, and has not been submitted elsewhere for any other degree or qualification.

**Student's Name:** Sawsan Al-Sarahina

**Signature:** 

**Date:** 15.10.2024

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## Abstract

**Background**: ABCDE bundle implementation is an evidence based and recommended practice to adequately manage mechanically ventilated patients, but application of this bundle in environment with shortage of resources and has no specific protocol to deal with mechanically ventilated patients is unknown.

**Objective**: to measure the impact of ABCDE bundle implementation on mechanically ventilated patients' outcomes: ICU length of stay, ventilator free days, delirium occurrence and duration, and early mobility at ICU in Hebron Governmental Hospital.

**Methods**: a prospective-quasi experimental study was conducted between December-2022 to March-2024, in which 76 patients on mechanical ventilation were divided into two groups. In the pre ABCDE bundle (n=36), traditional approach to deal with mechanically ventilated patients was used. In the post ABCDE bundle group (n=40), ABCDE bundle was used. Those outcomes were compared between both groups: ICU LOS, VFDs, delirium occurrence and duration, and early mobility.

**Results**: the results showed no statistically significant differences between two groups regarding ICU LOS, VFDs (P=0.88, P=0.9) respectively. The median duration of MV was less in the intervention group 3days in comparison to 3.5 days in control group (P=0.378). The percentage of early mobility was higher in ABCDE group (P=0.242). ABCDE group was more lightly sedated than non-ABCDE group who was more deeply sedated. Delirium occurrence and duration were less in ABCDE group (P= 0.362, P=0.22) respectively. Restraints use was significantly decreased in group who adapted bundle (20.5% in intervention group versus 44.4% in control group) with (P value=0.008).

**Conclusion**: ABCDE bundle helped in making mechanically ventilated patients more awake and oriented to environment and decreased using of restrains among them. It also minimized the use of benzodiazepines to half. Other outcomes like ICU LOS, VFDs, delirium occurrence and duration, and early mobility needs more research with larger sample size and more effective adherence to bundle. This study gave background for the future research to implement this bundle in environment with shortage of resources.

**Keywords**: ABCDE bundle; ICU LOS; Mechanical Ventilation; Delirium; Early Mobility.

# Chapter One

# Introduction

## 1.1 Background

### 1.1.1 Mechanical Ventilation

In the United States, approximately 310 persons per 100,000 adult populations undergo invasive ventilation for nonsurgical indications (Pham et al., 2017). The recent systematic review by (Alamaw et al., 2023)showed the universal need for intensive care has increased, given its role in decreasing mortality rate. Those intensive care units are closely associated with the mechanical ventilation needs which combined with ventilator induced complication.

The mortality rate among patients who received invasive MV is 48.61%(Alamaw et al., 2023). Pham et al. (2017)showed that MV has negative effects on intrathoracic pressure, alveolar and neural system and it causes different complications: ventilator induced lung injury, ventilator associated pneumonia, and it also has long term complications on physical, cognitive and mental status which are called post intensive care syndrome. Mechanical ventilation causes different ventilator associated events: ventilator induced lung injury (VILI), fluid overload (accounts for up to 48%), ARDS (5-20%) (Ramirez-Estrada et al., 2023). Those complications increased once the duration of MV increased, therefore early Extubation is recommended to avoid such those complications. Daily awakening and breathing trials, sedation vacation, light sedation accelerate weaning from MV and decrease its duration (Ramirez-Estrada et al., 2023)

### 1.1.2 ABCDE Bundle

Mechanically ventilated patients are exposed to different complications related to prolonged MV, use of sedation and bed rest (Haribhai & Mahboobi, 2022). So, using bundle like awakening and breathing coordination, Delirium monitoring /management, Early exercise and mobility (ABCDE) that deals with all of that can be really meaningful.

The Awakening and Breathing Coordination, Delirium monitoring and management, and Early mobilization (ABCDE bundle) is an evidence-based, multidisciplinary strategies aims to reduce intensive care unit (ICU) acquired delirium and weakness ( Otusanya et al., 2022). Collinsworth et al. (2020) reported bundle is a cost-effective intervention to reduce mortality in critically ill patients. Balas et al. (2012)showed one of the important principles for ABCDE bundle is to break the cycle of over sedation and prolonged MV that can cause delirium and muscle weakness. Hsieh et al. (2019) concluded ABCDE bundle resulted in reduction of MV duration, length of stay and hospital cost, liberated patients from restraints and decreased harmful complication.

One of goal of ABCDE bundle is to increase both mechanically ventilated patients' chances of survival and both their short- and long-term results (MD & DM, 2016). Serious comorbidities were acquired by a high percentage of patients admitted to the ICU and these conditions complicated their quality of life after discharge and adversely affected their recovery from critical conditions (MD & DM, 2016). Needham et al. (2012) defined this condition as Post Intensive Care Syndrome, which includes cognitive impairments, delirium, ICU-acquired weakness, physical impairments, mental health issues (anxiety and post-traumatic stress disorder (PTSD)), and physical impairments. Evidence-based patient-centered interventions were reported in the guidelines for the prevention and management of Pain, Agitation/Sedation, Delirium, Immobility, and Sleep disruption (PADIS) in ICU. These interventions aimed to lowering mortality, shortening the duration of mechanical ventilation, improving cognitive disabilities, and enhancing functional activities (Devlin et al., 2018).

### 1.1.3 Prolonged Ventilation

Li et al. (2022) showed that unplanned extubation occurred in approximately 6.6% of mechanically ventilated patients. Among those 50% of them didn’t have need for reintubation. Which is consistent with what (Boles et al., 2007)showed failing to successfully extubate patients who are ready for extubation is more harmful than failing to pass spontaneous breathing trial, in addition to that half of patients who are mechanically ventilated who developed self extubation didn’t have need for intubation which concludes patients present on MV longer than needed that expose them to different complication as Haribhai & Mahboobi (2020) reported: prolonged mechanical

ventilation causes different complications that increase hospital mortality, length of stay (LOS) in hospital and increase cost.

### 1.1.4 Sedation

Analgesics and sedatives are frequently required for mechanically ventilated patients to manage discomfort, anxiety, to facilitate care, to decrease oxygen consume and to maintain safety. However, these medications are associated with adverse effects: over sedation (half of ICU patients are over sedated), delirium and prolonged mechanical ventilation (Girard et al., 2008a).

Page & McKenzie (2021) reported that all evidence-based practices in the US, South American and Iberian, German, and UK guidance recommend light sedation because it is associated with easily roused patient, more comfortable and good pain control unless deep sedation is clinically required. There is a big change in sedation evidence which indicated the impact of sedation on delirium and the overall result on ICU mortality and long- term adverse effect on ICU survivors (Paulo Nassar Jr et al., 2019).The adaptation of light sedation is associated with decreasing time on MV, enhancing spontaneous breathing and facilitating early mobilization (Wong et al., 2020).

### 1.1.5 Delirium

The prevalence of delirium in mechanically ventilated patients is 60-80%, (Stollings et al., 2021). Tilouche et al. (2018) showed that delirium is associated with different negative outcomes: increased length of stay in ICU and hospital, increased duration of MV, increased cost and long-term cognitive impairment.

### 1.1.6 Muscle Weakness

Dirkes & Kozlowski (2019)mentioned that bed rest is associated with bad effects on muscle and functional ability of patients and studies showed skeletal muscle strength decrease 1%-1.5% each day with strict bed rest. In addition, Dirkes reported that muscle weakness occurs in about 25-65% of patients who are receiving mechanical ventilation, and it is associated with prolonged MV and increased ICU LOS and all of that will negatively effect on functional ability of patients after discharge such as: in elders leads to negative outcomes: readmission, inability to return to usual daily living. There is also cardiovascular effect of bed rest: about 11% of blood circulation will shift from legs to

chest, which increases workload on heart, that results in decrease cardiac output. Each day during bed rest, heart rate increases one beat that decreases diastolic filling time and makes the heart less able to respond to metabolic demand, in contrast, early mobility decreases incidence of delirium and increases ventilator free days (VFDs) (Dirkes & Kozlowski, 2019)

## 1.2 Previous Studies and Literature

Mechanical ventilation is a crucial type of life support for patients going through broad sedation or encountering respiratory failure in the setting of critical disease. It is considered as a lifesaving treatment, decreasing the work of breathing for patients and reversing acute life-threatening respiratory acidosis and hypoxemia (Guilhermino et al., 2018). Rackley. (2020) ensured the importance of Mechanical ventilation as a supportive treatment during ICU and mentioned that: in the United States alone, more than 4 million patients are admitted to ICU each year, and at any given time, up to 40% of those patients need invasive mechanical ventilation. Although all of that, these mechanically ventilated patients are in danger for various complications connected with both their basic illness states and the mechanical ventilation itself (Rackley, 2020).

### 1.2.1 MV Complications

Although mechanical ventilation is vital, it may cause complications including endotracheal tube complications, ventilator associated lung injury, barotrauma, ventilator associated pneumonia, diaphragm atrophy, psychological problems and communication difficulties (Guilhermino et al., 2018). MV complications are associated with longer duration of MV, which leads to higher rate of in hospital mortality, longer hospital stays and higher cost. high income nations, patients receiving MV require a cost between 15$and 27$ billion per year (Guilhermino et al., 2018). These complications are also reached to physiological effect of mechanical ventilation: expanded intrathoracic pressure, which innately influences the heart, nervous system, kidney, and liver (Silva et al., 2022). Moreover, clinical circumstances that lead to high intra-abdominal pressure merit exceptional consideration during respiratory framework observing, as the stomach compartment is an indispensable piece of the chest wall (Silva et al., 2022)

### 1.2.2 ICU Acquired Delirium and Weakness

An increasing body of research has shown that the majority of patients in critical illness are susceptible to two prevalent, potentially deadly, and iatrogenic conditions: weakness and intensive care unit (ICU) delirium (Balas et al., 2014a). In addition to having an adverse effect on a patient's prognosis for critical illness, ICU-acquired delirium and weakness are linked to poor physical, functional, and cognitive outcomes in the long run (Balas et al., 2014a). Boehm et al (2017) noted that delirium and acquired muscle weakness were recognized as extremely critical ICU issues. Once delirium duration grew, there was a negative correlation between the survival probability following patients' release from the intensive care unit and a significant cognitive disability (Boehm et al., 2016). Additionally, ICU acquired weakness has been linked to a rise in post-discharge mortality and a long-term decline in physical performance, according to Boehm et al. (2016), these conditions impose a heavy burden on society. For instance, the annual cost of caring for delirious patients on mechanical breathing is estimated to be between $6.5 and $20.4 billion in the United States alone. To improve outcomes for ICU patients, strategies to prevent and/or cure ICU-acquired frailty and delirium are desperately needed (Balas et al., 2014a). Weakness and delirium that develop in the intensive care unit are known to be associated with immobility, sedative drugs, and mechanical ventilation. When these factors mix with other known predisposing factors, the probability of experiencing delirium and weakness rises (Balas et al., 2014a).

Collins worth et al. (2020) mentioned that approximately 20–80% of patients in the ICU acquire delirium as a consequence of care. ICU-acquired delirium is closely associated with increasing cognitive and physical deficit, mortality, hospital length of stay (LOS), and healthcare costs. Those patients are at increased risk of the following effects: catheter removal, restraints use, increase duration of mechanical ventilation, self extubation, increase hospital LOS, in addition to increase hospital costs (Bounds et al., 2016).

### 1.2.3 ICUAW

ICU-acquired muscular weakness (ICUAW) is one of the many long-term consequences that survivors of critical illness may face. ICUAW affects 25–50% of critically ill patients and is linked to declines in the patients' quality of life, physical functioning, and long-term survival. Bed rest is a significant risk factor for ICUAW.

### 1.2.4 Impact of ABCDE Bundle on Delirium

According to Bounds et al. (2016), delirium prevalence and delirium-free days significantly decreased when the ABCDE bundle was implemented. Numerous critically ill patients are still handled without daily sedative interruptions or delirium screening, even though there may be advantages to decreased sedative use and delirium following bundle adaptation. These results may be attributed, in part, to the belief that patients with extreme illness need deep sedation as well as other obstacles to practice change (Hager et al., 2013).

### 1.2.5 The Importance of Bundle

One of the important issues related to ICU patients is post intensive care survival and ability of the patients to return to their daily life .ABCDE bundle focuses on those previous issues which has associated with decreasing ventilator days, delirium days, and hospital stays, beside enhancing hospital mobility and positive financial advantages (Boehm et al., 2017).

Implementation of ABCDE bundle is not only adapted by critical care societal American Association of critical care medicine), but also endorsed by national quality agencies (agency for health care research and quality, Institute for healthcare improvement, and the centers for disease control and prevention which showed the importance and effectiveness of it (Boehm et al., 2017).

### 1.2.6 ABCDE Bundle Development

If you take a quick tower about the development of ABCDE bundle, it was developed by Society of Critical Care Medicine which is considered as the main sponsor of this bundle (Ely, 2017)It was started as a spontaneous breathing trial (SBT) as RCT study by Ely et al. (1997) which showed its effectiveness. After that it was developed to include also spontaneous awakening trial (SAT). The duration of mechanical ventilation was

reduced by almost two days, and the length of stay in the intensive care unit was reduced by roughly 3.5 days, when the daily infusion of sedative medicines was stopped (Kress et al., 2000). Girard et al. (2008) demonstrated that a paired sedation and ventilator weaning protocol consisting of daily SATs plus SBTs resulted in patients spending more time off mechanical ventilation, less time in a coma, and less time in intensive care and the hospital. Additionally, the protocol improved 1-year survival compared with usual care. These findings indicate that both SBT and SAT are coordinated with each other. When applied to a broad patient group receiving critical care in community and university hospitals, the wake up and breathe technique proved to be beneficial and was linked to minimal adverse events. Later on, authors added both D (delirium prevention and management) and E (early mobility and exercise) which resulted in significant improvement in patients' outcomes in comparison to just using SAT and SBT as Balas study showed (Ely, 2017).

### 1.2.7 ABCDE Bundle

The Awakening and Breathing Coordination, Delirium monitoring/management, and Early exercise/mobility (ABCDE) bundle was identified by Collinsworth et al. (2020) as an interdisciplinary, multicomponent patient wellbeing intervention meant to reduce the incidence of delirium in intensive care units (ICUs) by fostering greater collaboration among clinical colleagues, restoring normalcy to care cycles, and disrupting the cycle of over sedation and postponed extubation. The ABCDE bundle resulted a significant increase in the number of patients who were moved out of bed during their ICU stay and sent to home, while also significantly reducing the prevalence of delirium, ventilator days, unconsciousness days, readmission, and in-hospital mortality. Additionally, the bundle is linked to improvements in several key patient-centered outcomes, such as higher survival, more days without delirium or coma, and fewer hospital and mechanical ventilation days (Balas et al., 2014a; Barnes-Daly et al., 2017; Kram et al., 2015). According to Boltey et al. (2019), increasing team members' awareness and familiarity is crucial for the ABCDE bundle's implementation.

The ABCDE bundle—which includes early exercise and mobility, delirium monitoring and management, and coordination of breathing and awakening—adapts the best evidence-based practices for sedation, delirium, immobility, and ventilator management. The multicomponent ABCDE bundle reduces the length of mechanical ventilation and

the risks associated with it for patients. Early mobility is a component of this bundle that enhances oxygenation and hemodynamics. The development of the ventilation/perfusion ratio and the circulatory system is facilitated by early mobility, which also strengthens the respiratory muscles, releases lipoproteinase from the alveolar wall, eases bronchial spasm, and stops inflammatory exudation from the lung tissues. Additionally, MV duration, ICU length of stay, and patient cardiopulmonary state are all correlated with spontaneous awakening trial and spontaneous breathing trial coordination. The Spontaneous Breathing Trial (SAT) lowers ventilator-induced hemodynamic problems and facilitates the weaning off of mechanical ventilation, hence reducing the time of mechanical ventilation. Consistent use of sedative medications results in delirium, metabolic acidosis, hemodynamic instability, and decrease of respiratory function, all of which lengthen the time patients need mechanical ventilation and increase ICU length of stay. Thus, the best possible use of sedatives can improve the condition of the patient. For patients on mechanical ventilation, the ABCDE bundle has been shown to be safe and effective, improving the patients' hemodynamic and respiratory conditions ( Moraes et al., 2019).

### 1.2.8 Strengths and Facilitators of ABCDE Bundle

The parallel format of the SAT plus SBT protocol, which includes specific safety screens and failure criteria, making it easy to replicate, the involvement of nurses and respiratory therapists among other intensive care staff, the use of patient target sedation and an SBT protocol in both groups, the use of validated and reliable instruments for the assessment of coma and delirium, and the multicenter study design with enrollment in both open and closed intensive care units are among the major strengths of the ABC trial (Girard et al., 2008a). The daily screening tests and spontaneous breathing attempts were easily integrated into staff procedures and often only took a few extra minutes per patient each day (Ely et al., 1997).But the bundle is adaptable enough to accommodate staff and patient needs (Balas et al., 2014b). Three main principles form the basis of the ABCDE bundle: (1) enhancing communication within the ICU team; (2) standardizing care procedures; and (3) breaking the cycle of excessive sedation and prolonged mechanical ventilation, which can cause delirium and muscle weakness (Balas et al., 2014b).

According to a study by Balas et al. (2012a), other factors were considered significant included developing early mobilization teams, adding to the daily rounding sheet, streamlining the process (i.e., making the policy easier to understand and shorter), and talking about the policy "consistently." In order to successfully implement the ABCDE bundle. The following conditions must be met: (1) a highly skilled team that can complete independent tasks with great quality, dependability, and timeliness; (2) sufficient communication between disciplines to ensure that the individual components are implemented in the correct order and sequence; and (3) effective leadership that can modify implementation to meet the needs of the local environment and culture while also providing ongoing support, resources, and training. The ABCDE bundle is complicated, but if it is implemented well, it could be very helpful for our sickest patients ( Balas et al., 2012a).

### 1.2.9 Nurse Role in ABCDE Bundle

Due to their vital significance in fulfilling all implementation requirements, nurses play a unique function in the ABCDE package. Using validated instruments, registered nurses oversee protocol-guided sedation efforts, which include daily SATs and delirium and sedation/agitation measurements. In addition, the nurse serves as a liaison between the various disciplines. According to Balas et al. (2012), the nurse's assessments of the patient's level of consciousness, pain, and other clinical parameters are communicated to respiratory therapists, physical therapists, and physicians, respectively. These assessments determine whether the patient moves on to the next steps of the ABCDE bundle with SBT, early mobility, and extubation.

### 1.2.10 ABCDE Bundle Barriers

However, the majority of ICUs encounter a number of significant obstacles to ABCDE bundle compliance, which fall into the following categories: worries about patient safety, gaps in knowledge, workload and documentation requirements, high staff and leadership turnover, low staff morale, and a lack of respect amongst the disciplines involved in bundle implementation (Stollings et al., 2019).

In this research, the ABCDE bundle was implemented in Hebron Governmental Hospital ICU that didn't adapt any protocol regarding to weaning, delirium and early mobility, and then according to the results of this research and its effectiveness, it can be decided if it may be adapted as a protocol in that ICU.

### 1.3 Research Problem

Mechanical ventilation is widely used for intensive care of mechanically ventilated patients. Approximately third of ICUs patients around the world need mechanical ventilation at least for 12 hours (Li et al., 2022).However, prolonged mechanical ventilation is associated with different complications such as at electasis and pneumonia. Therefore, it is crucial to wean patients from mechanical ventilation as soon as it is safe to do, in order to decrease the associated risks (Li et al., 2022).

Laverde-Sabogal et al. (2023) mentioned that up to 50% of patients with self-extubation don't need re intubation, so it can be ed that many patients are maintained on mechanical ventilation longer than is necessary (Boles et al., 2007), which will expose them to significant complications as Haribhai & Mahboobi (2020) showed: ventilator-associated pneumonia (VAP), sepsis, acute respiratory distress syndrome (ARDS), at electasis, and pulmonary edema. Ventilator-associated harm effects increase both morbidity and mortality. They may also increase duration of mechanical ventilation, ICU LOS, hospital LOS, and can also elevate hospital costs. Patients with prolonged intubation may have some complications such as muscle atrophy, functional impairment, and diaphragm dysfunction. In addition, they may also suffer from altered respiratory drive (Huang et al., 2022). Thus, criteria for readiness to begin weaning should be systematically evaluated each day to allow prompt initiation of weaning as soon as the patient is ready, that will shorten the weaning process and minimize time on mechanical ventilation (Boles et al., 2007).

Another type of main ICU induced issue is post-intensive care unit (ICU) syndrome such as pain, fatigue, loss of weight, sleep problem, anxiety, depression, decreasing of life quality, deficit in social aspect and loss of work. That might happened after ICU treatment and incorporates ICU-acquired weakness (ICU-AW), cognitive degradation, and mental issues. ICU-AW is muscle weakness in patients treated in the ICU and is impacted by the time of mechanical ventilation. Diaphragmatic weakness may likewise

happen in view of respiratory muscle dumping utilizing mechanical ventilators. ICU-AW is a free indicator of mortality and is related with longer length of mechanical ventilation and hospital stay (Ji & Won, 2024).For that causes medical care personnel supported use of evidence-based practices that prevent such that complications (Balas et al., 2014; Pandharipande et al., 2013; Skrobik et al., 2010). Among such practices is the ABCDE bundle, which is a bundle that provides systemic every day care to patients to decrease their exposure to sedation, delirium, and immobility (Balas et al., 2014; P. Pandharipande et al., 2010).

In the intensive care unit, delirium and muscle weakness are often diagnosed conditions with an incidence of 45% to 87%. With a reported 3.2-fold increase in 6-month mortality and associated expenses for the extra care given, delirium poses a considerable burden to patients as well as the healthcare system (Pinto & Biancofiore, 2016). Furthermore, delirium's effects persist into the post-discharge phase, where they may result in longer-term neurocognitive impairment, a higher risk of discharge to a location other than home, a greater functional decline, and a higher 6-month and 1-year mortality rate (Balas et al., 2014b).

Researcher during working in Hebron Governmental Hospital ICU observed no specific protocol or criteria that they use to deal with mechanically ventilated patients, researcher here talked about significant elements that really play important role in patients 'outcomes that were ignored: weaning criteria, delirium assessment and management and early mobility. Researcher showed in that ICU there was no criteria that was used to wean patients from mechanical ventilation and what was amazing thing is that extubation occurs via self extubation or by using some practical routine related to team interest and that is not depend on evidence based. So, patients in this ICU have prolonged duration of mechanical ventilation without need which expose them to significant complications. So, many patients in this ICU were connected to MV for prolonged period without need, that was also worse their outcomes. That malpractice was also related to delirium, it was really not considered in that ICU either its assessment or management. There were also no specific criteria was used to mobile patients safely. In addition to all of that, there was unclear communication between different health care teams that can also affect patients' outcomes as Stollings et al. (2019) mentioned that unclear communication has been identified as the significant

cause to clinical mistakes in the ICU. So, improve communication, lessen mistakes, decline length of stay, and lower mortality. Besides to all of that, this ward has resistance to change and the process of change needs comprehensive systemic elements like this bundle.

Therefore, according on what was mentioned about weaning, delirium and early mobility using a bundle that gather these three important issues are really meaningful and important. And that explained why the researcher depended on ABCDE bundle that dealt with these three important issues. According to the Society of Critical Care Medicine (SCCM) which is considered as a founder and adaptor of ABCDE bundle, this bundle was synergistically adopted to decrease ventilator time, decrease delirium days, and increase mobility (SCCM, 2024).

### 1.4 Significance of the Study

Mechanical ventilation induces different physiological and psychological problems which increase need for long term care (Bilotta et al., 2019). The ABCDE bundle is appropriate for use in conjunction with other life-maintaining therapies, with a focus on symptom assessment, prevention, and management rather than illness mechanisms. Adverse effects, such as agitation, psychosis, weakness, and sleep disorders, are common in critically sick patients. Patients became immobile due to the intensity and difficulty of those symptoms, which increased the need for sedation. Delirium and cognitive disorders can result from sedation. Delirium increases the amount of time spent on mechanical ventilation, length of stay in the intensive care unit, and death (Ebrahim et al., 2021). The ABCDE package is a unique team-based strategy designed to help patients become more attentive, mentally active, and physically better. In the end, patients are better equipped to communicate their requirements, both emotional and physical. A wealth of evidence (Ely, 2017; Paulo Nassar Jr et al., 2019; Pileggi et al., 2018) supports the safety and efficacy of implementing the ABCDE components while providing care for critically ill patients. Using the ABCDE bundle improved hemodynamic status, reduced ventilator-free days, shortened ICU stays, and reduced delirium in critically ill patients, among other benefits (Ebrahim et al., 2021). Several research on the ABCDE bundle have concentrated on preventing delirium and ICU-acquired weakness. However, few studies examined the effect of implementation of the ABCDE bundle in environment like Hebron Governmental Hospital with shortage of

resources and is considered as a resistive environment, in addition it hadn’t any specific protocol to deal with mechanically ventilated patients. According to the results of research, it can be concluded that if this bundle may be adapted in like this place and if it can really make difference.

## 1.5 Aim of the Study

The aim of this study was to measure the impact of ABCDE bundle implementation on mechanically ventilated patients' outcomes in Hebron Governmental Hospital ICU.

## 1.6 Objectives of the Study

The objectives of the study are:

- To measure the impact of ABCDE bundle implementation on ICU length of stay for mechanically ventilated patients in Hebron Governmental Hospital ICU.
- To measure the impact of ABCDE bundle implementation on ventilator free days for mechanically ventilated patients in Hebron Governmental Hospital ICU.
- To measure the impact of ABCDE bundle implementation on the occurrence and duration of delirium on mechanically ventilated patients.
- To measure the impact of ABCDE bundle implementation on the patients' early mobility during their ICU stays.

### 1.7 Research Hypothesis

- There is no significant difference between the ABCDE bundle implementation and ICU length of stay on mechanically ventilated patients at ICU in Hebron Governmental Hospital.
- There is no significant difference between the ABCDE bundle implementation and ventilator free days on mechanically ventilated patients at ICU in Hebron Governmental Hospital.

## 1.8 Research Questions

- What is the impact of ABCDE bundle implementation on the occurrence and duration of delirium on mechanically ventilated patients?

- What is the impact of ABCDE bundle implementation on mechanically ventilated patients' early mobility during their ICU stay?

## 1.9 Definitions

**ABCDE bundle: Conceptual definition**: The Awakening and Breathing Coordination, Delirium monitoring/management, and Early exercise/mobility (ABCDE) bundle is a multicomponent, evidence-based, inter professional approach that minimizes sedative exposure, shortens the duration of mechanical ventilation, and addresses acquired delirium and weakness in intensive care units (ICUs) (Balas et al., 2014a)

**Operational definition:** The ABCDE bundle is covered in great detail in a number of earlier publications. The bundle, to put it briefly, consists of five essential elements, among which is the everyday accomplishment of: 1) trials of spontaneous awakening (SATs); 2) trials of spontaneous breathing (SBTs); 3) coordination of components 1 and 2 (such that sedation is maintained prior to the initiation of the breathing trial); 4) routine assessment and management of delirium and sedation/agitation; and 5) early progressive mobilization. All components—aside from the monitoring and management of delirium—are directed by pre-established safety screen questions and success/failure standards that come from earlier RCTs. When a patient is in the intensive care unit (ICU), the bundle is supposed to be applied to them every day unless a licensed practitioner issues an order prohibiting its usage (also known as the "opt-out" technique).The bundle has some "adaptable" components, which allow them to be adjusted to the situation without compromising the effectiveness of the intervention as a whole. For instance, to better serve a certain patient demographic, an ICU may choose to include more safety screen questions or success/failure criteria (Balas et al., 2014b)

**ICU delirium: Conceptual definition**: a neuropsychiatric condition characterized by an abrupt onset and fluctuating disruption in consciousness, attention, and cognitive function (Ornago et al., 2024)

**Occurrence and Duration of delirium**: The length of delirium in an intensive care unit was measured using the confusion assessment method for ICU (CAM ICU), which was initially created by Inouye in 1994 and then modified by Ely et al. in 2001. A day was deemed to be delirium positive if the CAM-ICU result was positive even once throughout the day, and the total number of days was used to calculate the duration of delirium.

**Duration of coma**: According to Orman et al. (2015), a coma is characterized as a highly sedated state with a RASS score of -4 to -5, meaning that CAM-ICU cannot be evaluated. The study examined coma in cases where patients in the CAM ICU were unable to be monitored continuously. The total number of comatose days was used to calculate the length of the coma (Lee et al., 2020).

**Early mobilization**: **Conceptual definition**: series of mobilization interventions applied to patients in phases (such as passive movement or active exercises) that has physical benefits and is initiated and provided to patients during early phase in the ICU in cooperation with a multidisciplinary team (intensive care physicians, rehabilitation physicians, physical therapists, occupational therapists, respiratory therapists, and nurses) (Yang et al., 2023).

**Operational definition**: predefined criteria was used to assess the ability of the patient to start mobility or not. If it was passed, the early mobility was started from range of motion until walking out of bed. During mobilization there was also criteria that was used to assess if the patient failed to continue mobilization. Early mobility interventions include the following stages: sitting up in bed, sitting on the edge of the bed, standing, moving from the bed to sitting in a chair, and walking (Needham et al., 2012).

**Ventilator Free Days: Conceptual definition**: According to Lee et al. (2020), ventilator-free days were any day during which a patient was able to breathe without the use of a mechanical ventilator for a total of 28 days.

**Operational definition**: VFDs are the number of days that patients were able to breathe on their own during a 28-day period that started when they were enrolled in the trial. If the period of unassisted breathing lasted for at least 48 hours in a row, the period of

unassisted breathing ended with extubation. Zero VFDs were allocated to patients who passed away during the study period (Balas et al., 2014a).

**VFDs are typically defined as following:** If a person passes away while on mechanical ventilation within 28 days, VFDs = 0. If ventilation is successfully released x days after initiation, VFDs = 28 − x. If the patient has mechanical ventilation for more than 28 days, VFDs = 0. ( (Yehya et al., 2019)

**ICU length of stay: Conceptual definition:** ICU LOS was defined as the total days from ICU admission to ICU discharge (Lee et al., 2020)

**Operational definition**: I t was measured from the first day the patient admitted to ICU until 28days of the study enrollment (Lee et al., 2020)

# Chapter Two

# Research Methodology

The aim of the study was to measure the impact of ABCDE bundle on mechanically ventilated patients' outcomes in Hebron Governmental hospital. This aim was investigated by two research hypotheses that measure the level of significance of the ABCDE bundle on ICU LOS and ventilator free days for mechanically ventilated patients. In addition to two main questions that were also closely related to the main aim of the study if there was impact of bundle on occurrence/duration of delirium, and early mobility.

This chapter started with identifying study design, and then sampling process, after that data collection process was explained, the implementation protocol of ABCDE bundle was clearly identified after all that. Those also were explained: the measurements that were used to help in assessment of appropriately performance of any components were discussed, outcomes data were also identified, measurements and data quality, at end the methods that were used in data analysis and interpretation were also mentioned.

## 2.1 Research Philosophy& Research Type

In this research the positivist philosophy was adapted which testes the hypothesis and research questions in deductive quantitative confirmatory approach.

## 2.2 Study Design

In this prospective equasi experimental study, the whole process of data collection took about 16 months (period of data collection from control group, period of educational process, period of intervention). The study was performed in Hebron Governmental Hospital ICU (HGH ICU) with 15beds and it was the only adult ICU in this hospital. This ward was for both surgical and medical critically ill patients. There were two groups, one group who was ABCDE bundle implemented on them and other group was the control group). This study design was appropriate for the study because randomization of the sample was difficult because of time limited of the study, restricted number of patients (the number of patients who is usually ventilated in that ward are not sufficient to be randomized and, it can take longer time.

### 2.3 Population

Mechanically ventilated patients at Hebron Governmental Hospital ICU.

### 2.4 Sampling

The approach of sampling depended on convenience style until reaching appropriate number of patients (this was because of limited resources, time, in addition to limited number of mechanically ventilated patients who admitted to that ward (not all admission cases were mechanically ventilated)). A total of 76 patients met study eligibility criteria (36 patients before and 40 patients after). For those patients, the inclusion criteria were as follow: adult patients (≥18 years old) receiving full ventilatory support who required mechanical ventilation for 24 hours or more. Exclusion criteria: active ethanol/drug withdrawal, significant hemodynamic or respiratory instability, new coronary ischemia, intubation within the previous 6 hours without stabilization, moribund state (death was perceived to be imminent), status epilepticus, allergy to sedatives and analgesics, and current enrolment in another trial.

### 2.5 Data collection

The study data had been collected from the only adult ICU in Hebron Governmental Hospital which had 15 beds. The patients to nurse ratio was 3:1 regardless the complexity of patients situation. There were control group (36 patients) who were mechanically ventilated patients via ETT admitted to ICU between 1$^{st}$ December-2022 to 30$^{th}$ march-2023. This group was treated based on the routine care of mechanically ventilated patients without adapting any specific criteria. The following outcomes were collected from them since intubation in cooperation between health care team and researcher: Richmond Agitation Sedation Scale (RASS), Confusion Assessment Method ICU (CAM ICU), demographic data, patients' medical history and primary cause of admission, cause of intubation, ICU LOS, hospital LOS, delirium occurrence and duration, sedation use and type (boluses and infusions). For RASS and CAM ICU were performed by nurses per shift and once patients were intubated. Once RASS was less than -3, CAM ICU was not done and delayed to be performed on the next time. Regarding sedation, researcher was in daily contact per shift with nurses in that ward to be identified about patients' sedation situation (type of sedatives, amount, using of boluses or infusions). After that, researcher started process of education after approval

was given from hospital managers under supervision of the intensivist. The process of education was taken about four months to ensure adequate education was given for all team (especially nurses, medical resident, medical physicians, and intensivist). This process depended mainly on lectures that were given in that hospital based on education that was built from Society of Critical Care Medicine (SCCM) which was considered as the main developer of ABCDE bundle continuing education for all health care team. After that period, the instructions were given by both intensivist and ICU manager to health care team (nurses and doctors who were considered as the main core of this process) to start implementing this bundle. The implementation period was between 1$^{st}$ October -2023 to 30$^{th}$ march-2024 (it took time more than control group because of number of patients who was eligible to be entered to study was small at the beginning period of study).

The researcher was the main person who collected the data. But the researcher trained health care team especially nurses in that ward to collect data from participants to be as a cooperation process.

Data was recorded in computer in excel program.

**Education Process:** At the beginning, the education material was explained in details to intensives to put him in picture before starting education period and to take his notes about bundle and to take approval from him to start education process to be under his supervision.

For nurses the education lectures were given during both A and B shift according. The education was given in nursing room and sometimes around the ward counter. Researcher educate team about bundle through lecture and presentation. Each lecture took time between one to two hours. For every lecture there were about between three to five nurses educated. The lectures were continued until researcher confirmed all 34 nurses in that ward were well educated about the bundle. The lecture was repeated for those nurses who researcher felt they were not well saturated the bundle until it became saturated.

For doctors' education (intensives, three physicians and about 15 resident who are responsible for ICU): the intensivist divided residents' days to take lecture to different days at A shift according to their presence. firstly, the lectures were given in nursing room for doctors, two to three doctors for each education session. It took different sessions at different days to ensure the education was given for all doctors who are responsible for ICU. At end the, the last lecture was given in doctor meeting room for all remaining residents and physicians who are not previously educated.

### 2.6 Implementation of ABCDE bundle

The specific implementation was as follows:

**ABC**: The awakening and breathing coordination; every morning, a wake-up was carried out and evaluated by the nurse; the spontaneous breathing test was evaluated and implemented via cooperation between the nurses, medical physicians or intensivist at bedside, and the problems occurring during the implementation were monitored and treated by the nurses and intensivist in a timely manner and physician takes the decision of extubation. For the coordination to be occurred, effective and frequent communication were required between different disciplines.

The coordinating process of SAT &SBT is composed of 4 steps: step1 is to assess SAT safety screen. The nurse in this step determined if it was possible to shut off sedation infusion by predetermined safety screen criteria (table 1). If any item of this criteria was not passed, the sedation was not stopped and this criteria was repeated after 24 hours and the causes that prevent its success were discussed during multidisciplinary (the discussion of that causes during multidisciplinary round was not as expected because of communication barriers between different disciplines that were this ward suffered from it, which researcher tried to enhance it during education). If this step was passed. Step 2 was initiated.

**Table 1**

*SAT Safety Screen*

| SAT safety screen |
|---|
| No active seizures |
| No alcohol withdrawal |
| No agitation |
| No paralytics |
| No myocardial ischemia |
| Normal intracranial pressure |

(SCCM ,2008)

Step2 involved starting of SAT criteria by the nurses through stopping all sedatives infusions. Analgesic infusion was maintained only if patient had active pain. The bolus dose of analgesics was given if patient complained or showed signs of pain to be administered. If patient showed any criteria of SAT failure (table 2), the trial was stopped and sedative infusions were maintained at half of the previous dose if needed and optimized to target sedative level. Step 2 was repeated after 24 hours and the causes of SAT failure was discussed during round. Successful SAT was considered when patient was able to open his/her eyes to verbal stimulation (without SAT failure) regardless of the trial period. Success of trial was also considered when patient after 4 hours had no any criteria of SAT failure even not responded to any verbal stimulation. After step 2 was passed, step 3 was started.

After SAT was initiated and patient experienced agitation, use analgesosedation approach, treated pain with intravenous opioid to maintain patient safety and comfort. Firstly, the intravenous opioids bolus was started then opioid infusion restarted if boluses weren't effective. If patient had agitation, bolus dose of propofol could be given, then sedation infusion was restarted if it was not effective. Home anxiolytic or antipsychotic drugs were restarted for patients whose enteral absorption are maintained. If patient developed agitation after Extubation, halidol may be given sometimes after managing the cause of agitation if it was obvious.

Step 3, the patient ability to start SBT was determined by predetermined safety criteria (table 3). If any of these criteria was not passed, SBT was considered as failed and step3 was repeated after 24 hours.

**Table 2**

*SAT Failure*

| SAT Failure |
| --- |
| Anxiety, agitation, or pain |
| Respitatory rate > 35/min |
| Oxygen saturation < 88% |
| Respiratory distress |
| Acute cardiac arrhythmia |

(SCCM, 2024)

At this time sedative infusions were returned at half of the previous dose only if necessary and were titrated during 24 hours. If SBT safety screen criteria were passed, step 4 was started. Step 4 involved performing SBT. In this step patient was attached to spontaneous mode of ventilation (PSV). During trial, the SBT failure criteria (table 3) were assessed. If patient experienced any of them, the trial was stopped and patient was returned to the previous full ventilator support and the nurse returned patient to sedative infusion (at half of the previous dose) only if needed.

Step 1 was restarted after 24 hours and the patient condition was discussed during round. If patient successfully passed the trial after 30 or 120 minutes without experiencing any SBT failure criteria, SBT was considered passed and physician or intensivist were called to consider Extubation. The decision of Extubation was taken by intensivist and nurses followed patients' status after Extubation. If any problems the doctors who were responsible for patient were informed and management was taken by them. Anesthetic team was always in close contact if any deterioration of patient respiratory status occurred. In addition, intensivist was also available.

**Table 3**

*SBT Safety Screen & Failure*

| SBT Safety Screen |
|---|
| No agitation |
| Oxygen saturation >, = 88% |
| FiO2 <, = 50% |
| PEEP <, = 7.5 cmH2O |
| No myocardial ischemia |
| No vasopressor use |
| Inspiratory efforts |
| SBT Failure |
| Respiratory rate > 35/min |
| Respiratory rate < 8/ min |
| Oxygen saturation < 88% |
| Respiratory distress |
| Mental status change |
| Acute cardiac arrhythmia |

(SCCM, 2024)

**D: Delirium Monitoring/Management**; each day, the delirium in patients on mechanical ventilation was evaluated via prepared members with the CAM-ICU, and the delirium was assessed in parallel with RASS to asses if CAM ICU could be assessed or not. The level of delirium progression was assessed and monitored and the recording was in cooperation between nurses and researcher. The sedative level was assessed depending also on RASS and the level of sedation was adjusted based on both scales (RASS, CAM ICU). Those patients who had positive delirium test was also further assessed and managed by physicians and residents who were available.

The RASS was used to check sedation state for patients and was performed Q shift. According to American Journal of Critical Care delirium assessment was performed by nurse every shift and whenever patient experiences change in mental status and supervised by the researcher. (figure 1)

The brain broad map for round which can facilitate the identification of patient sedation status it was not adequately adapted which include: each day during interdisciplinary round, the nurse will inform team about: target sedation/ agitation level, actual sedation/ agitation level, delirium status and exposure to sedatives/ analgesics medications. The inadequate adaptation of this map related to cultural and communications difficulties in that hospital that may need comprehensive program to enhance it toward what is better

to patients' outcomes. Like those programs can break boundaries and barriers between health care team that effect on patient health care.

According to Stolling (2019), use this approach is to guide the management of delirium: stop, think and lastly medicate. This means to identify the etiology of delirium and different causes of delirium and manage them before initiating pharmacological treatment: evaluate patients medications and stop or decrease medication to the lowest dose that are associated with delirium, PADs guidelines recommend against using of benzodiazepines unless required in situations like (alcohol withdrawal, benzodiazepines withdrawal), increase benefits of propofol and dexmedetomidines over benzodiazepines regarding duration of mechanical ventilation and delirium. Important point in management of delirium is to stop all sedatives as soon as possible and to keep patients in light and arousable level of sedation. Then, focus on treating the possible causes of delirium by using THINK script to identify delirium causes in patient who is actually delirious as shown in (table4). Regarding to that previous key points to deal with delirium; the health care team understood the importance of analgesosedation technique, understood and used midazolam less than previously and tried to be away from it as they could. The physicians were responsible for THINK technique but not in direct mean. For using of medications: halidol was used as a last choice to treat hyperactive delirium in extubated patients.

**Table 4**

*Think Criteria for Delirium*

| *THINK criteria for delirium* |
|---|
| Toxic situations and medications: congestive heart failure, shock, dehydration, new organ failure (eg, liver, kidney), deliriogenic medications |
| Examples of deliriogenic medications include benzodiazepines, anticholinergic medications, and steroids |
| Hypoxemia |
| Infection/sepsis (nosocomial), inflammation, immobilization |
| Nonpharmacological interventions |
| K+ (potassium) or other electrolyte interventions |

(Balas et al., 2013)

**E: Early Exercise/Mobility;** the condition of patients determined the degree of patients mobility, four level of mobility was educated and adopted: Active range of motion exercises in bed and sitting position in bed, dangling, transfer to chair (active), includes standing without marching in place, and ambulation(marching in place, walking in room/hall).The researcher educate team about safety criteria that allowed changing the level of mobility from one level to another based on safety criteria that was mentioned in educational paper. Although those four levels of patients' mobility(the perfect levels of mobility that was adopted by SCCM), the most mobility activities which were performed for those patients in this ward were: active range of motion, passive range of motion, turning patients from side to side each shift, and sometimes it was developed to sitting position for those mechanically ventilated patients. But sitting in chair and moving at bedside were not performed for those mechanically ventilated patients unless patients were extubated and can start mobility. The next levels of mobility were only used for able extubated patients. The limitation of performance of this component of bundle related to many causes: the first and the most important one was the lack of resources and equipment that could make mobilization of patients easier and safer. The second cause was the shortage in team especially for physiotherapist; there was just one person for this ward and just came to that ward for period less than one hour daily except Friday and Saturday, in addition to holidays. The third cause was the workload that was on nurses and unequal ratio of patients that prevented them from making a real change in patients' early mobility.

**Rating Scale:** There were two scales: RASS (Richmond Agitation Sedation Scale) was used to assess level of consciousness and CPOT (critical care pain observation tool) was used to assess pain in ventilated ICU patients.

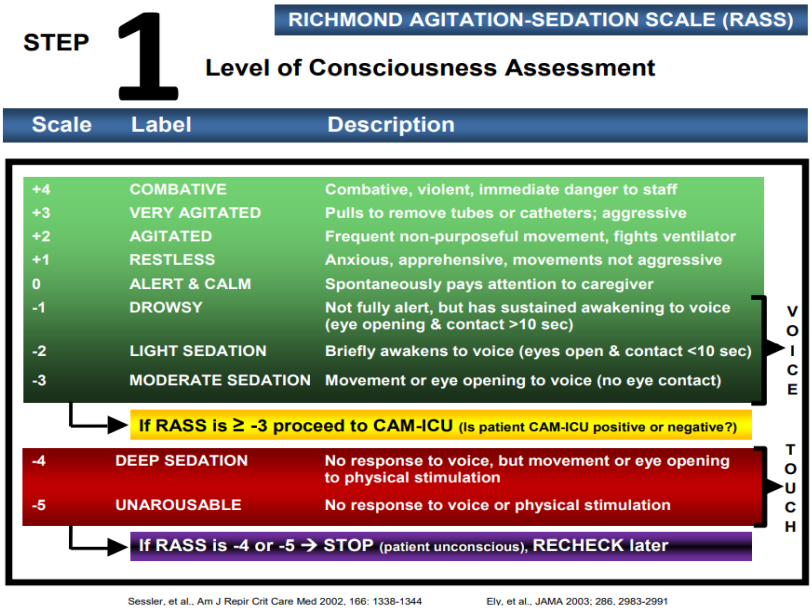
**RASS**: This scale assesses the level of consciousness; it ranges from +4 (aggressive) to -5 (unarousable). If patient fights with staff, endangers the staff, the score is +4 and patient was considered aggressive. If patient tried to remove IV lines or catheter, aggressive, score is +3 and patient was considered extremely agitated. If patient frequently had non purposeful movements, lack of cooperation with a ventilator, score is +2 and patient was considered agitated. If patient was worried or anxious without aggressive movements. score is +1 and patient was restless. If patient reacted spontaneously and listened to caregiver, score was 0 and patient was considered alert

and calm. If patient was not fully alert but fully consciously reacted to voice (eye opening and eye contact >10 second) score was -1 and patient was drowsy. If patient had short term awakening in response to voice (eye opening and eye contact <10 second), score is -2. If patient had eye movement or opening in response to voice (no eye contact), score was -3 and patient was moderately sedated. If RASS > or = -3, CAM ICU (positive or negative score) could be used. If RASS< -3, CAM ICU couldn't be assessed. If patient had no response to voice, had movement to physical stimulation, score is -4 and patient was considered deeply sedated. If patient had no response to voice or physical stimulation, score was -5 and patient was considered unarousable. RASS was assessed by nurses every shift and researcher was in 24 hours contact with health care team to follow the patients status regarding ABCDE bundle (table 4)

**CPOT**: This tool was designed to detect pain in critically ill patients and includes 4 behavioral categories: facial expressions, body movements, muscle tension, compliance with a ventilator (for intubated patients) or verbalization (for extubated patients). Each category is scored on a scale of 0–2 (in total 0–8 points). According to the data reported by Gélinas& Johnston. (2007), the cut-off point is 2–3, while a scoreof > 2 indicates the occurrence of pain. Protocol was explained in details in Appendix D

**Figure 1**

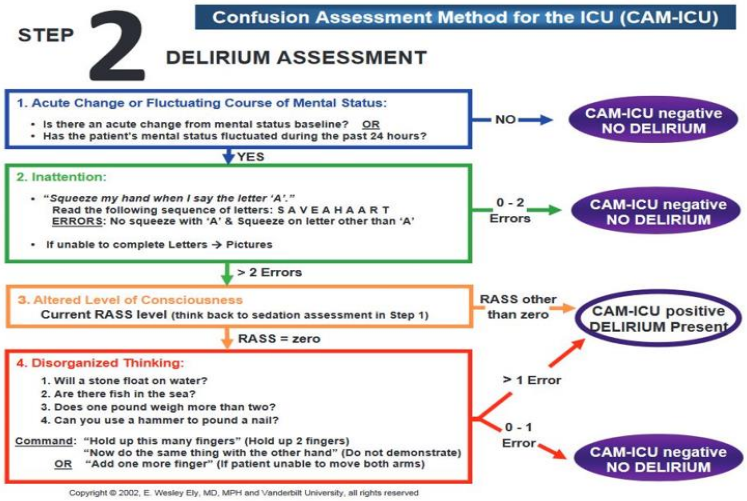
*Richmond Agitation Sedation Scale(RASS) for Sedation and Agitation Assessment*




(Ely et al., 2003)

**Figure 2**

*Confusion Assessment Method-ICU (CAM-ICU) for screening of delirium*




(Miranda et al., 2018)

## 2.7 Demographic Data

The following information was taken from each patient who was included in the study: age, gender, marital status, income (socioeconomic status), education, and employment.

## 2.8 In Vivo and in Vitro Biophysiological Measures

**In Vivo (Vital Signs):** Blood pressure, pulse, respiratory rate, temperature, O2 saturation and mean arterial blood pressure were taken each time daily at the time of starting SAT &SBT criteria. The routine taking of vital signs continued and followed to check patient V/S during the last 24 hours. Vital signs were also be taken once needed.

Nurses in the unit were considered the main arm for taking and recording the vital signs. Recording of them was mainly on both computer and flow sheet.

**In Vitro Biophysiological Measures:**

**ABG (Arterial Blood Gas):** The sample of blood for ABG was taken by nurses daily in a routine manner at 3 am, if any new change in MV parameters, if any new change in patient status, after put patient on pressure support ventilation (PSV) for SBT trial, and one hour after extubation. It was interpreted by physicians, intensivists, residents or nurses who had adequate skills in its interpretation. According to its result, the

parameters in the ventilator were modified and the ability of patient to pursue SBT for extubation was determined.

**Chest X-Ray:** It was taken each day at morning shift and once any deterioration of patient status was occurred. It was interpreted by the intensivist to determine if underlying disease process was resolved or improved.

**Ventilator Parameters:** Each time the SAT & SBT protocol and early mobility protocol were started, the following parameters were taken and recorded in data sheet by nurses: mode, FiO2, PEEP and PS.

### 2.9 Outcomes Data

1. Delirium occurrence and duration
2. Ventilator free days (VFDs)
3. Early mobility
4. Length of stay in ICU

**Delirium Occurrence and Duration:**

**The occurrence of delirium:** was assessed by using CAM ICU and RASS was also used to assist in determining the ability of using CAM ICU.

Both were assessed per shift and during any change in patient mental status. The performance and recording of them were in cooperation between nurses and researcher.

**Duration of delirium**: it was measured by the researcher by calculating the number of days which patient had positive CAM ICU from the starting of the study until 28 days (or until patient is discharged).

**VFDs:** It was measured by the researcher by calculating the days which patients were breathing without mechanical ventilator assistance during 28-day period from the beginning of extubation if the period of unassisted breathing lasted at least 48 consecutive hours. Patients who died during the study period were assigned 0 VFDs.

VFDs were typically defined as follows:

- VFDs = 0 if patients died within 28 days of mechanical ventilation or if patient was mechanically ventilated for >28 days.
- VFDs = 28 − *x* if successfully liberated from ventilation *x* days after initiation.

**Early Mobilization**: Predefined criteria were used to assess the ability of the patient to start mobility or not. If it was passed, the early mobility was started from range of motion until walking out of bed by starting from level one of mobilization until level 3 as mentioned previously. During mobilization there were also criteria that were used to assess if the patient failed to continue mobilization.

**ICU Length of Stay:** It was measured from the first day the intubated patient admitted to ICU until 28day of the study enrollment.

Duration of delirium, VFDs, ICU LOS and early mobility were calculated and determined by the researcher after data collection process.

### 2.10 Measurement and Data Quality

**Reliability**:

To increase reliability and minimize measurement error:

- The administration of the instrument or measurement strategy was standardized—all measurement were occurred in the most consistent manner possible (the administration of measurement strategies was consistent across all of the participants taking part in the study).
- Every person involved in data collection was thoroughly trained in the use of the measurement strategy. There were also repeated lectures and using of different education methods over the period of education and implementation to maintain consistency. Finally, every effort was taken to confirm that data was recorded, compiled, and analyzed accurately. Data entry was closely monitored.

**Validity of Instruments or Measurement:**

In the study hospital's clinical records, the researcher used variables such as length of stay in the intensive care unit (ICU), frequency, duration, and VFD for early mobility interventions. According to prior research by Schoenfeld & Sessler, in particular, RASS and VFD have been certified and are dependable (Lee et al., 2020).

CAM-ICU has demonstrated strong inter-rated reliability, sensitivity, and specificity and is a convenient tool for use in intensive care units (Guenther et al., 2010). Additionally, all data were measured precisely and consistently by qualified medical personnel following the research hospital's guidelines, guaranteeing validity and dependability. Ely et al. (2003) reported that the RASS was also validated and regarded as a useful instrument to assess the degree of consciousness and sedation.

**CAM ICU**:

The meta-analysis by Hamadnalla et al. (2021) demonstrated a good accuracy of CAM ICU: (sensitivity: 84%, specificity: 95%, P value: 0.04) and the accuracy of CAM ICU was also approved by previous meta-analyses (Gusmao-Flores et al., 2012; Neto et al., 2012).

Both direct care nurses and doctors received education program included using of CAM ICU for assessment of delirium. The education as mentioned in the previous studies was given firstly with the assessment of delirium in the ICUs in July 2012, with the competency validation happening in November 2012 before the begin of the ABCDE study. (Zhang et al., 2023) reported that: CAM ICU is valid and reliable tool for delirium prediction among patients in ICU (sensitivity: 82%, specificity: 92%).

**RASS:** RASS is considered as a standard protocol for measuring sedation and agitation in many previous studies (Almgren et al., 2010; Rashidi et al., 2020; Varndell et al., 2015). The reliability of RASS was also confirmed by Rashidi et al. (2020)with reliability coefficient 0.86 as well as the approved reliability and validity of the RASS in various studies, including those of Almgren et al. (2010) & Sessler et al. (2002).

**Content Validity:** Firstly, the researcher operationalizes the independent (ABCDE bundle) and dependent (patients' outcomes) variables that were used in the research. After that the researcher procedures, measures, instruments and data collection methods that were used, all of them were related to these variables (so content of the study is directly related to the major variables that were adapted).

**Face Validity**: The aims and questions made sense together. Based on earlier research, RASS and VFDs have been validated and are regarded as trustworthy (Yehya et al., 2019). According to Guenther et al. (2010), CAM ICU was deemed practical for application in the ICU and has demonstrated good sensitivity, specificity, and interrelated reliability.

RASS was also validated and was considered a good tool to measure both level of sedation and level of consciousness (Ely et al., 2003).

### 2.11 Ethical Consideration

**External Reviews and the Protection of Human Rights:** To conduct the study, all research ethics guidelines and general ethical values were adhered by researcher. An institutional review board (IRB) approval (Appendix A) was obtained from AN-Najah National University to allow the researcher to collect data. Researcher maintain strict confidentiality of patient information throughout the data collection process.

**Informed Consent:** The informed consent was developed to be taken from family members of the participant (most relative one) because the research participants was sedated and mechanically ventilated. (Appendix C). The oral approval was also used.

## 2.12 Data Analysis and Interpretation

The researcher analyzed data by using descriptive analysis (depending on mean, median, IQR and standard deviation) and after that inferential analysis was used to find the relationship between different variables in the study (Mann Whiteny, Chi square test, Fisher and exact test were used for data analysis (the researcher used two groups, one was control and other was experiment.). SPSS version 26 was used for analyzing of data. Power =0.8, Alpha =0.05.

## 2.13 Summary

This chapter provided a comprehensive overview of the methodology plan that was used to allow adequate and qualified implementation of ADCDE bundle from the beginning of outline plan before implementation up to application of bundle.

The next result and analysis chapter discussed the outcomes that resulted from using of this methodology plan.

# Chapter Three

# Results and Analysis

The aim of the study was to investigate the impact of ABCDE bundle on mechanically ventilated patients' outcomes: ICU LOS, VFDs, delirium occurrence and duration, and early mobility.

## 3.1 Baseline Characteristics

A total of 76 patients were enrolled in this study, 36 patients in control group and 40 patients in experimental group, the mean age in control group was 67 (15) while 63 (18) in experimental group, no difference between 2 groups(P =0.466). (Table 6).

The highest percent of the total sample is female in control group (61%),while male in the experimental group (57.5%), no significance difference between two groups (P =0.105).The mean APACHE3 score in patients before intervention 22 (6) was higher than the score in patients after intervention 20 (8), (P =0.267). Regarding SOFA the mean score in the intervention group was 9.88 (3.59) while 9.58 (3.77) in control one (P = 0.731). The mean time on mechanical ventilation that patient spent was higher in control group 4.79 (4) while 3.68 (3.34), but it was not significant (P =0.299).

The highest percent of primary cause of admission in control group was respiratory (38.9 %), followed by sepsis/septic shock/ARDS (22.2%), neurologic (16.7%), surgery (13.9%) respectively and each of cardiac, overdose and other causes had the same percent (2.8%). For the intervention group: the leading cause of admission was also respiratory (30%), then sepsis/septic/ARDS (25%), neurologic (15%), cardiac and surgery causes had the same percentages (10%), others (7.5%), and GI (2.5%). No significance difference between two groups (*P* =0.738).

The percent of patients who had restriction at hospital admission was higher in the control group (47.2%) while was (30%) in intervention group, regarding restriction at hospital discharge it was (2.5%) in intervention group, (19.4%) from control group and (22.5 %) of intervention group had no restriction, and the restriction of mobility was unknown in (45%) of intervention group and (33.3%) in control group.

There were no statically significant differences between two groups in the basic characteristics, that indicated an acceptable homogeneity between both groups, the sample was considered as a representative sample.

**Table 5**

*Comparison between two groups inbaseline characteristics : Demographic data, primary cause of admission &restriction of mobility*

| Descriptor | Control (N=36) | Experimental (N=40) | P value |
|---|---|---|---|
| Age, mean (SD) | 67 (15) | 63 (18) | 0.466 |
| Gender, % | | | 0.105 |
| female, % | 22(61%) | 17(42.5%) | |
| male, % | 14(38.9%) | 23(57.5%) | |
| APACHE3 score, mean, (SD) | 22 (6) | 20 (8) | 0.267 |
| SOFA, mean(SD) | 9.58 (3.77) | 9.88 (3.59) | 0.731 |
| Time on invasive MV, mean (SD) | 4.79 (4) | 3.68 (3.34) | 0.299 |
| Primary Diagnosis, % | | | 0.738 |
| sepsis/septic shock/ARDS | 22.20% | 25% | |
| Respiratory | 38.90% | 30% | |
| Neurologic | 16.70% | 15% | |
| Cardiac | 2.80% | 10% | |
| GI | 0% | 2.50% | |
| Surgery | 13.90% | 10% | |
| Overdose | 2.80% | 0% | |
| Other | 2.80% | 7.50% | |
| Restriction of mobility,n,%: | | | 0.382 |
| At hospital admission | 17 (47.2%) | 12 (30%) | |
| At hospital discharge | 0.00% | 1 (2.5%) | |
| No restriction | 7 (19.4%) | 9 (22.5%) | |
| Unknown | 12 (33.3%) | 18 (45%) | |

### 3.2 Primary Outcomes

Implementation of ABCDE bundle resulted in reduction of MV duration and ICU LOS (Hsieh et al., 2019).Adaptation of ABCDE bundle increased VFDs (Balas et al., 2014). This bundle also minimized sedation exposure and manage intensive care unit acquired delirium and weakness. Therefore, those outcomes (ICU LOS,VFDs, delirium occurrence and duration, and early mobility) beside the duration of MV were discussed in this section of results, in order to find their relation with the implementation of ABCDE bundle.

**ICU LOS:** Intensive care unit length of stay (ICU LOS) was measured in days for both pre-intervention group and post-intervention group. Median was used to test the difference. Both groups had the same median days regarding ICU LOS which was 4 days (Mann Whiteny U test was used to compare between pre intervention and post intervention group, *P*= 0.88).The null hypothesis which adapted the absence of difference between 2 groups was accepted because there was no significant difference. (Table 7).

**Duration of MV:** Regarding mechanical ventilation duration, median days for interventiongroup3 (3.75) was less than the control group 3.5(5.75).However, this difference was not significant (P= 0.378), (Mann Whiteny Utest was used here) (Table 7), (Figure 2).

**VFDs:** Mann Whiteny U test was used to compare between 2 groups. There was also no significant difference between 2 groups related to VFDs (P = 0.9). Median of VFDs for both groups were0 and interquartile range for experimental was 23.5 while 20.75 for control group. (Table 7)

**Early Mobility:** Percentages and counts were used to compare between 2 groups regarding early mobility. Early mobility occurred in about 7.5% of patients in experimental group which was greater than control group who have not adapted an early mobility for any patients 0%, but this difference was not significant (Fisher exact test was used here, *P* =0.242). (Table 7), (Figure 3).

**Table 6**

*Comparison of Primary Outcomes between two groups: ICU LOS, MV duration &VFDs*

| Variables | Control (median, IQR) | Experimental (median, IQR) | Z value | P value |
|---|---|---|---|---|
| ICU LOS | 4 (5.75) | 4 (4) | -0.146 | 0.88 |
| MVduration | 3.5 (5.75) | 3 (3.75) | -0.88 | 0.378 |
| VFDs | 0 (20.75) | 0 (23.5) | -0.124 | 0.902 |
| | | Control | Experimental | Total | P value |
| Early mobility | Yes | 0 | 3 | 3 | 0.242 |
| | | 0 | 7.5% | 3.9% | |
| | No | 36 | 37 | 73 | |
| | | 100% | 92.5% | 96.1% | |

*Mann Whitney test was used for ICU LOS, MV duration, and VFDs P: (0.88 ,0.378 ,0.902)
*Exact test was used for early mobility P: (0.242

**Figure 3**

*Box-plot for comparing median duration of MV between experimental and control group*

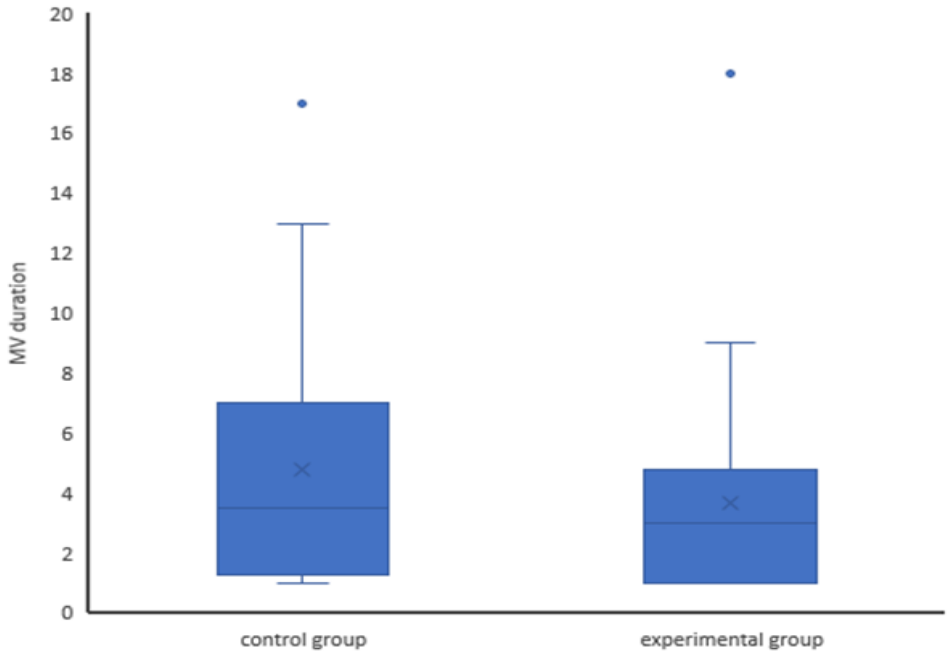
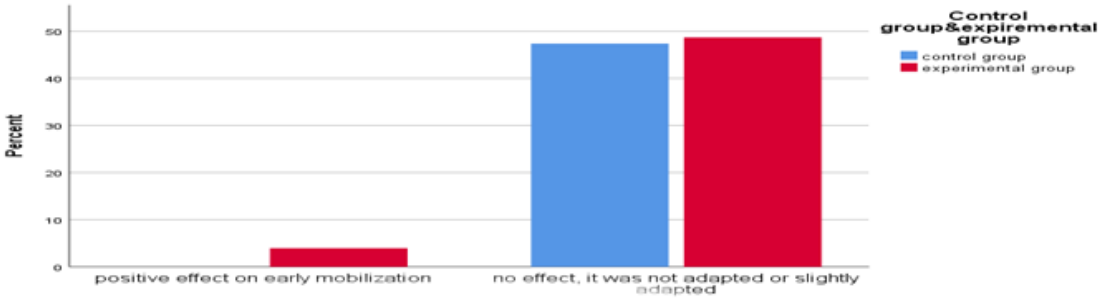


**Figure 4**

*Comparing between intervention and control group regarding the percentage of early mobility*




**Delirium Occurrence and Duration:** Delirium assessment was done by using: RASS, duration of delirium, delirium occurrence, and using of restraints (Bounds et al., 2016).The researcher built on these variables to measure delirium.

**RASS:** Mann Whiteny U test was used to compare the depth of sedation between two groups. The result was as following: the group who adapted ABCDE bundle experienced more time lightly sedated while the group who didn't adapt was more deeply sedated (P = 0.05). The mean rank of the control group (43) was greater than experimental group (34), while the median was the same for both 4 (2). (Table 8)

**Duration of Delirium:** Median and interquartile range was used to describe duration of delirium. Median for experimental group 1day (1) was less than control group which was 2days (1.75). Mann Whiteny U test was used to investigate difference. There was no significant difference between two groups (P =0.22). (Table 8)

**Delirium Occurrence:** The description of delirium occurrence was done by using percentages and counts. The occurrence of delirium in the experimental group was 57.5% which was less than control group 65.7%. That means the group without ABCDE bundle implementation suffered more days with delirium. Fisher exact test was used to investigate if there was difference, the result of the test indicated no significant difference between two groups regarding delirium occurrence ($P = 0.362$). (Table 8).

**Restraints:** The using of restraints in control group was higher than the intervention group (44.4% in control, 20.5% in intervention). This difference was confirmed by using Fisher exact test. There was statistically significant difference between two groups at significant level < 0.05, (P value was 0.008), and so the using of restraints in control group was greater than the intervention group. (Table 8).

**Table 7**

*Delirium Results: different variables for delirium assessment*

| Variables | Control (median,IQR) | Experimental (median,IQR) | Z | U value | P value | Control (Mean Rank) | Experimental (mean rank) |
|---|---|---|---|---|---|---|---|
| RASS | 4 (2) | 4 (2) | -1.919 | 540.5 | 0.05 | 43 | 34 |
| Duration of Delirium(days) | 2 (1.75) | 1 (1) | -1.227 | 272 | 0.22 | | |
| delirium occurrence | control (n,%) | | Experimental (n,%) | Total | P value | | |
| | Yes | 23 | 23 | 46 | | | |
| | | 65.70% | 57.50% | 61.30% | | | |
| | No | 1 | 5 | 6 | | | |
| | | 2.90% | 12.50% | 8% | | | |
| | Unknown | 11 | 12 | 23 | | | |
| | | 31.40% | 30% | 30.70% | 0.362 | | |
| | Restraints | | | | | | |
| | Yes | 16 | 8 | 24 | | | |
| | | 44.40% | 20.50% | 32% | | | |
| | No | 20 | 25 | 45 | | | |
| | | 55.60% | 64.10% | 60% | | | |
| | Unknown | 0 | 6 | 6 | 0.008 | | |
| | | 0 | 15.40% | 8% | | | |

### 3.3 Related Outcomes

Tracheostomy Applied: Tracheostomy was applied more in the control group 8.3% than experimental group 2.5%. However, no statistically significant difference between two groups (P =0.269). (Figure 4).

**Self Extubation:** This variable was observed more in control group (13.9%) compared to intervention group (2.5%), but this difference was not statistically significant (P =0.095). (Figure 5)

**Discharge Status:** Percentage of patients who died in ICU from control group was 72.2% compared to 67.5% of experimental group. Patients in pre intervention group who died in hospital after transferred to other wards was 5.6% while 2.5% in experimental group. Patients who discharged alive from hospital was higher in experimental group 30% compared to control group 22%. Fisher exact test showed no statistically significant difference between two groups related to discharge status (*P* = 0.634). (Figure 6).

**Re-Intubation:** No statistically significant difference between ABCDE bundle group and non-ABCDE bundle group regarding re-intubation. (*P* =0.702). (Figure 7).

**Related Outcomes:** Exact Test was used for all related outcomes.

**Figure 5**

*Bar-chart for comparing between intervention and control group regarding the percentage of tracheostomy applied*

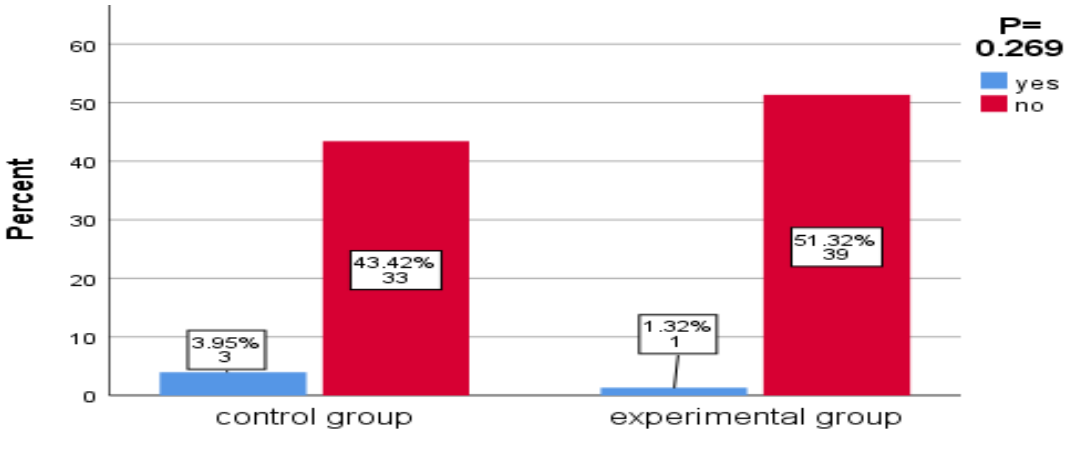


**Figure 6**

*Bar chart for comparison between intervention and control groups regarding self Extubation percentage*

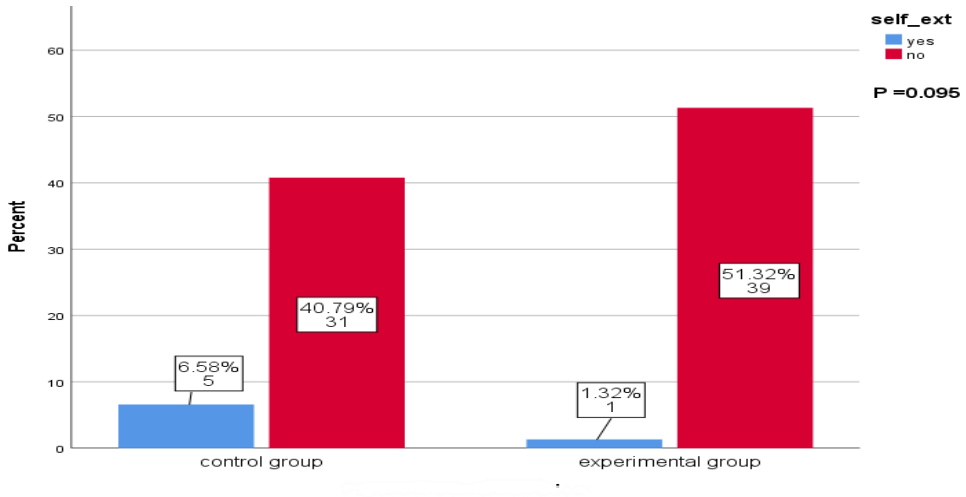



**Figure 7**

*Comparison between experimental and control group regarding percentage of patients in each discharge status*

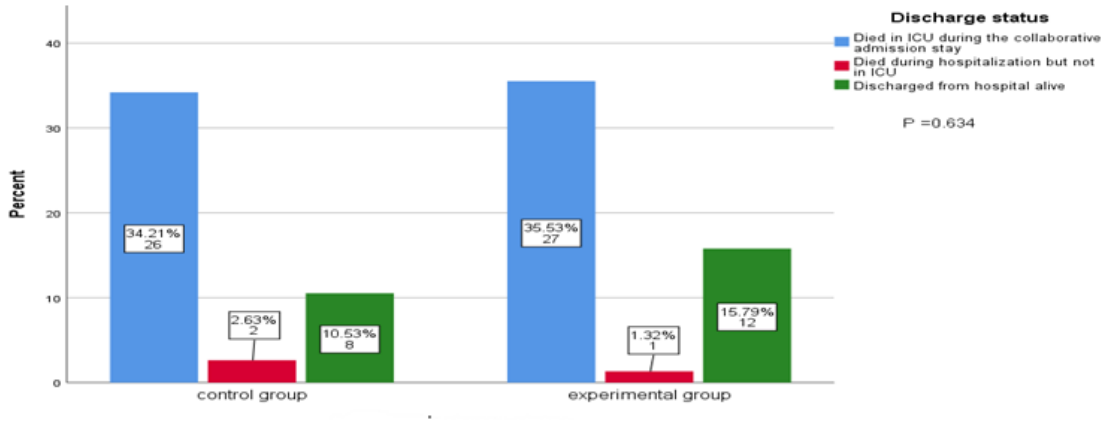
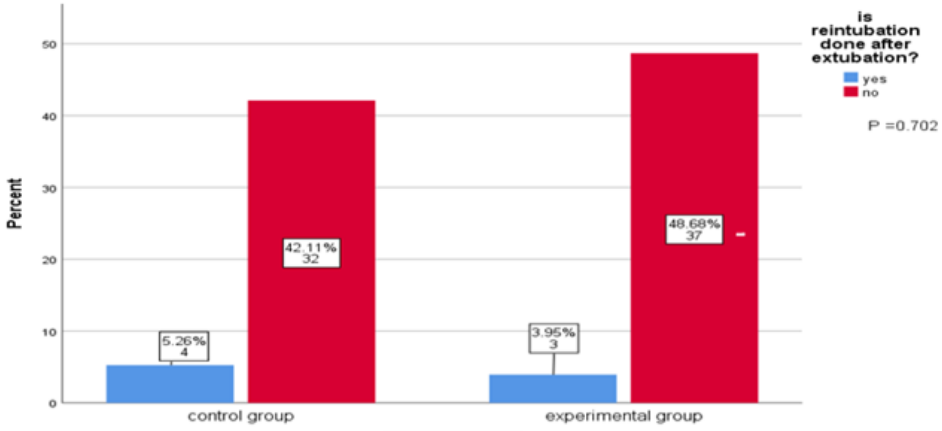


**Figure 8**

*Bar-chart: comparison between two groups regarding percentage of re-intubation*




**Sedation:** One of the main principles of the ABCDE bundle is cutting the cycle of over sedation that leads to delirium and weakness. Therefore, minimizing sedation is one of the basic elements of the bundle (Balas et al., 2014)

Mann Whitney Utest was used to test the difference between experimental and control groups. Finding from table 9 showed no statically difference between both groups regarding Total (tot) benzodiazepines, tot propofol, tot fentanyl, tot atracurium, since p values were not significant (0.55, 0.292, 0.224, 0.419) respectively. (Table 9).

**Table 8**

*Sedation & Others*

| Agent name | Control (median, IQR) | Experimental (median, IQR) | *Z* | *P* value | Mean Rank (control) | Mean Rankb (experimental) |
|---|---|---|---|---|---|---|
| Tot benzodiazepines | 20 (70.25) | 10 (93.5) | -0.589 | 0.55 | | |
| Tot propofol | 0(0) | 0(0) | -1.054 | 0.292 | 40 | 37 |
| Tot fentanyl | 2000 (5525) | 1810 (6249) | -1.217 | 0.224 | 41 | 35 |
| Tot atracurium | 0(0) | 0(12.5) | -0.808 | 0.419 | 34 | 37 |

*Tot: total

In conclusion, ABCDE bundle group experienced less time deeply sedated, the using of restraints was decreased (P= 0.05, P =0.008). Implication of bundle decreased MV duration, delirium duration, and occurrence, but those were not statistically significant (P= 0.378, P=0.22, P=0.362). No significant difference in ICU LOS, VFDs, early mobility, tracheostomy use, self extubation, discharge status, and sedation use.

# Chapter Four

## Discussions and Conclusions

This chapter started with an introduction that reviewed the major points in the study, then the researcher showed the results and after that interpreted them as primary outcomes that are closely related to the research hypotheses and questions, followed by related outcomes.

The aim of the study was to investigate the impact of ABCDE bundle on the patients 'outcomes. This aim was measured by applying two research questions and two hypotheses to know the impact of this bundle on specific outcomes which were: ICU LOS, VFDs, delirium occurrence and duration, early mobility on mechanically ventilated patients in Hebron Governmental Hospital ICU that has not adapted any specific protocol to deal with such patients (especially weaning criteria, delirium assessment and management, and early mobility).

The findings of the study regarding the primary outcomes: there were no significant differences between two groups associated with ICU LOS,VFDs. Although duration of MV, delirium occurrence and duration were less in the group who adapted ABCDE bundle but these findings were not significant. ABCDE bundle group had more effective early mobility but this difference was also not significant. There were positive outcomes related to sedation level and restraints use: experimental group had less days deeply sedated and restrained compared to other group and these results was significant.

The data suggested that no significant differences associated with related outcomes: tracheostomy applied, self Extubation, and re-intubation times despite of reducing occurrence of them after study enrollment. Patients who discharged alive from hospital were more in ABCDE group but this was not statistically significant. Benzodiazepines use was decreased to half after study implementation, however it was not statistically significant.

### 4.1 Primary Outcomes

**ICU LOS:**

Regarding ICU LOS, the result of the study highlighted no significant difference between two groups. This was concurrent with what resulted from others (Bunch, 2019; Balas et al., 2014). However, it was not consistent with the study done by Ebrahim et al. (2021) which indicated highly significant decrease in ICU LOS in intervention group. This was also parallel to other studies of (Ren et al., 2017; Needham et al., 2010; Girard et al., 2008; Kress et al., 2000).

**VFDs**:

The present study findings supported that no significant difference between control and experimental groups regarding VFDs. This resembles the study by Bunch. (2019) who found no statistically significant difference in VFDs after implication of the bundle. It also was consistent with the results that were reported by other studies of (Balas et al., 2012;Kress et al., 2000) which demonstrated no significant increase in VFDs after implementation of ABCDE bundle components. The result of that study was contradicted to other studiesof (Ebrahim et al., 2021;Girard et al., 2008;Balas et al., 2014) which found positive enhancement In VFDs for mechanically ventilated patients.

Some causes that resulted in the previous unexpected outcomes regarding VFDs, ICU LOS, which were contradicted to the previous studies as mentioned early in the discussion part: 1. high staff turnover 2. process resistance 3. Lack of motivation.

Some factors affected on implementation of the bundle were related to organizational aspect. Although the hospital sponsors welcomed and accepted the implication of bundle, the organizational policy hadn't adapted specific strategy to make it as an actual routine care of patients that can enhance its use by team members and if that occurred the bundle can be considered as criteria for team evaluation. The same was mentioned by (Boehm et al., 2016).

The significant barrier was health care provider attitudes (their way of thinking, resistance to change, considering bundle as a new load of work, fear to change, apprehension and discomfort toward bundle) all of these were considered as significant barriers to allow complete adaptation of this bundle. Those may be rationalized by some

factors: shortage of team, lack of motivation in this environment, burnout, turnover especially nurses and residents. Furthermore, usual routine practices which were not continuously developed made health care team from different disciplines not easy to accept change. (Boehm et al., 2016). Some of these barriers were realized like workload: the ratio of nurses to patients' number was not fair and put a high load on them. The same for doctors who were responsible for a large number of patients. There was also complexity in the tasks that were required from different disciplines especially nurses who was considered as the main core for implementation of bundle. Those were also mentioned by the previous studies (Boehm et al., 2016).

Other factors that might also negatively affect the empowerment of the bundle is unstructured communication and coordination between different health care team which consistent to what reported by Negro et al. (2022). The Stollings et al., (2019) demonstrated the importance of effective communication between different disciplines for effective conduction of bundle.

The adherence and implementation of the study health care team were not as demanded and this were related to the previous mentioned causes. That was consistent with Boehm et al. (2017) who mentioned that only 12% of team have implemented the bundle although of initiation of quality improvement who also reported if the workload decreased, the adherence of bundle increased.

**Some Other Causes:**

- The resources (that facilitated the implication of bundle in hospital) in the previous studies were more than what were available in this study, which implemented in hospital that has high shortage in resources that could assist in implementation of bundle items especially mobility equipment and adequate number of team.

- Most of the previous studies implemented bundle in environments didn’t resist change and had some protocols, strategies or criteria to deal with mechanically ventilated patients, which opposite to HGH ICU which didn’t adapt specific criteria and had different types of resistance toward change.

- Although researcher consumed all the best to allow adequate implementation of bundle but the adaptation of bundle was poor.

- The study size was small to observe clear changes.
- Presence of just one researcher for the study put many hard works on her and was required super work against to previous studies which had a cooperative group of researchers which made supervision, evaluation easier and as required.

**Early Mobility:**

Although early mobility occurred more through experimental group, this was not significant and most of mobility was in bed. This was similar to what was mentioned by Frade-Mera et al. (2022) who reported little enhancement in early mobility. Those also were confirmed by other studies (Hodgson et al., 2015; Liu et al., 2019).

Other studies such as Capell et al. (2019) indicated increase degree of mobility compared to other studies and the study considered sedation as the main barrier of early mobilization. Bounds et al. (2016) revealed increase degree of sitting position compared to other studies but out of bed mobility was not significant.

The insignificant of this result in this study may related to the clinical status of patients (coma, delirium, sedation, and pain) which can affect the degree of cooperation by the patients (Capell et al., 2019; Hodgson et al., 2015; Miller et al., 2015; Schwab et al., 2020) Other causes related to shortage of resources that were needed to allow effective and safety mobility (assistive devices, lifting devices, ambulator ventilators, walker, high back chair, oxygen tanks) (Negro et al., 2022).

**Delirium:**

One of the research questions was about delirium occurrence and duration if there were a statistically significant about both of them. Despite the study findings showed decreasing both delirium occurrence and duration in group who adapted bundle but those results were not statistically significant. The similar findings were also resulted in other studies (Lee et al., 2020; Burry et al., 2017; Luetz et al., 2014).

Other studies were contradicted to this study and demonstrated significant positive effect of ABCDE bundle on delirium like Balas et al. (2014) which showed patients who managed with ABCDE bundle experienced less delirium and this is concurrent with Frade-Mera et al. (2022) study which reported highly low incidence of delirium as

a result of ABCDE bundle performance. Those also came hand by hand with the study of (Bounds et al., 2016).

The insignificant of the study results regarding delirium occurrence and duration could be due to the focusing more on more apparent type of delirium (hyperactive) which is easy for assessment and can be managed. Additional causes may be related to some situation in which delirium couldn't be identified like coma cases as other studies mentioned that. In addition to the previous barriers that were mentioned earlier.

**Related to degree of sedation:**

This study reported significantly increase of light sedation in intervention group compared to more deeply sedation in control group, which was consistent with what was mentioned by (Frade-Mera et al., 2022).

**Restraints:**

This study revealed significantly decrease in restraints use in experimental group and this result is similar to what were reported by other studies (Frade-Mera et al., 2022; Arias-Rivera et al., 2020; Egerod et al., 2013). However, the study which was conducted by (Pun et al., 2019) in United States, and the study by Aziz pour et al. (2017) which showed the increase use of restraint in ICU in Canada were opposite to this result and showed increasing use.

**Sedation:**

Despite of the study finding toward benzodiazepines use was shown decreasing of its use to approximately half amount, this result was not statistically significant. The same was concluded by Bounds et al. (2016) who summarized no statistically significant in the average daily dose of sedatives after the ABCDE bundle was adapted. Which also was demonstrated by (Balas et al., 2014a).

The result of other studies like Mansouri et al. (2013) reported reduce use of sedatives where nurse-guided drug administration depending on analgesics& sedative protocol. Ren et al. (2017) highlighted the significant change in sedation when ABCDE bundle was performed and the same was also resulted by (Ebrahim et al., 2021).

## 4.2 Limitations

Researcher has done the best regarding trying all healthcare team to be more adhere and familiar with the bundle. Despite of all resistance that were faced (limitation of time for the ABCDE bundle, limitation of resources that helped on the simplifying the bundle, lack of place for presenting education, health care team thinking toward bundle as a complex, long time taken to get the acceptance from different managers in this hospital either to allow for education lectures or to allow for the bundle implication. Some conflicts that occurred between different disciplines about bundle, the longtime that was required from researcher to educate the different health care team, because the researcher tried to gather health care team from different disciplines through one week in continuing education, but it was failed). So, the researcher had to give lectures in different times according the availability of team and according to their time that allowed their presence in hospital (and that took hours and hours of work), sometimes because of the workload of team and shortage of team, the lectures were given next to patients' beds (around counter). In addition to many other resistances that researcher had faced and passed them always toward the next plan. Researcher also put different wall posts and different files in that ward to make team more familiar with that bundle. Any questions and helping about the bundle were allowed at any time.

**Strengths:**

The researcher, intensivist, and health care team were responsible for supervising the implementation of bundle in order to do the best to ensure adequate adherence and implementation of bundle. Researcher was 24 hours in contact with health care team during the period of observation of control group or the period of intervention (16 months) to evaluate and assess the implementation of bundle.

Researcher, intensivist, in addition to many other health care team members adapted the bundle implementation during all the days and consumed all of their power to ensure the bundle implementation. The bundle was as a big view of the researcher to change in that hospital ICU, so she didn’t serve any energy until to use toward the success of bundle.

**Some Facilitator for Future Researchers that C help Enhancing Implementation of Bundle as Researcher Concluded During Application of Bundle:**

- Complete training program
- Practice guided training
- Enhancing and empowering organizational culture
- Performance evaluation
- Continuing education
- Strengthening communication
- Adequate family involvement

Those were also reported by Lee et al.,2020.

Adaptation of bundle as a real protocol from hospital authority, simulation education, structured round process, and decrease workload in the future can enhance bundle enrollment.

Therefore, concentrating on the simplifying and decreasing the workload will enhance health care team adherence to bundle (Boehm et al., 2017).

Although the implementation of the study was not as expected, there were some practical changes like using benzodiazepines: it was really clinically decreased and team (nurses and doctors) became more depended on opioid infusion and used benzodiazepines as bolus doses just if really needed. They became away from benzodiazepine infusions unless critically needed. The attitude of team toward using sedation was changed to better.

ABCDE bundle has a new version of it since few years which was developed by SCCM which is ABCDEF (Assess, Prevent, and Manage Pain (A), Both Spontaneous Awakening Trials (SAT) and Spontaneous Breathing Trials (SBT) (B), Choice of analgesia and sedation (C), Delirium: Assess, Prevent, and Manage (D), Early mobility and Exercise (E), and Family engagement and empowerment (F)) version. Researcher

adapted old but not the new version because of the new component of this version which is F part: family engagement was not fit for environment like HGH ICU. That related to nature of culture in this society which needs a complete program for patients families in order to be more concentrate on patient centered of care. If the researcher adapted the F part of that bundle, the presence of family in that shape without promotion and education program to enhance centered of care toward patients will be load on the implementation of bundle.

Despite the results of the study was not statistically significant in relation to main outcomes; ICU LOS, VFDs, Delirium duration and occurrence, and early mobility, the little positive enhancement in those outcomes represented the ability to change in environment that mimics this ICU. This gives clues to future researchers how they can make differ in highly resistance environment with limited resources. That means if future researchers built up in this research and adapted the similar view to change, they can change when they take in their consideration to modify the barriers that faced researcher in this study like to do research as a group of researchers will ease process, in addition to make a clear plan to how overcome the barriers that were in this study.

### 4.3 Conclusions

This prospective study measured the differences in the ICU LOS, VFDs, delirium occurrence and duration, and early mobility after implementation of ABCDE bundle. No significant differences related to ICU LOS, VFDs. Despite the decreasing of MV duration, delirium occurrence and duration, and enhancing of early mobility in group who adapted the bundle but those outcomes were not significant. However, patients whose ABCDE bundle implemented on them were more alert, awake and restraints use among them were decreased significantly. Moreover, the adaptation of ABCDE bundle in ICU was found to be complex process and health care team faced many obstacles such as: shortage of team, limited time and resources, poor communication between different health care teams, and negative attitude.

### 4.4 What This Paper Added (Contribution of the Study)

- This study confirmed the probability of implementation of such bundle in highly resistance environment with limited resources.
- The study gives the future researchers the strategy to implement this bundle in case of facing any challenges.
- The decrease of sedation level that resulted from this study as assessed by RASS and decrease of restraints use reported the importance of strengthening the use of analgesosedation protocol to make patients more aware and oriented to their surroundings.
- ABC domain of the bundle that was the most components of the bundle which effectively adapted by team especially intensivist and nurses in this ward although of different types of shortage, and effective application and adherence of it may give the future researchers the clues to build on what we reached to get better outcomes.
- This study can provide the basic background for improving bundle implementation techniques and surveying levels of improvement in other intensive care unit.
- According to the researcher knowledge it is the first study for ABCDE bundle implementation in Palestine.
- The time elapsing from the beginning of bundle performance especially during ABC domain indicates increasing awareness and confidence of team toward bundle.

### 4.5 Recommendation for Theory

- Further researches are needed to investigate how to make the bundle effective in limited resources environments
- This study gave the clauses for the future researcher to how applying the bundle in the case of shortage of resources and they can build on it.

### 4.6 Clinical Recommendations

- Focusing on interventions that can decrease workload and make work environment more comfortable may facilitate the implementation of bundle.

- Considering use effective checklists, routine daily sheets in effective manner and multidisciplinary training until bundle become effectively saturated could enhance the outcomes that result from adequate bundle performance.

- Considering using larger sample size and different ICUs from various hospitals would develop more better outcomes and make generalization about bundle results.

- Issues related to management, coordination and interdisciplinary effective round need to be taken as a critical necessity of bundle to improve its enhancement.

- Continuing education and complete adapted training program about bundle until to be fully understood from different disciplines teams could be taken in view to improve patients' outcomes.

- This study identifies the various challenges that was faced during bundle implementation and the future researches could build on them and modifies practices to overcome those obstacles.

- Effective and complete adherence of ABCDE bundle as a routine care of mechanically ventilated patients may effectively enhance mechanically ventilated patients' outcomes (ICU LOS, VFDs, delirium occurrence and duration, and early mobility.

## List of Abbreviations

| Abbreviation | Meaning |
|---|---|
| ABCDE bundle | Awakening &Breathing Coordination, Delirium Assessment and Management, and Early Mobility |
| ICU LOS | Intensive Care unit Length of Stay |
| VFDs | Ventilator Free Days |
| MV | Mechanical Ventilation |
| MV patient | Mechanically Ventilated Patients |
| ICU | Intensive Care Unit |
| ICUAW | Intensive Care unit Acquired Weakness |
| SAT | Spontaneous Awakening Trial |
| SBT | Spontaneous Breathing Trial |
| SD | Standard deviation |
| RCT | Randomized Control Trial |
| PTSD | Psot Traumatic Stress Disorder |
| PSV | Pressure Support Ventilation |
| PICS | Post Intensive Care Syndrome |
| HGH | Hebron Governmental Hospital |
| CPOT | Critical Care Pain Observation Tool |
| RASS | Richmond Agitation Sedation Scale |
| CAM ICU | Confusion Assessment Method for the Intensive Care Unit |
| SCCM | Society of Critical Care Medicine |
| SOFA | Sequential Organ Failure Assessment |
| APACHE | Acute physiology and Chronic Health Evaluation |
| ARDS | Acute Respiratory Distress Syndrome |
| GI | Gastrointestinal |

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# Appendices

## Appendix A

## Approval Letter

An-Najah National University
Faculty of Medicine & Health Sciences
Institutional Review Board

جامعة النجاح الوطنية
كلية الطب وعلوم الصحة
لجنة اخلاقيات البحث العلمي

Ref: Mas. **Nov. 2022/6**

**IRB Approval Letter**

Title of Research:

**The impact of ABCDE bundle implementation on mechanically ventilated patients outcomes at ICU in Hebron governmental hospital.**

**Submitted by:**
Sawasn Al-Sarahinah.

**Supervisoe:**
Jamal Qaddumi

**Approved:**
6th Nov. 2022.

Your Study Title **"The impact of ABCDE bundle implementation on mechanically ventilated patients outcomes at ICU in Hebron governmental hospital."** reviewed by An-Najah National University IRB committee and was approved on 6th Nov. 2022.

**Hasan Fitian, MD**

**IRB Committee Chairman**

IRB
Institutional Review Board

Nablus - P.O Box :7 or 707 | Tel (970) (09) 2342902/4/7/8/14 | Faximile (970) (09) 2342910| E-mail : IRB@najah.edu

## Appendix B

## Facilitating Task Letter

State of Palestine
Ministry of Health
Education in Health and Scientific
Research Unit

دولة فلسطين
وزارة الصحة
وحدة التعليم الصحي
والبحث العلمي

Ref.: .....
Date:.....

الرقم: ٢٦٦/٢٦٦ ٢٠٢٢/٢٠٢٢
التاريخ: ٢٠٢٢/١٠/٣٠

**الأخ مدير عام الادارة العامة للمستشفيات المحترم،،،**

**تحية واحترام،،**

**الموضـــوع: تسهيل مهمة بحث**

يرجى تسهيل مهمة الطالبة: **سوسن بسام محمد السراحنة – ماجستير تمريض العناية المكثفة– جامعة النجاح**، لعمل بحث الماجستير بعنوان:

**"The Impact of ABCDE bundle implementation on mechanically ventilated patients outcomes at ICU in Hebron governmental hospital"**

حيث ستقوم الطالبة بجمع معلومات عن طريق المراقبة من أقسام العناية المكثفة، **بعد الحصول على موافقة رئيس قسم التخدير والانعاش**، وذلك في:

**– مستشفى عاليه الحكومي**

ما بين 2022/12/1–2022/12/28، مع العلم أن مشرف الدراسة: د. جمال قدومي.
على ان يتم الالتزام بالمحافظة على اخلاقيات البحث العلمي وسرية المعلومات.
على ان يتم الالتزام بجميع تعليمات واجراءات الوقاية والسلامة الصادرة عن وزارة الصحة بخصوص جائحة كورونا، وتحت طائلة المسؤولية. وابراز شهادة التطعيم قبل دخول مرافق وزارة الصحة.
على ان يتم تزويد الوزارة بنسخة PDF من نتائج البحث، التعهد بعدم النشر لحين الحصول على موافقة وزارة الصحة.

**مع الاحترام،،**

**د. عبد الله القواسمي**
**رئيس وحدة التعليم الصحي والبحث العلمي**

نسخة: مدير دائرة التمريض والقبالة المحترمة/ جامعة النجاح

Telfax.:09-2333901 scientificresearch.dep@gmail.com تلفاكس: 09-2333901

## Appendix C

## Consent Form

**Consent Form**

I understand that my relative patient is being to participate in a research study at Hebron Governmental Hospital. this research study will measure: what is the impact of ABCDE bundle implementation on mechanically ventilated patients. I agree to participate my relative in the study. she /he will be involved in the group whose ABCDE bundle will be implemented on them. The procedure is composed of number of steps (before any step to be passed, patient must pass safety screen criteria except delirium which will be evaluated by CAM ICU scale

All of the steps were explained to me by the researcher. The risks that my relative may expose to them were explained.

I realize that the knowledge gained from this study will benefit my relative or other mechanically ventilated patients in the future.

I realize my acceptance on participation of my relative in the study is entirely voluntary and I may withdraw my relative from the study at any time I wish. if I decide to discontinue my relative participation in this study, she /he will continue to be treated in usual and customary fashion.

I understand that all study data will be kept confidential. However, this information may be used in nursing publication or presentations.
I understand if my relative sustain injuries from her /his participation in this research project. she /he will not be automatically compensated by Hebron Governmental Hospital.
If I need to, I can contact the researcher anytime during the study.
The study has been explained to me. I have read and understand this consent form, all of my questions have been answered, and I agree to participate. I understand that I will be given a copy of this signed consent form

Signature of the relative Date

Signature of the witness Date

Signature of the investigator Date

## Appendix D

## Study Plan

**Proposal\Methods and Methodology\Proposal Contents\irb Procedure.docx**

## Education

**ABCDE PROTOCOL**

**According to Balas (2013):**

The foundation of ABCDE bundle is mainly built on three main principles :1. improving communication between ICU teams 2. Standardizing care process 3. Cutting the cycle of oversedation that increases the occurrence of delirium and muscle weakness among ICU patients.

There are different practices that will be changed if this bundle is adapted: change bed rest to as tolerated, change practice of using continuous sedative infusion to bolus doses (as needed), developing safety guidelines.

The use of ABCDE bundle is based on safety screen guidelines not on individual physician order, so it should be applied during routine care process of patients. This bundle is based on three main components: coordination of SAT & SBT, monitoring and management of delirium and early mobility. This bundle is flexible enough to be adapted to meet the needs of patients and staff.

Specific details about bundle and how it can be implemented:

SAT & SBT protocol: this protocol is used for each patient receiving mechanical ventilation (MV). This protocol depends mainly on multidisciplinary team, each of them has specific role in this protocol, nurse is responsible for SAT criteria, respiratory therapist is responsible for SBT criteria and physician will take the decision of extubation. For the coordination to be occurred, effective and frequent communication are required between different disciplines.

The coordinating process of SAT &SBT is composed of 4 steps: step1 is to assess SAT safety screen. The nurse in this step will determine if it is possible to shut off sedation infusion by predetermined safety screen criteria (table 1). If any item of this criteria is

not passed, the sedation will not stop and this criterion will be repeated after 24 hours and the causes that prevent its success will be discussed during multidisciplinary round. If this step was passed. step 2 will be initiated.

Table1, (SCCM ,2008)

| SAT Safety Screen |
| --- |
| No active seizures |
| No alcohol withdrawal |
| No agitation |
| No paralytics |
| No myocardial ischemia |
| Normal intracranial pressure |

Step2 involves starting of SAT criteria by the nurses through stopping all sedatives infusions. Analgesic infusion is maintained only if patient has active pain. The bolus dose of analgesics will be given if patient should complain or show signs of pain to be administered. If patient showed any criteria of SAT failure (table 2), the trial will be stopped and sedative infusions will be maintained at half of the previous dose if it is needed and optimize it to target sedative level. Step 2 will be repeated after 24 hours and the causes of SAT failure will be discussed during multidisciplinary round. Successful SAT is considered when patient is able to open his/her eyes to verbal stimulation (without SAT failure) regardless of the trial period. Success of trial is also considered when patient after 4 hours doesn't show any criteria of SAT failure even not respond to any verbal stimulation. After step 2 was passed, step 3 will be started.

According to Stolling (2019) Sedation should be titrated to a light level of sedation unless contraindicated because high and deep level of sedation is associated with increased time to extubation and increased of both hospital and long-termmortality. It is also associated with delirium,post-traumatic stress disorder (PTSD) and acute brain dysfunction.

PADs guidelines (2018) recommend using of nonbenzodiazepines and analgesic first approach to maintain patient comfort.

To be honest, all sedatives are combined with safety concern: propofol and dexmedetomidine may cause hypotension and bradycardia, midazolam is associated

with delirium and may accumulate in patients with hepatic and renal dysfunction, and lorazepam may cause propylene glycol toxicity.

PADs (2013) recommend maintain patient at light level of sedation (RASS -2 to -1).

After SAT was initiated and patient experiences agitation, use analgesosedation approach, treat pain with intravenous opioid to maintain patient safety and comfort.Firstly, use intravenous opioids bolus then restart opioid infusion if boluses weren't effective. If patient has agitation use bolus dose of propofol or midazolam, then restart sedation infusion if it is not effective. administer oral or enteral immediate opioid release opiates for patients who have chronic pain who are currently in pain or for whose cessation of opioids can result in opioid withdrawal. Restart home anxiolytic or antipsychotic drugs for patients whose enteral absorption are maintained. consider use of dexmedetomidine for patients whose use of propofol or IV infusion opiates post SAT is required but causes apnea during SBT. Consider using of anxiolytic and /or dexmedetomidine for hyperactive agitated patients despite the evaluation and management of pain.

**Pharmacology of Sedation, Neme (2020):**

1. The ideal sedative drug is the drug that has the following characteristics

    a. Ease for administration and ease titration

    b. It has rapid onset and short duration of action

    c. Lack of accumulation

    d. Without cardiovascular & respiratory effect

But this sedative drug is not available:

So, comparison between different types of sedative drugs is important to use the best one.

1. **Propofol Versus Midazolam:**

a. Propofol has rapid and predictable recovery than midazolam

b. Propofol has a good titration (it can effectively titrate the level of sedation)

c. Propofol decreases the time of extubation regardless the duration of sedation

d. Propofol decreases the ICU LOS

e. Propofol can be used for both short- and long-term sedation

2. **Ketamine for ICU Sedation:**

a. Ketamine can be used as an alternative sedative for sedation in adult ICU

b. It has advantage in hypotensive patients and those patients who need high dose of vasopressors

c. It can be used for long term infusion in compared to propofol and midazolam which they have toxic accumulation and can cause propofol infusion syndrome

d. Beneficial cardiovascular and respiratory effect when administered as continuous infusion (maintenance)

e. It has minimal effect on FRC, TV and minute ventilation when compared to other sedatives

f. It decreases airway resistance and maintain pharyngeal and laryngeal reflexes in an asthmatic patient with refractory bronchospasm.

g. It decreases audible wheezing, decreases co2 and improve RR and oxygenation.

h. It is recommended to be the sedative drug for choice when long term sedative is required because it has decreased side effects when compared to other sedatives.

So, it can be concluded that, ketamine is recommended in the 3 following conditions:

A. Longer continuous sedation

B. Asthmatic patients

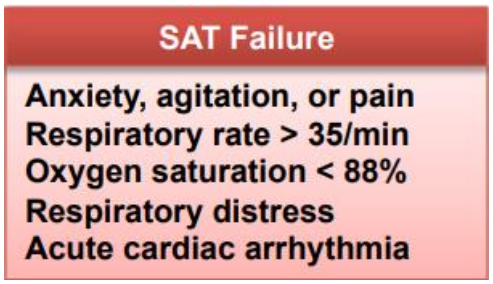
C. Hypotensive patients

**3. Midazolam Versus Diazepam:**

For urgent intubation, it is recommended to use diazepam over midazolam.

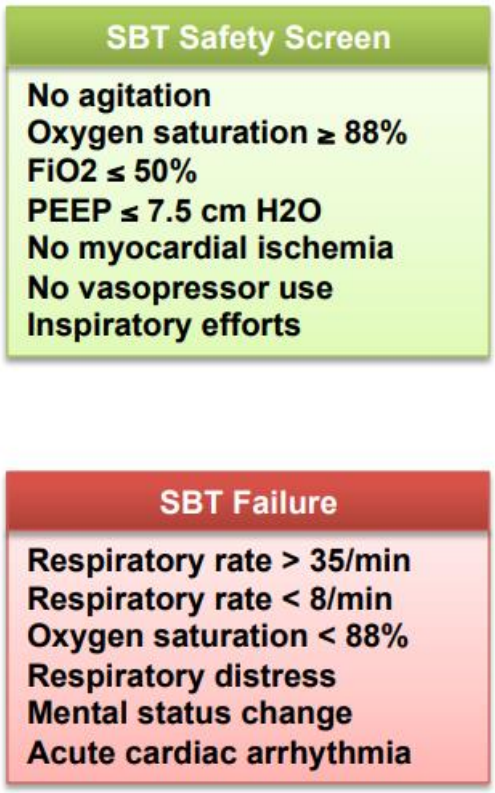
Step 3, the patient ability to start SBT is determined by predetermined safety criteria (table 3). If any of this criterion is not passed, SBT is considered as failed and step3 will be repeated

Table 2 , (SCCM ,2008)




after 24 hours. At this time sedative infusions will be returned at half of the previous dose only if necessary and will be titrated during 24 hours. If SBT safety screen criteria ispassed, step 4 will be started. Step 4 involves performing SBT. In this step patient will be attached to spontaneous mode of ventilation (CPAP5, PEEP 5 or T piece). During trial the SBT failure criteria (table 3) will be assessed. If patient experienced any of them, the trial will be stopped and patient will be returned to the previous full ventilatory support and the nurse will return patient to sedative infusion (at half of the

Table 3, (SCCM,2008)




previous dose) only if needed. Step 1 will be restarted after 24 hours and the patient condition will be discussed during multidisciplinary round. If patient successfully passed the trial after 30 minutes without experiencing any SBT failure criteria, SBT is considered passed and physician will be called to consider extubation.

**Delirium:**

Risk factors of delirium can be divided to: modifiable risk factors like: blood transfusion and benzodiazepine, nonmodifiable risk factors:dementia, old age and prior coma. (Devlin, (2018))

**Prediction of Delirium**, Devlin (2018):

The occurrence of delirium can be predicted at time of admission and in the first 24 hour of ICU admission by using Early PRE DELIRIC model, it contains 9 predictors:age, history of cognitive impairment, history of alcohol abuse, blood urea nitrogen,admission category, urgent admission, mean arterial BP, use of corticosteroids and respiratory failure.

There is online formula that was developed by Wassnaar (2015) to calculate risk of delirium in ICU patients by using Early PRE DELIRIC model.

The RASS will be used to check sedation state for patient and will be performed Q 2-4 hours with vital signs. Delirium assessment will be performed by using CAM ICU each shift and whenever patient experiences change in mental status.

Each day during interdisciplinary round, the nurse will inform team about: target sedation /agitation level, actual sedation / agitation level, delirium status and exposure to sedatives / analgesics medications.

According to Stolling (2019) use this approach to guide the management of delirium:stop, think and lastly medicate. This means to identify the etiology of delirium and different causes of delirium and manage them before initiating pharmacological treatment : evaluate patients medications and stop or decrease medication to the lowest dose that are associated with delirium , PADs guidelines recommend against using of benzodiazepines unless requires in situations like (alcohol withdrawal , benzodiazepines withdrawal ), increase benefits of propofol and dexmedetomidines over benzodiazepines regarding duration of mechanical ventilation and delirium . Important point in management of delirium is to stop all sedatives as soon as possible and patients at light and arousable level of sedation. Then, focus on treating the possible causes of delirium by using THINK script to identify delirium causes in patient who is actually delirious as shown in (table4)

**Multicomponent Strategies for Delirium, Devlin (2018):**

The use of multicomponent strategies that reduce the effect of risk factors associated with delirium are recommended which include: cognitive improvement (re-orientation, using clocks), optimizing sleep (minimize light and noise), visual and hearing optimization (using of visual or hearing aids device as needed)

**a. Immobility (Mobilization /Rehabilitation)**

Bed rest is strongly associated with ICU acquired muscle weakness, so early mobility is important.

**Safety and Risk of Early Mobility:**

Early mobility /rehabilitation are considered safe and is not associated with harmful safety concerns, so it is recommended.

**Indicators for Initiation:**

Major indicators for safely initiation of early mobility are cardiac, respiratory and neurological indicators.

Vasoactive infusions and MV are not barriers to initiate mobilization or rehabilitation.

**Indicators for Stopping**:

Cardiovascular, respiratory or neurologic components. Other indicators:falls.

**b. Sleep and Delirium**

Patients who experience abnormal sleep patterns or use sleep drugs are more likely to develop poor sleep quality during ICU. During ICU health care interruptions, medications, pain, environmental factors and respiratory factors all affect sleep quality in ICU. Other factors that may also associated with sleep disruptions: alkalosis, hypertension, spontaneous breathing, and delirium.

Studies showed association between sleep quality and delirium but cause effect relation is not established (sleep alteration is a modifiable risk factor for delirium). Patients with severely sleep disruption have 30 % risk for developing mental status change.

Monitoring: the Richard Campbell Sleep Questionnaire has been shown to be valid & reliable tool in critically ill adults to evaluate patients' perception of their own sleep if they are both alert and oriented.

**c. Mode of MV and Sleep:**

It is suggested that Assist /Control ventilator is preferred over pressure support ventilation because it improves sleep quality.

**d. Noise and Light Reduction:**

It is suggested that noise and light reduction improve sleep quality (using of earplug or eyeshades)

**e. Pharmacological Treatment for Sleep:**

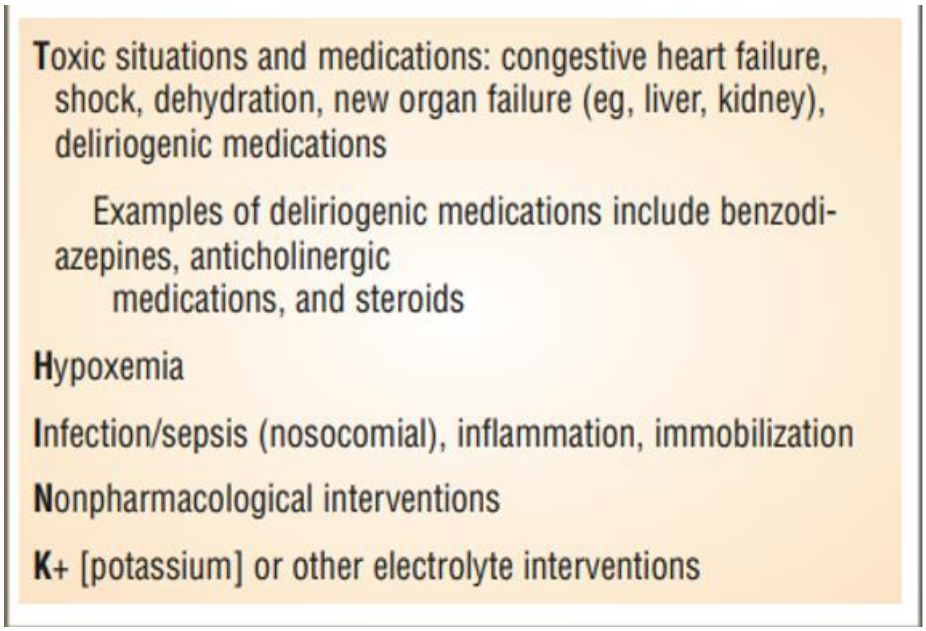
1. Melatonin is not recommended to improve sleep
2. Remelatonin is FDA drug approved and giving it at 20:00 for nondelirious patient is associated with decreased delirium occurrence (but further studies is needed)

**Pharmacological Treatment of Delirium:**

Considering pharmacological treatments after identifying different causes that lead to it and after managing of them.

No medication is used to treat delirium. Antipsychotic can be used only for treating hyperactivity that result from hyperactive type of delirium or in those at risk for hallucination. Antipsychotic is an alternative choice for antipsychotic drugs.

Table 4 (Balas ,2013)



**Early mobility:**

Patients who can start early mobility will be determined by specific criteria (table 5). If it is passed, early mobility will be started. Interdisciplinary team assesses patient ability to start mobility. Physical therapist who assesses pt ability to start mobility, nurses who checks patient physiological stability, Respiratory therapist who is responsible for monitoring patient airway and physician confirms that no contraindication to physical activity.

There are also criteria for halting early mobility after it is initiated (table 6) if patient experiences any of them, early mobility will be kept on level 1.

If patient doesn't meet the predefined safety criteria, start at level 1of mobility and evaluate in 12 hours (there is 4 levels for implementing progressive mobility, for each level there is target goal to be met, if it is met, the second level of mobility will be started (AACN, (2013)):

In the first level, there will be different interventions to be done: 1. Passive range of motion three times a day (TID) 2. Turn Q2 hours 3. Active resistance PT 4. Sitting position 20-minute TID. These interventions will be performed until the goal is met (clinical stability and able to move arm against gravity), If it is met, the second level of progressive mobility will be started: a. passive ROM TID b. turn Q 2hours c. active resistance PT d. sitting position 20 TID e. sitting on edge of the bed). The goal is: patient is able to sit upright move leg against gravity). If it is met, the third level of progressive mobility will be started: a. turn Q2hours b. active resistance PT c. sitting position 20-minuteTID d. sitting on edge of bed 5. Active transfer to chair>=20minute twice daily. The goal in this step is to increase strength and stand with minimal to moderate assist. If it is met, the fourth level of progressive mobility will be started: a. self or assisted turn Q 2 hours b. active resistance PT c. active transfer to chair >=20-minutethree-time daily d. ambulation (marching in place, walking in halls)

Patient will be evaluated each day to improve early mobility. Each eligible patient is encouraged to mobile at least once daily with specific level of activity geared to his /her readiness. Patients program through a 3 steps process embarking on the highest level of physical activity they can tolerate as mentioned in the figure1.

Table 5,(Balas ,2013)

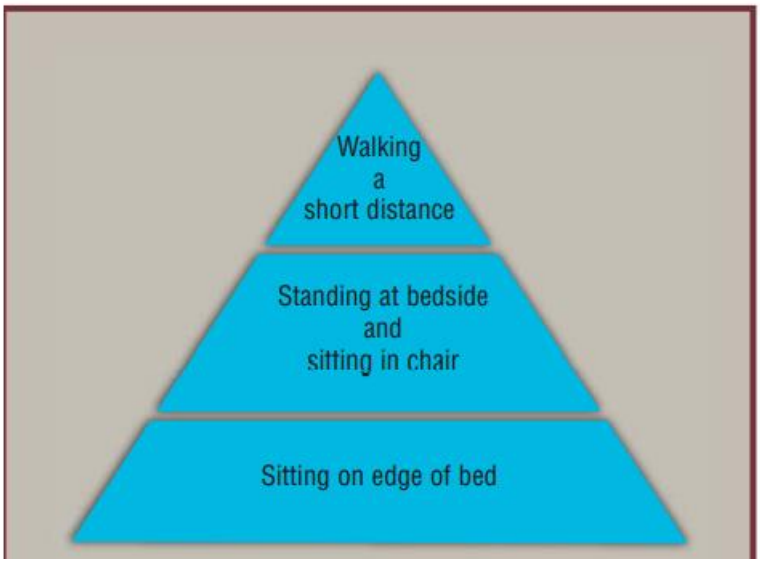
| |
|---|
| N – Neurological<br>a. Patient responds to verbal stimulation (ie, RASS score > -3)[a]<br>(1) Activity not started in comatose patients (RASS score -4 or -5)[a] |
| R – Respiratory<br>a. $FIO_2$ <0.6[a]<br>b. PEEP <10 cm $H_2O$[a] |
| C – Circulatory/central catheters/contraindications<br>a. No increase dose of any vasopressor infusion for at least 2 hours[a]<br>b. No evidence of active myocardial ischemia[a]<br>c. No arrhythmia requiring the administration of a new antiarrhythmic agent[a]<br>d. Not receiving therapies that restrict mobility (extracorporeal membrane oxygenation, open-abdomen, intracranial monitoring/drainage, femoral arterial catheter)[b]<br>e. No injuries in which mobility is contraindicated (eg, unstable fractures)[b] |

Table 6 (criteria for halting early mobility ,(Balas ,2013))

| |
|---|
| Symptomatic decrease in mean arterial pressure |
| Heart rate <50 or >130 beats per minute for 5 minutes |
| Respiratory rate <5 or >40 breaths per minute for 5 minutes |
| Systolic blood pressure >180 mm Hg for 5 minutes |
| Pulse oximetry reading <88% for 5 minutes |
| Marked ventilator dyssynchrony |
| Patient distress |
| New arrhythmia |
| Concern for myocardial ischemia |
| Concern for airway device integrity |
| Fall to knees |
| Endotracheal tube removal |

The use of protocol ends when patients is discharged from ICU.

Figure 1 (Balas ,2013)




**Health Care Team and Bundle:**

Acknowledge what every member does and identify how his /her action makes difference in someone else life (meaning fulrecognition)

Inter professional team members and bundle:

Focus on improving communication because it will decrease medical errors, mortality and length of stay. Standardize the rounding process: 1-make it meaningful by identify time,location, participants and rounding content .2- use checklist to guide practices 3- include RN, MD and pharmacist (physician /intensivist, clinicalnurse, pharmacist, occupational & physical therapist and RT). 4- The attending physician/intensivist functions as the team facilitator, ensuring that a defined process is followed, eliciting input from all members to support shared decision-making, and summarizing the team's defined daily goals for the patient. When present, physician trainees typically describe the patient's initial presentation or interim care in a systems format and generate the problem list and action plan. Enact recommendations brought to light by the multidisciplinary input through real-time orders. Encourage physicians to initiate and

complete daily documentation during rounds to decrease delays in care, increase accuracy of recording, and optimize accessibility of information to team members.

The clinical nurse provides the updated patient status, including cardiopulmonary support, mental and physical function, skin integrity, gut function, and nutrition tolerance, and relevant patient changes over the preceding 24 hours. During the Collaborative, having the clinical nurse start the rounds was observed to improve nurse contribution. The pharmacist ensures SAT performance and appropriate use of medications to prevent and treat pain, agitation, and delirium. The occupational and physical therapist provides updates on recent mobility and exercise, including targeted activity levels and barriers to achieving them. The respiratory therapist performs and reports on the safety screen and SBT outcomes in appropriate patients daily. The nutritionist ensures that nutrition delivery is optimal for wound healing and does not negate SBTs. The social worker and case manager assist with allocation of resources for patient and family support and begin planning for post hospitalization medical care.

**Pain:**

Pain assessment and management are important because it is considered one of the modifiable risk factors for the development of delirium. In addition to that the analgesosedation protocol according to PADs guidelines which we depend on it and SCCM was developed it is based on assessment of pain and management of it before initiation of sedation. So, assessment and management of pain are significant for ABCDE bundle.

Pain assessment, Stolling (2019):

Numerical Rating Scale (NRS) is used for patients who can express their pain.NRS: 1-4 represents mild pain, 4-6 moderate pain, and 7-10 for severe pain.

According to Herr (2019) the Hierarchy of pain assessment techniques can be used for both assessment and management of pain:

**a. Be aware of Potential Causes of Pain:**

Pathologic conditions (persistentpain, wounds, trauma, osteoarthritis and surgery) and common procedure that induce pain (repositioning, needle insertion, tube or drain

removal, wound care and rehabilitation). Use interventions to manage them (no pharmacological and non-opioid analgesics at first).

There are behavioral changes that result from pain or distress which include physiological changes (respiratory distress, heart failure and hypotension). There is comorbid condition associated with pain that cause behavioral changes: UTI, implanted hardwire infections and constipation and appropriate interventions should be taken.

Pain occurs at rest in critically ill patients and during standardize intensive care unit procedure: turning, positioning, drain and catheter insertion, suctioning and wound care)

**According to Devlin (2018):**

Pain during procedures is affected by different factors:

1. Pain intensity before procedure
2. Underlying surgical or trauma conditions
3. Type of procedure
4. Demographic data (women experience pain more than men, younger age and non-white patients experience more pain)

**During Procedure:**

The following procedures are associated with increased intensity of pain: arterial line insertion, chest tube removal,repositioning, tracheal suctioning and wound drain removal.

**b. Attempt Self-Report:**

Attempt should be made to know if patients can express their pain, for patients whocan'tverbalize, cognitive skills limiting use Yes/No technique, gestures such as head nods, eye blink, hand grasp. When it is impossible for patient to self-report their pain use behavioral pain assessment methods.

Self-report of pain should be attempted in all critically ill patients using NRS either visually or verbally. But, performing of such scale may be impossible in those patients'

r/t delirium, altered level of consciousness, cognitive and communication restraints and some neurological insult. Delirium assessment should be done in critically ill patients because it effects on patients' ability to self-report of pain.

**c. Observe Patients 'Behaviors:**

Self-report of pain and behavioral pain scale aren't correlated in intensity. Pain behaviors aren't specific for pain and may reflect physiological or emotional distress (and it is difficult to be discriminated). Potential causes of behaviors should be investigated and managed.

Sleep and sedation don't mean the absence of pain or pain relief.

Facial expression such as grimacing, brow lowering & wincing are often seen in critically ill patients experiencing.

Behavioral pain scales can't be used in those paralyzed patients or those can't respond behaviorally to pain (RASS 5 or GCS -3 or excessive sedated patients, RASS -4) and it is not appropriate in patients with brain injury with altered level of consciousness.

1. Assuming pain and administer analgesics in those who are kept on neuromuscular blocker and experience conditions and procedures that are known to cause pain.

2. When high dose of opioids to cause sedation are used with or without sedatives, muscle relaxants or neuromuscular blocker, pain may become underestimated and undertreated.

3. Changing in vital signs indicate need for further investigation of pain or anotherstressor. But it isn't be considered as indicative measures for the presence of pain.

Use of behavioral pain assessment tool:

Critical care pain observation tool (CPOT) has high validity among intubated critically ill patients.

**d. Solicit Proxyod Pain and Behavior/Activity Changes:**

Proxy reporters may involve:parents, family members,caregivers. Information about patient experience of pain can be taken from family members who know patient well (they can give information about their loved one related behaviors or subtle behaviors that they experience during pain). Judgement by caregivers about the presence of pain is considered as proxy assessment and must be added to other strategies to identify the presence of pain.

**e. Attempting Analgesic Trial**

Analgesic trail should be initiated in those behaviors indicate presence of pain or if pain behaviors continue until after needs were met (comfortsstrategies)

For those unable to express pain:

1. It is appropriate to start the trial with nonpharmacological, nonopioid drugs ( start with acetaminophen or NSADs (if it can be used for NSADs )
2. If behaviors change or decrease in behavioral pain assessment score has occurred, consider short acting opioid and observe its effect.
3. Doses may then be adjusted carefully until behavioral pain assessment score is reduced or patients bother some side effects
4. Use opioid for neuropathic pain
5. Considering titration from opioid because it will cause unwanted side effects especially in frail older adults, patients with obstructive sleep apnea and those with neurologic impairment.
6. Paralyzing agents, sedatives are not substitute for analgesics.
7. Consider that critically ill patients may need titrating from sedating dose of opioids although pain presence to facilitate removal of ETT.
8. Considering using nonopioid drugs to treat pain while facilitating weaning.

The goal of analgesic trial is to assess if pain is the cause of those behavioral changes in those patients. Pain is considered the cause if both behavioral improvement or decreasing of behavioral score were occurred. If behavioral pain assessment doesn't change or if behavioral improvement doesn't occur, consider other causes of those behaviors.

Establish an appropriate multimodal pain treatment plan based on identified or potential etiology, patient characteristics (comorbidities,polypharmacy, cognitive status and caregivers support)

Pharmacological and nonpharmacological interventions for pain according to PADs guidelines (2018)

**A. Pharmacological Adjuvant to Opioids:**

**1. Acetaminophen:**

It is recommended to be used in critically ill patients to reduce the consumption of opioid and to reduce pain intensity especially in those at risk for opioid concerns.

2. **Nefopam**: it is recommended to be used as adjunctive or alternative to opioids to decrease its dose or its safety concerns.

20mg nefopam equal effect of 6mg morphine as analgesic effect.

3. **Ketamine**: low dose of ketamine (0.5 mg /kg followed by 1-2mcg /kg/min infusion) as an adjunct to opioid therapy to reduce opioid consumption in post-surgical adult are admitted to ICU.

**4. Neuropathic Pain Medication:**

Neuropathic pain drugs (carbamazepine, pregabalins, gabapentin) with opioid have a good management of neuropathic pain

Pharmacological interventions to reduce procedural pain:

1. **Opioid and Dose: The** use of opioids (morphine, hydromorphine, fentanyl, remifentanyl) are recommended to be used at lowest effective dose for management of procedural pain.

2. **NSAIDs:** The use of NSAIDs (orally, rectally and IV) is recommended to be used as an alternative for opioids in critically ill patients during discrete irregular procedures.

**B. Nonpharmacological Interventions:**

1. **Massage:**

   Performing of massage (hands,feet,back) is recommended for management of pain in critically ill patients (10 – 30 minutes once or twice daily) for 1-7 days.

2. **Cold Therapy:**

   Cold ice therapy (for 10 minutes covered with dressing gauze) is recommended for management of procedural pain in critically ill patients.

3. **Relaxation Technique:**

   Relaxation technique is recommended to be used in critically ill patients in procedural interventions.

**Protocol Based Pain Assessment and Management According to PADs(2018) :**

1. Analgeso sedation protocol is recommended either analgesia first sedation (use analgesia usually opioid before sedatives to reach sedation level) or use analgesia-based sedation (use of opioid analgesia instead of sedatives to reach sedation level)

2. This requires routinely assessment of pain and sedation by using appropriate tools.

**Minimize Emphasis on Vital Signs:**

Vital signs like: change in BP, RR, HR are considered adverse effect of pain but they are not valid to discriminate pain from other sources of distress. Vital signs changes don't mean presence of pain and the absence of VS changes don't mean absence of pain,

changes of them just mean we need further investigation of pain by using behavioral changes or behavioral pain scores.

Pain should be assessed regularly and should be reassessed during procedures. It also should be assessed post interventions (pharmacological or nonpharmacological) to investigate the effectiveness of those interventions on pain.

**Data Collection plan for education**

The researcher will collect information depending on structured observation by using formal instruments and protocol:

a. Checklist and rating scale

There will be four checklists, the first one is bedside checklist for ABCDE protocol, the second one is for SAT and SBT safety screen and failure, third one will be for early mobility safety screen and failure and the last one is CAM ICU for checking the presence of delirium.

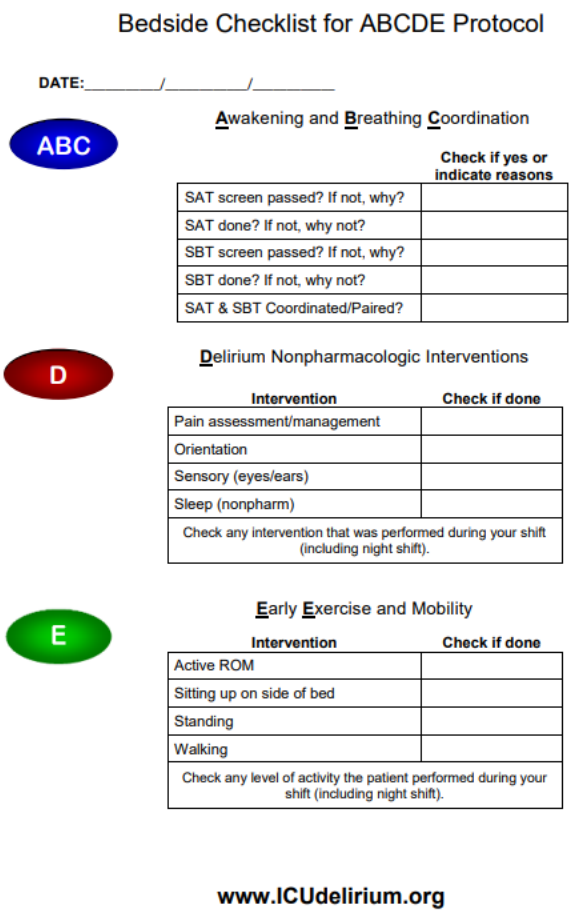
**The first checklist contains 3 tables**. The first table is for SAT &SBT criteria (it will be based on the SAT &SBT safety screen and failure checklist that will be explained in the following pages). It checks if SAT screen was passed and done, if not, the causes of its failing or not doing should be explained. the second two rows in this table will do the same with SBT. The last row in this table will check if coordination was occurred between SAT &SBT and if not, the reasons will be mentioned.

The second table is for delirium nonpharmacological interventions. Eligibility for this intervention will be the Richmond Agitation Sedation Scale (RASS) more than or equal to -3. (Any movement or eye opening to voice). the first row will check if pain assessment was done and if its management was done by using an objective scale. the following row will check orientation if it was done (talking about day (ifpossible),date,place, discuss current events,names, use calendar in room). The sensory (eyes,ears)check will be in the third row.Here, the need for hearing aids and eye glasses will be determined. In the last row, the nonpharmacological sleep interventions will be checked (provide and encourage sleep preservation techniques like: noise

reduction, day night variation, time out to minimize interruptions of sleep, promote comfort and relaxation)

The last table will check early exercise and mobility interventions if they were done. firstly, the patient ability to start mobility will be checked based on the checklist that is specific for early mobility screen and failure. If that checklist was passed, this table will be used to detect the level of early exercise and mobility, starting from checking the active range of motion exercises in bed and sitting position in bed, then dangling. After that, transferring to chair (active) include: standing without marching in place will be checked, lastly, ambulation /marching in place, walking in room /hall will be checked if they were done.

This checklist will be filled daily by the researcher or the nurses who will be asked to fill them daily in the morning depending on the information that will be taken from the following checklists.



Bedside Checklist for ABCDE Protocol

DATE:_____/_____/_____

ABC

Awakening and Breathing Coordination

| | Check if yes or indicate reasons |
|---|---|
| SAT screen passed? If not, why? | |
| SAT done? If not, why not? | |
| SBT screen passed? If not, why? | |
| SBT done? If not, why not? | |
| SAT & SBT Coordinated/Paired? | |

D

Delirium Nonpharmacologic Interventions

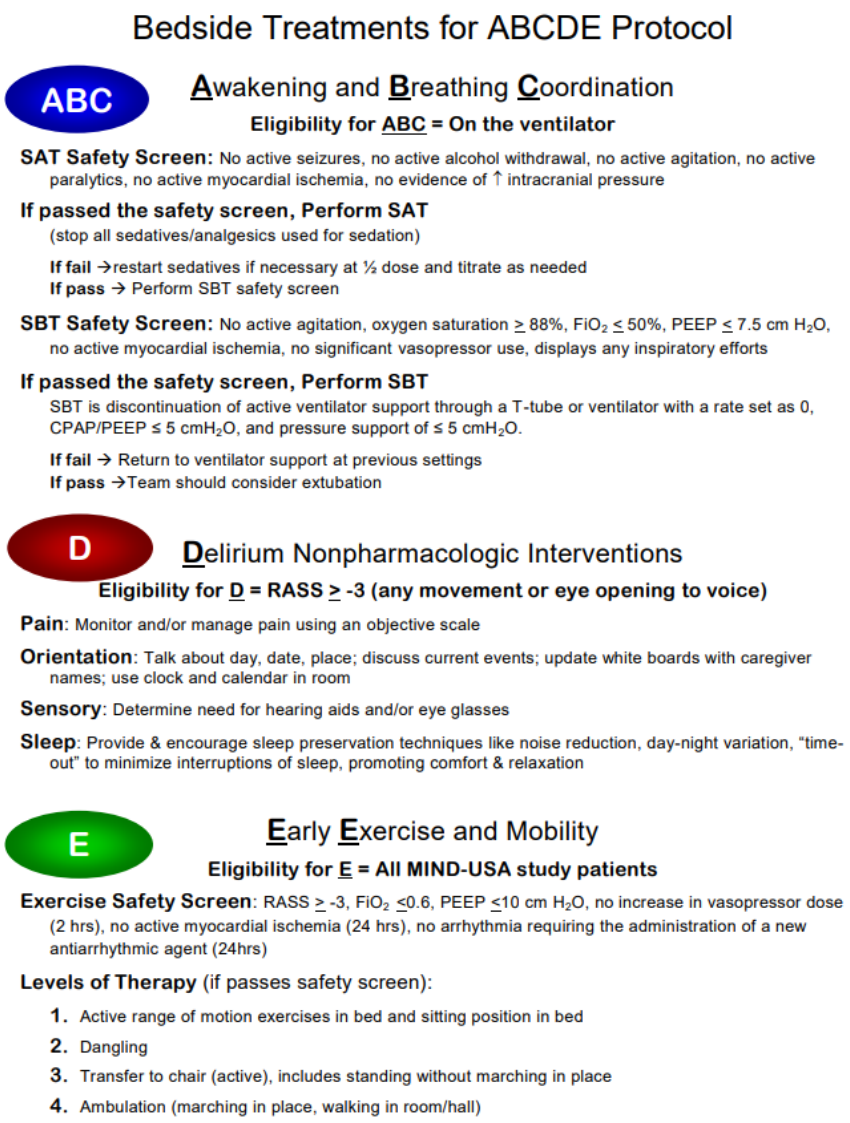
| Intervention | Check if done |
|---|---|
| Pain assessment/management | |
| Orientation | |
| Sensory (eyes/ears) | |
| Sleep (nonpharm) | |
| Check any intervention that was performed during your shift (including night shift). | |

E

Early Exercise and Mobility

| Intervention | Check if done |
|---|---|
| Active ROM | |
| Sitting up on side of bed | |
| Standing | |
| Walking | |
| Check any level of activity the patient performed during your shift (including night shift). | |

www.ICUdelirium.org




**The Second Checklist** is for wake up and breathe protocol. There will be 4 tables : the first one is for SAT safety screen, it contains 6 items (no active seizure ,no alcohol withdrawal, no agitation, no paralytics, no myocardial ischemia and normal intracranial pressure), if all of them were passed, then start spontaneous awakening trial .The second table is for SAT failure, if any items were answered yes, (anxiety, agitation or pain , RR more than 30 breath/ minute, oxygen saturation less than 88%, respiratory distress, acute cardiac arrhythmia), the SAT trial will be stopped. If all of them were passed, continue trial.

The third table is for SBT safety screen. After SAT trial was passed (patient is able to open his /her eyes to verbal stimulation while tolerating the sedatives being turned off) (without failure criteria) regardless of trial length, the nurse will conclude that: the

patient has passed the SAT. SAT is also considered successful in those patients who after 4 hours don't respond to verbal stimulation but don't display any of the failure criteria. SBT trial will be started. There are 7 items of SBT safety screen that will be checked (noagitation, oxygen saturation equal to or more than 88%, FiO2 equal to or less than 50%, PEEP equal to or less than 7.5 cmH2O, no myocardial ischemia, no vasopressor use, inspiratory effort). If all of them were passed, SBT trial will be started (change ventilator setting to continuous positive airway pressure 5, positive end expiratory pressure 5, use T piece) if any of these items was failed, stop trial (SBT safety screen was failed). Continue mechanical ventilation and repeat SBT safety screen in 24 hours. Restart sedatives at half the previous dose only if needed and titrate to the lowest necessary dose to maintain the sedation target. the interdisciplinary team will discuss the patient's condition during round.

The last table in this checklist will check SBT failure, it contains 6 items and all of them will be checked (RR>35 breath/minute, RR< 8 breath /minute, oxygen saturation <88%, respiratory distress, mental status change and acute cardiac arrhythmia). If all of them were passed, the SBT is considered as tolerable, if the patient tolerates spontaneous breathing for 30 -120 minute without failure criteria (SBT was successful). At this time, physician should consider extubation.

This checklist will be filled by nurses in ICU unit who is responsible for that patient who SAT & SBT protocol will be implemented on them. This checklist will be filled daily at morning. Intensivist and researcher will supervise the filling process continuously.

"Wake Up and Breathe" Protocol Spontaneous Awakening Trials (SATs) + Spontaneous Breathing Trials (SBTs)

| |
|---|
| SAT Safety Screen |
| No active seizure |
| No alcohol withdrawal |
| No agitation |
| No paralytics |
| No myocardial ischemia |
| Normal intracranial pressure |
| SAT Failure |
| Anxiety, agitation, or pain |
| Respiratory rate >35/min |
| Oxygen saturation <88% |

| |
|---|
| Respiratory distress |
| Acute cardiac arrhythmia |
| SBT Safety Screen |
| No agitation |
| Oxygen saturation >=88% |
| FiO2 <=50% |
| PEEP<=7.5 cmH2O |
| No myocardial ischemia |
| No vasopressor use |
| Inspiratory effort |
| SBT Failure |
| Respiratory rate >35/min |
| Respiratory rate <8/min |
| Oxygen saturation <88% |
| Respiratory distress |
| Mental status change |
| Acute cardiac arrhythmia |

**The Third Checklist** will be for early mobility which contains 2 tables, the first one will be criteria for early mobility that is derived from American Association of Critical Care, each patient will be checked by using safety screen criteria (daily will be used), the following will be checked: 1. Myocardial stability: a. no active cardiac ischemia within past 12-24 hours b. no arrhythmia requiring new antiarrhythmic agent within past 12-24 hour) 2. Oxygenation stability :( a. fio2 <0.85 on mechanical ventilation b. PEEP <15cm H2O c. no unsecured airway)

3. Vasopressor use: (no new or increase of any vasopressor within the last 2 hours) 4. Engages to voice (a. respond to verbal stimulation b. RASS<+3 or SAS < 6) 5. Neuro stability: (a. ICP <15 b. no acute or uncontrolled intracranial event)

If patient doesn't meet the above criteria, start at level 1of mobility and evaluate in 12 hours (there is 4 levels for implementing progressive mobility, for each level there is target goal to be met, if it is met, the second level of mobility will be started (AACN, (2013)):

In the first level, there will be different interventions to be done: 1. Passive range of motion three times a day (TID) 2. Turn Q2 hours 3. Active resistance PT 4. Sitting position 20-minuteTID. These interventions will be performed until the goal is met (clinical stability and able to move arm against gravity), If it is met, the second level of progressive mobility will be started: a. passive ROM TID b. turn Q 2hours c. active resistance PT d. sitting position 20 TID e. sitting on edge of the bed). The goal is:

patient abele to sit upright move leg against gravity). If it is met, the third level of progressive mobility will be started: a. turn Q2hours b. active resistance PT c. sitting position 20-minuteTID d. sitting on edge of bed 5. Active transfer to chair>=20minute twice daily. The goal in this step is to increase strength and stand with minimal to moderate assist. If it is met, the fourth level of progressive mobility will be started: a. self or assisted turn Q 2 hours b. active resistance PT c. active transfer to chair >=20-minutethree-time daily d. ambulation (marching in place, walking in halls)

The second table will be for checking of the successful of early mobility criteria after it was started. it contains 12 items that will be checked (symptomatic decrease in mean arterial pressure, heart rate < 50 or >130 beat /min for 5 minutes, RR< 5 or > 40 breath /min for 5 min for 5 minutes, systolic blood pressure > 180 mmHg for 5 minutes, pulse oximetry reading < 88% for 5 minutes, marked ventilator dyssynchrony, patient distress, new arrhythmia, concern for myocardial ischemia, airway device integrity, fall to knee and endotracheal tube removal). If any of them occurred, early mobility will be kept on the level one

This checklist will be filled by the nurses in the ICU and the performing of different levels of early mobility will be done by cooperation between nurses and physical therapist, the following of this step will be by the researcher and intensivist.

Minimum Criteria for Early Mmobility Protocol

1. Neurological
a. Patient responds to verbal stimulation (RASS> -3), activity not started in comatose patients (RASS score -4 or -5)
2. Respiratory
a. Fio2 <0.6
b. PEEP<10 cmH2O
3. Circulatory /central catheters /contraindications

a. No increase dose of any vasopressor infusion for at least 2 hours
b. No evidence of active myocardial ischemia
c. No arrhythmia requiring the administration of a new antiarrhythmic agent
d. Not receiving therapies that restrict mobility (extracorporeal membrane oxygenation, open abdomen, intracranial monitoring /drainage, femoral arterial catheter)
e. No injuries in which mobility is contraindicated (unstable fractures)

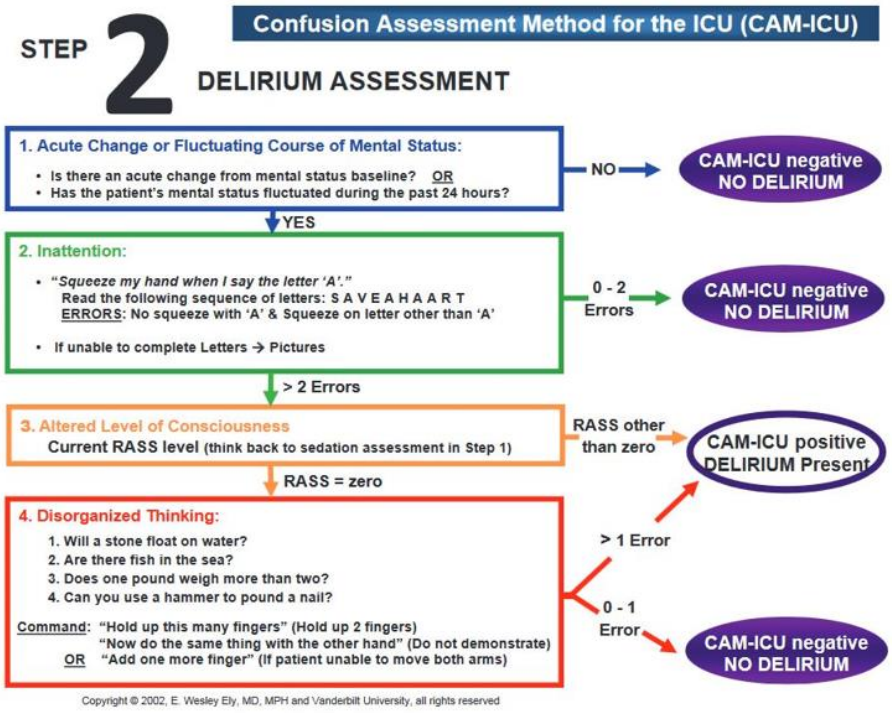
Criteria for Halting Early Mobility

a. Symptomatic decrease in mean arterial pressure
b. Heart rate <50 or >130 beat per minute for 5 minute
c. Respiratory rate <5 or > 40 breaths per minute for 5 minutes
d. Systolic blood pressure >180 mmHg for 5 minute

e. Pulse oximetry reading <88% for 5 minute
f. Marked ventilator dyssynchrony
g. Patient distress
h. New arrhythmia
i. Concern for myocardial ischemia
j. Concern for airway device integrity
k. Fall to knee
l. Endotracheal tube removal

**The Fourth Checklist** will be used for assessing of the presence of delirium, it contains 4 items. The first one will check acute change or fluctuating course of mental status (acute change from baseline mental status, the patient mental status fluctuating during the past 24 hour will be checked. If both were answered no, there is no delirium. If one of them was answered yes, the second item (inattention) will be checked by asking the patient to squeeze the observer hand when the observer says the letter A (in this step, the observer will read the following letters: (SAVEAHAART). Error will be considered if patient is not squeeze with A and squeeze on letter other than A. If 0-2 errors occurred, CAM ICU is negative (nodelirium). if more than 2 errors occurred, altered level of consciousness will be checked by using current RASS. If RASS equals 0, disorganized thinking will be checked by asking the patient the following questions: will a stone float on water? does one pound weigh more than two? can you use a hammer to pound a nail? If more than one error occurred. CAM ICU is positive (deliriumpresent). If 0-1 error, CAM ICU is negative (nodelirium)

According to American Journal of Critical Care delirium assessment will be performed by nurse every shift and whenever patient experience change in mental status and supervised by the researcher.



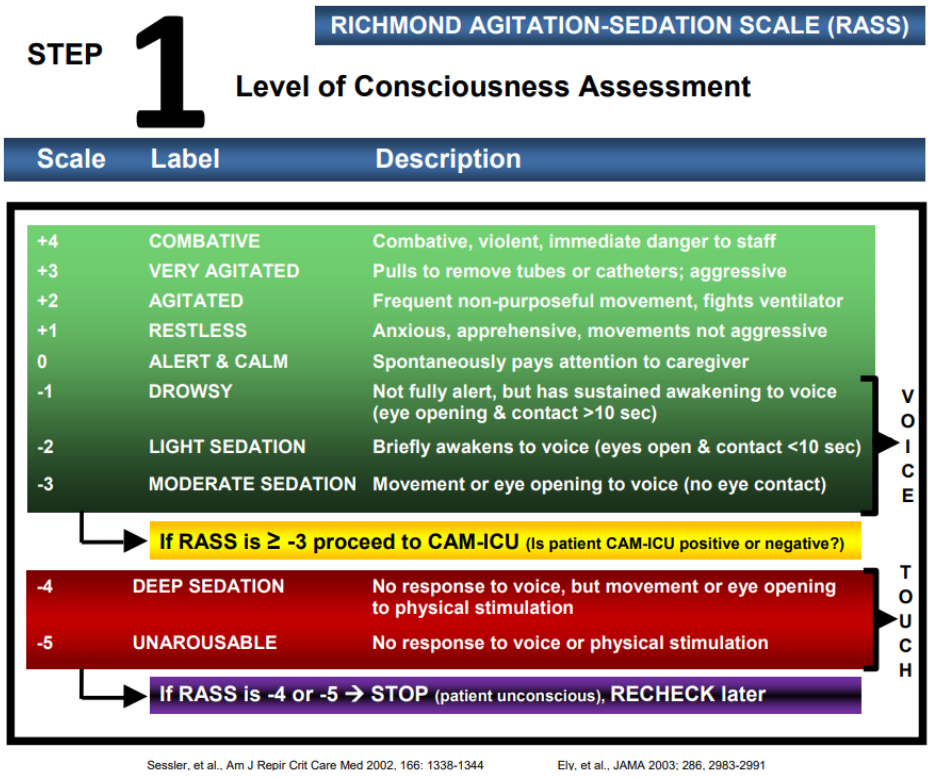

**Rating Scale:**

There will be two scales: RASS (Richmond Agitation Sedation Scale) will be used to assess level of consciousness and CPOT (critical care pain observation tool) to assess pain in ventilated ICU patients.

RASS: this scale will assess the level of consciousness; it ranges from +4 (aggressive) to -5 (unarousable). If patient fights with staff, endangers the staff, the score is +4 and patient is considered aggressive. If patient tries to remove IV lines or catheter, aggressive, score is +3 and patient is considered extremely agitated. If patient frequently has non purposeful movements, lack of cooperation with a ventilator, score is +2 and patient is considered agitated. If patient is worried or anxious without aggressive movements. score is +1 and patient is restless. If patient react spontaneously and listen to caregiver, score is 0 and patient is considered alert and calm. If patient is not fully alert but fully consciously react to voice (eye opening and eye contact >10 second) score is -1 and patient is drowsy. If patient has short term awakening in response to voice (eye opening and eye contact <10 second), score is -2. If patient has eye movement or opening in response to voice (no eye contact), score is -3 and patient is

moderately sedated. If RASS >or = -3, start CAM ICU (positive or negative score). If patient is not response to voice, has movement to physical stimulation, score is -4 and patient is considered deeply sedated. If patient has no response to voice or physical stimulation, score is -5 and patient is considered unarousable.

This checklist will be performed by nurses in ICU every 2-4 hours with vital signs and followed by researcher.




CPOT: This tool was designed to detect pain in critically ill patients and includes 4 behavioral categories: facial expressions, body movements, muscle tension, compliance with a ventilator (for intubated patients) or verbalization (for extubated patients). Each category is scored on a scale of 0–2 (in total 0–8 points). According to the data reported by Gelinas et al, the cut-off point is 2–3, while a scoreof > 2 indicates the occurrence of pain.

**Critical-Care Pain Observation Tool**

| Indicator | Description | Score | |
|---|---|---|---|
| Facial expression | No muscular tension observed | Relaxed, neutral | 0 |
| | Presence of frowning, brow lowering, orbit tightening, and levator contraction | Tense | 1 |
| | All of the above facial movements plus eyelid tightly closed | Grimacing | 2 |
| Body movements | Does not move at all (does not necessarily mean absence of pain) | Absence of movements | 0 |
| | Slow, cautious movements, touching or rubbing the pain site, seeking attention through movements | Protection | 1 |
| | Pulling tube, attempting to sit up, moving limbs/ thrashing, not following commands, striking at staff, trying to climb out of bed | Restlessness | 2 |
| Muscle tension<br>Evaluation by passive flexion and extension of upper extremities | No resistance to passive movements | Relaxed | 0 |
| | Resistance to passive movements | Tense, rigid | 1 |
| | Strong resistance to passive movements, inability to complete them | Very tense or rigid | 2 |
| Compliance with the ventilator (intubated patients) | Alarms not activated, easy ventilation | Tolerating ventilator or movement | 0 |
| | Alarms stop spontaneously | Coughing but tolerating | 1 |
| | Asynchrony: blocking ventilation, alarms frequently activated | Fighting ventilator | 2 |
| OR | | | |
| Vocalization (extubated patients) | Talking in normal tone or no sound | Talking in normal tone or no sound | 0 |
| | Sighing, moaning | Sighing, moaning | 1 |
| | Crying out, sobbing | Crying out, sobbing | 2 |
| Total, range | | | 0-8 |

## References for Education Material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جـامعـــة النجاح الوطنية

كليـــة الدراســـات العليـــا

# أثر تطبيق حزمة ABCDE على نتائج مرضى التهوية الميكانيكية في وحدة العناية المركزة في مستشفى الخليل الحكومي

إعداد

سوسن السراحنة

إشراف

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قدمت هذه الرسالة استكمالا لمتطلبات الحصول على درجة الماجستير في تمريض العناية المكثفة، من كلية الدراسات العليا، في جامعة النجاح الوطنية، نابلس– فلسطين.

2024

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## الملخص

**الخلفية:** تنفيذ حزمة ABCDE هو ممارسة قائمة على الأدلة وموصى بها لإدارة المرضى الذين يخضعون للتنفس الصناعي بشكل مناسب، ولكن توصيلها في بيئة شديدة المقاومة وليس لديها استراتيجية محددة للتعامل مع المرضى الذين يخضعون للتنفس الصناعي غير معروف.

**الهدف:** قياس تأثير تنفيذ حزمة ABCDE على نتائج المرضى الذين يتم تهويتهم ميكانيكيا: مدة الإقامة في وحدة العناية المركزة (ICU LOS)، والأيام الخالية من أجهزة التنفس الصناعي (VFDs)، وحدوث الهذيان ومدته، والتنقل المبكر في وحدة العناية المركزة في مستشفى الخليل الحكومي.

**الطريقة:** أجريت دراسة شبه تجريبية مستقبلية بين ديسمبر 2022 ومارس 2024، حيث تم تقسيم 76 مريضا على التهوية الميكانيكية (MV) إلى مجموعتين. في حزمة ما قبل ABCDE (ن = 36)، تم استخدام النهج التقليدي للتعامل مع المرضى ذوي التهوية الميكانيكية. في مجموعة حزم ABCDE اللاحقة (ن = 40)، تم استخدام حزمة EABCD. تمت مقارنة هذه النتائج بين كلتا المجموعتين: LOS، VFDs، حدوث الهذيان ومدته، والتنقل المبكر.

**النتائج:** أظهرت النتائج عدم وجود دلالة إحصائية بين مجموعتين فيما يتعلق LOS و VFDs (P = 0.88، P = 0.9) على التوالي. على الرغم من أن متوسط مدة MV كان أقل في مجموعة التدخل 3 أيام مقارنة ب 3.5 أيام في المجموعة الضابطة، إلا أن هذا الاختلاف لم يكن كبيرا (P = 0.378). كانت النسبة المئوية للتنقل المبكر أعلى في مجموعة ABCDE ولكن هذا الاختلاف لم يكن كبيراً (P = 0.242). كانت مجموعة ABCDE أقل تخديرا من المجموعة غير ABCDE التي كانت أكثر تخديرا. كان حدوث الهذيان ومدته أقل في مجموعة ABCDE ولكن تلك لم تكن ذات دلالة إحصائية (P = 0.362، P = 0.22) على التوالي. انخفض استخدام القيود بشكل ملحوظ في المجموعة التي تكيفت الحزمة (20.5٪ في مجموعة التدخل مقابل 44.4٪ في المجموعة الضابطة) مع قيمة (P = 0.008).

**الخلاصة:** ساعدت حزمة ABCDE في جعل المرضى الذين لديهم تهوية ميكانيكية أكثر يقظة ووعي نحو البيئة وقللت استخدام القيود. كما قلل من استخدام البنزوديازيبينات إلى النصف. تحتاج النتائج الأخرى مثل LOS ICU وVFDs وحدوث الهذيان ومدته والتنقل المبكر إلى مزيد من البحث مع حجم عينة أكبر والتزام أكثر فعالية بالحزمة. أعطت هذه الدراسة خلفية للبحث المستقبلي لتنفيذ هذه الحزمة في بيئة تعاني من نقص الموارد.

**الكلمات المفتاحية:** ABCDE، VFDs، LOS ICU، التهوية الميكانيكية، الهذيان، التنقل المبكر.