

**CLINICAL NURSING PRACTICE GUIDELINES
FOR SUCCESSFUL WEANING FROM
MECHANICAL VENTILATION**



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**Thematic Paper
Entitled**

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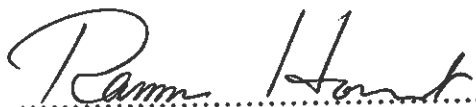
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CLINICAL NURSING PRACTICE GUIDELINES FOR SUCCESSFUL WEANING FROM MECHANICAL VENTILATION

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ABSTRACT

The objective of this study was to establish clinical nursing practice guidelines to promote successful weaning of patients from mechanical ventilation. The establishment of these guidelines was done by analysing and synthesising 42 relevant studies. The guidelines could help healthcare providers, especially nurses, to assist effective weaning from mechanical ventilation. Moreover, they would be useful in promoting communication within the healthcare team, and providing necessary information for nurses and physicians. This information could be used to make the best decision in giving proper treatment and care to ventilated patients to ensure successful weaning.

The guidelines establish three phases of nursing intervention: pre-weaning, weaning, and post-weaning. They focus on the assessment of readiness for weaning, the monitoring of the patients' ability in weaning and the evaluation of the outcome in each phase of weaning. Moreover, the guidelines were checked by experts in weaning techniques for accuracy of language and content and for their feasibility of use in clinical practice.

It is recommended that these guidelines be used as a format for helping nurses and other healthcare providers to help patients in weaning from mechanical ventilation. A pilot study using the guidelines in a real setting would also be useful for observing their application in practice and improving them.

KEY WORDS: CLINICAL NURSING PRACTICE GUIDELINE /
SUCCESSFUL WEANING / MECHANICAL VENTILATION

119 P.

แนวปฏิบัติการพยาบาลเพื่อส่งเสริมความสำเร็จในการหย่าเครื่องช่วยหายใจ (CLINICAL NURSING PRACTICE GUIDELINES FOR SUCCESSFUL WEANING FROM MECHANICAL VENTILATION)

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บทคัดย่อ

วัตถุประสงค์ของการศึกษานี้ คือการสร้างแนวปฏิบัติการพยาบาลเพื่อส่งเสริมความสำเร็จในการหย่าเครื่องช่วยหายใจสร้างขึ้นตามกระบวนการใช้ผลการวิจัย จากการวิเคราะห์และสังเคราะห์งานวิจัยและผลงานอ้างอิงทางวิชาการจำนวน 42 เรื่อง แนวปฏิบัติการพยาบาลนี้ช่วยให้นักวิชาการในทีมสุขภาพให้การดูแลผู้ป่วยหย่าเครื่องช่วยหายใจได้อย่างมีประสิทธิภาพ รวมทั้งช่วยส่งเสริมในการติดต่อสื่อสารภายในทีมสุขภาพ และได้รับข้อมูลที่จำเป็นในการวางแผนการพยาบาลแก่ผู้ป่วยในการหย่าเครื่องช่วยหายใจได้อย่างตรงเป้าหมายและมีประสิทธิภาพ

แนวปฏิบัติการพยาบาลได้จำแนกเป็น 3 ระยะ คือ ระยะก่อนการหย่าเครื่องช่วยหายใจ ระยะหย่าเครื่องช่วยหายใจ และระยะหลังการหย่าเครื่องช่วยหายใจ แนวปฏิบัติได้มุ่งเน้นในเรื่องการประเมินความพร้อมในการหย่าเครื่องช่วยหายใจ การติดตามและเฝ้าระวังผู้ป่วยขณะหย่าเครื่องช่วยหายใจ รวมทั้งการประเมินผลลัพธ์ในแต่ละระยะของการหย่าเครื่องช่วยหายใจ และแนวปฏิบัติการพยาบาลที่สร้างขึ้นผ่านการตรวจสอบจากผู้ทรงคุณวุฒิ ในด้านของความถูกต้องของเนื้อหา และผู้ทรงคุณวุฒิให้ความเห็นว่าสามารถนำไปปฏิบัติได้ในคลินิก

การศึกษานี้ มีข้อเสนอแนะว่าควรนำแนวปฏิบัติการพยาบาลเข้าสู่การปฏิบัติการพยาบาล เพื่อเป็นการส่งเสริมให้มีรูปแบบในการดูแลผู้ป่วยที่หย่าเครื่องช่วยหายใจ นอกจากนั้นควรมีการทดลองนำไปปฏิบัติโดยมีการประเมินและติดตามผล เพื่อพัฒนา ปรับปรุงแนวปฏิบัติการพยาบาลให้เหมาะสมในหน่วยงานนั้นๆต่อไป

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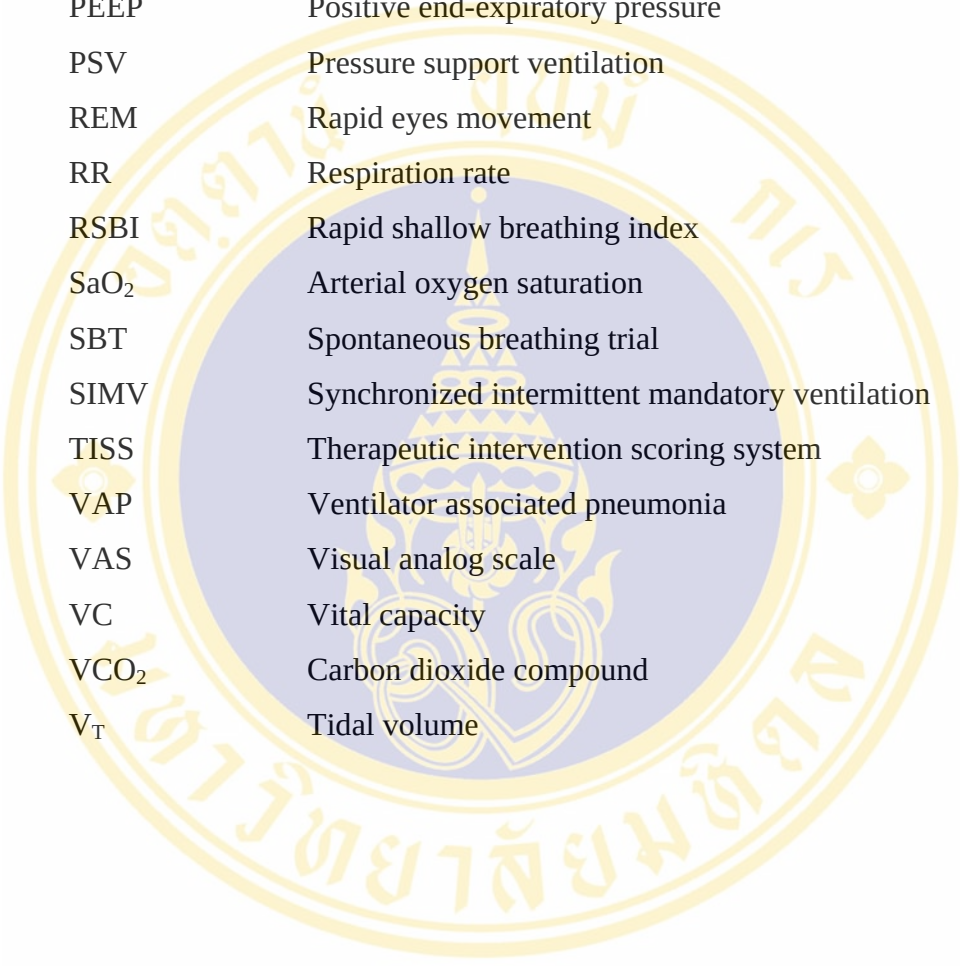
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LIST OF ABBREVIATIONS

AACN	The American Association of Critical Care Nurse
ABG	Arterial blood gas
ADL	Activity of daily living
APACHE III	Acute physiology and chronic health evaluation III
ARDS	Adult respiratory distress syndrome
BMI	Body mass index
BP	Blood pressure
BPM	Breath per minute
BWAP	Burns wean assessment program
Ca	Calcium
CNPG	Clinical nursing practice guideline
CPAP	Continuous positive airway pressure
EKG	Electrocardiography
f	Breathing frequency
f / V _T	Frequency-tidal volume ratio
FCV	Force vital capacity
FiO ₂	Fraction of inspired oxygen
HR	Heart rate
ICU	Intensive care unit
K	Potassium
Mg	Magnesium
MIP	Maximal inspiratory pressure
MV	Minute volume
NEP	Negative expiratory pressure
NIP	Negative inspiratory pressure
Non - REM	Non- Rapid eyes movement
pH	Acid-base status
Po ₄	Phosphorus

LIST OF ABBREVIATIONS (CONT.)



PaCO ₂	Partial pressure of arterial oxygen
PaO ₂	Partial pressure of arterial carbon dioxide
PEEP	Positive end-expiratory pressure
PSV	Pressure support ventilation
REM	Rapid eyes movement
RR	Respiration rate
RSBI	Rapid shallow breathing index
SaO ₂	Arterial oxygen saturation
SBT	Spontaneous breathing trial
SIMV	Synchronized intermittent mandatory ventilation
TISS	Therapeutic intervention scoring system
VAP	Ventilator associated pneumonia
VAS	Visual analog scale
VC	Vital capacity
VCO ₂	Carbon dioxide compound
V _T	Tidal volume

CHAPTER I

INTRODUCTION

Background and rationale

In the recent years of high technology in healthcare, mechanical ventilation is considered a technological advancement that can be lifesaving for critically ill patients with acute respiratory failure as it supports ventilation and improves oxygenation (Esteban, 2002; Shown, 2004). Although a mechanical ventilation is essential in lifesaving for patients with acute respiratory failure, receiving mechanical ventilation more than three days may cause complications physiologically and psychologically (Burns, 1999). Physiological complications include respiratory infection, particularly ventilator-associated pneumonia (VAP) (Tobin, 1994, cited in Wipapat Sungkhaw, B.E. 2545), barotrauma, oxygen toxicity, and stress ulcer (Apirak Palawatwichai, B.E. 2546; Marini and Wheeler, 1997; Sirival Wattanasinthu, B.E. 2545). Fatigue of respiratory muscles due to decreased working and tracheal stenosis from prolonged intubation tube is also a complication of using mechanical ventilation (Apirak Palawatwichai, B.E. 2546).

Moreover, mechanical ventilation can be considered a cause of major distress for patients including immobility, pain, and anxiety. Immobility and pain are caused by endotracheal tube and endotracheal tube suction, which lead to sleep deprivation. In addition, use of mechanical ventilation makes them feel anxious from communication difficulties, and high cost of treatment in a critical care unit can also be a cause of concern (Apirak Palawatwichai, B.E. 2546; Burns, Fahey, Barton and Slach, 1991; Knebel, 1991; Poonsrup Wongsurakeart, B.E. 2546; Orasa Ngimruksa, B.E. 2545).

Therefore, once the cause of acute respiratory failure is solved, the efforts should focus on weaning the patients from the ventilator as rapidly as possible (Epstien, 2002). The aims of weaning from mechanical ventilation are to decrease complication, cost of care, and length of hospital stay (Burns, 1999; Knebel, 1991). However, Cook and colleagues (2003) reported that there were 37 % of the patients

who could not be successfully from weaning mechanical ventilation. In addition, there were 24% of the patients who had to be reintubated tube after extubation (Vassilakopoulos et al., 1999, cited in Siriwal Wattanasinhu, B.E. 2545). Unsuccessful weaning leads to increased cost of treatment, length of stay, mortality rate, negative attitude toward treatment, stress, helplessness, and hopelessness, all of these increase trouble for weaning mechanical ventilation (Burns, 1999; Orasa Panpakdee, B.E. 2542). Thus, physicians and nurses who take care of the patients should consider these factors associated with success or failure of weaning the patients from mechanical ventilation.

The factors that facilitate successful weaning include: 1) the readiness of the patients to wean, 2) the process of weaning, and 3) the competency of the healthcare team. Therefore, most studies focused on the factors related to weaning from mechanical ventilation such as assessing readiness for weaning (Brochard et al., 1994; Cook et al., 2003; Constantin, 2002; Esteban et al., 1995; MacIntyre, 2001; Walsh, Dodds and McArdle, 2004), comparisons of effectiveness of various weaning methods (Brochard et al., 1994; Esteban et al., 1995; Matic and Majeric- Kogier, 2004), the protocol-directed weaning from mechanical ventilation (Ely et al., 1996; Kollef et al., 1997), and a multidisciplinary ventilator management team and collaborative weaning plan (Cohen et al., 1991; Henneman, 2001).

In addition, the quality of assessment and improvement in nursing practice of weaning patients from mechanical ventilation are on interest of nurses (Stewart et al., 1992, cited in Sountaree Jianvitayakij, B.E. 2546). Many nursing studies have focused on factors relating to readiness of weaning including physiological and psychological aspects, as well as weaning outcome (Burns, Fahey, et al., 1991; Burns, Marchall, et al., 1998; Knebel, 1991; Martenson and Fridlund, 2002; Twibell and Mahmoodi, 2003). The American Association of Critical Care Nurses (AACN) convened a group of weaning study from mechanical ventilation and proposed a conceptual model to convey the complex weaning process and promote a framework for further weaning research (Knebel et al., 1994).

In Thailand, there has been some medical researches in weaning from mechanical ventilation. For example, studies were conducted to compare the effectiveness of ventilator weaning protocol with physician-directed weaning (Kantima

Pisitkul, Apirak Palawatwichai, and Sathaporn Thitiwicheanleart, B.E. 2545). Other studies have focused on the guideline for weaning (Apirak Palawatwichai, B.E. 2546; Chaiwat Bamrunakit, B.E. 2545; Sumalee Keartboonsri, B.E. 2545; Thananchai Boonburapong, B.E. 2543). As for a nursing research, five nursing research studies were related to successful weaning, which are the following: 1) a study of factors predicting successful weaning (Panaporn Rattanapanadda, B.E. 2546), 2) three intervention studies on reducing anxiety during weaning (Jiraporn Chontichachalalauk, B.E. 2546; Tipporn Sai-choen, B.E. 2545; Wipapat Sungkhaw, B.E. 2544), and 3) a study of nurses' competency of weaning (Sountaree Jianvitayakij, B. E. 2546). The findings of those studies have indicated that nurses have increased knowledge of factors relating to readiness of weaning and the weaning process that influences quality of patient care.

From the investigator's experiences of working in a medical intensive care unit, the successful of evidence-based weaning has not been implemented in a clinical practice. Staff nurses usually perform weaning patients from a mechanical ventilation as a routine. It means that the weaning starts when the physician prescribes weaning, then nurses assess the vital signs, tidal volume, minute volume, and arterial blood gas. Nurses also encourage the patients to do deep breathing and reassure the patients that they are all right. Mostly, the usual care process of weaning is gradual weaning. The patients receive weaning by T- piece and if they can tolerate weaning for 24 hours without dyspnea, the physicians will extubate the endotracheal tube. This procedure indicates that the patients mostly are successful from weaning. However, the process of weaning occurs with weaning physicians' prescribed which has been delayed to start weaning and the mechanical ventilation period is prolonged. In addition, the rational of delay weaning is that the healthcare team has not paid attention to the influencing factors of weaning as much as the patient's needs. The weaning procedure makes the patients feel distressed and fearful. Moreover, the healthcare team has no more experiences to assess the patients in the process. These make them lose of confidence to wean. Furthermore, there is no guideline for weaning and there is not clear guideline for the healthcare team to communicate, so the weaning may not be continuous weaning or the duration of weaning may be prolonged.

According to the above information, weaning from mechanical ventilation is a major clinical problem of the critical care patients who are treated with mechanical ventilation. However, the quality of nursing care and its contribution to weaning such as: 1) the healthcare team's competency, 2) communication with the healthcare team, and 3) understanding of the patients' needs will affect the successful weaning outcome. Therefore, in this study the investigator developed a clinical nursing practice guideline by utilizing evidence-based approach to promote successful weaning from mechanical ventilation in critically ill patients. The evidence-based process was used to establish this guideline. It is anticipated that the guideline would help nurses in promoting successful weaning, as well as increasing the healthcare team's knowledge of weaning. In addition, the guideline would increase quality of nursing care in the future.

Objective of the study

To establish a clinical nursing practice guideline by research utilization to promote successful weaning from mechanical ventilation.

Expected benefits from the study

1. The patients will receive readiness of assessment for successful weaning from mechanical ventilation.
2. The successful weaning outcome of patients with mechanical ventilation will improve nursing capability.
3. The collaborative of the healthcare team will promote successful weaning outcomes.

Conceptual Framework

The clinical nursing guideline for successful weaning from mechanical ventilation is based on the weaning concept of the American Association of Critical Care Nurses (AACN)'s Third National Study Group (Knebel et al., 1994; Knebel et al., 1998). This study group proposed a concept model to schematically convey the complex weaning process. In this concept model, the weaning process consists of three phases: pre-weaning phase, weaning phase, and weaning outcome. In the pre-weaning

phase, the nursing intervention focused on assessing of the patient's readiness to start weaning. In the weaning phase, nurses must monitor signs and symptoms and assess the appropriate time to stop weaning. For the appropriateness of the study, the investigator modified the third phase, weaning outcome, to post-weaning phase focused on nursing care for prevention of repeat use ventilator support or reintubation an endotracheal tube. Also, the clinical nursing practice guideline is based on the evidence-based medicine to guide for compilation the evidence for establishment this guideline.

Definition of Terms

Weaning from mechanical ventilation is a process which reduces the respiratory assistance in patients on ventilator support so as to enable them to breathe by themselves and eventually to stop using the ventilator. Weaning from ventilator support can be divided into two types as follows:

1. Abrupt weaning or ventilator discontinuation which means that the patients immediately stop using the machine completely. This is possible among patients whose respiratory failure is not severe, who have been dependent on respiratory support for a short time, or who have no pathology of the lungs such as patients with severe asthma attack and patients who have regained consciousness.
2. Gradual weaning which is characterized by a gradual decrease in patients' dependence on the ventilator. This is used with the patients who have severe respiratory failure or who take a long time to recover such as those with Acute Respiratory Distress Syndrome (ARDS) or Chronic Obstructive Pulmonary Disease (COPD).

CHAPTER II

LITERATURE REVIEW

The present study aimed to establish the clinical nursing practice guideline to promote the effectiveness of the weaning from ventilator support process in patients with respiratory failure. In this chapter, related literature is reviewed in the following topics:

1. Concept of weaning from ventilator support
2. Assessment of readiness to wean
3. Factors promoting successful weaning and outcome weaning
4. Interventions of post weaning and extubation care

Concept of weaning from ventilator support

Patients with respiratory failure have to rely on ventilator support for ventilation and for oxygen supply to the body. However, prolonged use of a ventilator leads to complications such as lung inflammation, complications of the trachea after it has been pressed by the endotracheal tube for a period of time, barotrauma, oxygen toxicity, and suffering caused by having the tube inserted for a long time. These symptoms can increase the length of hospital stay, medical expenses, and mortality rate (Apirak Palawatvichai, B.E. 2546; Burns, 1999; MacIntyre, 2001; Sirival Wattanasinthu, B.E. 2545). Thus, the doctors tend to have the patients wean from ventilator support as soon as their conditions allow (Burns, 1999; Esptein, 2002; MacIntyre, 2001).

Definition of weaning from ventilator support

According to a review of related literature, weaning from ventilator support is a process which reduces the respiratory assistance in patients on ventilator support so as to enable them to breathe by themselves and eventually stop using the ventilator (Apirak Palawatvichai, B.E. 2546; Knebel et al., 1994; Martenson and Fridlund, 2002).

MacIntyre (2001) defined weaning from ventilator support as the discontinuation of the ventilator and the patients are able to breathe by themselves without the machine. Weaning from ventilator support can be divided into two types:

1. Abrupt weaning or ventilator discontinuation which means that the patients immediately stop using the machine completely. This is possible among patients whose respiratory failure is not severe, who have been dependent on ventilation support for a short period of time, or those with no pathology of the lungs. For example, for patients with severe asthma attack, after the tracheal expands itself after treatment and after the patients regained consciousness, they can immediately stop using the ventilator.

2. Gradual weaning which is characterized by gradual decrease in patients' dependence on the ventilator. This is used with the patients who have severe respiratory failure or whose acute respiratory failure takes a long time to recover such as those with ARDS or COPD. The second type of weaning may best suit the meaning of the term "weaning."

As regards gradual weaning, in the past, the patients would be assessed for their readiness before weaning took place. However, at present, the patients are assessed for their readiness as soon as they started using the ventilator and their readiness is promoted so that weaning can begin as soon as possible (Chaiwat Bamrunngkit, B.E. 2545). As such, several concepts regarding weaning have been proposed as guidelines in developing ways to assess the patients' readiness, to plan for care of weaning patients, and to actually wean the patients from the ventilator (Ingersoll, 1995). These concepts are proposed by different investigators and researchers as follows:

According to Fernando and Esteban (2003), weaning from ventilator support could be divided into three Phases. Phase one involved assessing the patients' clinical readiness to wean, which was conducted after the patients' symptoms had improved. If the patients were ready, weaning can start. During Phase two, the patients breathe by themselves using either the T-piece or they change from the ventilator they use to the pressure support, which releases oxygen pressure into the patients' respiratory system while the patients were breathing by themselves. Initially, the pressure support was high, and it was decreased to < 5 cmH₂O. If the patients could breathe without

dyspnea for 24 hours, the ventilator would be removed. Finally, Phase three involved the removal of the ventilator. During this Phase, the patients' ability to cough and the amount of the patients' secretion would be assessed. If the patients could not cough effectively, their trachea may be blocked by secretion, and the ventilator would be required for another 72 hours (Knebel et al., 1994), which was then considered unsuccessful weaning.

Walsh and colleagues (2004) pointed out that weaning was a complicated process consisting of different steps. First, the patients had received treatment until they had recovered from their critical condition. Second, the patients were able to breathe with less and less dependence of the ventilator until they could breathe by themselves. Third, the ventilator could be removed, followed by the endotracheal tube, and the patients were eventually be able to breathe by themselves for 24 hours. In each phase, guidelines in assessing the patients leading to weaning is necessary, as well as care given to enable the patients to wean successfully.

In addition, The American Association of Critical Care Nurses (AACN) identified the pattern of weaning in 1994 (Knebel et al., 1994). In 1998, this model was refined and called the Weaning Continuum Model (Knebel et al., 1998). This includes of three phases: pre-weaning, weaning, and weaning outcome or post-weaning.

First, the pre-weaning phase is the period during which the decision is made whether the subjects can wean from ventilator support or not. The patients' both physiological and psychological readiness is assessed. If the patients are found to be ready for weaning, weaning can start after the most appropriate weaning method has been chosen.

Physiological readiness for weaning involves solving the problems or causes of respiratory failure. The patients have stable circulation, good consciousness, good nutritional status, as well as balance of water, acid - base, and electrolyte. They also need to have enough strength of breathing muscles and sufficient gas exchange. On the other hand, psychological readiness means the patients have confidence, relaxation, and motivation. All of these are important factors leading to successful weaning (Burns et al., 1991; Burns, 1999; Fernando and Esteban, 2003; Knebel, 1991).

Second, the weaning phase is when the patients are ready to wean. The next step is to make decision regarding the method of weaning. What is taken into consideration includes type of work, advantages, limitations, and effectiveness of different weaning methods. The four most popular weaning methods are 1) T-piece, 2) Synchronize Intermittent Mandatory Ventilation (SIMV), 3) Pressure Support Ventilation (PSV), 4) Continuous Positive Airways Pressure (CPAP). Nursing care is also given to support patients who are weaning from the ventilator, with a scale assessing the decision to stop the weaning process.

Third, the weaning outcome or post-weaning phase aims at ensuring successful weaning which is signified by the removal of the endotracheal tube. The patients are considered able to successfully breathe by themselves to remove the trachea tube when they can cough strongly and do not have a lot of secretion, and they have to be able to breathe by themselves for two to six hours. As for those who have the tube inserted through their neck, the time frame may have to be extended to 18 to 48 hours, depending on each individual patient's condition (Knebel, 1991).

The investigator summarize that, the concept of the weaning mechanical ventilation process consist of three phases: pre-weaning phase, weaning phase, and post-weaning phase. In the pre-weaning phase, it focuses on the assessment the readiness of weaning and perform nursing interventions to improve the problem factors for the patients can start weaning earlier. The weaning-phase, the nursing interventions to increase the changes of successful weaning outcome is solved. The assessment the patients' ability of breathe by themselves and preventing of reused mechanical ventilator support or reintubation endotracheal tube is focused in the post-weaning phase. Therefore, based on the above concepts, it can be seen that most mainly discuss dealing with the cause of respiratory failure, weaning from ventilator support after assessment of the patients' readiness, and finally removal of the endotracheal tube after the patients are able to breathe by themselves for the specified time.

Weaning is a complex process, so there are a large number of studies on weaning, especially successful and effective weaning. As the aim of weaning is the removal of the ventilator and the endotracheal tube, assessment of the patients' readiness is deemed crucial. A review of literature indicates that numerous research

exists, which can be used to extensively and effectively assess the patients' readiness, eventually resulting in successful weaning.

Assessment of patients' readiness to wean

After the cause of respiratory failure has been dealt with or solved, it will be considered whether the patients are ready to wean to prevent complications caused by prolonged use of the ventilator. Before weaning can take place, the patients' readiness needs to be assessed (Knebel, 1991; MacIntyre, 2001). A review of literature reveals that studies have been conducted on readiness to wean from ventilator support and assessment criteria as follows:

First, Knebel (1991) studied assessment of the patients' readiness before weaning which is composed of physiological readiness and psychological readiness as follows:

1. Physiological readiness

Physiological readiness involves causes of respiratory failure which has been solved. For example, COPD patients with respiratory failure caused by infection in the respiratory system have to receive antibiotics until the symptoms have improved. Assessment of physiological readiness includes the following:

1.1 Pulmonary assessment. The pulmonary factors affecting weaning success must be assessed prior to begin weaning

Important pulmonary assessment includes respiratory rate, depth of breath, stability, movement of the chest and the abdominal cavity, and detection of abnormal breathing sounds such as wheezing which indicates pulmonary edema or bronchospasm and rhonchi sound which indicates the amount of secretion, etc. In addition, the assessment involves the muscles used in breathing, breathing through the mouth, and breathing with a flare nose, etc. Which signifies the increased work load of breathing which may result from flatulence, flat lungs, constricted trachea, and exhausted respiratory muscles, etc. Moreover, the respiratory muscle strength and endurance, and gas exchanges were assessed as follows:

1.1.1 Maximal inspiratory pressure (MIP, or PI_{max}): It is an important bedside test to detect, and especially for ruling out, inspiratory muscle weakness. The normal inspiratory pressure is -100 cmH₂O. If negative inspiratory

pressure is greater than $-20 \text{ cmH}_2\text{O}$. mean that the patient lacks sufficient muscle strength for deep breathing or effective coughing (Tananchai Boonburapong, B.E. 2543).

1.1.2 Maximal expiratory pressure (MEP, or PE_{max}): MEP is measured at total lung capacity (TLC), where the strength of expiratory muscle is optimal. Burns (1999) has suggested that in order to predict outcome of weaning, MEP should be greater than $30 \text{ cmH}_2\text{O}$.

1.1.3 Spontaneous tidal volume: The normal tidal volume is approximately $8 - 10 \text{ ml. per kilogram of body weight}$ (Sumalee Kiatboonsri, B.E. 2545). For a patient to be ready for weaning from mechanical ventilation, the tidal volume should be more than $5 \text{ ml. per kilogram of body weight}$ (Knebel, 1991; Tananchai Boonburapong, B.E. 2543).

1.1.4 Vital capacity: The exhaled volume is the vital capacity to prevent atelectasis and ensure that the patient is moving enough air for gas exchange. So, a vital capacity of $10 \text{ to } 15 \text{ ml. per kilograms}$ is need (Burns et al., 1991; Sumalee Kiatboonsri, B.E. 2545; Tananchai Boonburapong, B.E. 2543).

1.1.5 Arterial blood gas. Measurements of blood pH, arterial oxygen tension, and carbon dioxide tension are obtained when patients with respiratory problem are managed adjustment of oxygen therapy. For the patient who is ready to wean, the arterial oxygen tension (PaO_2) should be greater than 60 mmHg , with a fraction of inspired oxygen (FiO_2) of less than 0.4 , the arterial pH and the arterial carbon dioxide tension (PaCO_2) should be held within the normal range of $7.35 \text{ to } 7.45$, and $35 \text{ to } 45 \text{ mmHg}$, respectively (Burns et al., 1991; Tananchai Boonburapong, B.E. 2543).

1.2 Cardiovascular and haemodynamic assessment. The heart and blood vessels' ability to function affects the transportation of oxygen and cardiac output per minute. The transportation of oxygen depends on red blood cells which carry oxygen to different tissues in the body. If the patients are anemic, having hemoglobin lower than $8\text{-}10 \text{ g/dl}$ and hematocrit lower than 25% , the tissues will receive insufficient amount of oxygen, making the breathing muscles weak and the individuals have to use more energy when breathing to increase the amount of oxygen to the body (Burns et al., 1991). Thus, the assessment of hemoglobin and hematocrit is

important for the patients who are weaning. As for the cardiac output, it can be assessed from the rate of heartbeat, blood pressure, and arrhythmia. Also, chest pain is an indicator of the condition in which the myocardial infarction, thus decreasing the effectiveness of the cardiac output.

1.3 Central nervous system assessment. The subjects who are ready to wean from ventilator support have to have good consciousness and be able to follow instructions. They need to be able to cough to excrete secretion and have sufficient sleep. If they receive a large dose of tranquilizers, their breathing ability will be affected.

1.4 Metabolic assessment. In general, the patients should receive about 1,500 to 2,500 calories per day. During weaning, if the patients receive a large amount of carbohydrates or food intake, the carbon dioxide compound (VCO_2) in their body will increase. The patients generally experience the limitation in carbon dioxide excretion. If there is more carbon dioxide due to a high level of carbohydrate intake, excess carbon dioxide will be left in the patients' body, making them less alert and leading to unsuccessful weaning. Thus, the patients should receive energy from protein and fat intake instead of carbohydrate, with protein intake of 1-1.5 g/kg. of body weight. Furthermore, a fever can also increase the level of VCO_2 . Thus, the patients should fully recover from infections before undergoing weaning.

1.5 Renal assessment. Renal assessment can be done based on the balance of electrolytes in the body such as potassium, magnesium, and phosphorus. Lack of these electrolytes weakens the muscles needed in breathing. Moreover, the balances of bodily water and body weight have to be assessed, as they can indicate pulmonary edema, directly affecting the gas exchange in the lungs.

2. Psychological readiness

Psychological readiness is a factor which enables the patients to successfully wean from the ventilator. It affects the patients, especially those who have had to depend on the ventilator for a long time (Seamlan, 1995, cited in Wipapat Sungkhaw, B.E. 2544). The patients may be worried about weaning as their ability to breathe by themselves has reduced. After they have become used to the ventilator, they may be afraid of being out of breath and die, especially those who have experience of unsuccessful weaning in the past. Research findings have suggested that

the patients' psychological condition affects weaning (Burns, 1991; Knebel et al., 1994; Wonderlich, Perry, and Teatz, 1999). Thus, reducing the patients' fear and anxiety is necessary for successful weaning. In addition, the patients with the tube inserted are unable to communicate normally, and they are unable to indicate their needs and wants, so they can have more anxiety and stress (Bergbem, 1989, cited in Thomas, 2003).

Second, Burns and colleagues (1991) studied and developed readiness assessment using Burns Wean Assessment Program (BWAP). This instrument focuses on two areas. First, it assesses general conditions such as hematocrit circulation, metabolism, balance of water and electrolyte, nutritional status, colon function, anxiety, sleep, pain, and activities, totaling 12 items. Second, it assesses respiratory system, ability to expel secretion, size of endotracheal tube, strength and endurance of breathing, acid-base condition, and gas exchange, totaling 14 items. Problems with any of these aspects will be solved so that the patients can start weaning as soon as possible. The scoring of the BWAP is as follows: Yes = the patients meet the criteria, No = the patients do not meet the criteria, and NA = the patients are not available this item. The scores from the total of 26 items are then calculated in the form of percentage (total score Yes x 100 ÷ total assess). If the score is equal to or higher than 50%, the patients are ready to wean. If the score is 64% or higher, the patients have a chance to successfully wean from the ventilator (Burns et al., 1994; Burns et al., 1991; Burns and Sidenia, 2002).

A number of previous studies have investigated the success rate of BWAP in assessing the patients' readiness to wean. For instance, Burns et al. (1994) examined clinical and weaning indices which consist of BWAP; weaning index (WI); Fluency tidal volume ration; Compliance, resistance, oxygenation and pressure index; and negative respiratory pressure during weaning in 37 critical patients who had relied on the ventilator for at least seven days and were ready to wean. The findings showed that BWAP could be used to assess the patients' readiness to breathe by themselves, with the score of 64% indicating that the patients could breathe by themselves for 24 hours. Furthermore, BWAP could be used to assess the success of weaning just like readiness to wean with statistical significance ($p < .05$).

After that, Burns, Ryan and Burns (2000) conducted a descriptive study to examine stages of weaning using Acute Physiology and Chronic Health Evaluation III (APACHE III), BWAP, Therapeutic Intervention Scoring System (TISS), and Weaning Index (WI), adapted from the American Association of Critical Care Nurses Third National Study Group's Weaning Assessment Model (acute, pre-wean, wean, and outcome). The subjects were 97 critical patients who had used the ventilator for three days. According to the findings, the acute stage, pre-wean stage, wean stage, and outcome took 5.6, 6.3, 3.7, and 2.6 days on average, respectively. Also, the scores of the APACHE III, TISS, and BWAP could indicate the differences of the duration of the acute, pre-wean, and wean stages with statistical significance, but they could not be used to differentiate the wean stage from the outcome. Finally, the findings showed that BWAP was associated with TISS ($r^2 = 0.64$, $p < .01$), APACHE III ($r^2 = 0.077$, $p < .01$), and WI ($r^2 = 0.036$, $p > .01$). The researchers then concluded that BWAP is an instrument which can be used to assess the readiness of the patients regarding both the respiratory system factor and general factors; therefore, it is considered a holistic assessment tool.

Besides, Epstein, El-Mokadem and Purlessl (2002) carried out a pilot study to explore the use of BWAP in ten trauma and surgical patients aged 60 years or older who were on the ventilator for more than three days (long-term mechanical ventilation). BWAP was used in assessing the patients together with assessment of haemodynamic and gas exchange variable and oxygen cost of breathing. As regards reliability, the interrater reliability of BWAP is at an excellent level (0.95) when three subjects were randomly selected. In Thailand, BWAP has been widely used to assess the patients' readiness to wean, with studies indicating that BWAP is an appropriate tool for assessment of readiness to wean which involves both physiological and psychological aspects, and which is easy to use and not time consuming (Panaporn Rattanapanadda, B.E. 2546; Sountaree Jianvitayakij, B.E. 2546; Wipapat Sungkhaw, B.E. 2544).

Third, Epstein (2002) investigated the readiness to wean from the ventilator, explaining that assessment of readiness is based on the patients' signs and symptoms. Clinical factors, both physiologically and psychologically, help predict the patients'

success in breathing by themselves. The criteria generally used in assessing the patients' readiness to breathe by themselves are as follows:

1. The ratio of PaO_2 and $\text{FiO}_2 \geq 150$ or $\text{SaO}_2 \geq 90\%$, while $\text{FiO}_2 \leq 40\%$ and $\text{PEEP} \leq 5 \text{ cmH}_2\text{O}$.
2. Stable haemodynamic or the patients receiving a low dose of medication to increase blood pressure.
3. The patients having good consciousness, being easy to alert, and having the Glasgow Coma Scale score higher than 11 points.
4. The patients not receiving a tranquilizer, receiving a tranquilizer occasionally, or receiving a tranquilizer intravenously but still easy to awake.
5. Hemoglobin equal to or higher than 8 to 10 g/dl.
6. Body temperature equal to or lower than $38-38.5^\circ\text{C}$
7. Respiratory rate equal to or lower than 35 breath per minute, spontaneous tidal volume more than 5 ml/kg. and negative respiratory force lower than or equal to 20 to 25 cmH_2O .

Fourth, Fernando and Esteban (2003) compiled data regarding clinical assessment of readiness to wean as suggested by the American College of Chest, Physicians of the American Association for Respiratory Care, and The American College of Critical Care Medicine. They proposed the principles in assessing the patients' readiness to wean as follows:

1. Sufficient oxygenation as assessed from $\text{PaO}_2 \geq 60 \text{ mmHg}$. when $\text{FiO}_2 \leq 0.4$ or when the ratio between PaO_2 and FiO_2 is equal to 150 – 300 and positive end-expiratory pressure $\leq 5 \text{ cmH}_2\text{O}$, with stable circulation, no condition of myocardial infarction, or low blood pressure
2. Sufficient transportation of oxygen as assessed from hemoglobin equal to or higher than 8 to 10 g/dl.
3. A good level of consciousness as assessed from the patients' ability to be easily awoken.

Many researchers (Burns et al., 1991; Epstein, 2002; Fernando and Esteban, 2003; Knebel, 1991) studied factors or criteria used in effectively assessing the readiness of the patients to wean from the ventilator. Likewise, Walsh et al. (2004)

investigated the criteria in assessing readiness to wean in 325 critical patients by developing an easy to use checklist including:

1. The patients having consciousness and without any pain
2. The patients being able to cough after suction
3. The ratio between PaO_2 and FiO_2 higher than 150
4. Positive pressure lower than 10 cmH_2O
5. Hemoglobin level higher than 7 g/dl
6. Body temperature under the armpit equal to 36 - 38.5° C
7. The level of blood potassium higher than 3 and lower than 5 mEq/L
8. The level of blood sodium higher than 128 and lower than 150 mEq/L
9. Decreased use or no increased use of inotropics within 24 hours
10. Ability to breathe more than six times while on the ventilator.

It was found that there were 97 patients in the ICU who needed to be on the ventilator. Of these, 67% were able to successfully wean from the machine. Also, 83% of those who succeeded possessed readiness to wean as specified in the criteria. The advantages of this instrument are that it is easy and convenient to use, and it is not time consuming. However, it assesses only physiological readiness, not psychological readiness. In addition, the ability to predict weaning success is high during the first two days, and it decreases as more than four days have passed. The patients would take longer to wean, and they had a risk of endotracheal tube insertion.

Thus, appropriate criteria of readiness to wean should cover the patients' bodily systems involved in breathing. It should be carried out with the tools easily available in the hospital, and it should be easily done by physicians or nurses. Moreover, in examining the patients' lung mechanics by measuring respiratory rate / tidal volume (liters) (f / V_T) when the patients are breathing by themselves for a minute is specific and most sensitive. If the outcome is higher than 105, the patients have rapid shallow breathing caused by exhausted respiratory muscles or the patients need to exert more energy to breathe.

Likewise, Yang and Tobin (1991) conducted prospective study to determine to threshold values of the indexes that discriminated best between successful weaning and weaning failure and to assess the accuracy of each index in an additional group of

patients. One hundred subjects who were clinically stable and whose physicians considered them ready to wean. These subjects received 8 days of ventilation support in medical intensive care unit. The finding showed that sensitivity was highest for $P_{I\max}$ (1.00), followed closely by the f / V_T ratio (0.97). Specificity was highest for the f / V_T (0.64) and lowest for $P_{I\max}$ (0.11). The f / V_T ratio was the best predictor of successful weaning, and $P_{I\max}$ and the f/V_T ratio were the best predictors of failure.

For this reason, all patients who have been on the ventilator for more than 24 hours should be examined for the causes of their pathology. When their respiratory symptoms have improved, they should be examined every morning whether they meet the criteria so that weaning can start (MacIntyre, 2001; Yang and Tobin, 1991). A study of MacIntyre (2001) found that assessment of readiness to wean should start as soon as the subjects are on the ventilator to solve their problems, prevent further complications, and promote readiness to wean.

After the patients have been assessed as ready to wean from the ventilator, and the most appropriate weaning method has been selected, what is most important is that the patients' symptoms have to be closely monitored and assessment should be conducted every 15 - 30 minutes (Pikul Tantitham, B.E. 2547) with data recorded in the weaning record. If the patients are not able to stand the weaning procedure, the process should be terminated and causes of the patients' inability to wean should be explored before weaning can start again. The criteria used in assessing the termination of weaning include; (Chaiwat Bamrunngkit, B.E. 2545; Esteban et al., 1995; MacIntyre, 2001; Pikul Tantitham, B.E. 2547).

1. Changes in vital signs – pulse ≥ 140 beats/minute or an increase of 20 beats/minute, systolic blood pressure ≥ 140 mmHg. or systolic blood pressure ≤ 90 mmHg. or an increase of 20% (of base line), respiratory rate > 35 breath/minute, with arrhythmia.

2. Worsening changes in pulmonary mechanics such as tidal volume lower than 200 ml., minute volume of 5 liters or more than 12 liters, and rapid shallow breathing index (RSBI) more than 105.

3. Changes in arterial blood gas due to weakened muscles and diaphragms such as $PaCO_2$ more than 45 mmHg (except in COPD patients), oxygen pressure lower than 60 mmHg, pH lower than 7.35, and SaO_2 lower than 90%.

4. Abnormal signs such as weakness, restlessness, anxiety, diaphoresis, and cyanosis.

If it has been assessed that the patients do not have any of the aforementioned abnormal signs and symptoms, and that they are able to breathe by themselves in the specified time, removal of the ventilator can then be considered.

A review of literature on readiness to wean has led to a conclusion that the assessment begins after the patients have been on ventilator support for more than 24 hours (Burns et al., 1991; Burns and Sidenia, 2002; Knebel, 1991; MacIntyre, 2001). The physicians will consider weaning as soon as the causes of respiratory failure have been solved. The assessment of the patients' readiness include physiological and psychological assessments, which involve a number of following factors:

1. The circulation system and oxygen transportation. They depend on the function of the heart muscles and the cardiac output in a minute. Changing from the ventilator to breathing by the patients themselves means that the workload of breathing is increased. Also, switching from positive pressure ventilation to negative pressure ventilation means the heart has to work harder (Tananchai Boonburapong, B.E. 2543). Thus, the function of the heart and the circulation system has to be in a good condition, as can be assessed from heart rate, blood pressure, and heartbeat, which have to be at a normal level. In addition, the patients should receive a low dose of medication (inotropic drugs, ie. Dopamine.) to increase blood pressure no more than 5 µg/kg./minute.

Moreover, the transportation of oxygen depends on the red blood cells which carry oxygen to different tissues, the anemic condition means that tissues will receive insufficient oxygen, making the respiratory muscles weak and the patients need to use more energy to breathe to increase oxygen for the body (Burns et al., 1991). Thus, the hemoglobin and hematocrit levels have to be assessed as sufficient.

2. Production of carbon dioxide. The production of carbon dioxide depends on the body's metabolism. If the metabolism increases as the patients experience seizure, fever, inflammation, or the patients have too much carbohydrate intake, breathing can become more laborious, and the muscles become weak, so the patients' have less ability to withstand weaning.

3. Oxygen consumption due to psychological factors. The patients who have fear, anxiety, and pain breathe faster, and the body needs more oxygen, and they will be easily exhausted. As a result, a decrease in pain, fear, and anxiety will reduce the body's need of oxygen and promote weaning.

4. Muscle strength. The strength of the muscles depends on nutritional status, water, and electrolytes. If the patients have insufficient food intake, with unbalanced water and electrolytes in the body, their muscles will be weakened and they cannot wean successfully.

5. Respiratory system. The patients who are ready to wean successfully need to have good gas exchange. They need oxygen which is not too high in concentration such as $\text{PaO}_2 > 60 \text{ mmHg}$, while $\text{FiO}_2 \leq 0.4$ and with use of PEEP $\leq 5 \text{ cmH}_2\text{O}$. The patients have to be able to expel secretion in the respiratory tract, and have strong respiratory muscles such as minute ventilation of 5 –10 L/min and maximal inspiratory pressure (MIP) more than – 20 cmH₂O. These factors are important for indicating the patients' ability to breathe by themselves.

It can be seen that assessment of readiness to wean is important. Different scholars and researchers have recognized its significance, and they have attempted to design assessment methods which are easy to carry out, extensive, and effective. In addition, there are also other factors which promote successful weaning from the ventilator, which are also considered crucial.

Factors promoting successful weaning and outcomes

In order to weaning to be successful, a crucial factor is the assessment of the patients' physiological and psychological readiness. Weaning that is done when the patients are not ready can lead to different adverse effects. For example, poor air exchange, increased cardiovascular stress, and loss of airway protection overload the heart muscles, making them exhausted. When this happens, some patients have to wait for as long as 24 hours before they can try again, making weaning more difficult (Loghi et al., 1995, cited in Chaiwat Bamrunngkit, B.E. 2545). It can be seen that apart from readiness to wean from the ventilator, there are other important factors which promote successful weaning. Firstly, there should be a decrease in use of energy by reducing work of breathing by choosing the weaning method which is most

appropriate to the patients. Secondly, the need for oxygen should be reduced by reducing the patients' anxiety, fear, and pain during weaning. Thirdly, the increase in the patients' energy is needed to make them ready for weaning such as by having a good nutritional status and sufficient rest (Burns et al., 1991; Knebel, 1991; Tananchai Boonburapong, B.E. 2543). Lastly, there should be protocols in weaning (Burns et al., 2003; Ely et al., 1996; Fernando and Esteban, 2003; Kollef et al., 1997; Tananchai Boonburapong, B.E. 2543). Most of these factors increase the patients' chance of successful weaning. The details are as follows:

1. Promotion to decrease using energy

There are several weaning methods. Selecting the method most appropriate for each patient encourages the reduction in use of limited energy the patients have during weaning. In other words, it is reduction of work of breathing (Knebel, 1991). There are four techniques of weaning which are most widely used. They are T-piece method, continuous positive airway pressure (CPAP), synchronized intermittent mandatory ventilator (SIMV), and pressure support ventilator (PSV) (Apirak Palawatvichai, B.E. 2546; Knebel, 1991; Sirival Wattanasinthu, B.E. 2545). In addition, what should be taken into consideration when selecting the weaning method is understanding and expertise in using each method of weaning, knowledge of the type of the disease, and the understanding of the patients' mental condition (Sumalee Kiatboonsri, B.E. 2545). Each technique of weaning has its own advantages and disadvantages as follows (Apirak Palawatvichai, B.E. 2546; Epstein, 2002; Fernando and Esteban, 2003; Knebel, 1991; Sirival Wattanasinthu, B.E. 2545; Sumalee Kiatboonsri, B.E. 2545).

T-piece method

The T-piece method is a technique in which the patients have to perform spontaneous breathing all through the weaning process, and the patients have to exert energy to breathe using the oxygen from the T-piece. The patients need to have readiness and be prompt enough for spontaneous breathing. If they are not able to withstand it, they should rest for 24 hours before starting weaning again. Weaning with the T-piece method takes less time than other techniques, but the patients have similar chances to be back on the ventilator to such methods as SIMV or PSV. There are two T-piece methods;

1. The patients breathe with the T-piece only once a day until they can do spontaneous breathing for 1 – 2 hours before removal of the endotracheal tube can be considered.

2. The patients perform spontaneous breathing for 15 to 30 minutes followed by the ventilator for at least 1 hour so that they can rest. This can be done twice a day, with the duration of spontaneous breathing increases each time until it lasts 1 – 2 hours before removal of the tube can be made.

The advantages of the T-piece method is that it is widely used as it does not increase the work of breathing through ventilator valves or tubes in the ventilator. The patients can have a full rest for a long time before the next weaning starts. The patients should have a long rest to prevent the problem of heart muscle fatigue (Aldrich, 1989, cited in Patipan Tomthong, B.E. 2546). The disadvantages are that it is not appropriate for the patients who have been on the ventilator for a long period of time as they have collapsed breathing muscles due to prolonged lack of spontaneous breathing. It is also not appropriate for the patients who are afraid of using the weaning method which does not have a warning system when the patients are developed shortness of breathe. For these patients, weaning has to be stopped at nighttime, making weaning not continuous (Sumalee Kiatboonsri, B.E. 2545).

Continuous Positive Airway Pressure (CPAP)

It is a method used while the patients are still on the ventilator which continuously pushing the expiratory positive pressure into the respiratory tract during spontaneous breathing.

The advantages of CPAP are that it increases the lung volume, decreases the condition of blocked respiratory tract and collapsed lungs, increases gas exchange in the lung, and reduces the work of breathing. It is especially appropriate for the patients with COPD as they have problems with intrinsic PEEP.

Synchronize Intermittent Mandatory Ventilation (SIMV)

This is a techniques which has been popular in the past 30 years. It involves a gradual reduction in the amount of ventilatory support and a gradual increase in the amount of patient's respiratory work. It delivers a present number of volume controlled breaths per minute wilt allowing the patient to take spontaneous breaths in

between machine breaths. SIMV may be used with mode flow by, PEEP, or inspiratory support to reduce work of breathing during spontaneous breathing.

The advantages of SIMV is that it gives the patients a chance to adjust themselves and reduces the fatigue of breathing muscles, especially those who have been on the ventilator for a long time and have low barotraumas and thus reduced chances to use narcotics or tranquilizers to allow them to breathe with the machine. The limitation of SIMV is that the patients may be tired for they have to breathe by themselves intermittently and their breathing muscles can be exhausted. Also, if the assistance rate of the machine is reduced too fast, weaning may take longer than it should.

Pressure Support Ventilation (PSV)

The weaning technique reduces work of breathing while the patients perform spontaneous breathing. The machine releases oxygen pressure into the respiratory tract while the patients inhale by themselves. In general, pressure support will start at 5 - 8 cmH₂O and it will be gradually reduced by 2 to 4 cmH₂O per day until it reaches 0 cmH₂O (Vassilateopoulous et al., 1999, cited in Sirival Wattanasinthu, B.E. 2545). The PSV is generally used with SIMV and CPAP with those who have difficulty weaning such as paralyzed patients.

The advantages of PSV are that it reduces work of breathing during spontaneous breathing and it decreases the breathing muscles' need for oxygen. Furthermore, the patients feel comfortable as they can also breathe simultaneously with the machine. They can determine the rate of airflow and their breathing rate as well. However, it can only be used with the patients who have normal breathing center as the patients breathe by themselves, so they can be more easily exhausted.

Evidence- based practice on successful weaning is as follows:

Brochard and colleagues (1994) conducted a randomized controlled trial to make a comparison among three weaning methods T-piece, SIMV, and PSV. The expected outcome was that weaning was successful within a period of 21 days and the patients did not have to have the endotracheal tube inserted again after weaning. The subjects were randomly selected from the patients who had been on the ventilator for more than 24 hours. Also, the patients met the standardized criteria for readiness to wean, but they could not do the spontaneous breathing trial in 2 hours. The findings

showed that in the third group, weaning failure (it was not possible to remove the endotracheal tube within 21 days) accounted for 23%, which was statistically significantly lower than the rates of the T-piece group (42%) and the SIMV group (also 42%). In addition, the PSV group took the shortest time to wean with statistical significance.

Likewise, Matic and Majeric-Kogler (2004) carried out a prospective randomized controlled trial to compare and contrast the T-piece method and PSV in 260 subjects who had had the tube inserted for more than 48 hours. One hundred and ten subjects weaned with the T-piece method, while the remaining subjects weaned with the PSV at 8 cmH₂O. It was found that the subjects who weaned with the latter method spent a shorter time in the ICU and were on a ventilator for a shorter period of time when compared with those who weaned with the former method. Furthermore, among those who had difficulty weaning from the ventilator, the PSV at 8 cmH₂O resulted in a higher success rate with statistical significance.

Moreover, Esteban and colleagues (1995) compared four methods of weaning: SIMV, PSV, Intermittent T-piece (the patients perform spontaneous breathing for 15 to 30 minutes followed by the ventilator at least 1 hour for rest, do twice a day), and T-piece once daily (the patients breathe with T-piece only once a day) in 130 subjects on the ventilator who had difficulty breathing spontaneously during the two hours weaning. Randomization was used to select one of the four weaning methods to be used by the subjects once a day. According to the findings, using the T-piece method once a day resulted in a higher success rate than using SIMV or PSV with statistical significance. However, using the T-piece method once a day showed similar outcomes to using the Intermittent T-piece. In addition to this, the average weaning duration for the SIMV was 5 days, for the PSV was 4 days, and for the Intermittent T-piece and the T-piece was 3 days. Thus, it was concluded that successful weaning with the T-piece method took a shorter time than that of the PSV and SIMV with statistical significance.

The aforementioned studies indicated that there are different findings when it comes to the effectiveness of weaning methods and the duration each method requires. One plausible explanation is that these studies used different used different methods and had different criteria to determine the weaning success.

According to Apirak Palawatvichai (B.E. 2546), weaning methods result in similar success rates. However, when selecting the weaning method for the patients, each method's appropriateness for each of the patients has to be taken into careful consideration. The T-piece method may take the shortest time, and the strengthen of the breathing muscles, but it is not appropriate for those who have been on the ventilator for a long time and are afraid of weaning. Thus, PSV or SIMV may be more appropriate for this particular group of patients. Moreover, the PSV method is appropriate for the patients with cardiac arrest who cannot withstand the immediate venous return, as well as those with a stable condition and those with fatigue from using the ventilator to control their breathing. On the other hand, CPAP may be more appropriate with those who have the problem with collapsed lungs (Knebel, 1991; Sirival Wattanasinthu, B.E. 2545; Sumalee Kiatboonsri, B.E. 2545).

2. Intervention to reduce the patients' anxiety and fear

For the patients who have been on the ventilator for a long period of time, even though they may have readiness to wean, they may not be able to wean successfully due to their fear of having the machine removed and having to breathe by themselves. They may think that if they have to do spontaneous breathing, they may not have enough air and then die (Sumalee Kiatboonsri, B.E. 2545; Tananchai Boonburapong, B.E. 2543), especially those who have experienced weaning failure before. Furthermore, the patients who have the endotracheal tube inserted are unable to communicate as usual, and they are unable to indicate their needs and wants, so they have more anxiety and stress (Thomas, 2003). As a result, they may breathe faster and become more tired, making gas exchange ineffective. When they exert more energy, their tissues also need more oxygen (Tananchai Boonburapong, B.E. 2543; Thomas, 2003). Thus, reducing the patients' fear and anxiety means reducing their need for oxygen, making weaning faster and more successful. Helping the patients reduce their fear and anxiety includes giving the patients information, ensuring effective communicate with the healthcare team and their relatives, using music therapy, and using muscle relaxation, with details as follows:

2.1 Giving the patients information means explaining different steps they need to undergo during weaning and weaning objectives so as to get them involved in weaning. The patients should also be advised to breathe slowly and

rhythmically to create energy and self-control. These can help the patients adjust themselves to effectively deal with stress (Wipapat Sungkhaw, B.E. 2544; Wonderlich et al., 1999). To instill the sense of the confidence in the patients, nurses should reassure them that close care will always be provided and that the patients can ask for help all the time using the bell provided (Orasa Panpakdee, B.E. 2542). There are studies which investigated the effectiveness of information provision to reduce anxiety of patients weaning from the ventilator. For example, Wipapat Sungkhaw (B.E. 2544) conducted a quasi-experimental study to determine the effect of systematic provision of information and different relaxation techniques on weaning in 32 patients in the ICU. In this study, 16 subjects in the control group received routine nursing care, while the other 16 in the experimental group were provided with information and a relaxation technique of breathing management when undergoing weaning with the T-piece method. The findings indicated that the subjects in the experimental group had a lower level of anxiety than that of the subjects in the control group with statistical significance.

2.2 Ensuring effective communication between the patients and their relatives and healthcare team members is necessary as the patients on the ventilator are unable to talk as they used to, so they can experience stress, uneasiness, fear, anxiety, and insecurity, making them more exhausted and unable to wean (Thomas, 2003).

Effective communication between the patients and their relatives and the healthcare team members makes the patients relaxed, reducing the rate of oxygen use and increasing the speed of recovery. This gives them more chances of fast and successful weaning (Johnson and Sexton, 1990, cited in Roongpetch Homsuwan, B.E. 2545). In addition, when nurses show that they are ready to listen to the patients, try to understand them, and tell them that their inability to speak is only temporary, they can help the patients reduce their stress, uneasiness, and anxiety (Orasa Panpakdee, B.E. 2542).

Nurses can help the patients seek ways to communicate effectively and appropriately by assessing factors which affect the patients' ability to communicate such as the patients' consciousness, writing ability, language, culture, value, muscle strength, perception ability (sight and hearing), balance of electrolytes and minerals especially potassium and magnesium, and techniques to communicate

with the patients (Thomas, 2003). After the patients have been assessed, nurses can then choose the communication technique which is appropriate for each patient such as writing, using a picture, using a cue card, using sign language, reading lips, and using short answers to which the patient can respond by nodding or shaking his or her head, etc. (Fontaine, 1994; Ubolrat Deeprom, B.E. 2546). Three to four methods can be used together to ensure most effective communication, which can be done by also considering the patients' ability and environment to accomplish the goal (Filch et al., 1995, cited in Roongpetch Homsuwan, B.E. 2545).

Research evidence related to communication techniques of patients dependent on the ventilator is reviewed. Menzel (1998) studied communication techniques and found that the patients used language sign most, followed by written words, lip reading, and facial expression, respectively. In contrast, Happ (2004) discovered that elderly patients with ventilator support used lip reading most, followed by moving their head, and using nonverbal language. Also, Stoveskey et al., 1991; cited in Fontaine, 1994) compared three communication techniques of writing, lip reading, and using pictures in 20 patients undergoing a heart surgery. The findings revealed that the patients were most satisfied with using picture boards. As for Thailand, Tipporn Sai-Choen (B.E. 2545) studied the interaction between nurses and patients on ventilator support among 429 patients in the intensive care unit at four hospitals and found that the frequently used techniques were nodding/shaking head, facial expression, hand movement, and eye contact. On the other hand, the most commonly used technique by nurses was asking open-ended questions for the patients to indicate yes or no answers, followed by talking, interpreting the patients' body movement, observing the patients' facial expressions, and making eye contact. These studies provide basic information which can enable nurses taking care of the patients on ventilator support to understand communication techniques and realize the significance of the interaction between nurses and patients on ventilator support and to find ways to better help the patients together with other healthcare team members.

In addition to this, studies have been conducted to explore the patients' suffering while on the ventilator support. For instance, Wojnicki (2001, cited in Thomas, 2003) conducted a study with 22 patients on the ventilator support and found that nurses' communication techniques included using body language, touch,

and lip reading, respectively. On the other hand, the patients' communication techniques to nurses were body language, touch, and writing, respectively. Moreover, the patients assessed that nurses were able to communicate effectively and paid attention to them. It was also discovered that the patients had difficulty communicating while on the ventilator and had negative experience with ventilator support. The factors which hindered the patients' communication were the complications of the disease they had, their emotional status, their pathology, and attention and care from their relatives.

Therefore, communication with the patients is deemed important as the patients who are on the ventilator and are unable to communicate their needs leading to stress, which eventually leads to unsuccessful weaning. For this reason, nurses should try to communicate with patients by asking them to write or using easy questions with yes/no answers, after the patients' strength and language ability have been assessed and appropriate techniques for each patient have been considered and chosen (Knebel, 1991).

2.3 Using music therapy is also considered another effective technique to reduce the patients' stress. This is because music can reduce anxiety and promote health and happiness, for music affects the function of the limbic system and hormone secretion in the body. To be exact, music stimulates the brain to secrete endorphin which can relieve stress and anxiety. This particularly benefits the patients weaning from the ventilator who tend to have stress and in fear of being unable to breathe by themselves. In addition, of reducing stress and anxiety, music can decrease heart rate, heart rhythm, and blood pressure (Fontaine, 1994; Thomas, 2003). Research has proved that music therapy can reduce the patients' stress. For example, Jiraporn Chonthichachalaluck (B.E. 2547) carried out a quasi-experimental study to investigate the effect of music therapy on anxiety and physiological responses during weaning. The subjects were 20 critical patients who were recruited by means of purposive sampling. They were acting as the self-control group. In the study, the subjects listened to music for an interval of 30 minutes during weaning. The findings indicated that listening to the music the subjects had a lower level of anxiety, heart rate, and average blood pressure than those who did not listen to the music with statistical significance.

2.4 Using relaxation techniques to relieve stress and anxiety means applying specific techniques to induce physical and mental relaxation to release muscle tension, distract attention, and reduce anxiety, making the patients more satisfied and happy (Vichit Boonyahotara, B.E. 2536). There are different relaxation techniques, and which techniques should be chosen depends on interest, belief, and each patient's readiness. More than one technique can also be used. The commonly used techniques in nursing practices are breathing exercise, muscle relaxation, and breathing management. For a relaxation technique to be effective requires proper environment and the patients' both physical and mental readiness (Department of Mental Health, Ministry of Public Health, B.E. 2539) as follows:

Breathing exercise: while under stress, the patients will use the chest muscles in breathing. The breathing pattern will be fast and shallow, with intermittent sighs to increase oxygen intake. Thus, practicing breathing by using the diaphragms and abdominal muscles will enable the lungs to get more oxygen. When practicing breathing, the patients should lay their hands on their abdomen and observe the movement of the abdomen when inhaling and exhaling. They should inhale deeply and slowly and hold their breath for a short while before exhaling. This can be done continuously for 1 to 20 minutes, and they should practice this regularly until they can do it automatically. This type of breathing increases the body's oxygen intake, making the brain fresh and ready for doing activities especially weaning (Department of Mental Health, Ministry of Public Health, 1996). Wipapat Sungkhaw (B.E. 2544) studied the effect of systematic provision of information and use of relaxation techniques on weaning of ICU patients and found that those in the experimental group who received information and used relaxation techniques had a lower level of stress than those who received only regular nursing care. Also, biofeedback and relaxation technique were found to promote successful weaning (Aldrich et al., 1989, cited in Sountaree Jianwitayakij, B.E. 2546; Holiday and Hyers, 1990).

The principle behind muscle relaxation is to tighten and release each group of muscles to experience the differences between tenseness and relaxness. When under stress, the body responds by unconsciously tensing different muscles. Thus, when intentionally tensing the muscles as much as possible and when this has been practiced regularly, the patients will realize when their muscles become tense and they

can then relax their muscles by themselves. The organs involved include hands, arms, face, mouth, neck, chest, shoulders, abdomen, bottom, feet, and legs. As for practice duration, the muscles will be tensed for 3 to 5 seconds before they are relaxed for 10 to 15 seconds. This should be repeated 8 to 12 times during each practice (Department of Mental Health, Ministry of Public Health, 1996). Previous studies have shown evidence supporting the effectiveness of using muscle relaxation. For instance, Prapai Meesap and Kanyarat Puengbanharn (B.E. 2546) studied the effects of muscle relaxation techniques among ICU patients on ventilator support and found that they could help reduce the patients' sufferings. Furthermore, Acosta (1987) studied relaxation techniques in COPD patients on ventilator support who were weaning with the T-piece method. The findings indicated that the patients' anxiety reduced, they could wean for a longer period of time, their heartbeat and heart rate were lowered, and the amount of oxygen at their fingertips increased.

3. Promoting energy increase during weaning

To promote energy increase during weaning enables the patients to have sufficient energy. It can also make breathing muscles strong, enabling the patients to withstand weaning better (Burns et al., 1991; Cook et al., 2003). This includes promoting good nutritional status and sufficient rest, with details as follows:

3.1 Promoting good nutritional status: Assessing the nutritional status of the patients on ventilator support is necessary. The patients should receive sufficient nutrition in the shortest amount of time because lack of nutrition leads to malnutrition which, in turn, results in complications of the lungs, decreasing muscle mass, and lack of energy in the muscles, especially those necessary in breathing. If the breathing muscles are exhausted, the tidal volume will decrease, making weaning unsuccessful (Burns et al., 1991; Knebel, 1991; Ubolrat Deeprom, B.E. 2546). In addition, malnutrition brings about a decrease in protein synthesis, which affects the production of surfactant, lowering the flexibility of the lungs and their immunity. Thus, the lungs are more susceptible to infection (Ubolrat Deeprom, B.E. 2546).

The roles of nurses in taking care of patients and making sure they receive sufficient nutrition are as follows:

1. Nurses have to assess the nutritional status of the patients. This can be done by measuring the patients' body weight and height as the information can be

used to calculate the quantity of energy to be given to the patients. Also, nurses should monitor the patients' electrolytes, especially calcium, magnesium, and phosphorus, as an insufficient amount of these substances can lead to muscle exhaustion. Nurses have to monitor the patients' albumin results. If albumin is lower than 3.0 mg./dl., weaning may not be successful (Burns et al., 1991; Knebel, 1991).

2. Nurses have to make sure that the patients receive nutrition which gives enough energy for the body's needs (25-30 Kcal/Kg/day). They need to make sure that the patients receive enough nutrition in every meal and that they receive energy more from protein and fat than from carbohydrates to reduce the production of carbon dioxide. This is because if there is a high level of carbon dioxide, the patients need to exert more energy to breathe, making weaning more difficult (Cook et al., 2003; McConachine, 1999, cited in Ubolrat Deeprom, B.E. 2546). Cook et al. (2003) compared nutritional intake high in fat and low in carbohydrates with that high in carbohydrates and low in fat and examined their effects on weaning success among eight COPD patients. The findings revealed that the duration for successful weaning among those who received nutrition high in fat and low in carbohydrates was statistically significantly lower than that of the other group.

3. Nurses have to assess the patients' digestive ability and feed them according to the treatment plan. As most of the subjects receive food through enteral feeding, nurses have to check bowel sound, gastric content, and gas in the stomach. If the subjects have a bloated stomach with excess gastric content, they will not be able to consume food and have a higher risk of choking (Orasa Panpakdee, B.E. 2542).

4. Nurses have to take care of the patients to make sure that they have bowel movement every 2-3 days by assessing their habits, arranging the environment in which the patients can have bowel movement in discretion, and help them move their body and limbs to stimulate the colon to move. If the patients have constipation, they should administer laxatives (Orasa Panpakdee, B.E. 2542).

As for evidence related to malnutrition in patients on respiratory support and weaning, Chadaporn Prempramamorn (B.E. 2545) studied nutritional status and dietary sufficiency of 198 patients on respiratory support by recording food intake within 24 hours, circumference of the mid-upper arm, thickness of fat under the skin in the triceps area, blood albumin level, and lymphocyte level. The findings

revealed that the longer the patients stayed in the hospital, the higher the rate of malnutrition. Most of the patients did not receive enough energy when compared to what they should have received according to the calculation. It was also found that the number of patients with malnutrition who successfully weaned from the ventilator was lower than that of the patients who did not experience malnutrition with statistical significance.

3.2 Nurses have to make sure that the patients have sufficient rest to preserve and promote the energy for weaning. The patients who are on the ventilator and who are being treated in the ward are constantly disturbed by treatment, stress, pain, and changing environment, so they do not have enough quality rest. In other words, they may not be able to sleep at all, or they may not be able to sleep continuously. Lack of REM sleep and Non - REM sleep results in irritability, loss of concentration, poor memory, and forgetfulness. Lack of Non - REM sleep also leads to inactivity, loss of energy, and exhaustion. Therefore, having inadequate sleep affects the patients' self-care ability, decision making ability, and ability to use energy to do activities, especially during weaning (Richard, 1998; Orasa Panpakdee, B.E. 2542).

Nursing care which enables the patients to have enough sleep is one of the nursing goals to preserve energy. The roles of nurses are as follows: (Christiane, 2002; Vicky, 2003):

1. Nurses have to plan nursing activities to avoid disturbing the patients' sleep by reducing unnecessary stimulation such as doing the suction every two hours which can be very disturbing. Thus, nurses should assess the amount of secretion and make sure the patients receive enough oxygen. If the patients experience hypoxemia, they may not be able to sleep. The patients should sleep continuously at least for two hours.

2. Nurses should give the patients reassurance that they will be safe and that they are under constant care of the nurses. They can inform the patients of how to call the nurses when they need help such as by ringing the bell provided.

3. Nurses should take care of the patients' environment by cleaning the bedding, getting rid of disturbances especially the noises caused by the nurses' and healthcare team members' talks, turning down the telephone volume, turning off lights

during nighttime to let the patients sleep, making sure there is enough ventilation in the room, and monitoring the room temperature.

4. Nurses should pay attention to the patients' well being and comfort, especially those who have to be in bed for a long time. Pain should be assessed periodically, particularly when the endotracheal tube has just been inserted, and nurses should reduce the patients' pain by changing their positions, using a hot water bottle or ice pad, and administering pain management to help the patients sleep more.

5. Nurses should use complementary therapy and holistic nursing care to promote the patients' sleep as they emphasize care given not only to the patients' physical being but also mental and spiritual beings. Most frequently used complementary therapy and holistic nursing care are body massage, music therapy, relaxation techniques, and use of imagination (Fontaine, 1994; Thomas, 2003), which can be further described as follows:

Massage: It involves the use of body touch to create comfort and relaxation. Sometimes massage is used with other techniques especially aromatherapy and hydrotherapy (Kesinee Suthavarangkul, B.E. 2544). Massage is used to relieve tenseness and muscle ache, making the patients feel more relaxed. For instance, back massage can relieve back pain as well as pain caused by muscle spasm. Back massage benefits the patients' physiology, mental condition, spirituality, and immune system. They can relieve pain and promote rest and relaxation, making the patients have enough sleep in terms of both quantity and quality. In addition, it has been found that back massage is a nursing practice which is effective in reducing stress and inducing relaxation without having any effect on the body's circulation system (Donna, 1999). Richards (1998) studied the effect of back rub on sleep using a randomized controlled trial with 69 critical male patients in the coronary care unit. Twenty-four subjects in the first experimental group receive a back rub for six minutes, 28 subjects in the second experimental group received the relaxation technique, and 17 subjects received routine nursing care. The findings showed that the subjects who received a back rub could sleep for 62.5 minutes longer than those who did not receive a back rub. Similar findings can be found in the study of Dunn et al. (1995, cited in Janet, 1999) who studied the effect of body massage on relaxation. The authors concluded that body

massage is a nursing practice which can be used in nursing planning to take care of the body's mental and spiritual well being and promote their sleep.

Music therapy: It can reduce stress and anxiety and promote sleep as it affects the function of the limbic system and hormone secretion in the body. Zimmerman et al. (1996, cited in Richards, 1998) investigated the effect of music on sleep of 96 patients undergoing heart surgery comparing the use of music therapy and a sleep table. The findings indicated that music therapy better promoted sleep than a sleep table. However, the music used for relaxation purposes needs to be soft and something that the patients like, with the use of a headphone to adjust the volume.

Relaxation technique: using relaxation technique and imagery leading are techniques which promote sleep as they stimulate the functioning of the parasympathetic system, making the patients calm and their muscles relaxed. In addition to promoting sleep, the techniques can also decrease pain and anxiety in the patients in the ICU (Thomas, 2003).

4. Using a protocol and program in weaning

In order for weaning to be successful, there are other factors that play a role in addition to the weaning method. Previous studies have pointed out that using a protocol leads to increased success in weaning, reducing the duration of weaning, the length of hospital stay, and the cost of medical care (Fernando and Esteban, 2003; Kollef et al., 1997). Evidence – based practice for using the protocol in weaning is as follows:

Burns and colleagues (2003) conducted a quasi-experimental study with a longitudinal design to examine the use of a health promoting program and its effects on the cost of medical care of patients on respiratory support. The subjects were patients in five critical wards who had been on respiratory support for more than 3 days. There were 595 subjects in the control group who received normal nursing care (data were collected 18 months retrospectively before the experiment) and 510 subjects in the experimental group who received nursing care using the program consisting of multidisciplinary nursing using evidence-based clinical pathway and a protocol. Four advanced practice nurses assessed the patients daily using Burns Wean Assessment Program (BWAP) and reported the findings to the multidisciplinary team. The findings revealed that the number of days the subjects who received a program

were on the ventilator reduced from 10 days to 9 days, the number of days they were hospitalized in the critical ward was reduced from 15 days to 11 days on average, the total length of hospitalization was reduced from 22 days to 10 days, and the mortality rate was reduced from 38% to 31%, with statistical significance.

Brochard and colleagues (1994) conducted a randomized controlled trial to compare among weaning methods among 109 patients who were considered ready for weaning and were unable to spontaneously breathe for two hours. The subjects were divided into three groups and each group received each of the three methods of pressure support, intermittent mandatory ventilation, and spontaneous breathing trials with protocol. The subjects who were weaning with the PSV method received a decrease of 2 to 4 cmH₂O, and if there were able to breathe well enough, it will be reduced to twice a day. For the subjects in the SIMV group, the breathing rate was reduced to 2 to 4 times per minute twice a day. Finally, the subjects who were weaning with the T-piece method breathed ≥ 2 hours. It was discovered that using the protocol in weaning creates safety and makes weaning more effective.

Ely and colleagues (1996) also conducted a randomized controlled trial to investigate the effective of systematic weaning on the duration of respiratory support. The subjects were randomly selected from the patients in the intensive care unit. One hundred and forty-nine subjects in the experimental group were screened for their readiness to wean from respiratory support once in the morning by a respiratory therapist using the following parameters:

1. $\text{PaO}_2 / \text{FiO}_2 > 200$; $\text{PEEP} \leq 5 \text{ cmH}_2\text{O}$.
2. Ability to coughing strongly enough during suction
3. $f / V_T \leq 105$, and no use of vasopressure or sedatives.

The patients who met all of the specified criteria were tested for spontaneous breathing using the T-piece method or CPAP 5 cmH₂O. If the subjects were able to breathe for two hours, their physicians would be informed so that extubation could be considered. On the other hand, 151 subjects would also receive screening once a day, but they did not have to take the spontaneous breathing test. According to the findings, the subjects who systematically weaned from respiratory support had a shorter duration, less complication, and lower medical expenses than those in the control group with statistical significance.

Kollef and colleagues (1997) conducted a randomized controlled trial to compare nursing care using protocol-directed weaning by respiratory therapists and nurses and traditional physician-directed weaning. The subjects were 357 critical patients who were assigned to the experimental group (179 subjects) and the control group (178 subjects). The subjects in the control group were under the care of the physicians who assessed their readiness and made a decision about weaning. On the other hand, the subjects in the experimental groups were under the care of respiratory therapists and nurses and they were assessed for readiness based on the following criteria: 1) $\text{PaO}_2/\text{FiO}_2 > 200$, 2) $\text{PEEP} \leq 5 \text{ cmH}_2\text{O}$, 3) Heart rate $< 140 \text{ beats/min}$, 4) Respiratory rate $\leq 35 \text{ breaths/min}$, 5) Awake and oriented mental status, and 6) No dependence on vasoactive or inotropic agent.

The findings indicated that the total number of hours the experimental groups were on the ventilator was 35 hours, while that of the control group was 44 hours. It could be concluded that the patients who weaned from respiratory support with the protocol managed by nurses and specialists were safe and able to wean faster.

In summary, weaning with the protocol carried out by the healthcare team means that the patients are assessed for their readiness and their symptoms during weaning are closely monitored, thus enabling them to wean effectively and fast. Weaning then takes less time, the chances for complications are lessened, and the cost of medical expenses was also reduced. It also promotes cooperation among the interdisciplinary teams which, in turn, promotes provision of quality care to the patients.

Interventions of post weaning and extubation care

Regarding of post weaning care refer to two phase of post weaning as follows: post weaning care and post extubation care.

Firstly, post weaning care means the patients are able to breathe effectively in the case that the patients' condition is not critical and they can spontaneously breathe for 30 to 120 minutes (Esteban et al., 2004; MacIntyre, 2001) or in the case that the patients who have been on the respiratory support for a long time, have gradual weaning, and are finally able to breathe by themselves for 24 hours (Burns et al., 2000). The patients who do not have any limitation to wean (such as not being able to

cough well enough) will be considered for extubation tube after the assessment is done taking the following factors into account. First, the patients have a good level of consciousness. Second, they do not have blocked upper respiratory tracts, Third, the patients are able to cough well during suction (Fernando and Esteban, 2003; MacIntyre, 2001). These patients will be considered for extubation and will be under close care for at least another 24 hours.

However, there are some patients who are able to breathe spontaneously but need to remain on respiratory support because they are unable to clear their respiratory tract. These patients may be lethargic, unconscious, or they may have problems with the central nervous system or experience blocked upper respiratory tract. Some may not be able to cough strongly enough. These patients are able to wean, but extubation has to be postponed (Apirak Palawatvichai, B.E. 2546; MacIntyre, 2001)

Lastly, post extubation care, problems can arise which makes it necessary for the patients to be back on respiratory support. For example, the patients may have upper airway obstruction. One of the common causes of upper airway obstruction is laryngeal edema, which can be caused when the respiratory tract becomes narrower by 20%. Also, examinations may reveal the stridor sound, which is commonly found in the patients who have experienced accidents with their larynx, those who have been on respiratory support for longer than 36 hours, and those who have difficulty having the tube inserted (MacIntyre, 2001).

Therefore, in cases of laryngeal edema that are not so serious and do not require immediate re-insertion of the tube, care can be provided as follows (Tananchai Boonburapong, B.E. 2543).

1. Using corticosteroids in the form of dexamethasone 0.1 – 0.5 mg/kg every 6 hours and for another 48 hours after extubation by considering the possibility before extubation is done based on the cuff leak test.
2. Administering aerosol epinephrine (2.25% racemic epinephrine)
3. Using mask CPAP or non-invasive positive pressure ventilation (NIPPV) to dilate the respiratory tract and reduce the work of breathing, making the trachea narrow.

In the contrast, Darmon and colleagues (1992) conducted a randomized controlled double blind trial to determine the possible risk factors for laryngeal edema

occurrence after extubation in adult and to evaluate the efficacy of corticosteroids in its prevention. The subjects were 700 patients in six critical care units who had been required tracheal intubation tube. Patients were divided into two groups; those in whom short – duration intubation (less than 36 hrs.), and those in whom long – duration intubation (more than 36 hrs.). Patients in both of intervention group were randomly given an intravenous bolus of 8 mg. dexamethasone before extubation in 1 hour. And the patients in short – duration intubation and long – duration intubation in control group were randomly given a placebo. The findings showed that the overall incidence of post extubation laryngeal edema in adult is small and that risk factors for laryngeal edema include an intubation duration of more than 36 hrs. and female gender. In addition, 8 mg. dexamethasone given as an intravenous bolus 1 hour before extubation does not appear to prevent laryngeal edema in both group.

In conclusion, intervention after extubation that was focused on the assessment patients' ability for spontaneous breathing by themselves after extubation and monitoring after extubation. The conditions which might be assessed before extubation included: 1) the patients have a good level of consciousness, 2) do not have blocked upper respiratory tract, and 3) the patients are able to cough well during suction and having minimal amount of secretion. If the patients have met these conditions, the patients will be considered for extubation and will be under close monitoring for at least another 24 hours.

Weaning is a complicated process, rendering numerous studies on successful and effective weaning. Assessing the patients' readiness was crucial in weaning. A review of literature reveals that existing research provides information which can be used in assessing the patients' readiness extensively and effectively, enabling them to eventually successfully wean from respiratory support.

Summary

Weaning mechanical ventilation is a process which depends on various factors. Then, important factors were related to the assessing the patients' readiness to wean and the other factors with promote successful weaning. In the assessing the patient' readiness to wean, that is the assessment the patient's ability for weaning when they were solved from the causes of respiratory failure. In addition, the effective

assessment must be covered both factors of physiological and psychological factors. Factors which promote successful weaning are selection of the weaning method such as T-piece, continuous positive airway pressure, synchronize intermittent mandatory ventilation, and pressure support ventilation, reduction of the need to use oxygen by decreasing the patients fear and anxiety (giving information, making communication effective, using music therapy, using relaxation technique, etc.), promotion of sufficient energy for weaning (good nutritional status, sufficient sleep, etc.), use of a weaning protocol, and provision of care during weaning and after extubation. These factors make promote weaning and challenging for the healthcare team to practice. Researchers have attempted to seek ways to make positive weaning outcome. The effective weaning outcome after to use the CNPG that most interested are to reducing the duration of respiratory support, to reducing the anxiety and fear of the patients during weaning, reducing the length of stay in intensive care unit, enabling the patients to wean successfully without having to be back on respiratory support or breathing spontaneously for 2 hours, (in spontaneous breathing trial), 24 hours (in gradual weaning) and preventing the patients from having the reintubation endotracheal tube within 48 hours after extubation. Thus, this paper will provide a CNPG by review and evidence-based literature which will develop the clinical practice guideline to meet quality care of the patients in intensive care unit.

CHAPTER III

METHODS

In this study, the objective was to present the process of using evidence-based method in developing a clinical nursing practice guideline (CNPG) to promote successful weaning from mechanical ventilation in critically ill adult patients. The study process included the following:

1. The compilation of relevant research literature,
2. Critical appraisal on literature review, and
3. Establishment of CNPG for successful weaning and verify the accuracy of the developed CNPG

I. The compilation of relevant research literature

Data source

The initial search for the evidence-based weaning from mechanical ventilation was conducted with several electronic databases from CINAHL, PubMed, Ovid, and Mulinet, which are reliable resources in the healthcare and nursing fields. Other resources of information were from web sites of www.arhq.gov and www.google.com. The keywords that had been used to search the literature were “weaning and,” “mechanical ventilation,” and “adult,” “assessment,” “protocol or guideline,” “method,” “nutrition,” “intervention and nursing.” Furthermore, reference lists from selected articles, textbooks, and article journal indexes related to nursing and medicine were recruited.

Study selection

The article selection was conducted by reviewing each of the articles. The articles which did not fit the criteria were eliminated. The criteria were the following: weaning from mechanical ventilation, adult, endotracheal tube, in the English or Thai languages, from 1990 to 2004. In addition, there were same studies in several databases, so only one was selected by the investigator.

Then, the selected studies were brought to search the full text from the internet, English and Thai journals, textbooks and researches. If the research did not contain full text, it would be excluded. The number of relevant research literature selected was shown in Table 1.

Table 1 Number of selected relevant research studies classified by resources, key words, and limited criteria.

Database	keyword	Limited criteria	Number of research	Number of relevant research
CINAHL	weaning and MV and adult	Abstract	197	1
	weaning and MV and assessment	and full	20	1
	weaning and MV and protocol	text and	10	1
	weaning and MV and method	1990 -	9	-
	weaning and MV and nutrition	2004	-	-
	weaning and MV and nursing and intervention		5	2
PubMed	weaning and MV and adult	All fields	2,242	-
	weaning and MV and assessment	and 1990-	100	2
	weaning and MV and protocol	2004	110	1
	weaning and MV and method		31	1
	weaning and MV and nutrition		55	1
	weaning and MV and nursing or intervention		100	2

Table 1 Number of selected relevant research literature classified by resources, key words, and limited criteria (cont.).

Database	Keyword	Limited criteria	Number of research	Number of relevant research
Ovid	weaning and MV and adult	Abstract	20	-
	weaning and MV and assessment	and full	15	1
	weaning and MV and protocol	text and	8	-
	weaning and MV and method	1990 -2004	18	1
	weaning and MV and nutrition		2	1
	weaning and MV and nursing and intervention		32	2
www.google.com	weaning and MV and adult	Abstract	1,880	-
	weaning and MV and assessment	and full	100	-
	weaning and MV and protocol	text and	500	1
	weaning and MV and method	1990 -2004	165	-
	weaning and MV and nutrition		200	-
	weaning and MV and nursing and intervention		350	2
www.arhq.gov.	weaning and MV and adult	Abstract	5	1
	and protocol	and full - Text		
Mulinet	weaning and MV and adult	Abstract	8	4
	total	-	-	25
Other resources	weaning and MV	Full text	-	17
	total	-	-	42

MV = mechanical ventilation

With regard to the compilation of the relevant literature review (Table 1), the following articles were found and chosen. First, as for the CINAHL database (1990 – 2004), 241 related studies were identified but only five studies were selected to be used in this study. Second, from PubMed, 2,638 related studies were identified and seven studies were selected. Third, from Ovid, 95 related studies were identified and five studies were selected. Fourth, from www.google.com, 3,195 related studies were identified and three studies were selected. Fifth, from www.arhq.gov, five related studies were identified but only one study was selected. As for the last electronic database, Mulinet, eight related studies were identified and four research studies were selected. There were 25 studies from the relevant evidence-base approach from electronic database. In addition, regarding other resources, seven related studies were selected from the reference lists of the selected studies, and ten articles were selected from textbooks and journals. A total of 42 studies related to nursing and medical fields were used in this study to develop the CNPG.

II. Critical appraisal on literature review

The selected studies were analyzed and synthesized regarding to the criteria of research utilization (Polit and Hungler, 1997). The criteria aim to evaluate the quality of evidence including clinical relevance, scientific-merit and implementation potential, which are described as follows:

1. Clinical relevance: the research findings related to the identified problem
2. Scientific-merit: for assessing whether the findings and conclusions of the study were accurate, believable, and generalizable. The form of analysis and synthesis was modified from the worksheet for critique of Rosswurm and Larrabee (1999) and Renu Pookboonmee (B.E. 2547). In order to identify the quality of the evidence, the classification system as proposed by The Royal Thai College of Internal Medicine (B.E. 2544) was used in this study. The scientific evidence is categorized into the following four levels:

Level A: Evidence is the evidence from a systemic review of a well- designed randomized control trial or the randomized control clinical trials (RCT).

Level B: Evidence is the evidence from a systemic review of a well- designed control clinical study, or evidence obtained from at least one properly designed randomized controlled trial, or a well-designed and non-randomized clinical trial.

Level C: Evidence is obtained from comparative studies or descriptive studies.

Level D: Evidence is obtained from opinions of respected authorities, reports of expert (i.e. consensus) committees, or case studies.

3. Implementation potential: The grouping was under three headings:

3.1 Transferability of the findings: The main issue in the transferability of the findings was that the result of studies were selected to practice in congruence with the setting including conceptualization, the type of clients, and the unit (i.e. personnel, financial, and administrative structure).

3.2 Feasibility of implementation: the results of research addressed a number of practical concern about the availability of staff and resources, the organizational climate, and the ability to manipulate the independent variable.

3.3 Cost–Benefit Ratio: A cost and benefit assessment encompassed likely costs and benefits to various groups, including clients, staff, the organization as a whole, and even the nursing profession as a whole.

Twenty-six relevant research studies were analyzed in accordance with the criteria of research evaluation and consideration for implementation. Major examination and research findings from each study were described and analyzed, and the implication of each study was illustrated in the Table 2.

Table 2 Analysis and synthesis relevant research to weaning mechanical ventilation (n = 26)

Authors / year	Designs/ Level of evidence/objective	Sample / setting / Intervention	Findings	Implication / Implementation potential
1. Dammon, J.Y, et al. (1992)	- Prospective randomized controlled double – blind trail - Level A - Objective : To determine the possible risk factors for laryngeal edema (LE) occurrence after extubation and to evaluate the potential efficacy of corticosteroids to reduce its incidence	Sample : The 700 patients who were required tracheal intubation. Setting : Six ICU. Intervention : - Patients were stratified in to two group : 1) short - duration intubation (SDI, less than 36 hr.) (n = 328), 2) long – duration intubation (LDI, more than 36 hr.) (n = 372). - Patients in both the SDI and LDI were allocated randomly to assigns the following : 1) SDI (n = 162) and LDI (n = 186) were receive 1 hr. before extubation, either an 8 mg (IV) of dexamethasone sodium phosphate, 2) SDI (n = 166) and LDI (n = 186) were receive a placebo. - Patients were obtained for LE occurrence 24 hr. post extubation such as laryngeal dyspnea and stridor and reintubation.	- Laryngeal edema occurred more frequently after LDI than after SDI ($P < 0.001$). - The overall incidence (e.g. age, gender, intubation duration, admission diagnosis, rate of intubation) was not different between patients given dexamethasone and those given placebo, whether they were in the SDI or LDI group ($P > 0.05$).	- This study suggested that the incidence of LE after extubation in adult is low, but occurs significantly more often in patients with LDI and female patients intubation. - Then the patients should be observe closely during the immediate post – extubation period. - The monitoring for LE occurrence in 24 hr. post – extubation included : 1) Laryngeal dyspnea was signs of upper obstruction, such as a prolong inspiratory phase associated with recruitment of accessory respiratory muscle, 2) stridor as a crowing sound present with inspiration, in addition, tracheal extubation should be performed during in the morning. - the result of this study can apply in clinical practice.
2. Burns.S.M., Burns,J.E.and Truweit, J.D. (1994)	- Prospective descriptive study. - Level : C Objective : 1) To test the efficacy of five clinical weaning indices such as Burns Weaning Assessment Program (BWAP);	Sample : 37 adult patients requiring mechanical ventilation for at 7 days. Setting : medical – surgical ICU. Data collection : - The patients who were identified as stable and ready to wean by medical team. - Data were collected on all weaning indices (BWAP, WI, (fV_T), CROP, NIP) for every other day until the patient was weaned	- The threshold score of 64% was to correlate with the ability to spontaneous breathe for 24 hr. and score < 64% were found to have strong negative predictive ability. - With the exception of the BWAP, weaning indices did not change significantly from preweaning and wean stage.	- The clinical weaning indices like BWAP can apply in clinical practice. - The result of this study suggested that BWAP might best serve as tool to track trends in progress, keep care planning on target, and prevent unsuccessful weaning trails.

Table 2 Analysis and synthesis relevant research to weaning mechanical ventilation (cont.)

Authors / year	Designs/ Level of evidence/objective	Sample / setting / Intervention	Findings	Implication / Implementation potential
2. Burns, S.M., Burns, J.E. and Truweit, J.D. (1994) (cont.)	Weaning Index (WI); Frequency Tidal Volume (f/V _T); compliance, resistance oxygenation and pressure index (CROP); and negative inspiratory pressure (NIF) at regular intervals during withdrawal of ventilatory support. 2) To determine threshold levels for the BWAP.		- The study failed to demonstrate positive predictive power of the five indices, although all the indices had negative predictive values that may be helpful in predicting unsuccessful weaning trails.	
3. Burns, S.M. et al. (1994)	- Randomized controlled trial - Level : A - Objective : To determine the body that optimizes breathing pattern (tidal volume and respiratory rate) in spontaneously breathing intubated patients with a large	Sample : The 19 intubate patients with abdominal distention, ascites or obesity. Setting : ICU Intervention : - The patients who were on CPAP and PSV mode, were assigned to each position including : the 0 degrees, 45 degrees, 90 degrees and reverse Trendelenburg's (RT) at 45 degrees position for 5 minutes prior to data collection.	- The RT at 45 degree position resulted in a significantly larger tidal volume and lower respiratory rate than at 90 degree in intubated, spontaneously breathing patients with a large abdomen. - The 45 degrees position resulted in a significantly lower respiratory rate than at 90 degrees (P < .05), and no difference in tidal volume (P > 0.05).	- The elevation of the patient's head 45 degrees as an optimal position for diaphragmatic expression in patients with weaning trail. - This result can apply in clinical practice.

Table 2 Analysis and synthesis relevant research to weaning mechanical ventilation (cont.)

Authors / year	Designs/ Level of evidence/objective	Sample / setting / Intervention	Findings	Implication / Implementation potential
4. Esteban, A, et al. (1995)	- Prospective randomized controlled trial - Level : A Objective : To compare four methods of weaning patients from mechanical ventilation.	Sample : 130 adult patients who were used ventilator more than 9 days. Setting : Medical ICU. Intervention : - The patients were randomly assigned to undergo one of four weaning technique. - Protocols were followed for each group : group 1 : SIMV : decrease by 2-4 breaths/min, 2 times/day. (n = 29) group 2 : PSV : decrease by 2-4 mH₂O, 2 times/day. (n = 37) group 3 : T- Piece (once) : as tolerated up to 2 hr. (n = 33) group 4 : T-Piece (multiple) : T-piece as tolerated multiple times per day (up to 2 hr. per trial). (n = 31)	- The median duration of weaning was 5 days for SIMV, 4 days for PSV, 3 days for multiple T- piece, and 3 days for a once daily T- piece. - The rate of successful weaning was higher with once – daily T-piece than SIMV (P<0.006) or PSV (P<0.04). - There was no significant difference in the rate of success between once – daily T-piece and multiple T-piece.	- The result of this study could apply to practice because of the same adult patient and using ventilator more than 3 days - T- piece method is the highest successful for weaning and used shorter in duration of weaning. - This study suggested that using protocol in mechanical ventilation weaning is : a) T- piece once daily : tolerated up to 2 hr. or as tolerated multiple times per day. (up to 2 hr. per trail) b) SIMV: decrease by 2-4 breaths/min, 2 times /day . c) PSV: decrease by 2-4 mH₂O, 2 times/day
5. Ely, F.W, et al. (1996)	- Randomized controlled trial -Level : A Objective : To determine the screening patients daily to identify the patients, who can breathe spontaneously and notifying physicians promptly and promote the earlier discontinuation of mechanical ventilation	Sample : 300 adult patients receiving mechanical ventilation. Setting : Medical and coronary ICU. Intervention : - The experimental group (n =149) : the patients underwent the protocol for the following: 1) daily screening by physicians, respiratory therapists, and nurses 2) To identify those possible capable of breathing spontaneously by used parameter Following; a) PaO₂ to FiO₂ ratio >200 b) PEEP ≤ 5 cmH₂O, c) good cough during suction, d) F/V_T ≤ 105,	- The experimental group receiving mechanical ventilation for a median of 4.5 days, as compared with 6 days in control group. (P= 0.003) - The median interval between the time a patient met the screening criteria and the discontinuation was 1 day in experimental group and 3 days in control group. - Complications such as removal tube by the patient, reintubation, tracheostomy and mechanical ventilation for more than 21 days, occurred in 20% of experimental group and 11% of control group. - The number of days of ICU and hospital care was similar in 2 groups.	This result of study can be applied in clinical practice , that is protocol for weaning including :1) daily screening of respiratory function by nurses and physicians, 2) followed by SBT 2 hr., 3) notification of physicians when the trails were successful. 4) the assessment of readiness for weaning. 5) Monitoring during weaning.

Table 2 Analysis and synthesis relevant research to weaning mechanical ventilation (cont.)

Authors / year	Designs/ Level of evidence/objective	Sample / setting / Intervention	Findings	Implication / Implementation potential
6. Sapijaszko, M. et al., (1996)	- Prospective observational trial - Level C: - Objective: To determine the role of serum albumin predictor of mechanical ventilation dependency. - predictor of mechanical ventilation dependency	e) no used sedative or vasopressor drug. 3) Successful tests were followed by 2 hr. trails of spontaneous breathing (SBT: T- piece and CPAP) - 4) Physicians were notified when the patients successfully complete SBT - The control group (n = 151): patients were assigned to have daily screening but no other interventions. Sample: 145 consecutive adult patients who requiring mechanical ventilation for more than 72 hrs. Setting: Multidisciplinary ICU in a university hospital. Data Collection : 1) Patients were classified in to five different group based on the cause of respiratory 2) The following parameters were recorded daily serum albumin concentration, APACHE II score, and fluid balance. 2) The following parameters were recorded daily serum albumin concentration, APACHE II score, and fluid balance.	-Total costs for ICU were lower in the experimental group (mean, \$ 15,740, vs \$ 20,890 in controls). - Albumin concentration (25 g/L) was significantly lower and the APACHE II score was significantly higher in ICU nonsurvivors than in ICU survivors. -At the time of weaning patients from ventilator , median albumin concentration was higher than the patients continued to be supported by ventilator	-The researcher suggested that serum albumin was important in determining for being successfully weaned from the ventilator. That is the patient who was weaning from ventilator should have been serum albumin concentration 25 g/L or more than. - These result can apply in clinical guideline. - These result can apply in clinical guideline.

Table 2 Analysis and synthesis relevant research to weaning mechanical ventilation (cont.)

Authors / year	Designs/ Level of evidence/objective	Sample / setting / Intervention	Findings	Implication / Implementation potential
7. Marik, P.E. (1996)	-Descriptive study -Level C: - Objective: -To determine the positive and negative predictive value of cuff- leak test in predicting post-extubation	Sample: 100 consecutive patients who had been intubated for longer than 24 hrs. Setting: Medical – surgical ICUs. Data collection: - The cuff – leak test was performed by two different methods. 1) The endotracheal cuff was completed deflated, the lumen of the tracheal tube was excluded, and assessed the peritubular leak during SBT. 2) The test described in (1) was repeated during ventilation using the patients' pre-weaning tidal volume. -Then, the patients were observed for the develop of signs of upper- airway obstruction for 24 hr. Laryngeal edema was diagnosed when either upper – airway obstruction or stridor.	- Six patients had no leak with both tests, 22 patients had a small leak with both test, and 60 patients had a large air leak with the both test. -Two patients developed post-extubation stridor. -The different in the incidence of stridor between the two groups were statistically significant ($P = 0.003$). -The cuff – leak tests had a negative predictive value of 100% and a positive predictive value of 35%.	-The result of this study was the following : 1) The cuff leak test , before extubation, was completed deflated and assessed the peritubular leak during SBT. 2) The patients should be observed for the signs of upper- airway obstruction for 24 hr. following extubation. -These result can apply in clinical practice guideline.
8..Kollef, V.H, et al. (1997)	Randomized controlled trail - Level : A - Objective : To compare a practice of protocol – directed weaning mechanical ventilation implemented by nurses and respiratory therapists with traditional physician - directed weaning.	Sample: 357 patients were requiring mechanical ventilation. Setting: Medical and surgery ICU in two university – affiliated teaching hospitals. Intervention : - The patients were randomly assigned to receive either protocol-directed (n = 179) or physician- directed (n = 178) weaning from mechanical ventilation. Protocol including : 1). Underlying of mechanical ventilator improved and meet criteria following : a) PaO_2 to FiO_2 ratio > 200, b) PEEP $\leq$ 5 cmH ₂ O, c) HR < 140 beats/ min,	The patients to protocol- directed weaning had significantly shorter durations of mechanical ventilation compared with control group. (35 hr. vs 44 hr; $P = 0.024$) - The rate of successful weaning was significantly greater for patients receiving physician – directed weaning. ($P = 0.039$) - The hospital mortality rate for the two treatment groups were similar. - Hospital cost savings for patients in protocol- directed weaning were \$42,960 compared with hospital costs for patients in physician-directed group.	- The result of study can apply in clinical practice guideline because the same adult medicine patient in ICU, according, the protocol for weaning including : 1. Assessment for readiness for weaning. 2. Method of weaning. 3. Monitoring during weaning. 4. Criteria to stop weaning.

Table 2 Analysis and synthesis relevant research to weaning mechanical ventilation (cont.)

Authors / year	Designs/ Level of evidence/objective	Sample / setting / Intervention	Findings	Implication / Implementation potential
8..Kollef, V.H, et al. (1997) (cont.)		d) RR $\leq$ 35 beats/min, e) awake and oriented mental status, f) not requiring vasoactive or inotropic agents. 2). Criteria to stop weaning : a) RR > 35 beats/min , b) oxygen saturation of ABG < 90%, c)HR $\geq$ 140 beats/min, d) BP > 180 or < 90 mmHg. e) agitation, diaphoresis or anxiety, f) requirement for vasopressors or inotropic agents, g) chest pain. 3). Method of weaning was selected by housestaff physicians including : a) CPAP $\leq$ 5 cmH₂O in 1-2 hr., b) PSV $\leq$ 6 cmH₂O in 1-2 hr., c) SIMV with PEEP $\leq$ 5 cmH₂O and PSV $\leq$ 6 cmH₂O by decreased RR $\leq$ 4 beats/min and placed on a ventilatory rate of zero for 30 – 60 min. - Outcome : It was duration of mechanical ventilation, the need for intubation length of stay, mortality rate, and hospital cost.		
9..Manzel,L. K. (1997)	-Descriptive comparative study -Level C - Objective : To examine patients' communication related responses .during intubation and after extubation.	Sample: 29 adult patients intubated for 24 hr. or more hours. During intubation and after extubation. Setting : Four ICUs in university affiliated mid – western medical center. -Data collection: The patients had answered the Emotion scale subscales and Ease of Communication scales, whether during intubation or after extubation the time was recorded.	-There was no significant difference over time in the mean score of the Emotion. - Significant difference in subjects' worry /fear at being an able to speak and difficulty with communication. These were found in relation to history of prior intubation and total number of days intubated.	This result was the way to nurse for understand the patients who required endotracheal tube by the following: 1) Careful assessment of the patients' communication ability. 2) Should provide the intervention that also match with the patients' needs to decrease patients' distress. - this result can apply in clinical practice guideline.

Table 2 Analysis and synthesis relevant research to weaning mechanical ventilation (cont.)

Authors / year	Designs/ Level of evidence/objective	Sample / setting / Intervention	Findings	Implication / Implementation potential
10. Chlan, L. (1998)	-Randomized controlled trial with two group, pretest – posttest experimental designs.. - Level A : - Objective : -To test the effects of music therapy on relaxation and anxiety reduction for patients receiving ventilatory assistance.	Sample : 54 adult and non sedated patients receiving mechanical ventilation. Setting : Four urban Midwestern ICU. Intervention : -Patients were randomized to either control group or to experimental group. -The experimental group (n = 27) received the music listening for 30 minutes. The environment was also enhanced to promote rest and relaxation identical to control condition. - The control group (n = 27) received 30 minutes rest period. The environment was enhanced to promote rest by closing the blinds, dimming the lights and posting a pluse “Do not Disturb”. - Two group were measured including : 1)state anxiety, 2) Heart rate and respiratory rate.	- Patients who receiving music therapy reported significantly less anxiety posttest than subjects in the control group. - Heart rate and respiratory rate decreased overtime for those subjects in music group as compare with the control group subjects.	-Music therapy in 30 minutes has been nursing intervention to promote relaxation and decreasing anxiety for the patients are weaning mechanical ventilation. - The patients should select the music’s collection by themselves. - According, the environment management is also to promote rest and relaxation such as decrease the noise, dimming the light, and nursing care. - Music therapy and environment management can apply in clinical practice guideline.
11. Richard, K. C. (1998)	- Randomized controlled trail - Level A - Objective : To determine the effect of back massage and relaxation intervention an sleep in critically ill patients.	Sample: 69 male patients Setting : Hospital CCU, USA. Intervention : The patients were assigned to: Group 1:(n=24) received a 6 minutes back massage at bed time. Group 2: (n=24) received a teaching on relaxation and a 7.5 minute audiotape at bedtime. Group 3(n=17) received normal nursing care with a 6 minutes rest period at bedtime.	-Patient who received a 6 minutes back massage sleep 1 hr. longer than control group. -Non significant trend toward increased sleep efficiency percent stage 2 non rapid eye movement (NREM) sleep; REM sleep, percent wake after sleep onset; and latency to sleep onset in the each group.	- The back massage in 6 minute at bed time, that the critical care nurses should offer it to their patients for promote to sleep. In order to, the patients can tolerate for weaning . - this result can apply in clinical practice guideline.

Table 2 Analysis and synthesis relevant research to weaning mechanical ventilation (cont.)

Authors / year	Designs/ Level of evidence/objective	Sample / setting / Intervention	Findings	Implication / Implementation potential
12. Prapai, Maesap, and Kanyarat Pongbunhan, (1999)	Quasi – experimental and 2 groups pretest – posttest design. -Level B Objective: To evaluate distress level and the outcome of relaxation technique in reducing distress of patients with assist mechanical ventilation.	Sample: 30 purposive adult patients receiving ventilator. Setting: Surgical ICU Intervention: -The experimental group (n = 15) : performed the relaxation technique 20 minutes, twice a day for three days by tape of relaxation technique with cassette tape – player and earphones. - The control group (n = 15) : received routine nursing care. -This study used demographic data interview form, along with Gaberson's anxiety scale and Johnson's distress scale.	-The distress score in the experimental group was significantly decreased after performing the relaxation technique (P = 0.001). -The distress score in the experimental group was significantly lower than control group (P = 0.001).	-The relaxation technique (20 min / twice a day) by listening the tape can apply in clinical practice guideline. - This technique should perform the patients with interesting and condition of the individual patients.
13. Huang, Y.C. et al. (1999)	- Descriptive Correlation study. - Level : C - Objective : To assess and compare the nutrition status of mechanically ventilated critically ill patients who were receiving nutrition support.	Sample : 49 purposive patients who were requiring at least 14 days of mechanical ventilation. Setting: General ICU. Data collection: -Patients were divided in to 3 groups based on the type of nutrition support - Gr.I : EN; 22 patients received the composition of tube feeding . Gr II : TPN; 9 patients was given as a continuous infusion via a superior venacaval vein. - Gr.III: 18 patients received combined nutrition (EN and TPN) - Patients' basal energy expenditure (BEE) was determined by the Harris-Benedict formular.	- The length of ventilator dependency was significantly positively correlated with calorie and carbohydrate intake in the pooled group (all patients). - Patients receiving enteral and combined nutrition showed significantly lower anthropometric measurements at the 14 th day after admission. -Patients in all	-The result of this study included : 1) The basal energy expenditure was determined by the Harris – Benedict. 2) The nutrition status was assessed in 24 hr. of admission for the following : a) height and weight b) BMI (kg / m ²) c) serum albumin or prealbumin d) 24 hrs. urinary creatinin excretion. -These result can apply in clinical practice guideline

Table 2 Analysis and synthesis relevant research to weaning mechanical ventilation (cont.)

Authors / year	Designs/ Level of evidence/objective	Sample / setting / Intervention	Findings	Implication / Implementation potential
13.Huang, Y.C. et al. (1999) (cont.)		- Adjustments were made on a daily basis for fluctuations in electrolytes and blood glucose by dietitians. - Nutrition status was assessed within 24 hr. of admission and after 2 weeks in ICU. - Anthropometric and biochemical measurements, and medical status (APACHE II score) were assessed at 1st day and 14th day of admission in ICU, according, length of ventilator dependency, ICU and hospital stay were obtained.	- Patients averaged 5.6, 6.3, 3.7, and 2.6 days in acute, pre-wean, wean and outcome stage. - Score difference were significant between acute and pre-wean and between pre-wean and wean from APACHE III, TISS and BWAP except the WI. - None of difference between wean and outcome stages were significant. - There is significant of four indices but modest correlation among the APACHE –TISS ($r^2 = 0.239$, $P < .01$), APACHE–WI ($r^2 = .084$, $P < .01$), APACHE – BWAP ($r^2 = .077$, $P < .01$), BWAP- TISS ($r^2 = .063$, $P < .01$).	- BWAP can apply in clinical guideline to assess readiness weaning ability of patients. - BWAP is a comprehensive wean index and incorporates both respiratory and general factors.
14. Burns, S.M, Ryan, B. and Burns, J. E. (2000)	- Prospective convenience cohort. - Level : C - Objective : 1) To determine whether four stages of weaning (acute, pre-wean, wean and outcome) could be identified by using clinical instruments designed to quantify severity of illness, patient stability or weaning readiness.	Sample: 97 adult patients who were requiring mechanical ventilation > 3 days. Setting : University medical ICU. Data collection : - Score for the Acute Physiological And Chronic Health Evaluation (APACHE III), the Therapeutic Intervention Scoring System (TISS), the Burns Wean Assessment Program (BWAP), and the Weaning Index (WI) were collected (by five outcome manager) in patients every other day until they wean, were transferred or died. - Outcome described for each stage of weaning were dated on the clinical pathway when achieved.	- Patients averaged 5.6, 6.3, 3.7, and 2.6 days in acute, pre-wean, wean and outcome stage. - Score difference were significant between acute and pre-wean and between pre-wean and wean from APACHE III, TISS and BWAP except the WI. - None of difference between wean and outcome stages were significant. - There is significant of four indices but modest correlation among the APACHE –TISS ($r^2 = 0.239$, $P < .01$), APACHE–WI ($r^2 = .084$, $P < .01$), APACHE – BWAP ($r^2 = .077$, $P < .01$), BWAP- TISS ($r^2 = .063$, $P < .01$).	- BWAP can apply in clinical guideline to assess readiness weaning ability of patients. - BWAP is a comprehensive wean index and incorporates both respiratory and general factors.

Table 2 Analysis and synthesis relevant research to weaning mechanical ventilation (cont.)

Authors / year	Designs/ Level of evidence/objective	Sample / setting / Intervention	Findings	Implication / Implementation potential
15. Wipapat Sungkhaw, (B.E. 2544).	- Quasi – experimental design with repeated measured - Level: B - Objective: To determine the effect of providing information and relaxation technique on anxiety in weaning from mechanical ventilation.	Sample : The 32 purposive adult patients who have been weaning with T-piece method. Setting : Medical ICU - The experimental group (n = 15) was provided information and relaxation. - Provided information about : 1. Physiological readiness 2. Process of weaning. 3. Activity during weaning 4. Security and caring during weaning 5. Communication for aiding request 6. Instilling of confidence in ability to breath 7. Deep breathing relaxation technique - The control group (n=15) was provided normal nursing care.	The mean scores on anxiety in weaning of patients who perceived information and used relaxation technique were significant lower than before experiment. (P< 0.001)	- Providing information and using relaxation technique before weaning is a good mean in improving nursing care by decreasing the anxiety of the patients during weaning mechanical ventilation. - This result can apply in clinical practice guideline.
16. Khamices M, et al. (2001)	- Descriptive study - Level : C - Objective : - To explore that cough strength and the magnitude of endotracheal secretions affect extubation outcome.	Sample: 91 adult patients who had successfully completed in spontaneous breathing trial (SBT) and were about to be extubated. Setting : Medical – cardiac ICUs . Data collection : - The patient was measured the cough strength, , the magnitude of endotracheal secretion by observer, and using with card test. - The successful of weaning defined as did not require reintubation in 72 hr..	- After patients recovering from respiratory failure have successfully completed on SBT, factors affecting airway competence, such as cough strength and amount of endotracheal secretions, may be important predictors of extubation outcome.	The result of this study can apply in clinical practice guideline for the following: 1. Assessment the cough strength by to ask the patients to cough and assessed the movement of air through endotracheal tube 2) Assessment amount of endotracheal secretion by observation the frequency of endotracheal secretion every 2 hrs.

Table 2 Analysis and synthesis relevant research to weaning mechanical ventilation (cont.)

Authors / year	Designs/ Level of evidence/objective	Sample / setting / Intervention	Findings	Implication / Implementation potential
17.Pisitkurl,G, et al. (2002)	Prospective Quasi – experimental Design - Level: B - Objective: To compare the efficacy of ventilator weaning protocol with physician.	Sample: 70 purposive adult patients who have been mechanical ventilation. Setting: Medical ICU Intervention: - The experimental group (n = 32): the patients were allocated to protocol – directed weaning which is following : 1. Staff nurses assess ready to wean for daily. 2. When patient met criteria a nurse discussed with doctor for decision making for start weaning by T-piece and criteria for weaning followed : a) Cause of use ventilator was improved, b) Vital signs stable, not used Inotropic highdose, c) Peep < 5 cmH ₂ O, d) Good cough reflex,) PaO ₂ to FiO ₂ ratio >200, f) F/V _T < 100 after spontaneous breath in 1 minute. - The control group (n=38) : the patients were allocated to physicians – directed weaning.	- The mean duration time of weaning from mechanical ventilation in protocol- directed group was significantly less than in physician-directed group (0.65 vs 2.47 days, P = 0.005) - Complication were including reintubation rate, mean length of ICU and hospital stay were not significantly difference in both group.(P>.05)	The result of this study can apply to clinical practice guideline, that are the weaning protocol including : 1.The assessment for weaning in 24 hr. (by staff nursing ICU) after on mechanical ventilator, that was promoting the patient to started weaning rapidly. 2) The criteria for decision making for start weaning.
18.Matensson, I.E, & Fridlund, B.(2002)	- Descriptive survey study Level : C - Objective : To establish the factor taken into consideration and documented during weaning at the intensive care unit.	Sample : 92 ICUs for adult. Setting : Multidisciplinary and specialized ICU in Sweden. Data collection: - All ICU received the questionnaire, that was divided into nine parts, subdivided into the factors influencing the weaning phase.	1. Regarding the nutrition status of parameter most used weight, body mass index and laboratory test, serum albumin was most used. 2. Communication: the method most used for communication was pencil and paper, following by speech, lip reading. 3.Psychological factor : the most used was well- being, daily routine and need information. 4. Metabolic factor : PaCO ₂ , base excess and pH. 5.The analgesics used was paracetamol, opioids, and NSAID.	- The factor affecting the patients during weaning are considered : nutrition, communication, psychological, metabolic, analgesics and sedative, weaning method and measurable parameters. These factors can apply in clinical guideline. - And, this study suggested that : a holistic approach to weaning is important for the quality of care. - This result of the study can apply in clinical practice guideline.

Table 2 Analysis and synthesis relevant research to weaning mechanical ventilation (cont.)

Authors / year	Designs/ Level of evidence/objective	Sample / setting / Intervention	Findings	Implication / Implementation potential
19.Tipporn, Sae - choen, (B.E. 2545).	- Descriptive study - Level : C - Objective: To describes nurse – patient interaction	Sample :The 29 purposive sampling who were the patients with endotracheal intubation - The 31 nurses who interacted with the patients. Setting : ICU Data collection : - This study was to explore the interaction between nurses and patients with endotracheal intubation including : communication method, the patients' problem, need a perceived by nurses and the patients' satisfaction in interaction with nurses.	- The pop four patients' communication method were shacking (100%), facial expression (97%), using hand (92.5%), eye contract. (90%) - The pop four nurses' communication method were interpreting body gestures of the patients (100%), yes – no question (100%), speaking to the patients (100%), explaining/cheer up (97%) and eye contract (85%). - The patients' problem and need including positioning(67.5%), information needs related to treatment plan(40%), suctioning (35%), control body temperature (36%), discomfort/ Pain (22%),and dyspnea (20%).	- The result of this study can be used to apply with the adult patients with endotracheal tube in ICU. - This result was to provide nurses to understand the patients and meet the patients' need such as change position, need comfort and relief pain, suction that it related to physiological variable for weaning such as dyspnea or anxiety
20.Chadaporn Preampramamorn (B.E.2545	- Prospective descriptive study - Level : C - Objective : - To elucidate the relationship between nutrition status and successfulness from weaning and duration time of mechanical ventilation.	Sample : The 198 purposive adult patients who have been mechanically ventilated. Setting : ICU Data collection : The patient were recorded the diet for 24 hr., mid – circumference arm, skin-fold of tricep muscle, serum albumin level, lymphocyte count at 24 hr. after admission and 2 week later	- The patients who have been mechanical ventilation with malnutrition were significantly less in successful from weaning ventilation than the patients without malnutrition. ($P<0.05$) - There was a no significant difference between duration times with mechanical ventilation and the difference of nutrition status patients. - The ratio of the malnutrition patients decreased from first week and be highest in the last week.	The result of this study can apply to clinical practice guideline because of the same adult patient and including - Assessment nutrition status was serum albumin at once a week. -The patients who have been mechanical ventilation and malnutrition were not successful from weaning.

Table 2 Analysis and synthesis relevant research to weaning mechanical ventilation (cont.)

Authors / year	Designs/ Level of evidence/objective	Sample / setting / Intervention	Findings	Implication / Implementation potential
21. Burns, S. M., et al. (2003)	- Quasi- experimental design. - Level B - Objective: To determine the effect of an institutional approach to the care of patients requiring mechanical ventilation for longer than three consecutive ICU on clinical and financial outcome.	Sample : 1105 adult patients who were requiring mechanical ventilation for longer than 3 days from 1999 – 2000. Setting: ICUs in Atlantic academic medical center included coronary care, MICU, neuroscience ICU, surgical trauma ICU, and thoracic cardiovascular ICU Intervention: (outcome-management, OM) 1) Evidence – based clinical pathway 2) Protocol of weaning and sedation use. 3) Four APN to management and monitor the program. - 595 patients (pre – OM); retrospective baseline (18 mo.) - 510 patients (pro – OM) : prospective (12 mo.) Measurement : 1) ventilator duration 2) ICU length of stay. 3) Hospital length of stay. 4) Mortality rate 5) cost	- Statistically significant differences in clinical outcome were demonstrated in the OM patients compared with those managed before OM. - Outcome included : 1) ventilator duration (median declined from 10 to 9; P = .001) 2) ICU length of stay median declined from 15 to 12 ; P = .008) 3) Hospital length of stay (median declined from 22 to 20; P = .001) 4) Mortality rate (median declined from 38%-31% ;P= 0.02) 5) Cost saving more than \$ 3,000,000 were realized in the OM group.	- This result was the following : 1) Daily assessment by using the Burns Wean Assessment Program (BWAP) 2) Management and monitoring by nurse. 3) Communication in the medical team during daily round and throughout a plane of care. - this result should be promoting the quality of care , that can apply in clinical practice guideline.
22. Twibell, R, Siela, D and Mahmoodi, M. (2003)	- Descriptive, correlation design - Level: C Objective : To explore the subjective perceptions of dyspnea, fatigue, and self- efficacy and selected physiological variables in patients being weaned from mechanical ventilation.	Sample: 68 adult patients who received mechanical ventilation for at least 24 hr. Setting : ICU Data collection : - Subjective perceptions were measured by using 3 visual analog scales. - Physiological variables were measured by using the Burns Weaning Assessment Program and a patient profile	-During weaning, the patients reported mild dyspnea, moderate fatigue and high weaning self- efficacy. -The physiological variables significantly associated with complete weaning (extubation and spontaneous breathing without distress occurred within 24 hr.) included PaO₂ 60 mmHg or greater, PaCO₂ 40 mmHg or less when FiO₂ was 0.4, stable haemodynamic status adequate cough / swallow reflex, no metabolic change such as fever, and no abdominal distention.	The indicators of readiness to be weaned were primary (physiological variables) and secondary (subjective perception) indicator, that can apply in clinical practice guideline.

Table 2 Analysis and synthesis relevant research to weaning mechanical ventilation (cont.)

Authors / year	Designs/ Level of evidence/objective	Sample / setting / Intervention	Findings	Implication / Implementation potential
23.Sountaree Jianvitayakij, (B.E.2546) (cont.)	-Objective: - To determine the effects of the nurses weaning competency promoting program on nurses' performance and satisfaction in weaning - To examine weaning outcome of the patients with mechanical ventilators	weaning readiness assessment tool, and nursing guidelines. -The The nurse sample answered the questionnaire by nurse ire before and after participation in the program.	- The mean scores of nurses' weaning performance after participation significantly higher than before participation (P< 0.01). - There was no significant difference in the weaning satisfaction of nurses before and after the program (P>.05). - The was no significant difference in weaning outcome of the patients before and after nurses' participation in the program (P> .05).	- This result of the study included - The assessment readiness for weaning by BWAP. - The guideline for weaning patients with mechanical ventilator in pre- weaning phase, weaning – phase, and post- weaning phase. - Intervention program included teaching, demonstrating the use of the weaning assessment tool, training, and counseling. - These program can apply in clinical practice guideline.
24.Walsh et al. (2004)	Prospective observation cohort study - Level : C - Objective : To evaluate the ability of a checklist of simple metabolic, cardiorespiratory and neurological criteria to determine whether it could be used reliable to predict successful discontinuation of	Sample : 325 adult patients Setting : General ICU Data collection : - The weaning checklist used: - Cooperative and pain free - Good enough reflex to tracheal suctioning - PaO₂ to FiO₂ ratio >200 - PEEP < 10 cmH₂O - Hb > 7 g/dl, T = 36 – 38.5°C - Plasma K⁺ > 3 mmol, < 5 mmol. - Na⁺ > 128 mmol, < 150 mmol. - Inotropic reduced or unchanged over previous 24 hr. - Spontaneous ventilation > 6/ min	-The ventilation patients (67%) achieved ventilation independence during ICU admission and in this group 83% met the set criteria. -The simple criteria was strong predictor of subsequent ventilator independence when criteria were met by day 1 or 2 but weaker when met by ≥ 4 days.	- The result of this study can apply in clinical guideline, that is the simple criteria checklist. According, psychological factors would be adding in this checklist because of it is also the major determine of outcome for weaning.

Table 2 Analysis and synthesis relevant research to weaning mechanical ventilation (cont.)

Authors / year	Designs/ Level of evidence/objective	Sample / setting / Intervention	Findings	Implication / Implementation potential
25.Jiraporn Chonticha-chalalauk, (B.E. 2547).	- Quasi – experimental design with repeated measured - Level: B - Objective : - To test of music therapy on mean changes of the anxiety level, physiological response of patients weaning from mechanical.	Sample : 20 purposive adult patients who have been weaning mechanical ventilation Setting : Medical ICU in Ramathibodi Hospital. Intervention : - The experimental phase : the patients have been listening music in 30 minutes. - The control phase: the patients have not been listening music. - To measure anxiety, heart rate, respiratory rate, blood pressure, oxygen saturation, tidal volume and rapid shallow breathing index in both phase.	- During listening music, the patients have been anxiety, respiratory rate and blood pressure were significantly decreased more than in during not listening music.($P < .05$)	The result of this study could apply to practice because of the same adult ICU patient - Music therapy in 30 minute was used to reduce anxiety, respiratory rate and blood pressure in weaning mechanical ventilation. - The result of study suggest that music therapy should e promoted the relaxation in the weaning patients and helped to reserve energy and healing. - The music that was used for relaxation should selected by the patients.
26.Esteban, et al. (2004)	- Randomized controlled trail - Level A: - Objective : - To evaluate the effort of noninvasive positive - pressure ventilation, as compared with standard medical therapy, which would reduce the rate of death in ICU.	Sample : 221 patients (> 18 years old) who were electively extubated after at least 48 hr. of mechanical ventilation and who had respiratory failure within the subsequent 48 hr. Setting : 37 center in 8 countries of ICU. Intervention: - Patients had been randomly assigned to either noninvasive ventilation (n = 114) or standard medical therapy (n = 107) - After extubation, patients were obtained the patients met at least two or more of	There was no difference between the noninvasive ventilation group and the standard therapy group in the need for reintubation. - The rate of death in ICU was higher in noninvasive ventilation group than in the standard therapy group. ($P = .048$). - The median time from respiratory failure to reintubation was longer in the noninvasive ventilation group ($P = .02$).	- The standard medical therapy for the following : 1) To receive supplement oxygen. 2) Respiratory bronchodilators . - And, after extubation, patients were observed for 48 hr. for the onset of respiratory failure and observed for the criteria for reintubation , these result of study can apply in clinical guideline.

Table 2 Analysis and synthesis relevant research to weaning mechanical ventilation (cont.)

Authors / year	Designs/ Level of evidence/objective	Sample / setting / Intervention	Findings	Implication / Implementation potential
26.Esteban, et al. (2004) (cont.)		the criteria of respiratory failure were randomly assigned to each group for the following: # noninvasive ventilation : 1) To receive ventilation through a full facial mask from a ventilator in ICU (set mode pressure support, TV > 5 ml/kg, RR< 25 BPM, FiO₂ and PEEP were titrated to maintain SaO₂ >90%) 2) The head of the patient's bed was positioned at a 45 degree angle. 3) To maintain arterial pH > 7.25 # Standard medical therapy 1) To receive supplement oxygen. 2) Respiratory physiotherapy 3) Bronchodilators. 4) Any other therapies as directed by physician. 5) These patients could be reintubated or crossed over to receive noninvasive ventilation if they met criteria for reintubation. # Criteria for reintubation: met at least one of the following 1) Lack of improvement pH or PaCO₂. 2) Change in mental status. 3) Decrease in SaO₂ > 85% with high FiO₂ 4) Lack of improvement of respiratory muscle fatigue. 5) Hypotension, sBP < 90 mmHg. (30 min during volume challenge or use of vasopressors, or both). 6) Could not be adequately clear the secretion or associated with acidosis, hypoxia, or change in mental status.		

Finally, 42 studies were used to developing the CNPG. In the Table 2, 26 studies were the research studies and 16 articles were from textbooks and journals. These 16 articles were not show in the Table 2.

III. Establishment CNPG for successful weaning and verify the accuracy on the develop CNPG.

The selected evidence was used to establish CNPG for successful weaning. Then, the investigator brought the developed CNPG to have validity content by three experts in nursing and medical fields (Appendix A) as following :

- | | |
|--|----------|
| 1. A pulmonary specialized | 1 person |
| 2. A respiratory care unit clinical instructor | 1 person |
| 3. A head nurse of critical care unit. | 1 person |

Three experts gave their opinions on the evaluation form.

1. If they agree on the content in CNPG, the experts have to mark √ in the box “Agree”.
2. If they disagree on the content in CNPG, the experts have to mark √ in the box “Disagree”.
3. If they have other suggestions, the experts can write them down in the box “Suggestion”.

After passing the validity testing by three experts. The investigator modified the guideline base on experts' comment and suggestions. Then, the CNPG should be able to use in the clinical setting.

CHAPTER IV

RESULTS

Clinical Nursing Practice Guidelines for successful weaning from mechanical ventilation

This study aimed to establish the clinical nursing practice guideline to promote successful weaning for the patients who were receiving mechanical ventilation due to the problem of respiratory failure. The Clinical Nursing Practice Guideline (CNPG) was based on the process of research utilization in order to help the healthcare providers, especially nurses, to perform the effective weaning from mechanical ventilation. Furthermore, the CNPG would be useful in promoting the effective communications within the healthcare team, and would provide necessary information for nurses and physicians which could be used to achieve the best decision in giving proper treatment and care to ventilated patients to ensure successful weaning. This chapter presents the results of the analysis and synthesis on the evidence-based findings as follows:

- I. Components of Clinical Nursing Practice Guideline for weaning
- II. The validity testing of the CNPG for successful weaning from mechanical ventilation

I. Clinical nursing practice guideline for weaning

The clinical nursing practice guideline was composed of objective, definition, diagram, and components of CNPG including the pre-weaning phase, weaning phase, post-weaning phase as follows:

Clinical Nursing Practice Guidelines for successful weaning from mechanical ventilation

Objective

To facilitate nurses and the other healthcare providers in assessing the readiness for weaning and to provide a guideline of weaning for the patients who need weaning from a mechanical ventilation, the CNPG for successful weaning from a mechanical ventilation was developed.

Definition

Weaning from mechanical ventilation is a process which reduces the respiratory assistance in patients on ventilator support so as to enable them to breathe by themselves and eventually to stop using the ventilator. (Apirak Palawatvichai, B.E. 2546; Knebel et al., 1998, MacIntyre, 2001).

Components of Clinical Nursing Practice Guideline

The clinical nursing practice guideline consists of 3 phases including the pre-weaning phase, weaning phase, and post-weaning phase. The detail of each phase is as follows:

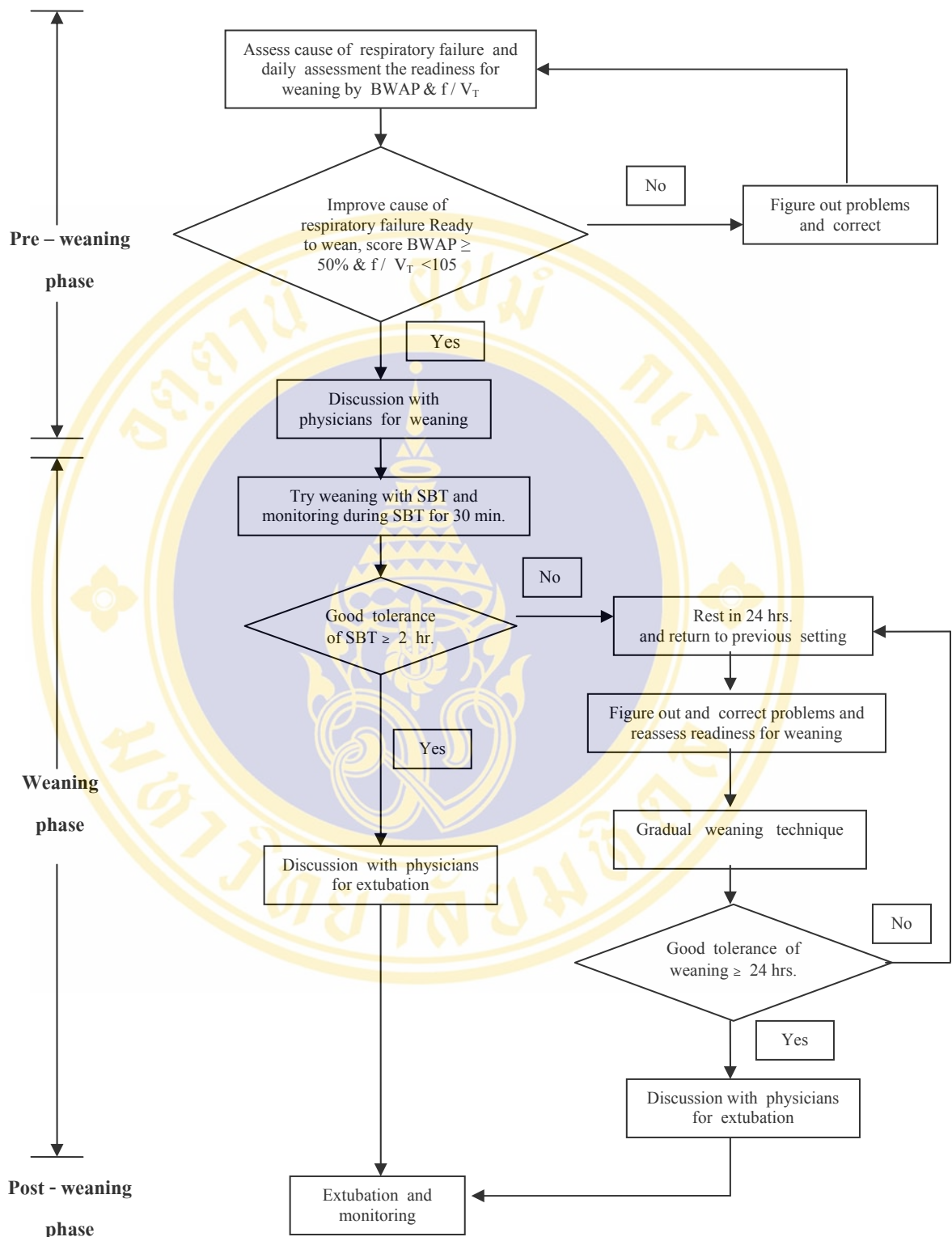


Diagram : Clinical Nursing Practice Guideline for weaning (Adapted from Fernando & Esteban, 2003; Apirak Palawatvichai, B.E. 2546).

SBT = Spontaneous breathing trial (i.e., T- piece , CPAP 3 -5 cm.H₂O, PS 3 -5 cm.H₂O)
 BWAP = Burns Wean Assessment Program.

Clinical Nursing Practice Guidelines

Pre-weaning phase

Assessment cause of respiratory failure

1. Discussion with physicians is conducted to assess and correct the cause of respiratory failure for the patients who have required mechanical ventilation for more than 24 hours.
2. The physical assessment might be done every day in the morning.
3. The other examinations such as chest x-ray, follow up laboratory, arterial blood gas, etc. should be done only when necessary, especially, chest x-ray, which may be repeated when the patients' clinical condition was changed (Evidence Levels A⁴ & D)

Weaning readiness assessment

The patients who have required mechanical ventilation for more than 24 hours might be assessed daily for the readiness to wean by physicians or staff nurses to evaluate weaning trial readiness, track progress, and keep care planning on target for the patients for weaning (Evidence Levels A⁵, B^{17,21} & D). The assessment tools of readiness to wean are the following:

1. Using the modified Burns Wean Assessment Program (BWAP), with 26 items on the checklist for evaluation of the readiness to wean. There are 14 items of evaluation of respiration conditions of the patients and 12 items of the general conditions of the patients. The total score is 100% if the patients pass every criteria. If the total score is $\geq 50\%$, it means the patients are ready to wean (Appendixes B & D) (Evidence Levels A⁸, B²¹, C^{2, 14, 24} & D).
2. Using the calculating of f/V_T if the values are < 105 , it means the patients have a good chance for weaning success (f = respiratory rate [breath/min], V_T = tidal volume [liters]) (Evidence Levels A⁸ & D).
3. The criteria for considering the readiness to wean are the BWAP score $\geq 50\%$ and $f / V_T < 105$. If the BWAP score is $< 50\%$ and $f / V_T > 105$, it means the

patients are not yet ready to wean. Discussion with the physicians to figure out and correct the problems is needed.

Nursing intervention guideline to correct the obstacle for readiness weaning

1. Maintain airway to decrease work of breathing (Evidence Levels B²³ & D)

1.1 Select the appropriate size of the endotracheal tube (if available), which should not be the smallest one. (In Thai females, the tube size should be 7.0 – 7.5 mm. on average, in males, the tube size should be 7.5 – 8.0 mm.) (Evidence Level D)

1.2 If the tube has been inserted to the appropriate position, the tip of the tube should be cut by 1 – 1 ½ inches above the lip and fixed with adhesive-plaster to protect the tube from coming off or irritating the airway (Evidence Levels C⁷ & D).

1.3 Protect secretion obstruction, suction should be done effectively.

1.4 Change position every 2 hours, and do the percussion of the lung 1 - 2 times/day (if there is no limitation), as well as encourage the patients to make deep breathing and cough effectively (Evidence Levels A²⁶, B²³ & D).

1.5 Protect the bronchospasm, which can increase resistance of the airway and administer bronchodilator as treatment planning. (Evidence Level A²⁶)

1.6 Monitor the arterial blood gas, as appropriate in order to assess the gas exchange in the lung (Evidence Level D).

2. Metabolic condition management (Evidence Levels C^{14, 18}, B²³ & D)

2.1 Monitor the electrolytes and minerals, especially Ca, Mg, PO₄ and K. If the electrolytes and minerals are abnormal, the problem needs to be discussed with the physician and to be corrected.

2.2 Monitor for optimal fluid to prevent thick secretion, which should be assessed and should be recorded the intake and output every hour.

2.3 Collaborate with other healthcare members to free the patients from fever and infectious in order to decrease metabolism.

3. Nutrition management (Evidence Levels B²³, C^{6, 13, 18, 20} & D)

3.1 Promote patients' energy needs appropriately, that is 25 – 35 Kcal/kg. body weight or by using the calculated basal energy from Harris-Benedict equation, while ensuring that the diet caloric source is fat rather than carbohydrates.

3.2 Assess and correct the digestion dysfunctions such as flatulence, constipation, and diarrhea.

3.3 Monitor body weight once a week for evaluation of nutritional status such as BMI (normal range for Thai people = 18.5 – 24.9 [weight/high²]).

3.4 Monitor the serum albumin level (should be > 2.5 g / dl.).

4. Pain management (Evidence Levels B²³, C¹⁸ & D)

4.1 Assess the level of pain intensity by using the numeric rating scales or visual analog scales (VAS) (Appendix E).

4.2 Avoid delaying management of the patients' pain, collaborate with the physician to administer pain medications, and provide the complementary therapy to relieve pain such as using, relaxation technique, music therapy, etc.

5. Sleep and rest management (Evidence Levels B²³ & D)

5.1 Assess the patients' sleep pattern.

5.2 Promote the patients' sleep period, which should be continued for 4 – 6 hours at night and ½ - 2 hours during the day. Set the schedule to give nursing care that does not disturb sleep periods, manage the environment, and decrease the healthcare's noise level.

6. Exercise management (Evidence Levels B²³ & D)

6.1 Provide passive range of motion for the patients at least once a day (if there is no limitation).

6.2 Assist and help the patients to do activities of daily living (ADL) as seen appropriate.

6.3 Assist the patients with the positions of sitting or sitting down on a chair at bed side, as seen appropriate.

7. Psychological support management (Evidence Levels B²³, C^{14, 18, 22} & D)

7.1 Establish a reassuring interpersonal relationship with the patients that create their self- confidence to wean.

7.2 Identify and be aware of the patients' level of anxiety to assess their needs.

7.3 Assess and select the communication method between healthcare team members and the patients such as using hand signals, facial expression, body language, writing, and board pictures. (Appendix H) (Evidence Levels C^{9,19} & D)

7.4 Provide information by using simple terms and repetition about weaning including weaning goal, stage of weaning, treatment, and patients' participation. (Evidence Levels B¹⁵ & C¹⁸)

7.5 Encourage the use of complementary therapy to decrease anxiety and fear of their illness and to receive the mechanical ventilation including massage, music therapy, relaxation technique, which should be used during weaning. (Appendixes F & G) (Evidence Levels A^{10,11}, B^{12,25} & D)

7.6 Encourage other family members to participate or stay with the patients for motivation and moral support.

Then, the patients are assessed for the readiness to wean again with BWAP and f / V_T . If the BWAP score is $\geq 50\%$ and the value of $f / V_T < 105$, it means the patients are ready to wean.

After that, discussion with the physician to plan spontaneous breathing trial has to be conducted immediately.

Clinical Nursing Practice Guidelines

Weaning phase

When the patients have been assessed for readiness to wean, discussion with the physician to start weaning has to be carried out immediately. There are 2 stages of weaning including: 1) spontaneous breathing trial (SBT) and 2) gradual weaning technique, which are as follows:

Spontaneous Breathing trial (SBT)

In the weaning phase, the patients should try to have spontaneous breathing trial for 30-120 minutes. The method, which is appropriate for the patients, can be selected from the following (Evidence levels A^{5,8} & D):

T-piece. Set FiO₂ no less than FiO₂ during required ventilation, but FiO₂ should not be greater than 0.5.

Continuous Positive Airway Pressure (CPAP). Set pressure of CPAP level no greater than 3 - 5 cmH₂O.

Pressure support ventilation (PSV). Set low PSV level at 3 – 5 cmH₂O.

Nursing intervention guideline for SBT

1. Select time to start weaning in the morning, as appropriate (Evidence Level D).
2. Provide information regarding the stage of weaning, give the confidence on SBT, and help patients in case of increasing dyspnea (Evidence Levels B¹⁵ & C¹⁸).
3. Clear airway by suctioning before weaning and using a self-inflating bag about 2 – 3 times until dyspnea has decreased, then start weaning (Evidence Level D).
4. Place the patients' bed head position at 45 degrees (if there is no limitation) to ensure best movement of the diaphragmatic muscle (Evidence Levels A³ & D).
5. Prevent atelectasis for prolonged SBT by using a self-inflating bag 3 - 5 times per hour (Evidence Level D).
6. Teach and assist the patients in deep breathing exercise (Evidence Level D).

7. Administer bronchodilator to promote airway patency and to prevent thick secretion as prescribed (Evidence Level D).

8. Assess and record weaning parameters during SBT in the weaning record (Appendix C) including ABG (arterial blood gas), MV (minute volume), V_T (tidal volume), vital signs, beginning time, ending time, duration of weaning, and cause of stop of weaning (Evidence Level D).

9. Monitor continuously the capability for SBT in 30 minutes for 3 times. If the following changes are detected, SBT should be terminated (Evidence Levels A^{5,8} & D):

Criteria to stop using spontaneous breathing trial

1. BP change > 20 mmHg. (from baseline)
2. Increase HR > 20 beats/min (from baseline), RR > 35 BPM
3. EKG showing arrhythmia, ischemia, or bradycardia
4. ABG increasing to $\text{PaCO}_2 > 10$ mmHg. and pH lower than 7.35
5. $V_T < 200$ ml., MV < 5 liters or > 12 liters, $f / V_T > 105$
6. Diaphoresis, or change in level of consciousness
7. Signs of muscle weakness such as using intercostals muscle for breathing or paradoxical breathing
8. Patients' complaints of weakness, dyspnea, or inability to breathe.

If the patients are able to tolerate weaning well with no criteria to stop using SBT in 2 hours, the physicians should be discussed for extubation (Evidence Levels A^{5,8} & D).

If patients cannot tolerate SBT in 2 hours, put the patients back to the previously required setting of ventilator for 24 hours for rest. Then, promote the patients to wean again the next day, or seen appropriate (Evidence Level D).

Discuss with physicians to sort those problems out (see nursing intervention guideline to correct the obstacle factors for readiness weaning in items 1-7 page 65 - 67).

Then, assess the readiness to wean again. If the patients are ready to wean, discuss with the physicians to consider the gradual weaning technique to resume weaning (Evidence Level D).

Gradual weaning technique

If patients are not successful with SBT in 2 hours, discuss with the physicians to use the gradual weaning technique by selecting one of the following techniques (Evidence Level A^{4,8} B¹⁷ & D):

T- piece. The stage of weaning method include:

1. Administer O₂ T- piece by setting FiO₂ no less than FiO₂ during required ventilation, or base on flow rate, amount of air mix, and the technique of T – piece.
2. Assist the patients to breathe with T-piece for 5 – 10 minutes and turn over to the required mechanical ventilation for rest in 1 hour. Increase the weaning duration, from 30 minutes, to 1 , 2, and 3 hours, and stop weaning at night.
3. Wean continuously with the T- piece for 1 – 2 days, until, the patients are able to breathe by themselves all day and all night long.
4. Avoid prolonging weaning that may make the patients unable to tolerate weaning:

Synchronized Intermittent Mandatory Ventilation with Pressure Support Ventilation (SIMV with PSV)

1. Change the respiratory mode from control mode to SIMV with PSV.
2. Start at the PSV level set over the systemic resistance, generally < 10 cmH₂O.
3. Reduce the ventilatory rate by 2 – 4 beats/minute. If patients tolerate well, reduce ventilatory rate every 1 – 2 hours, at least 2 times a day.
4. Reduce the ventilation rate decrements until the ventilatory rate is ≤ 4 times, then reduce the PSV level by 2 – 4 cmH₂O., 2 – 3 times/day until the PSV level reaches ≤ 5 cmH₂O.

Pressure Support Ventilation (PSV)

1. Change the respiratory mode from the assisted control mode to the PSV mode.
2. Start at the max level of PSV set to achieve tidal volume at 5 – 7 ml./kg., and assure a respiratory rate of 16 – 20 breaths/min.

3. Reduce the PSV level by 2 – 4 cmH₂O. every 2 – 4 hours, at least 2 – 3 times/day decrements until the PSV level reaches ≤ 5 cmH₂O.

Continuous Positive Airway Pressure (CPAP)

1. Avoid the CO₂ retention, starting the CPAP level at ≤ 8 cmH₂O.
2. Reduce the CPAP level by 2 – 3 cmH₂O. decrements until reaches 5 cmH₂O., to decrease the work of breathing. If the patients can tolerate the CPAP level of zero cmH₂O, they can do spontaneous breathing.

Nursing implementation guideline for gradual weaning

1. Perform nursing care in the same as manner during spontaneous breathing trial (items 1 – 7 page 68 - 69)
2. Reduce the patients' anxiety during weaning by:
 - 2.1 Explain to the patients the goal and steps of weaning so as to ensure understanding and participation with the healthcare team (Evidence Levels B¹⁵, C¹⁸ & D)
 - 2.2 Give the patients reassurance of safety by being by close at their bedside until the patients have the confidence and no agitation (Evidence Levels C¹⁸ & D).
 - 2.3 Direct the attention of the patients and encouraging the use of massage, relaxation technique or music therapy to reduce anxiety of illness and weaning (Appendixes F & G) (Evidence Levels A^{10, 11}, B^{12, 25} & D).
 - 2.4 Encourage the patients to have effective communication with family members and the healthcare team (Appendix H) (Evidence Levels B²³, C^{9, 19} & D).
3. Assess and record weaning parameters including the vital signs, O₂ saturation, V_T, VC, and MV before starting weaning and during weaning at the first period every 15 - 30 minutes, and then every hour, in order to monitor the progress and the tolerance of the patients (Appendix C) (Evidence Level D).
4. Monitor continuously the capability to tolerate breathing. If patients meet the following criteria, weaning has to be stop (Evidence Levels A⁸ & D)

Criteria to stop using gradual weaning:

1. Restlessness, distress, or diaphoresis
2. BP change > 20 % of baseline, or BP $\geq$ 160 mmHg., $\leq$ 90 mmHg.
3. HR change > 20 % of baseline, or HR $\geq$ 140 beats/min.
4. $V_T < 200$ ml., RR > 35 breathe/min
5. $f / V_T > 105$, MV < 5 liters or > 12 liters
6. $PaCO_2 > 45$ mmHg. (except COPD), pH < 7.35, $PaO_2 < 60$ mmHg., $SaO_2 < 90\%$

If patients can well tolerate the gradual weaning technique for longer than 24 hours, discuss with the physicians to assess extubation (Evidence Level D).

After the patients have received the gradual weaning technique, but they cannot undergo weaning for more than 24 hours or meet the criteria for stop weaning, the following may be done (Evidence Level D):

1. Place the patients back on the previous ventilator setting or the CMV mode in 24 hours for resting.
2. Discuss with the physicians to sort problem out.

After, the problems for unsuccessful weaning have been solved, the patients should be reassessed for readiness for weaning. Discussion with the physician to start weaning with gradual weaning technique should be followed by CNPG (Evidence Level D).

Nursing intervention guideline to correct the problems in weaning

1. Decrease airflow resistance. Implement the same nursing intervention to correct the problems of lack of readiness to wean (see detail in item 1 page 65)
2. Discuss with the physician to solve the problems to prevent complications of pulmonary edema, atelectasis, ARDS, pneumonia, bronchospasm, etc. These problems should be solved before weaning starts again (Evidence Level D).
3. Correct the respiratory muscle fatigue using including metabolism management, nutrition management, pain management, sleep and rest management, and psychological support management. Implement the same nursing intervention to correct problems for lack of readiness to wean (see detail in item 2 – 7 page 65 - 67).

Clinical Nursing Practice Guidelines

Post-weaning phase

When the patients are able to wean ventilator for 2 hours of SBT or 24 hours of gradual weaning, and when they do not meet the criteria to stop weaning and do not have the limitation for extubation such as unconsciousness, ineffective cough, and muscle weakness disease, discussion with the physicians to consider extubation should be carried out.

Criteria for extubation (Appendix C) (Evidence Levels A²⁶, C¹⁶ & D)

1. The patients have good consciousness.
2. The patients have an effective cough which can be assessed as follows:
 - 2.1 Observe at the bedside during suction if the patients can cough with strength.
 - 2.2 Auscultate lung sounds after suction, which can be heard from the secretion sound, which means that the patients cannot remove the secretion by themselves. Then, the endotracheal tube should not be taken off.
 - 2.3 Measure MIP < - 20 cmH₂O, FVC > 10 ml./kg.
3. The patients have the minimal secretion by observation from suction interval of 2 hours.
4. The patients have not signs of upper airway obstruction which were stridor.

Nursing intervention before extubation (Evidence Level D)

1. Promote adequate sleep for the patients in order to rest the respiratory muscle.
2. Select time for extubation should be in the morning. It is safer because there are many healthcare members for close observation.
3. Give NPO the patients at least 4 hours in order to protect aspiration, and to prepare in case reintubation is needed.
4. Administer bronchodilator which may be used to relieve bronchospasm. Bronchodilator should be administered for 15 minutes before extubation as prescribed (Evidence Level A²⁶).

5. Prepare the materials for use such as face mask and oxygen and corrugate tube for oxygen support.

Nursing intervention during extubation (Evidence Levels B²³ & D)

1. Suction secretion in endotracheal tube and mouth.
2. Position the patients to 45 degrees of the head of the bed for best movement of the diaphragmatic muscle (Evidence Levels A²⁶ & D).
3. Deflate cuff
4. Encourage the patients to make force inspiratory, and do extubation.

Nursing intervention after extubation (Evidence Levels B²³ & D)

1. Administer the oxygen therapy and provide high humidity in order to reduce the sticky secretion.
2. Provide mouth hygiene frequently after extubation.
3. Closely monitor the patients for 12 - 24 hours including vital signs, O₂ saturation, for every hour and continue at least for 8 hours (Evidence Levels A^{1,26} & D).
4. Assess signs and symptoms of respiratory failure including:
 1. RR > 30 BPM or RR < 10 BPM
 2. Hearing stridor
 3. PaO₂ < 60 mmHg.
 4. PaCO₂ > 15%

If patients meet the criteria of respiratory failure, discuss with the physician to reintubate the tube (Evidence Levels A²⁶, B²³).

If patients who have severe laryngeal edema or upper airway obstruction. Discussion with the physicians to reintubation tube or tracheostomy.

Nursing Outcome

1. The patients have successful weaning.
2. The patients do not have reintubation in 24 hours after extubation.
3. Decrease in the ventilation days.
4. Decrease in the length of stay in the ICU.

II. The verify the accuracy on the CNPG

Regarding the validity contents of CNPG by 3 experts including a pulmonary specialist, a head nurse of medical intensive care unit (M-ICU), and a respiratory care nursing instructor. Most experts agreed on the established clinical nursing practice guideline, but they gave some suggestions for revision as follows:

For the diagram of the CNPG, in the pre-weaning phase, the nursing instructor suggested that the sentence “improvement of the cause of respiratory failure” be added to the step of assessment to be “improvement of the cause of respiratory failure and ready to wean, score BWAP $\geq 50\%$ & $f / V_T < 105$.” In the weaning phase, the pulmonary specialist suggested the addition of the frequency of “SBT and monitoring criteria for trial failure in 30 minutes.” The new statement is “SBT and monitoring criteria for trial failure in 30 minutes for 3 times.” Moreover, the expert suggested the addition of the step of “Rest and return to 24 hours of previous setting.” to the step “Discussion with the physicians for SBT.” The new statement is the step of “Rest and return to 24 hours of previous setting.” to the step “sort problem out and reassess, if ready to wean.”

In the component of the CNPG, the pre-weaning phase, item 1-- assessment of cause of respiratory failure, the pulmonary specialist suggested rewriting the explanation of frequency of assessment cause of the respiratory failure. Therefore, the statement “the assessment of physical status might be done every day in the morning such as physical examination, chest x- ray, follow up laboratory, arterial blood gas, etc.” was changed to be “the assessment of physical examination might be done every day in the morning and the other examinations such as chest x-ray, follow up laboratory, and arterial blood gas should be done only when necessary, in particular, chest x-ray may be repeated when the patients’ clinical signs have been changed.”

In item 2--weaning readiness assessment, the nursing instructor suggested adding the reason of daily weaning readiness assessment. Therefore, the new sentence is “daily assessment the readiness to wean by physicians or staff nurses to evaluate weaning trial readiness, track process, and keep care planning on the target of the patients for weaning.” In the part of the weaning phase, spontaneous breathing trial, the physician who is specialized in pulmonary medicine suggested setting FiO_2 in the

T-piece method, which was changed to be “FiO₂ should be more than FiO₂ of required ventilator based on flow rate, amount of air mix, and the T-piece technique.”

Moreover, in the topic of nursing intervention guideline for SBT, the pulmonary specialist suggested the correction of the sentence in item 3, which was changed to be “Maintain clear airway by suctioning before weaning and using self-inflating bag about 2 – 3 times until dyspnea has decreased, then start weaning.” Regarding gradual weaning technique, the expert suggestions on the setting in each mode of weaning. Therefore, the same setting in each mode was changed to be, “in SIMV with PSV mode, the PSV level should be started at a low level of < 10 cmH₂O. In the PSV mode, the PSV level should start to achieve at the V_T of 5 – 7 ml/kg. and RR of 16-20 breaths/min, and in the CPAP mode, the CPAP level should start at ≤ 8 cmH₂O.” Regarding the post-weaning phase, as for the criteria of extubation, the pulmonary specialist suggested the deletion of the procedure of the cuff leak test because it was a controversy issue. In order to assess the patients’ ability of airway clearance, the expert recommended that the patients’ cough be observed at bedside during suction and MIP (maximum inspiratory pressure) or FVC (force vital capacity) be measured. For the tool of weaning, in the weaning assessment form, a nursing instructor who specialized in respiratory care unit suggested the modification of length of record that should take place for more than 2 days. In the weaning record form, the pulmonary specialist suggested rewriting item 2 in which “Weaning” was changed to be “End of weaning,” in item 3 “Arterial blood gas” was changed to be “Duration of weaning,” and in item 4 “Duration of weaning” was changed to be “Comment.” In the nursing intervention guideline to correct the problem of weaning, a nursing instructor in the intermediate unit suggested the use of a nursing intervention guideline to correct problems in the pre-weaning phase as it could cover the problems most.

Regarding the suggestions of experts on CNPG to promote successful weaning from mechanical ventilation in overall implementation potential, as for the part of transferability of the CNPG, all 3 experts agreed on the CNPG, as the CNPG was justified with the patients receiving mechanical ventilation in the M-ICU and intermediate care unit.

In the part of feasibility of implementation, a respiratory care nursing instructor stated that the CNPG was used for nursing practice as healthcare providers

have ability to manipulate and control the intervention, so there is no difficulty to practice and collaborate in using the CNPG. Moreover, before using the CNPG, healthcare providers might be educated about CNPG in order to increase awareness of weaning and enable practitioners to utilize the CNPG correctly. Furthermore, the CNPG should contain the agreement on improvement among members of the healthcare team. With those reasons, it could improve the weaning outcome. This was consistent with the idea of head nurse of critical care unit stated that the CNPG was appropriate with the unit that could perform effective nurse-physician collaboration to provide the effective continuous nursing care.

Likewise, the pulmonary specialist stated that the CNPG could help healthcare providers to make a decision for successful weaning. However, the best solution of respiratory care process would be an appropriate method for healthcare providers to weaning. In addition, the CNPG used in the practice should be applied appropriately with each patient. Therefore, successful weaning depends on the collaboration of healthcare team members which leads to the quality of the patient care.

In the part of the cost and benefit of the use of the CNPG, the nursing instructor and the head nurse had the same opinions that using the CNPG could promote the weaning outcome including decreasing the weaning time, preventing complications from using the ventilators, reducing of the length of stay in the intensive care unit and the cost of treatment, as well as preventing risks of implementation.

In conclusion, the establishment the CNPG in order to promote successful weaning from mechanical ventilation by using research utilization includes compilation of relevant research literature and critiques and determination of sufficiency of research-based evidence with analysis and synthesis of the relevant evidence-based approach for weaning. Then, the developed CNPG was validated. After that, the investigator revised and adjusted the CNPG to increase content validity, language appropriateness, implementation and correction according to the experts' comments and suggestions (as diagram and component on page 63 – 71). Finally, the CNPG will be trail in the clinical and adaptation of the change to fit the practice needs.

CHAPTER V

DISCUSSION

The objective of this study was to utilize an evidence-based methodology to establish a CNPG to promote successful weaning from mechanical ventilation. The results of the study elicited some interesting issues, as follows:

Establishment of the CNPG

Compilation and critical appraisal of relevant evidence-based literature

After compilation of the relevant evidence-based literature, there were a total of 42 studies related to weaning from mechanical ventilation. Twenty-five studies were derived from electronic databases and 17 articles were drawn from reference lists, textbooks, and journals. There were 8 studies with level A-quality research, which could be utilized as good evidence for establishing the CNPG. Furthermore, there were 6 studies with level B-quality research, 12 with level C, and 16 with level D.

Regarding analysis of evidence-based information to develop a CNPG, the Royal College of Physicians of Thailand (B.E. 2544) stated that primary clinical research results suitable for the Thai context should be selected. From primary clinical research results, where there are many different study types, the more appropriate ones should be selected, such as randomized controlled trials. If those research results were still inappropriate for Thailand, they could be used to develop the guideline, but the research result limitations must be noted. Furthermore, where there were no data or evidence to develop a guideline, the researcher could use the opinions and consensus of experts in their areas of expertise. Similarly, in this study, the investigator selected evidence from primary clinical research results, developed guidelines that were suitable for Thailand, and the consensus of experts to determine the establishment of this comprehensive guideline.

Moreover, Nicoll and Beyea (1999) stated that strategies and experience in analysis and synthesis lead to the successful development of a CNPG. Where there is less experience or lack of confidence, clinical experts or other experts in related fields

might be required to criticize the CNPG again, which was the method used in this study.

Verifying the accuracy of the CNPG

Three experts tested the validity of the CNPG for successful weaning from mechanical ventilation, i.e. a physician specializing in pulmonary medicine, a head nurse with experience in a medical intensive care unit, and a nursing instructor with experience in an intermediate care unit. They suggested corrections to some steps in the CNPG diagram, including the step of assessment of readiness to wean and the weaning step. The components of the CNPG in the pre-weaning phase, weaning phase, and post-weaning phase should be adjusted for appropriate implementation. In addition, the experts suggested correcting the weaning readiness assessment form and the weaning record form for appropriate use. The investigator improved and revised the guideline according to the experts' suggestions.

Suggestions regarding the validated content of the CNPG were significant, especially the suggestions from experts experienced in other professional fields, which were regarded as specific viewpoints (McPheeter and Lohr, 1999). Furthermore, the experts' recommendations were the most important part of the nursing practice guidelines, because the guidelines are composed of many sections, each section containing many procedures, and the details of the recommendations should be noted for decision-making when following the guidelines (Jintana Penchan, B.E. 2546). In addition, the synthesized guidelines should be made available for stakeholder and expert recommendations before implementation (Royal College of Physicians of Thailand, B.E. 2544).

Moreover, in establishing a nursing practice guideline, there must be patient involvement in its development (Thomas and Hotchkiss, 2002). Patient involvement could not be encouraged throughout the process of developing the current guideline due to the limitations of their illnesses. However, the investigator encouraged patients to participate indirectly in establishing the CNPG in respect of selecting the qualitative studies and regarding the needs of weaning patients, which were evidence for developing the guidelines.

Components of the clinical nursing practice guideline

The investigator developed the components of this guideline by using the weaning continuum concept model of the American Association of Critical Care Nurses (AACN)'s Third National Study Group (Knebel, 1998). The model consisted of three phases, as in the diagram; the details include:

1. The **pre-weaning phase** focused on assessment of readiness to wean by using the weaning readiness assessment tool when the patients' respiratory failure condition had improved. In addition, the nurses would develop a nursing care plan and provide nursing intervention to improve the problem factors, to assist patients to start weaning more easily.
2. The **weaning phase** focused on the optimal nursing intervention, which was performed to increase the chances of successful weaning. In addition, the nursing intervention in this phase included bedside monitoring, assessment of toleration for weaning, and the provision of psychological support.
3. The **post-weaning phase** focused on assessing the patient's capacity for extubation and bedside monitoring to forestall mechanical ventilation reuse or endotracheal reintubation.

The weaning from mechanical ventilation diagram shows the weaning steps in three weaning phases; these steps could help healthcare providers by making the process and understanding of weaning from mechanical ventilation simpler. It clearly explains the steps in the nursing intervention, i.e. assessment of readiness to wean, ways to correct obstacles to weaning, monitoring during weaning, post-weaning/extubation. It also provides a systemic way to make weaning easier (Burns and Dampsey, 2003). When compared with the previous clinical practice of weaning, for which there are no guidelines, this guideline could help practitioners, especially novice and advanced-beginner nurses to develop their knowledge and increased confidence to provide standard nursing care efficiently.

In addition, based on the investigator's experience, patients with mechanical ventilation start weaning late. Implementing this weaning CNPG will help the patient to start weaning earlier. Patients will benefit from implementation of the CNPG in clinical practice, e.g., by decreased pulmonary complication, reduced duration of ventilator use, demonstrated safety, decreased variation in practice and length of stay in

the intensive care unit, and lower treatment cost. Esteban et al. (1994) conducted a randomized controlled trial to determine the effectiveness of different weaning modes and methods on the duration of weaning trials. They designed utilization protocols for pressure support ventilation, intermittent mandatory ventilation, and T-piece. The finding showed that T-piece resulted in better weaning times. Kollef et al. (1997) conducted a randomized controlled trial to compare nursing care using protocol-directed weaning by respiratory therapists and nurses, and traditional physician-directed weaning. The finding indicated that patients weaned from ventilator support using the protocol managed by nurses and specialists were safe, and able to wean more quickly. Likewise, Ely et al. (1996) conducted a randomized controlled trial in a medical and surgical intensive care unit to investigate the effectiveness of a weaning protocol on duration of ventilator support, and found that the patients using the protocol had shorter durations of ventilator support and fewer complications. It may be concluded that use of the guideline by the healthcare team means that patients are assessed for their readiness, and that their symptoms during weaning are closely monitored, thus enabling them to wean effectively and quickly. Weaning then takes less time, the risks of complications are reduced, and the medical costs are also reduced. Similarly, Fain (1999) stated that the CNPG can promote consistency, cost-effective quality care, and improved patient outcome.

Moreover, this CNPG could promote patient-centered teamwork in the healthcare team, because, in the process of using the CNPG, the team will discuss and share information with each other. In addition, the CNPG would be used as a medium for communication in healthcare team, to understand the work process, for ongoing nursing care, and to decrease the duration of weaning. Similarly, Cohen et al. (1991) compared patients receiving mechanical ventilation admitted 1 year before and after the inception of a ventilation management team (consisting of physicians, nurses, and respiratory therapists) and found that the ventilation management team group had fewer ventilator days, fewer days in the intensive care unit, and lower costs.

In addition, this weaning CNPG showed evidence of the quality level for each intervention. It will also assist healthcare providers to make the decision whether to use the CNPG, or not. The Royal College of Physicians of Thailand (B.E. 2544) emphasized that the synthesis of clinical practice guidelines should indicate the quality

or strength of evidence to facilitate healthcare providers' decision-making for practice or their development as appropriate for their setting.

Furthermore, this CNPG could promote healthcare providers' use of research in practice. Thomson, Angus and Scott (2000) noted that the CNPG was developed through the research utilization process, and the content was validated by experts. Thus, using CNPG in practice was using research utilization in practice; it would improve the quality of patient care and enhance clinical judgment.

Although several research results and models have emerged to guide practitioners in using research findings in clinical practice, practitioners continue to have difficulty synthesizing empirical and contextual evidence and integrating evidence-based changes into practice. Barriers to the use of research findings in clinical practice included such factors as an inadequate scientific base, nursing staff with limited training or less experience in research and utilization, and the burden of a heavy workload. For these reasons, practitioners were unable to critique and determine research findings into practice (Polit and Hungler, 1997). In addition, the guideline could help practitioners to decrease the barriers to research utilization, and the guideline could fill the gap between research findings and clinical practice.

Weaning assessment tools

Weaning assessment utilized the weaning readiness assessment tool and the rapid shallow breathing index (RSBI or f/V_T). The weaning readiness assessment tool was modified from the Burns Wean Assessment Program (BWAP), which consisted of 26 factors, i.e. 14 respiratory and 12 general factors. In this study, the investigator modified 2 items in the tool: the item "oral ETT" was changed from oral ETT diameter > 7.5 or tracheostomy tube diameter > 7.5 to oral ETT or tracheostomy diameter $\geq 7.0 - 7.5$ mm. (female) or $\geq 7.5 - 8.0$ mm. (male), and item "pH" was changed from pH 7.30 - 7.45 to pH 7.35 - 7.45, as the experts recommended (Sumalee Kiatboonsri, B.E. 2545).

The advantages of the BWAP are that it is easy to use (in a checklist format), and administration takes only 5 - 10 minutes. It can assess both patients' physiological and psychological statuses. It also is of benefit for follow-up on improvement in readiness for weaning, and can predict successful weaning. In addition, the assessment can be used to screen and determine unsolved factors affecting weaning, thus rendering

useful information necessary in planning for nursing care and in providing immediate solutions by the healthcare team. It also provides a direction for care planning, and encourages collaboration among healthcare providers. All of these increase patients' successful weaning from a ventilator. BWAP scoring is as follows: $\geq 50\%$ means patients are ready to wean, while if the score is $< 50\%$, patients are not ready to wean. If the score is $\geq 64\%$, patients have the chance to wean successfully from the ventilator

In addition, the evidence-based nursing practice model was an objective practice to improve the quality of patient care and enhance clinical judgment. Similarly, the Nursing Council of Thailand provides standards for nursing and midwifery (B.E. 2540), emphasizing the quality of the nursing practice that nurses perform, up-to-date technology, and evidence-based practice. Regarding evidence-based nursing practice, Rosswurm and Larrabee (1999) described a model for guiding nurses and other healthcare providers. It has six steps, as follows:

- 1) Assess need for change in practice
- 2) Link problem interventions outcome
- 3) Synthesize best evidence
- 4) Design practice change
- 5) Implement and evaluate change in practice
- 6) Integrate and maintain change in practice

In this study, the investigator traversed steps 1-3 to develop the CNPG. Consequently, it should be continuously processed with the other three steps of evidence-based nursing practice, consisting of designing a change in practice by defining outcomes, implementing and evaluating the change in practice by pilot study with close monitoring, evaluating the process and outcomes and analyzing the data, integrating and maintaining the changed practice by communicating the recommended change to stakeholders and present staff about the change in practice, then integrating it into standard practice. Therefore, the effectiveness of the CNPG should be developed as a standard of care for any unit caring for mechanically ventilated patients, and the pilot study for the change is revised. The pilot allows practitioners to influence adaptation of the change to correspond with their practice needs. Finally, the CNPG would improve the quality of critical-patient care and enhance clinical judgment in the unit.

CHAPTER VI

CONCLUSIONS

In this chapter, the conclusions of the study will be presented, followed by the best points of the CNPG, limitations of this CNPG and implementation and recommendations for nursing practice.

Conclusions of the study

The clinical nursing practice guideline for successful weaning from mechanical ventilation was established by evidence-based synthesise process. Those process were assembling the relevant literature, critique, and determining the adequacy of research base. In the part of assembling the relevant research literature, there were a total 42 studies related to weaning mechanical ventilation was used to develop the CNPG. The guideline was analyzed and synthesized to provide an evidence-based with eight researches in level A-quality level evidence, six researches in level B-quality level evidence, 12 researches in level C-quality level research and 16 studies in level D-quality level evidence. Therefore, This CNPG was validated the contents and feasibility to implementation by three experts who were experienced for weaning mechanical ventilation.

In addition, the CNPG be presented the nursing intervention that consisted of three stages of the weaning process as following: 1) the pre-weaning stage, nurses assess weaning ability of the patients for and figure out the problem or influencing factors and correct them, which those, the patients can start weaning earlier, 2) the weaning stage, the optimal nursing intervention was done for increasing of a successful weaning outcome, and 3) the post-weaning stage was focused on the prevention of reintubation tube.

Limitations of the CNPG

The investigator had recommendations the limitation of the CNPG as follows:

1. The CNPG that consisted of three stages of weaning including pre-weaning phase, weaning phase and post-weaning phase. There were the specifically of procedure to do as appropriate with individual patient in each phase. Therefore, the implementation by the CNPG in order to ensure their nursing interventions adherence to nursing guideline for weaning and correctly. So that, the education for CNPG and tools were provided healthcare providers to has skill for using by teaching, demonstrating and training.
2. This CNPG could not be appreciated for implementation the patients who use short-term ventilator such as the patient was post operation or without anesthesia.
3. According to the research utilizing process, the CNPG was developed from evidence-based and was validated by experts. However, the present CNPG did not test for feasibility in a clinical setting. Therefore, the present CNPG should be encouraged to test how it works and value in the clinical setting.

Implementation and recommendation for nursing practice

According to establish the CNPG, the investigator had suggestion for the implementation. The CNPG should be introduced to other healthcare providers in order to promote routine use of the CNPG including:

1. Introduce the CNPG to the head of ICU nurse for getting participation of distribute the CNPG in the unit and share with other healthcare providers, especially, physicians who work in the critical care unit.
2. Introduce the CNPG to the practitioners and present the significance of utilizing the CNPG in ICU monthly meeting.
3. Training the CNPG for practitioners in unit that will help practitioners to be able to utilize practice guideline correctly and with a standardized procedure.
4. Implementation the CNPG in a pilot study with continuous monitoring and evaluation outcomes from utilizing so that, modifying and developing the CNPG to fit their practice needs.
5. After pilot study, the CNPG should be published in media such as journals, internet, intranet or conferences so that the CNPG was distributed to other unit. In

addition, personnel opinions about the implemented change should provide information for development of the CNPG efficiency.

6. Introduce the CNPG to nursing standard for weaning mechanical ventilation.



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APPENDIX A INSTRUMENTS FOR THE DEVELOPMENT OF CNPG

เครื่องมือที่ใช้ในการสร้างแนวปฏิบัติการพยาบาลประกอบด้วย 3 ส่วน ดังนี้

ส่วนที่ 1 แบบวิเคราะห์ สังเคราะห์งานวิจัย

ส่วนที่ 2 แบบแสดงความคิดเห็นของผู้ทรงคุณวุฒิในการตรวจสอบแนวปฏิบัติการ
พยาบาล

ส่วนที่ 1 แบบวิเคราะห์ สังเคราะห์งานวิจัย

Table 2 Analysis and synthesis relevant research to weaning mechanical ventilation

Authors / year	Designs/ Level of evidence/Objective	Sample / setting / Intervention	Findings	Implication / Implementation potential
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ส่วนที่ 2 แบบแสดงความคิดเห็นของผู้ทรงคุณวุฒิในการตรวจสอบแนวปฏิบัติการพยาบาลเพื่อ ส่งเสริมความสำเร็จในการหยาเครื่องช่วยหายใจ

คำชี้แจง แบบแสดงความคิดเห็นในการตรวจสอบแนวปฏิบัติการพยาบาลเพื่อส่งเสริมความสำเร็จการ
หยาเครื่องช่วยหายใจ ประกอบด้วย 3 ส่วน คือ

1. แบบแสดงความคิดเห็นเกี่ยวกับ Diagram of Clinical nursing practice guideline
2. แบบแสดงความคิดเห็นของผู้ทรงคุณวุฒิของแนวทางการปฏิบัติการพยาบาล
3. แบบแสดงความคิดเห็นในภาพรวมของแนวปฏิบัติการพยาบาล

ส่วนที่ 2 โปรดทำเครื่องหมาย ✓ ลงในช่องตามความคิดเห็นของท่านดังต่อไปนี้

เห็นด้วย	หมายถึง เห็นด้วยกับข้อความนั้นทั้งหมด
ไม่เห็นด้วย	หมายถึง ไม่เห็นด้วยกับข้อความนั้น

และหากท่านมีความคิดเห็นเพิ่มเติมในแต่ละข้อ ขอความกรุณาแสดงความคิดเห็นในช่อง
“ข้อเสนอแนะ”

แบบแสดงความคิดเห็นของผู้ทรงคุณวุฒิในการตรวจสอบ

Diagram of Clinical Nursing Practice Guideline

ข้อเสนอแนะ.....

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**แบบแสดงความคิดเห็นของผู้ทรงคุณวุฒิในการตรวจสอบแนวปฏิบัติการพยาบาลเพื่อ ส่งเสริม
ความสำเร็จในการหย่าเครื่องช่วยหายใจ (ต่อ)**

ข้อความ	ความเห็นของผู้ทรงคุณวุฒิ		
	เห็นด้วย	ไม่เห็นด้วย	ข้อเสนอแนะ
แนวการปฏิบัติการพยาบาล ระยะก่อนการหย่าเครื่องช่วยหายใจ			
1. ประเมินสาเหตุของ Respiratory failure			
2. การประเมินความพร้อมในการหย่าเครื่องช่วยหายใจ			
2.1 การใช้แบบประเมิน BWAP..			
2.2 การคำนวณ f/V_T			
2.3 เกณฑ์การตัดสินใจความพร้อมในการหย่าเครื่องช่วยหายใจ			
3. แนวทางแก้ไขปัญหหรืออุปสรรคของความพร้อมหย่าเครื่อง			
3.1 ดูแลเกี่ยวกับทางเดินหายใจ			
3.2 ดูแลระบบการเผาผลาญของ ร่างกาย			
3.3 ดูแลภาวะ โภชนาการ			
3.4 ดูแลเรื่องความปวด			
3.5 ดูแลเรื่องการนอนหลับ			
3.6 ส่งเสริมความแข็งแรงของกล้ามเนื้อ			
3.7 การสนับสนุนด้านจิตใจ			
แนวการปฏิบัติการพยาบาล (ต่อ) ระยะการหย่าเครื่องช่วยหายใจ			
1. การทดลองเริ่มหย่าเครื่องช่วยหายใจ			
2. การดูแลผู้ป่วยขณะทดลองเริ่มหย่าเครื่องช่วยหายใจ			
3. เกณฑ์บ่งชี้ให้หยุดทดลองเริ่มหย่าเครื่องช่วยหายใจ			
4. วิธีการหย่าเครื่องแบบค่อยเป็นค่อยไป			
5. การดูแลขณะหย่าเครื่องช่วยหายใจแบบ gradual weaning technique.			
6. เกณฑ์บ่งชี้หยุดการหย่าเครื่องช่วยหายใจ.			
7. แนวทางแก้ไขปัญห เมื่อหายใจด้วยวิธี gradual weaning technique ไม่สำเร็จ			

**แบบแสดงความคิดเห็นของผู้ทรงคุณวุฒิในการตรวจสอบแนวปฏิบัติการพยาบาล
เพื่อส่งเสริมความสำเร็จในการหยาเครื่องช่วยหายใจ (ต่อ)**

ข้อความ	ความเห็นของผู้ทรงคุณวุฒิ		
	เห็นด้วย	ไม่เห็นด้วย	ข้อเสนอแนะ
แนวการปฏิบัติการพยาบาล (ต่อ)			
ระยะหลังการหยาเครื่องช่วยหายใจ			
1. เกณฑ์การประเมินก่อนการถอดท่อช่วยหายใจ.			
2. การดูแลระยะก่อนถอดท่อช่วยหายใจ			
3. การดูแลขณะถอดท่อช่วยหายใจ			
4. การดูแลหลังถอดท่อช่วยหายใจ.			
Outcome			
1. ผู้ป่วยหยาเครื่องช่วยหายใจได้สำเร็จ			
2. ผู้ป่วยไม่กลับมาใส่เครื่องช่วยหายใจใหม่ภายใน 24 ชั่วโมง			
3. ผู้ป่วยไม่กลับมาใส่ท่อช่วยหายใจใหม่ภายใน 48 ชั่วโมง หลังถอดท่อช่วยหายใจ.			
4. จำนวนวันใส่เครื่องช่วยหายใจลดลง			
5. จำนวนวันนอนใน ICU ลดลง.			

**แบบแสดงความคิดเห็นในภาพรวมของผู้ทรงคุณวุฒิในการตรวจสอบแนวปฏิบัติการพยาบาล
เพื่อส่งเสริมความสำเร็จในการหยาเครื่องช่วยหายใจ**

แนวปฏิบัติการพยาบาลเพื่อส่งเสริมความสำเร็จในการหยาเครื่องช่วยหายใจ มีแนวโน้ม /
ความเป็นไปได้ที่จะนำไปใช้ในการปฏิบัติ โดยพิจารณาจาก

- 1) แนวปฏิบัติพยาบาลนี้ มีความเหมาะสมกับหน่วยงาน กลุ่มผู้ป่วย
- 2) แนวปฏิบัติพยาบาลนี้ พยาบาลมีสิทธิโดยชอบในการปฏิบัติ ผู้ร่วมงานน่าจะให้ความ
ร่วมมือในการเปลี่ยนแปลงการปฏิบัติ วิธีการปฏิบัติไม่ยุ่งยาก
- 3) การใช้แนวปฏิบัติพยาบาลนี้ ก่อให้เกิดประโยชน์ในแง่ลดภาวะแทรกซ้อน หรือค่าใช้จ่ายใน
การปฏิบัติอย่างไร

ความคิดเห็น.....

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APPENDIX B

THE WEANING READINESS ASSESSMENT TOOL

แบบประเมินความพร้อมในการหย่าเครื่องช่วยหายใจ

ชื่อผู้ป่วย อายุ.....ปี HN.....

วันที่รับไว้ในหอผู้ป่วย.....การวินิจฉัยโรค.....

parameter	Date								
	Y	N	NA	Y	N	NA	Y	N	NA
I. Respiratory Assessment									
<i>Gas flow and work of breathing</i>									
1. Eupnic respiratory rate and pattern (spontaneous RR < 25 BPM, without dyspnea, absence of accessory muscle use)									
2. Absence of adventitious breath sounds? (rhonchi, rales, wheezing)									
3. Secretions thin and minimal?									
4. Absence of neuromuscular disease / deformity?									
5. Absence of abdominal distension/obesity/ascites?									
6. Oral ET or trach $\geq 7.0 - 7.5$ mm. (female) or $7.5 - 8.0$ mm. (male)?									
<i>Airway clearance</i>									
7. Cough and swallow reflexes adequate?									
<i>Strength</i>									
8. Negative inspiratory pressure (NIP) < - 20 ?									
9. Positive expiratory pressure (PEP) > + 30 ?									
<i>Endurance</i>									
10. Spontaneous tidal volume (STV) > 5 ml / kg ?									
11. Vital capacity (VC) > 10 -15 ml/kg?									
<i>ABGS</i>									
12. pH 7.35 - 7.45 ?									
13. PaCO ₂ = 35 - 45 mmHg (or baseline) with MV < 10 L/ min									
14. PaO ₂ > 60 mmHg. on FiO ₂ 0.4									

(Modified from BWAP bedside assessment worksheet: Burns et al., 1998;

สุนทรี เจริญวิทยกิจ, 2546)

แบบประเมินความพร้อมในการหย่าเครื่องช่วยหายใจ (ต่อ)

Parameter	Date								
	Y	N	NA	Y	N	NA	Y	N	NA
II General Assessment									
15. Hemodynamically stable? (pulse rate, blood pressure)									
16. Free from factors that increase or decrease metabolism rate (seizures, temperature, sepsis, bacteremia, hypo/ hyperthyroid)?									
17. Hematocrit > 30 % (or baseline)?									
18. Systemically hydrated? (weight at or near baseline, balanced intake and output)?									
19. Nourished?(albumin>2.5g/dlparenteral/ enteral feedings maximized)?									
20. Serum electrolytes within normal limits (including Ca ⁺⁺ , Mg ⁺⁺ , PO ₄)?									
21. Pain controlled? (subjective determination)									
22. Adequate sleep/rest? (subjective determination)									
23. Appropriate level of anxiety and nervousness? (subjective determination).									
24. Absence of bowel problems (diarrhea, constipation, ileus)?									
25. Improved general body strength /endurance (i.e. out of bed in chair, progressive activity program)?									
26. Chest x- ray improving or returned to baseline?									
% of Yes (yes ÷ total assess) x 100									
Value of f / V _T									
Signature									

Y = Yes, patient meet standard for this parameter

N = No, not meet standard for this parameter

NA = Not available

f = Respiratory rate (breathe/min)

V_T = Tidal volume (liters)* BWAP ≥ 50% & f / V_T < 105 = ready to wean

แบบบันทึกการหย่าเครื่องช่วยหายใจ

ชื่อ..... อายุ การวินิจฉัยโรค
 หอผู้ป่วย

[illegible]

(ดัดแปลงมาจาก weaning record ของ พิภูล ตันติธรรม, 2547; อภิรักษ์ ปาลวัฒน์วิไชย, 2546)

APPENDIX D

THE COMPONENTS OF WEANING READINESS FOR ASSESSMENT TOOL

แบบประเมินความพร้อมในการหย่าเครื่องช่วยหายใจ

แบบประเมินความพร้อมในการหย่าเครื่องช่วยหายใจ เพื่อให้บุคลากรทางการแพทย์ใช้ ประเมินผู้ป่วยว่ามีความพร้อมในการหย่าเครื่อง ที่ครอบคลุมปัจจัยด้านร่างกาย และด้านจิตใจ

สามารถวางแผนในการดูแลผู้ป่วยได้อย่างมีประสิทธิภาพ ประกอบด้วย 1) แบบประเมิน ที่ประยุกต์จาก BWAP และ 2) การประเมินความพร้อมด้วย Rapid shallow breathing index (RSBI) มีรายละเอียดดังต่อไปนี้

1. แบบประเมินความพร้อมในการหย่าเครื่องช่วยหายใจ ประยุกต์จาก Burns

weaning assessment program (BWAP) ประกอบด้วย การประเมินด้านระบบหายใจ 14 ข้อ และการประเมินด้านทั่วไป 12 ข้อ รวมเป็น 26 ข้อ มีรายละเอียดในการประเมินดังต่อไปนี้ (Burns, 1999; Burns, Fahey, et al., 1991; Burns, Marshall, et al., 1998; Epstein, El-Mokadem, et al., 2002)

การประเมินด้านระบบหายใจ ประกอบด้วย ลักษณะการหายใจและงานของการหายใจ การจัดเสมหะในทางเดินหายใจ ความแข็งแรงและความทนทานของกล้ามเนื้อที่ช่วยในการหายใจ ความสามารถในการแลกเปลี่ยนก๊าซของปอด มีทั้งหมด 14 ข้อ ดังนี้

1. อัตราการหายใจและรูปแบบการหายใจ โดยประเมินอัตราการหายใจขณะที่ใส่เครื่องช่วยหายใจ ไม่ควรเกิน 25 ครั้ง/นาที ประเมินลักษณะการหายใจว่ามีการหอบเหนื่อยหรือไม่ หรือใช้กล้ามเนื้อในการหายใจหรือไม่ ซึ่งผู้ป่วยที่พร้อมจะหย่าเครื่องช่วยหายใจไม่ควรมีการใช้กล้ามเนื้อช่วยในการหายใจ (วิภาภัทร ชังขาว, 2544)

2. เสียงของการหายใจ โดยประเมินจากการฟังเสียงปอดว่ามีเสียงผิดปกติหรือไม่ เช่น ถ้าได้ยินเสียง wheezing แสดงถึงการตีบแคบหรือมีการอุดกั้นของทางเดินหายใจ ได้ยินเสียง rhonchi แสดงมีลมผ่านบริเวณที่มีเสมหะ เป็นต้น ซึ่งเสียงปอดที่ฟังได้สามารถบ่งบอกถึงพยาธิสภาพของปอดที่มีผลต่อการแลกเปลี่ยนก๊าซที่ปอด ทำให้การหย่าเครื่องช่วยหายใจไม่สำเร็จ (Knebel, 1991)

3. ลักษณะของเสมหะ ประเมินดูว่าเสมหะมีลักษณะอย่างไร มีปริมาณมากน้อยเท่าไร ถ้าหากผู้ป่วยมีเสมหะเหนียว และมีจำนวนมาก ผู้ป่วยก็จะไม่สามารถไอเอาเสมหะออกได้เอง ทำให้เสมหะอุดกั้นบริเวณทางเดินหายใจ มีผลต่อการแลกเปลี่ยนก๊าซที่ปอด (khamices, 2001; Knebel, 1991) ดังนั้นควรประเมินปริมาณเสมหะก่อนเริ่มการหย่าเครื่องช่วยหายใจ

4. ระบบประสาทและกล้ามเนื้อ ประเมินว่าผู้ป่วยมีโรคเกี่ยวกับระบบประสาทหรือกล้ามเนื้อหรือไม่ เช่น Multiple sclerosis, Myasthenia gravis, Guillain –Barre syndrome เนื่องจากการหย่าเครื่องช่วยหายใจนั้น ผู้ป่วยต้องมีความแข็งแรงพอที่จะหายใจเอง และสามารถไอได้อย่างมีประสิทธิภาพถ้าผู้ป่วยเป็นโรคเหล่านี้ก็ทำให้การหย่าเครื่องช่วยหายใจมีความยากลำบากมากขึ้น (ทนนชัย บุญบุรพงศ์, 2543; MacIntyre, 2001)

5. ภาวะที่ทำให้บริเวณท้องแน่นตึง ประเมินว่าผู้ป่วยมีภาวะ ascitis หรือโรคอ้วนหรือไม่ เนื่องจากภาวะดังกล่าวจะทำให้การเคลื่อนไหวของทรวงอกได้ไม่ดี (Burns et al., 1994)

6. ขนาดของท่อช่วยหายใจ ประเมินขนาดท่อช่วยหายใจขนาดเส้นผ่าศูนย์กลางเฉลี่ย $\geq 7.0 - 7.5$ มิลลิเมตร ในผู้หญิงไทย และ $\geq 7.5 - 8.0$ มิลลิเมตร ในผู้ชายไทย หรือไม่ เพราะขนาดของท่อช่วยหายใจที่มีขนาดเล็ก และยาวเกินไป จะมีแรงต้านของทางเดินหายใจเพิ่มมากขึ้น ทำให้กล้ามเนื้อในการหายใจอ่อนแรง เนื่องจากการหายใจเพิ่มขึ้น ส่งผลให้การหย่าเครื่องช่วยหายใจไม่สำเร็จ (สุมาลี เกียรติบุญศรี, 2545; Epstein, 1997)

7. การจัดเสมหะในระบบทางเดินหายใจ ประเมินได้จาก การไอและการขับเสมหะ ถ้าผู้ป่วยสามารถไอได้อย่างมีประสิทธิภาพ แสดงว่าผู้ป่วยสามารถการจัดเสมหะในทางเดินหายใจได้ดี (Dammon, 1992; Khamices, 2001)

8. ความแข็งแรงกล้ามเนื้อในการหายใจ ประเมินได้จาก Maximal inspiratory pressure (MIP) หรือ Negative inspiratory pressure (NIP) เป็นค่าที่ใช้วัดความแข็งแรงของกล้ามเนื้อหายใจโดยทางอ้อม ผู้ป่วยที่จะประสบความสำเร็จในการหย่าเครื่องช่วยหายใจได้นั้น ควรมีค่า MIP มากกว่า $-20 \text{ cmH}_2\text{O}$ ถ้าค่า MIP ต่ำกว่า $-20 \text{ cmH}_2\text{O}$ ก็สามารถหย่าเครื่องช่วยหายใจได้ แต่เสี่ยงต่อการเกิดปอดแฟบ และเสมหะอุดตัน เนื่องมาจากการไอที่ไม่มีประสิทธิภาพ (สุมาลี เกียรติบุญศรี, 2545)

9. การประเมิน Maximal expiratory pressure (MEP) หรือ Negative expiratory pressure (NEP) เป็นค่าที่แสดงความแข็งแรงของกล้ามเนื้อเช่นเดียวกันโดยมีค่ามากกว่า $30 \text{ cmH}_2\text{O}$ ถ้าหากค่านี้ต่ำกว่านี้ แสดงว่ายังมีพยาธิสภาพที่ปอด ซึ่งอาจแสดงออกในรูป hypoxia หรือ work of breathing ที่มากขึ้น (สุมาลี เกียรติบุญศรี, 2545)

10. การประเมินปริมาตรลมหายใจออก spontaneous tidal volume (STV) เป็นการวัดความทนทานของกล้ามเนื้อในการหายใจ ควรมีค่าไม่ต่ำกว่า 5 ml/kg โดยที่ผู้ป่วยมีน้ำหนักที่ $50 - 70 \text{ kg}$. ในกรณีที่น้ำหนักน้อยกว่า 40 kg , STV ควรมากกว่า 5 ml/kg . ถ้าผู้ป่วยมีน้ำหนักมากกว่า 80 kg . ต้องการ STV ที่น้อยกว่า 5 ml/kg . ดังนั้นผู้ป่วยที่พร้อมที่จะหย่าเครื่องช่วยหายใจ ควรมี STV อยู่ระหว่าง $250 - 400 \text{ ml}$. (ทนนชัย บุญบุรพงศ์, 2543; สุมาลี เกียรติบุญศรี, 2545)

11. การประเมินปริมาตรลมหายใจที่ผู้ป่วยสามารถเป่าออกได้มากที่สุด Vital Capacity (VC) ควรมีค่ามากกว่า 10 mL/kg. ซึ่ง VC เป็นตัววัดที่มีความเฉพาะและความไวสูงต่อการประเมินความแข็งแรง และความทนทานของกล้ามเนื้อที่ช่วยในการหายใจ เป็นการวัดที่ง่าย ไม่ต้องใช้เครื่องมือพิเศษในการวัด (สุมาลี เกียรติบุญศรี, 2545; Knebel, 1991)

12. ประเมิน pH ควรอยู่ในเกณฑ์ปกติ เท่ากับ 7.35 – 7.45 เป็นการบ่งบอกถึงความเป็น กรด-ด่าง ภายในร่างกาย (อรสา หงิมรักษา, 2546)

13. $\text{Pa O}_2 > 60 \text{ mmHg}$. ขณะหายใจด้วยเครื่องช่วยหายใจที่ $\text{FiO}_2 = 0.4$

14. $\text{PaCO}_2 = 35 - 45 \text{ mmHg}$. ขณะหายใจด้วยเครื่องช่วยหายใจ ถ้า PaCO_2 เพิ่มขึ้น ($> 45 \text{ mmHg}$) เกิดภาวะ respiratory acidosis ร่างกายก็จะพยายามปรับสมดุลด้วยการหายใจเร็วมากขึ้นเพื่อขับคาร์บอนไดออกไซด์ออก ก็จะทำให้ผู้ป่วยหายใจเร็วและเกิดภาวะ respiratory alkalosis ตามมา ผู้ป่วย COPD ที่มีภาวะ PaCO_2 คงที่เรื้อรังนั้น ควรรักษาระดับ PaCO_2 ที่ใกล้เคียงกับภาวะปกติของผู้ป่วยรายนั้น หรือประมาณ 50 mmHg. ก่อนเริ่มหยาเครื่องช่วยหายใจ (ทนันชัย บุญบุรพวงศ์, 2543)

การประเมินด้านทั่วไป ประกอบด้วย การประเมินด้านสรีระวิทยาและการประเมินด้านจิตใจ อีก 12 ข้อ รวมเป็น 26 ข้อ ซึ่งมีรายละเอียดในการประเมินดังนี้

1. ระบบการไหลเวียนโลหิต (hemodynamic) เป็นการประเมินการทำหน้าที่ของหัวใจ ซึ่งประเมินได้จากสัญญาณชีพ และปริมาณเลือดที่ออกจากหัวใจใน 1 นาที ได้แก่ สัญญาณชีพควรปกติ คือ มีอัตราการเต้นของหัวใจมากกว่า 50 - 120 ครั้ง/นาที ความดันซิสโตลิก มีค่าประมาณ 90 – 120 mmHg. ความดันไดแอสโตลิกมีค่า ประมาณ 60 – 90 mmHg. ไม่พบ ภาวะหัวใจเต้นผิดจังหวะ หากพบความผิดปกติ ไม่ควรทำการหยาเครื่องช่วยหายใจ

2. การเผาผลาญอาหาร ประเมินว่าผู้ป่วยมีภาวะใดที่ทำให้อัตราการเผาผลาญอาหารเพิ่มขึ้นหรือลดลงหรือไม่ เช่น อาการชัก มีไข้ ติดเชื้อในร่างกาย มีภาวะ hypothyroidism หรือ hyperthyroidism ถ้าพบว่ามีภาวะดังกล่าวแสดงว่าผู้ป่วยยังไม่พร้อมที่จะหยาเครื่องช่วยหายใจ เนื่องจากอาการเหล่านี้ทำให้เพิ่มงานของการหายใจมากขึ้น ส่งผลให้กล้ามเนื้อหายใจอ่อนแรง ผู้ป่วยไม่สามารถทนต่อการหายใจเองได้นาน (สุรัตน์ โคมินทร์, 2545; Hung et al., 1999)

3 ภาวะช็อค ประเมินจากค่า ซีมาโตคริต ควรอยู่ในเกณฑ์ปกติ $\geq 30 \%$ (สุนทรี เจริญวิทยกิจ, 2546) ซีโมโกลบิน $> 8 - 10 \text{ g/dl}$ ถ้าหากผู้ป่วยมีภาวะช็อค จะทำให้การขนส่งออกซิเจนลดน้อยลง หัวใจจะทำงานหนักมากขึ้น เพื่อนำออกซิเจนไปเลี้ยงร่างกายให้เพียงพอ ส่งผลให้หยาเครื่องได้ยากมากยิ่งขึ้น (MacIntyre, 2001)

4. ภาวะโภชนาการ ประเมินจากค่า albumin ควรมากกว่า 2.5 g/dl (Sapizascko et al., 1996) ผู้ป่วยควรได้รับสารอาหารที่เพียงพอและเร็วที่สุด ได้รับพลังงานประมาณ 30 – 35 Kcal/kg/day (สุรัตน์ โคมินทร์, 2545) และได้รับสารอาหารประเภทโปรตีน 1– 1.5 gm/kg/day ถ้าผู้ป่วยได้รับสารอาหารไม่เพียงพอจะนำไปสู่ภาวะขาดสารอาหาร ทำให้กล้ามเนื้ออ่อนแรงและลิ้นเล็ก ภูมิคุ้มกันต่ำลง ปอดติดเชื้อได้ง่าย นอกจากนี้ ผู้ป่วยควรได้รับพลังงานจากไขมันมากกว่า คาร์โบไฮเดรต เพื่อลดการสร้างคาร์บอนไดออกไซด์จากสารอาหารคาร์โบไฮเดรต เนื่องจากการมีคาร์บอนไดออกไซด์มากจะทำให้ต้องใช้แรงในการหายใจมาก ทำให้ยากต่อการหยาเครื่องช่วยหายใจ (Knebel, 1991)

5. ความสมดุลของน้ำ ประเมินจากน้ำหนัก ความสมดุลของปริมาณน้ำเข้าและออกจากร่างกายในแต่ละวัน เป็นตัวบ่งบอกถึงภาวะ pulmonary edema ซึ่งมีผลโดยตรงกับการแลกเปลี่ยนก๊าซในปอด (Knebel, 1991)

6. ความสมดุลของอิเล็กโทรไลต์ ควรอยู่ในเกณฑ์ปกติ โดยเฉพาะโปแตสเซียม (ค่าปกติ = 3.5 - 5.5 mEq/L) แคลเซียม (ค่าปกติ = 8.8 – 10 mg/dl) แมกนีเซียม (ค่าปกติ = 1.5 – 2 mg/dl) ฟอสฟอรัส (ค่าปกติ = 3.4 - 4.6 mg/dl) ถ้าพบว่าอิเล็กโทรไลต์เหล่านี้ผิดปกติ จะทำให้กล้ามเนื้อที่ช่วยในการหายใจอ่อนแรง และทวีความรุนแรงมากขึ้นในผู้ป่วยที่มีโรคกล้ามเนื้ออ่อนแรงอยู่แล้ว หรือมีโรคปอดเรื้อรัง (Knebel, 1991)

7. การจับถ่ายโดยประเมินจากอาการ ท้องเสีย ท้องผูก ท้องอืด ซึ่งอาการเหล่านี้มีผลต่อการหยาเครื่องช่วยหายใจ เช่น อาการท้องเสียจะทำให้ผู้ป่วยสูญเสียน้ำและอิเล็กโทรไลต์ ทำให้อ่อนเพลีย ไม่มีแรง ส่วนอาการท้องอืดและอาการท้องผูก ทำให้ผู้ป่วยแน่นอึดอัด ไม่สบายหายใจได้ไม่เต็มที่ (อรสา พันธุ์ศักดิ์, 2542)

8. ความก้าวหน้าของพยาธิสภาพที่ปอด โดยประเมินจากภาพรังสีปอด (chest x-ray) ว่าพยาธิสภาพของปอด เช่น ภาวะ pulmonary edema, pneumonia นั้นดีขึ้น เบลลงหรือกลับเข้าสู่ระดับเดิมก่อนการเกิด acute respiratory failure เนื่องจากพยาธิสภาพดังกล่าวมีผลต่อการแลกเปลี่ยนก๊าซ และการระบายอากาศ (ทนนชัย บุญบุรพงค์, 2543; MacIntyre, 2001)

9. ความแข็งแรงของร่างกาย โดยประเมินจากผู้ป่วยสามารถลุกขึ้นนั่งได้ ทำกิจกรรมต่างๆบนเตียง หรือลุกขึ้นจากที่นอนมานั่งที่ข้างเตียงได้ แสดงให้เห็นว่าผู้ป่วยสามารถที่จะไอและหายใจได้อย่างมีประสิทธิภาพ (วิภาภัทร ชังขาว, 2544)

10. ความปวด ประเมินโดยการสอบถามจากผู้ป่วยว่ามีความปวดหรือไม่ รวมทั้งสังเกตจากอาการแสดงด้านร่างกาย เช่น ชีพจรเร็ว หรือร้องไห้ เพราะถ้าผู้ป่วยมีความปวดแล้ว จะไม่สามารถหายใจหรือไอได้อย่างมีประสิทธิภาพ ควรมีการประเมินความปวดและการจัดการ

กับความปวดอย่างมีประสิทธิภาพ ก่อนเริ่มการหยาเครื่องช่วยหายใจ (อุบลรัตน์ ดีพร้อม, 2546; Thomas, 2003)

11. การนอนหลับพักผ่อน โดยประเมินจากการสอบถามผู้ป่วยว่านอนหลับหรือไม่ (ทั้งปริมาณและคุณภาพ) ควรนอนหลับติดต่อกันอย่างน้อย 2-4 ชั่วโมง และนอนหลับ 6-8 ชั่วโมงต่อวัน ถ้าผู้ป่วยนอนหลับไม่เพียงพอ จะทำให้เกิดความเครียด หงุดหงิด ซึมเศร้า และไม่ร่วมมือในการหยาเครื่องช่วยหายใจ (Vicky, 2003)

12. ระดับความวิตกกังวล ประเมินโดยการสังเกต และสอบถามผู้ป่วยว่ามีความวิตกกังวลในเรื่องใดและระดับใด พร้อมทั้งให้การช่วยเหลือให้ตรงความต้องการของผู้ป่วย ความวิตกกังวลดังกล่าวจะไปกระตุ้นระบบประสาทซิมพาเรติก ทำให้ผู้ป่วยหายใจเร็วขึ้น เป็นการเพิ่มงานในการหายใจ ส่งผลให้ร่างกายต้องการพลังงานมากขึ้น ผู้ป่วยจะมีการหอบเหนื่อย และไม่สามารหยาเครื่องช่วยหายใจได้สำเร็จ (Knebel, 1991)

การให้คะแนนในการประเมินความพร้อมตามแบบประเมิน BWAP มีดังนี้คือ

Yes หมายถึง ผู้ป่วยมีเกณฑ์ตามที่กำหนด

No หมายถึง ผู้ป่วยไม่มีเกณฑ์ตามที่กำหนด

NA หมายถึง ไม่สามารถประเมินข้อนั้นได้ ซึ่งต้องนำไปหักออกจากจำนวนข้อทั้งหมด

26 ข้อ

นำคะแนนที่ประเมินได้ทั้งหมด 26 ข้อ มาคำนวณหาค่าเป็นเปอร์เซ็นต์ ดังนี้คือ

$$\text{คะแนนที่คำนวณได้} = \frac{\text{จำนวนข้อที่ตอบ Yes} \times 100}{\text{จำนวนข้อที่ประเมินได้ทั้งหมด}} (\%)$$

ในกรณีที่ผู้ป่วยๆ ไม่ได้รับการประเมินในข้อนั้น (NA) ยกตัวอย่างเช่น ไม่สามารถประเมินใน ข้อ 8 เกี่ยวกับ negative inspiratory pressure ได้เนื่องจากไม่มีเครื่องมือ ดังนั้นจึงเหลือจำนวนข้อทั้งหมด 26 - 1 = 25 ข้อ

หลังจากประเมินความพร้อมด้วย BWAP แล้ว นำคะแนนที่ได้มาคำนวณหาเปอร์เซ็นต์ความพร้อมในการหยาเครื่องช่วยหายใจ การแปลผล ถ้าคะแนนที่คำนวณได้มากกว่าหรือเท่ากับ 50% แสดงว่า พร้อมที่จะหยาเครื่องช่วยหายใจได้ ถ้าคะแนนที่คำนวณได้น้อยกว่า 50% แสดงว่า ไม่พร้อมที่จะหยาเครื่องช่วยหายใจได้

ข้อดีของแบบประเมินด้วย BWAP ก็คือใช้ได้ง่าย (เป็นแบบ checklist) ไม่ต้องใช้อุปกรณ์ที่ใช้เทคโนโลยีสูงในการวัด (non - invasive) ใช้เวลาไม่มากเพียง 5 - 10 นาทีในการประเมิน สามารถประเมินได้ครอบคลุมทั้งทางด้านร่างกายและจิตใจ มีประโยชน์ในการติดตามความก้าวหน้าในเรื่องความพร้อมในการหยาเครื่องช่วยหายใจ รวมทั้งสามารถใช้ในการทำนายความสำเร็จในการหยาเครื่องช่วยหายใจได้ด้วย นอกจากนั้น การประเมินดังกล่าวยังเป็นการช่วย

คัดกรองและค้นหาปัจจัยที่ส่งผลต่อการหย่าเครื่องช่วยหายใจที่ยังไม่ได้รับการแก้ไข ซึ่งจะเป็นข้อมูลในการช่วยวางแผนการรักษาพยาบาล เพื่อแก้ไขปัญหาที่พบจากทีมสุขภาพอย่างรวดเร็ว เพื่อให้ผู้ป่วยได้มีโอกาสหย่าเครื่องช่วยหายใจได้เร็วขึ้น ส่วนข้อจำกัด คือ คะแนนที่ได้จากการประเมิน $\geq 50\%$ แสดงว่ามีความพร้อมในการหย่าเครื่องช่วยหายใจ (Burns, 1999; Burns et al., 1995 ; Epstein et al., 2002) ซึ่งคะแนนที่ได้จากการประเมินความพร้อมในระบบหายใจ ควรได้คะแนน ≥ 7 คะแนน หรือมีความพร้อมในระบบหายใจอย่างน้อย 7 ข้อ เนื่องจากระบบหายใจเป็นปัจจัยโดยตรง ที่มีผลต่อการเกิดภาวะหายใจล้มเหลว (Esteban, 2002) และแบบประเมินให้คะแนนในแต่ละข้อเท่ากัน คะแนนที่ได้ $> 50\%$ ที่แสดงว่าผู้ป่วยพร้อมหย่าเครื่องนั้น อาจเป็นคะแนนที่ได้จากปัจจัยทางอ้อมที่มีผลต่อการหย่าเครื่องช่วยหายใจ

2. **Rapid shallow breathing index (RSBI)** หรือ f / V_T (สุมาลี เกียรติบุญศรี, 2545; Ely et al, 1996) เป็นตัวชี้วัดความพร้อมและสามารถทำนายความสำเร็จของการหย่าเครื่องช่วยหายใจที่ดีอีกตัวหนึ่ง RSBI คือ จำนวนครั้งที่ผู้ป่วยต้องหายใจเองใน 1 นาที เพื่อให้ได้ tidal volume 1 ลิตร หรือคำนวณได้ จากสูตร $RSBI = f / V_T$ โดยที่ F คือ frequency หรือ อัตราการหายใจ (ครั้ง/ นาที) V_T คือ tidal volume มีหน่วยเป็นลิตร วิธีการวัด โดยต่อ spirometer กับท่อช่วยหายใจ ให้ผู้ป่วยหายใจครบ 1 นาที อ่านค่า minute volume ที่ได้แล้วหารด้วย อัตราการหายใจจะได้ค่า V_T ดังนั้น การแปลผล ค่า f / V_T ไม่เกิน 105 มีโอกาสหย่าเครื่องช่วยหายใจได้สำเร็จสูง ถ้าค่า f / V_T เกิน 105 มีโอกาสหย่าเครื่องช่วยหายใจได้สำเร็จน้อย

APPENDIX E

THE PAIN ASSESSMENT TOOL

การประเมินความปวด

การวัดระดับความปวด

การบอกความรู้สึกเป็นตัวเลข (Numerical rating scales : NRS)

เป็นการประเมินความปวดด้วยตัวเลข โดยพยาบาลจะบอกผู้ป่วยว่าถ้า **ไม่ปวดเลย** แทนด้วยเลข 0 และปวดรุนแรงมาก แทนด้วยเลข 10 ให้ผู้ป่วยเลือกความปวดขณะนั้นอยู่ที่เลขใด

ผู้ป่วยให้คะแนนความปวด (pain score)

คะแนน 1-2 คือ ยอมรับได้ไม่ต้องการการรักษาพยาบาล

คะแนน 3-4 คือมีความเล็กน้อยพอทนได้

คะแนน 5-6 คือมีความปวดปานกลาง ต้องการการบรรเทาความปวดด้วยวิธีใดวิธีหนึ่ง

ซึ่งบางครั้งอาจไม่จำเป็นต้องใช้ยาระงับปวด

คะแนนมากกว่า 6 ขึ้นไป คือมีความปวดมาก ควรได้รับการบำบัดรักษา อาจใช้ยาแก้ปวด
ร่วมด้วย ซึ่งไม่จำเป็นต้องรอให้ถึง 10 หรือผู้ป่วยทนไม่ไหว เพราะการรักษาแต่เนิ่นๆ เป็น
วิธีการที่ถูกต้อง และให้ผลดีทั้งทางร่างกายและจิตใจ

การใช้ Visual rating scales : VRS

เป็นการวัดโดยใช้เส้นตรงยาว 10 เซนติเมตร แบ่งเป็น 10 ช่องๆละ 1 เซนติเมตร ให้ผู้ป่วยทำเครื่องหมายบนเส้นตรง ที่มีตัวเลขแทนค่าความรุนแรงของความปวด ให้ปลายข้างหนึ่งแทนค่าด้วยเลข 0 หมายถึงไม่ปวด ปลายอีกข้างหนึ่งแทนค่าด้วยเลข 10 หมายถึงปวดรุนแรงมากที่สุด ผู้ป่วยทำเครื่องหมายตรงเลขใดถือเป็นคะแนนความปวด ตามรูป



(ดัดแปลงมาจาก แบบประเมินความปวด ของ เจื้อกุล อโนชาธรมณ์, 2545)

APPENDIX F

THE GUIDELINE FOR ELAXATION TCHNIQUE INTERVENTION FOR MECHANICAL VENTILATION PATIENT

การใช้เทคนิคการผ่อนคลายในผู้ป่วยที่ใช้เครื่องช่วยหายใจ

เทคนิคการผ่อนคลายหมายถึง วิธีการที่จะทำให้เกิดการผ่อนคลายทางกายและใจ การผ่อนคลายช่วยลดความตึงตัวของกล้ามเนื้อ เบี่ยงเบนความสนใจ ลดความวิตกกังวล ทำให้ผู้ป่วยพึงพอใจและสุขสบายขึ้น (วิจิตร บุญยะโทตระ, 2536)

วัตถุประสงค์

เพื่อใช้เทคนิคการผ่อนคลายในการลดความวิตกกังวล และช่วยในการผ่อนคลายขณะที่ผู้ป่วยใช้เครื่องช่วยหายใจ

เทคนิคการผ่อนคลาย

วิธีการทำให้เกิดการผ่อนคลายมีหลายวิธี เรียกรวมๆว่า เทคนิคการผ่อนคลาย แต่ละวิธีมีรายละเอียดในการปฏิบัติแตกต่างกัน แต่มีลักษณะร่วมกันหลายประเภท คือ อาศัยสมาธิ สิ่งแวดล้อมที่สงบเงียบ อยู่ในท่าที่สุขสบายมากที่สุด การจะเลือกวิธีใดมาใช้ ขึ้นอยู่กับความสนใจ ความเชื่อ และสภาพความพร้อมของผู้ป่วยแต่ละคน เทคนิคการผ่อนคลายที่นำมาใช้บ่อยๆ ได้แก่

1. การหายใจเข้า – ออกเป็นจังหวะ หรือ การฝึกการหายใจ
2. การผ่อนคลายกล้ามเนื้อทีละส่วน
3. การฝึกสมาธิ

1. การฝึกการหายใจ เป็นวิธีการที่ง่าย สามารถทำได้ต่อเนื่องตั้งแต่ 30 – 60 วินาที จนถึง 20 นาที และอย่างน้อยวันละ 2 ครั้ง อาจใช้ในการเริ่มต้นก่อนที่จะฝึกวิธีการอื่นๆ ขั้นตอนการปฏิบัติมีดังนี้

- 1) จัดให้นอนหงาย หรือนั่งในท่าที่สบาย
- 2) วางมือแนบไว้บนหน้าท้อง
- 3) สูดลมหายใจเข้า ช้าๆ ลึกๆ จนหน้าท้องโป่ง พร้อมกับ 1..2..ในใจ
- 4) ผ่อนลมหายใจออกช้าๆ จนหน้าท้องแฟบ นับ 1..2..3..4 ในใจ
- 5) ทำซ้ำขั้นตอนที่ 3 และ 4 ติดต่อกัน เป็นเวลา 20 นาที
- 6) ครึ่งสุดท้ายที่หายใจเข้าและออก ลึกๆ บอกกับตัวเองว่า “รู้สึกสบายและผ่อนคลาย”

2. การผ่อนคลายกล้ามเนื้อที่ละส่วน เทคนิคนี้มีหลักสำคัญคือ ให้มีการเกร็งและคลายกล้ามเนื้อที่ละมัด เพื่อให้รู้สึกถึงความแตกต่างระหว่างการเกร็งกับการผ่อนคลาย การผ่อนคลายกล้ามเนื้อที่ละส่วนมีลำดับดังนี้

- 1) มือและแขนขวา โดยกำมือ เกร็งแขน แล้วคลาย
- 2) มือและแขนซ้าย โดยทำเช่นเดียวกัน
- 3) หน้าผาก โดยเลิกิ้วสูงแล้วคลาย ขมวดคิ้วแล้วคลาย
- 4) ตา แก้ม จมูก โดยหลับตาแน่น ย่นจมูกแล้วคลาย
- 5) ขากรรไกร ลิ้น ริมฝีปาก โดยกัดฟัน ใช้ลิ้นดันเพดานปากแล้วคลาย เม้มปากแน่นแล้ว

คลาย

- 6) คอ โดยก้มหน้าให้คางจรดคอแล้วคลาย เงยหน้าจนสุด แล้วคลาย
- 7) ออก ไหล่ และหลัง โดยหายใจเข้าลึกๆ กลั้นไว้แล้วคลาย ยกไหล่สูงแล้วคลาย
- 8) หน้าท้องและก้น โดยแขม่วท้องแล้วคลาย ขมิบก้นแล้วคลาย
- 9) เท้า และขาขวา โดยเหยียดขา งอนิ้วเท้า แล้วคลาย เหยียดขากระดกปลายเท้าแล้ว

คลาย

- 10) เท้าและขาซ้าย โดยทำเช่นเดียวกัน

ข้อแนะนำ ระยะเวลาที่ใช้เกร็งกล้ามเนื้อน้อยกว่าระยะที่ผ่อนคลาย เช่น เกร็ง 3—5 วินาที ผ่อนคลาย 10—15 วินาที ฝึกประมาณ 8—12 ครั้งเพื่อให้เกิดความชำนาญ

3. การฝึกสมาธิ หลักของการฝึกสมาธิ คือ การกำหนดจิตใจให้แน่วแน้อยู่ที่สิ่งใดสิ่งหนึ่ง โดยอาศัยจินตนาการ หรือความคิด จะช่วยให้เกิดภาวะผ่อนคลายในระดับลึก การฝึกสมาธิ นั่งหรือนอนในท่าที่สบาย แล้วปฏิบัติตามลำดับดังนี้

- 1) หลับตาทายใจเข้า หายใจออกช้าๆ
- 2) เริ่มนับลมหายใจเข้าออกดังนี้ หายใจเข้านับ 1 หายใจออกนับ 1
- 3) หายใจเข้านับ 2 หายใจออกนับ 2
- 4) นับไปเรื่อยๆ จนถึง 5 แล้วเริ่มนับ 1 ใหม่
- 5) นับจนถึง 6 แล้วเริ่มนับ 1 ใหม่ ..ทำต่อไปเรื่อยๆ ..
- 6) นับจนถึง 10 , ครบ 10 ถือเป็น 1 รอบ ทำต่อไปเรื่อยๆ ฯลฯ.

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APPENDIX G

THE GUIDELINE FOR MUSIC INTERVENTION FOR THE MECHANICAL VENTILATION

การใช้ดนตรีบำบัดเพื่อการผ่อนคลายในผู้ป่วยที่ใช้เครื่องช่วยหายใจ

วัตถุประสงค์

เพื่อใช้ดนตรีบำบัดในการลดความวิตกกังวล และช่วยในการผ่อนคลายขณะใส่เครื่องช่วยหายใจ

ขั้นตอนการปฏิบัติมีดังนี้

1. ผู้ป่วยที่สามารถนำดนตรีบำบัดมาใช้ควรมีลักษณะดังนี้คือ
 - * ได้รับการใส่เครื่องช่วยหายใจ
 - * รู้สึกตัวดี ไม่ได้รับยาสงบประสาทใดๆ ไม่อยู่ในภาวะ shock, fever, dyspnea
 - * มีความสนใจในการใช้ดนตรีบำบัดเพื่อการผ่อนคลาย
2. ให้ผู้ป่วยเลือกฟังเพลงที่ตนเองชอบ หรือเพลงที่เคยฟัง
3. จัดสิ่งแวดล้อมให้สงบ โดยแขวนป้าย “ชั่วโม่งสงบ” ไว้หน้าห้องผู้ป่วย ปิดประตูห้อง ป้องกันเสียงรบกวน หรือแสงสว่างลง
4. เลือกเวลาในการฟังดนตรี คือ หลังจากดูดเสมหะ, อาหารเรียบร้อยแล้วประมาณ 1 ชม.
5. ดูแลความสุขสบายทั่วไปของผู้ป่วย เช่น ให้อุ่นในท่าที่สบายที่สุด
6. ให้ผู้ป่วยฟังดนตรีจากหูฟัง ประมาณ 30 นาที
7. ลดการรบกวนผู้ป่วยจากการทำกิจกรรมพยาบาล เช่น การวัดสัญญาณชีพ เป็นต้น ให้เฝ้าสังเกตอาการจาก monitor แทน

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APPENDIX H

THE GUIDELINE FOR PROMOTE COMMUNICATION IN THE MECHANICAL VENTILATION

แนวปฏิบัติการพยาบาลเพื่อส่งเสริมการสื่อสารระหว่างผู้ป่วยที่ใส่ท่อทางเดินหายใจ

วัตถุประสงค์

เพื่อเป็นแนวทางปฏิบัติการพยาบาลเพื่อส่งเสริมการสื่อสารระหว่างผู้ป่วยที่ใส่ท่อทางเดินหายใจกับญาติ และเจ้าหน้าที่ในทีมสุขภาพ

คำจำกัดความ

การสื่อสาร (communication) หมายถึง การรับส่งข้อมูลระหว่างผู้ป่วยที่ใส่ท่อทางเดินหายใจ ที่รู้สึกตัวดีและมีการรับรู้ปกติในหอผู้ป่วยวิกฤตอายุรกรรม เพื่อให้สามารถเข้าใจข้อมูลหรือความหมายที่ต้องการ โดยใช้วิธีรับส่งข้อมูลในรูปแบบของการขยับริมฝีปากอย่างช้าๆ การแสดงสีหน้า การแสดงท่าทางประกอบการชี้มือ การใช้ปากกาเขียนข้อความ การใช้บัตรข้อความ หรือการใช้รูปภาพประกอบการอธิบาย

ขั้นตอนการปฏิบัติการพยาบาล

1. การประเมินความพร้อมและคัดเลือกวิธีการสื่อสารกับผู้ป่วย ตามแนวทางการคัดเลือกวิธีการสื่อสารในผู้ป่วยใส่ท่อทางเดินหายใจอย่างมีขั้นตอน (ตามเอกสาร ก)
2. แนะนำตัว สร้างสัมพันธภาพให้ผู้ป่วยเกิดความคุ้นเคย ไว้ว่างใจ
3. จัดสภาพแวดล้อมที่เอื้ออำนวยต่อการสื่อสาร เช่น ไม่มีเสียงดังเกินไป แสงสว่างเพียงพอ ไม่มีการทำหัตถการใดๆ ในขณะนั้น เป็นต้น
4. แนะนำวิธีการสื่อสารที่ใช้ขณะมีท่อทางเดินหายใจ

4.1 แนะนำวิธีการสื่อสารที่สามารถใช้ได้ตามความสามารถ และความต้องการของผู้ป่วย เพื่อสื่อสารความต้องการของตนเองโดยใช้แบบผสมผสาน ดังนี้

4.1.1 แนะนำการแสดงออกด้วยท่าทาง

4.1.2 แนะนำการใช้ศีรษะเคลื่อนไหว หรือสัญญาณมือเพื่อตอบรับหรือปฏิเสธ เน้นเวลาส่ายหน้าหรือพยักหน้า ท่อจะขยับอาจเจ็บคอหรือท่อเลื่อนหลุด

4.2 แนะนำการสื่อสารโดยการใช้อุปกรณ์ช่วยในการสื่อสารโดยมีรูปแบบต่างๆ ดังนี้

4.2.1 วิธีการใช้ปากกาเขียนข้อความพร้อมทั้งเตรียมอุปกรณ์ ซึ่งประกอบด้วยแผ่นรองเขียนซึ่งมีลักษณะแข็งแรง เบา พร้อมปากกาที่น้ำหนักไม่หนักไหลต่อเนื่อง โดยไม่ต้องใช้แรงกดมากและกระดาก

4.2.2 วิธีการใช้แผ่นรูปภาพที่แสดงความต้องการของผู้ป่วยที่สำคัญ มีลักษณะเป็นรูปภาพประกอบคำอธิบายได้รูปภาพ (อุปกรณ์แผ่นภาพการสื่อสาร)

5. เทคนิคการสื่อสารของทีมสุขภาพกับผู้ป่วย

5.1 ตกลงกับผู้ป่วยถึงวิธีการสื่อสารที่ผู้ป่วยสามารถปฏิบัติได้ ตามความสามารถ

5.2 เตรียมอุปกรณ์ช่วยในการสื่อสารให้เหมาะสมในกรณีที่ต้องใช้

5.3 ให้ความสำคัญ ความสนใจ และเวลาแก่ผู้ป่วยระหว่างการสื่อสาร โดยสวดาขณะสื่อสารกับผู้ป่วย

5.4 คาดเดาความต้องการของผู้ป่วยอย่างมีเหตุผล ไม่ถามคำถามซ้ำๆ จะทำให้ผู้ป่วยเกิดความเบื่อหน่าย คับข้องใจได้

5.5 ตอบสนองความต้องการของผู้ป่วยทันทีเมื่อผู้ป่วยสื่อสารความต้องการได้

5.6 ปรับเปลี่ยนวิธีการสื่อสารในรูปแบบอื่นเมื่อเกิดปัญหา หรือเมื่อผู้ป่วยไม่สามารถสื่อสารได้ตามความต้องการของตนได้

5.7 ค้นหาแหล่งสนับสนุนทางครอบครัวเพื่อช่วยในการสื่อสาร

6. ประสานงานการสื่อสารระหว่างผู้ป่วย ญาติ และทีมสุขภาพ

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APPENDIX I

LIST OF EXPERTS

The content verify of the clinical nursing practice guideline were determined by 3 experts including:

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