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The Effect of a Nurse-Respiratory Therapist Weaning Protocol on the Duration of Mechanical Ventilation and the Incidence of Ventilator-Associated Pneumonia

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Abstract

The Effect of a Nurse-Respiratory Therapist

Weaning Protocol on the Duration of Mechanical Ventilation

And the Incidence of Ventilator-Associated Pneumonia

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The purpose of this research study was to show the effectiveness of implementing a standardized nurse-respiratory driven weaning protocol in decreasing the time spent on mechanical ventilation and the incidence of ventilator-associated pneumonia in mechanically ventilated patients compared to using individual physician methods. Chart reviews were performed to compare the incidence of ventilator-associated pneumonia (VAP) prior to the initiation of the nurse-respiratory driven weaning protocol. Sister Callista Roy's Adaptation theory was used as a framework for this study to show that nurses could promote adaption by using a standardized ventilator weaning protocol. The study did not show statistical significance that the use of the weaning protocol decreased the incidence of ventilator-associated pneumonia or decreased the time spent on mechanical ventilation. Continuing research with more subjects is needed to show the effectiveness of weaning protocols on the incidence of VAP and duration of mechanical ventilation.

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Chapter One

Introduction

The purpose of this quantitative non-experimental, two group longitudinal exploratory study was to show that a nurse-respiratory therapist weaning protocol was more effective in decreasing the time patients were on mechanical ventilation when compared to physician's orders. Another purpose of this study was to show that the use of a standardized weaning protocol also decreases the frequency of ventilator-associated pneumonia than individual physician weaning methods. Sister Callista Roy's Adaptation Model was used as a framework throughout this study.

Pneumonia accounts for an estimated 15% of all hospital-associated infections. This percentage increases to 27% of infections acquired in the medical Intensive Care Unit (ICU). It is the second most common hospital-associated infection after urinary tract infections. Mechanical ventilation is the primary risk factor for hospital-associated bacterial pneumonia (CDC, 2003). Ventilator-associated pneumonia (VAP) is defined as pneumonia that develops in a patient who has been mechanically ventilated for at least 48 hours. VAP increases patient's length of stay, mortality rates, and overall health-care costs.

Ventilator-associated pneumonia affects the patient's ability to adapt to their environment and role. Adaptation is the center of Roy's model and is defined as the process whereby "thinking persons use conscious awareness and choice to create human and environmental integration" (Roy, 2007). Roy's theory was incorporated throughout this study by integrating Roy's main concepts and assumptions with the mechanically

ventilated patient and the weaning protocol.

Background/Significance

Ventilator-associated pneumonia is defined by the Center for Disease Control and Prevention (CDC, 2003) as an infection in patients on mechanical ventilation for greater than 48 hours who present with a chest radiographic examination that reveals new or progressive infiltrate, consolidation, cavitations, or pleural effusion and at least one of the following: new onset of purulent sputum; organisms cultured from blood; isolation of an etiologic agent from a specimen obtained by tracheal aspirate; bronchial brushing or biopsy; leukocytosis; or fever. Kollef (1993) set the criteria for the diagnosis of VAP. A new infiltrate is defined as having occurred more than 48 hours after the initiation of mechanical ventilation and within 48 hour of extubation. Fever is described as an increase in core temperature of 1 degree Celsius or higher and core temperature of higher than 38.3 degrees Celsius. Leukosytosis is characterized as having a 25% rise in leukocytes from the patient's baseline and tracheal aspirates must have neutrophils present on Gram's stain with 10 epithelial cells or less per high-power field.

Mechanical ventilation has increased since advancement in medical technology. However, this advancement in medical care does not come without complications. Ventilator-associated pneumonia is one complication linked with prolonged mechanical ventilation. VAP accounts for up to 47% of all infections in Intensive Care Unit patients (Cason, Tyner, Saunders, and Broome, 2007). The incidence of VAP ranges from 6-52% of intubated patients depending on the patient's risk factors. The cumulative frequency is approximately 1-3% per day of intubation.

The estimated mortality rate ranges from 20% to 70% in patients who develop VAP. The average healthcare cost to treat nosocomial pneumonia is estimated at $3000 to $6000 and increases the length of hospital stay to an estimated 13 more days (Collard and Saint, 2001). Cocanour et al. (2005) found that VAP costs $57,000 per episode.

Ventilator-associated pneumonia will continue to increase if nothing is done to prevent it. Nurses will be taking care of more critical patients because of the patient's condition will deteriorate with an added infection. Mortality rates of patients who are mechanically ventilated will keep rising if nothing is done to decrease the incidence of VAP. If the problem of VAP is solved, patients will have a reduced stay in the ICU and health-care costs will decrease. Nurses will have an increase in job satisfaction due to helping prevent further complications in patients.

Preventing ventilator-associated pneumonia will accomplish both national and state goals. One of the objectives of Healthy People 2010 is to reduce the number of hospital-acquired infections in critical care areas including VAP. The baseline in 2002-03 was 3.0 infections per 1,000 days use and the target for 2010 is to reduce it to 2.7 (Healthy People 2010, 2005). A reduction of infectious diseases such as pneumonia is also one of the goals of Healthy People 2010 in West Virginia (WV Healthy People, 2001). The Institute of Healthcare Improvement (IHI) has an aim to decrease VAP using Ventilator Bundle as a basis for this reduction. This goal is part of the new Protecting 5 Million lives from harm campaign initiated in December 2006 and will last until December 2008 (IHI, n.d.).

There are many interventions that can be done to prevent VAP. The Center of

Disease Control and Prevention (2003) published guidelines for the prevention of VAP. Turning therapy, prophylactic administration of antimicrobial agents, and closed system for suctioning will help to prevent this type of pneumonia. Nurses can also make sure that good hand hygiene is practiced with all health-care workers that have contact with the patient. The nursing staff can also provide a comprehensive oral hygiene program. The IHI recommends using Ventilator Bundle to prevent VAP. The Ventilator Bundle components are:

- Elevation of the head of the bed
- Daily "Sedation Vacations" and assessment of readiness to extubate
- Peptic Ulcer disease prophylaxis
- Deep Venous Thrombosis prophylaxis (IHI, n.d.).

Ventilator-associated pneumonia can also be prevented if the patient is weaned from the ventilator in a timely manner. Prolonged intubation means an increase in the risk of the patient developing VAP. McLean, Jensen, Schroeder, Gibney, and Skjodt (2006) found that by implementing a weaning protocol the duration of mechanical ventilation was reduced from mean of 86.0 hours before intervention to 70.8 hours after intervention. This outcome may reduce the number of days in the ICU and reduce the risks associated with mechanical ventilation.

Untimely discontinuation of mechanical ventilation can result in futile extubation, causing reintubation. Reintubation rates range from 4% to 33%. The estimated risk for nosocomial pneumonia is 8 times higher and the increase for mortality increases 6- to 12-fold in patients who have to be reintubated. A balance between the possibility of

untimely extubation and unnecessary prolonged ventilation has to be made (McLean, Jensen, Schroeder, Gibney, and Skjodt, 2006). A consistently used weaning protocol can create the balance needed to wean patients at the right time.

Weaning is defined as the process of aiding patients to breathe without mechanical ventilatory support (Knebel, Shekleton, Burns, Clochesy, and Hanneman, 1998). There are a variety of methods available to wean patients from mechanical ventilation. Physicians can write orders for weaning parameters once a day or the physician can have the nurse initiate a nurse-respiratory driven weaning protocol. Evidence from clinical trials suggests that consistently used weaning protocols reduce the length of use of mechanical ventilation, reduce the incidence of ventilator-associated pneumonia, and decrease the rate of reintubation. The reduction of 56 hours spent on a ventilator and a reduction of VAP in surgical patients that were weaned by a protocol was shown in Marelich's et al. (2000) study involving a weaning protocol by respiratory therapists and nurses. In Dries' et al. (2004) study, protocol-directed weaning resulted in reductions in the rates of both VAP and reintubation.

Weaning a mechanically ventilated patient can be related to Roy's scientific assumptions. Roy states "system relationships include acceptance, protection, and fostering interdependence" (Roy, 2007). Nurses must help protect their patient who is depending on the nursing staff to help them through their sickness.

Problem Statement

Ventilator-associated pneumonia is a devastating complication of mechanical ventilation. VAP is related to an increase length of stay in the hospital, increase in cost of

health-care, and a rise in patient mortality. This study was vital since prolonged intubation is one risk factor for VAP that can be modified. Nursing as a profession can be more proactive in decreasing the frequency of VAP by initiating a consistent weaning protocol. Nurses who use evidence-based practice such as using a weaning protocol are being strong advocates for their patient. By using the weaning protocol nurses are able to integrate Roy's theory of adaptation. Nurses can help compromised patients adapt to their environment and situation while helping them improve their health.

Decreasing the incidence of VAP with the use of a nurse-respiratory driven weaning protocol interests the author because of the high number of patients with VAP at the author's hospital. A new weaning protocol had also just started at the hospital and this study will be able to show evidence that the protocol works. At this hospital in West Virginia, the incidence of VAP is above the national average. This study will help nurses in the ICU understand the need to use a nurse-respiratory weaning protocol to prevent VAP.

Chapter Two

Researchers use conceptual models or frameworks for inspiration in creating research questions. Roy's Adaptation will be discussed in this chapter. The literature review discussed in this chapter focuses on three studies that involved mechanical ventilation and weaning protocols and one study that looked at the significance of VAP.

Theoretical Framework

The Roy Adaptation Model for Nursing was developed in 1964 after Sister Callista Roy attended a seminar by her advisor Dorothy E. Johnson. Johnson spoke on the need to define the goal of nursing. Roy proposed that the goal of nursing was promoting patient adaptation. Throughout her masters program at University of California Los Angeles, Dorothy Johnson encouraged Roy to develop the concept of adaptation. Von Bertalanffy's systems theory, along with the work of Helson was important in the development of her concept. Adaptation defined by Helson is a "process of responding positively to environmental changes and described three types of stimuli, focal, contextual and residual" (Roy, 2007). Roy expanded on this definition to create her model. Many other authors influenced the development of the main concepts of the model included Lazarus, Mechanic, Selye, and Dohrenwend.

Roy worked with the faculty at Mount St. Mary's College in Los Angeles to develop the second phase of the model. Roy's Model became the framework for a nursing-based integrated curriculum in 1970. The model is now one of the most widely used conceptual descriptions of nursing (Roy & Andrews, 1999).

Major concepts of the Roy Adaptation Model that relate to this study are health, environment, and adaptation. Health defined in this model is a progression of being and becoming an integrated and whole person. The patient's health will be compromised when there is an absence of integration. Environment includes everything that surrounds and affects the development of persons as adaptive systems. The environment includes all stimuli that may influence a person's ability to adapt. Roy also focuses on the patient as an adaptive system with the use of four adaptive modes in three levels of adaptation. The four adaptive modes are physiologic-physical, self-concept-group identity, role function, and interdependence (Roy & Andrews, 1999). The physiologic-physical mode will be utilized in this study. The goal of nursing defined by Roy is "the promotion of adaptation in each of the four modes" (Roy & Andrews, 1999, p 31).

The physiologic-physical mode identifies five needs related to physiologic integrity: protection, elimination, activity and rest, nutrition, and oxygenation (Roy & Andrews, 1999). The needs of oxygenation and protection will be the main focus of this study.

Oxygenation involves the fundamental life processes of ventilation, exchange of gases, and transport of gases (Roy & Andrews, 1999). It is when these fundamental processes are disturbed that patients are placed on mechanical ventilation. It is the goal of a nurse-respiratory weaning protocol to help the patient adapt with their illness and return to a normal breathing pattern.

Protection consists of nonspecific and specific defenses processes. These two defense systems, together, act to protect the body from foreign substances such as bacteria, viruses, and abnormal body cells. Nonspecific defense processes include the skin and mucous membranes; and cellular and chemical defenses. Specific defense processes is the body's immune system (Roy & Andrews, 1999). When the patient is mechanically ventilated the nonspecific defense processes are broken, allowing bacteria to enter the lungs. The immune system works to fight off the bacteria. It is one goal of nursing to promote and maintain a patient's nonspecific and specific defense processes, thus contributing to the overall integrity of the patient. A weaning protocol may help shorten the length of mechanical ventilation, allowing the patient to maintain their nonspecific defense processes.

Adaptation is the product of integration of human and environment meanings. This adaptation occurs on what Roy describes as adaptation levels. Adaptation levels represent the condition of the life processes on three levels. The first is integrated adaptation level where structures and functions of the life processes work as a whole to meet human needs. In the compensatory adaptation level, the cognator and regulator subsystems are activated by a challenge to the integrated life processes. Compromised adaptation level results from inadequate integrated and compensatory life processes; an adaptation problem (Roy & Andrews, 1999). This level is the focus of this study. Patient's placed on mechanical ventilation have compromised adaptation. The patient has not been able to adapt to the environment and their health has been compromised. Roy believes that nurses must aim to assist with adaptation in the four modes, thus

contributing to the patient's health and quality of life. It is also the nurse's responsibility to promote adaptation in situations of illness and to improve the interaction of human systems with the environment. This will lead to health (Roy & Andrews, 1999).

The target population of the Roy Adaptation Model is individuals, families, groups, communities, and societies. Roy's model can be applied to many different areas in nursing. Humans, individual or group, are the focus of all nursing activities. This model helps nurses with their assessment of the factors affecting adaptation and then intervening and promoting adaptive abilities (Roy & Andrews, 1999).

The Adaptation Model is widely used and more than 100,000 nurses had been educated in Roy Adaptation Model based programs. It has been implemented in a Neonatal Intensive Care Unit, an acute surgical ward, a neurosurgical unit, and by a hospital to help with staff retention and recruitment (Roy, 2007). The model is also testable. It has been a basis for at least 163 research studies. One study tested the validity of two propositions of Roy's model with the target population of battered women. The study found positive relationships between the focal stimuli of abuse and levels of physiologic distress. It found negative relationships between the focal stimuli of abuse and self-esteem (Wood, 1997).

Roy's model fits this study because adaptation must occur before the patient in the ICU will be able to get well. Patients in the ICU are in the comprised level of her model. These patients are unable to adapt to the situations they face due to the severity of their illness. Negative stimuli surround the patient interfering with their ability to cope. These stimuli include noisy, stressful environment, invasive procedures, and prolonged

mechanical ventilation. The cognator and regulator coping subsystems respond to the stimuli, helping the patient to cope with the severity of their illness and the negative stimuli. The ICU nurse can help the patient stabilize and adapt by initiating the weaning protocol and getting the patient off the ventilator. This will decrease the negative stimuli and helping the patient adapt to the environment.

This theory was chosen for this research study because of its ability to link theory with research. The model's main idea is a person is an adaptive system. People have the ability to adapt to the environment and situations around them. This research study's aim was to show that when ICU patients are weaned from mechanical ventilation using a standardized weaning protocol, they will adapt better to the weaning process and be extubated faster with fewer complications.

Specific Aims

This study's aims were to: (1) determine if a nurse-respiratory driven weaning protocol is more effective in weaning patients in a timely manner from mechanical ventilation than patients weaned using physician's orders; (2) determine if a nurse-respiratory driven weaning protocol decreases the incidence of VAP in mechanically ventilated patients when compared to the incidence of VAP in patients weaned using physician's orders.

Operational Definitions

For the purpose of this study, the following definitions will be used:

Nurse-respiratory weaning protocol, independent variable, is a set of routine orders used to wean adult patients off of mechanical ventilation. It was developed by the

hospital pulmonary committee in 2006 (See Appendix A).

Ventilator-associated pneumonia, dependent variable, is defined as pneumonia that develops in a patient who has been mechanically ventilated for at least 48 hours as measured by two of the following: (1) temperature greater than 38.3 degrees Celsius; (2) chest radiographic examination of new or worsening infiltrate; (3) purulent sputum; (4) positive endotracheal tube aspirate or bronchoscopy cultures; and (5) leukocytosis (Kollef, 1993).

Adaptation is the process whereby "thinking persons use conscious awareness and choice to create human and environmental integration" (Roy, 2007) as measured by primary breathing disorder stable or improving, hemodynamically stable, spontaneous respiratory rate of less than 30 breaths per minute, negative inspiratory force of 20cm or more, vital capacity over 10ml/kg, minute ventilation less than 15 liters per minute resting, and rapid shallow breathing index of 100 or less.

APACHE (acute physiology and chronic health evaluation) II score is used to classify patients in the ICU. The results estimate the mortality rate for ICU patients.

Successful extubation is defined as independence from ventilator support for a period of at least 48 hours.

Unsuccessful extubation is defined as need for reintubation within a 48 hour period.

Literature Review

Mechanical ventilation is commonly used in the ICU setting for patients who are critically ill. It is a lifesaving measure but it does not come without complications. Reducing the time on mechanical ventilation would improve the patient's health and reduce health-care costs.

Marelich et al. (2000) studied the effect of a single ventilator management protocol (VMP) on critically ill medical and surgical patients. The purpose of this prospective randomized control study was to examine the efficacy of a single VMP in medical and surgical ICU patients on the duration of mechanical ventilation. The second objective was to determine the effect of the protocol on VAP. The authors randomly assigned patients to either physician order control group or to the VMP experimental group. A stratified randomization design was used. This study did not identify the use of any type of framework.

Marelich et al. (2000) studied 335 mechanically ventilated patients in the medical and trauma ICUs at the University of California Medical Center. The inclusion criteria included the following: (1) PaO_2/fraction of inspired oxygen (FiO_2) $\geq$ 200; (2) static compliance $\geq$ 25 mL/cm H_2O; (3) minute volume $\leq$ 15 mL/min ($\leq$ 200mL/kg/min); and (4) lack of failure of ventilator discontinuation within past 24 hours. The authors excluded patients who were either pregnant, less than 18 years old, mentally disabled patients, or prisoners.

Patients in the VMP group were screened for spontaneous breathing trials (SBT) twice a day. If the patient passed the SBT screen then a thirty minute SBT was used.

Physicians were asked at the end of a successful SBT to approve extubation. If the patient did not tolerate the spontaneous breathing trial, the patients were returned back to their previous ventilator settings and rescreened in six hours. Patients in the physician order control group were managed per standard practice. Physician's orders were required for all ventilator changes and weaning parameters (Marelich et al., 2000).

Wilcoxon rank sum statistic or X^2 was used to examine univariate relationships between experimental group assignments and outcomes. Kaplan-Meier survival curves were constructed for each group. To compare time to each end point, Cox proportional hazards analysis was used. The authors expected the study to have 80% power to detect a 1.5-day difference between groups with respect to the time to extubation. The authors also estimated a comparable degree of power to detect a 1.5% definite change in frequency rate of ventilator-associated pneumonia (Marelich et al., 2000).

The median duration of mechanical ventilation in the MICU was 232 hours in the physician weaning group and 78 hours in the weaning protocol group ($p = 0.0003$). Multivariate analysis showed the odds of attaining ventilator independence were statistically better in the weaning protocol group than the physician group ($p = 0.009$). The median duration of mechanical ventilation in the trauma ICU was 52 hours in the physician weaning group and 33 hours in the weaning protocol group ($p = 0.067$). Multivariate analysis showed that the protocol group led to more rapid ventilator extubation ($p = 0.006$).

There were 31 instances of VAP noted in the study. Twenty subjects from the physician group and eleven from the weaning protocol group developed VAP ($p = 0.100$). Binary logistic regression proposed a protective effect of the weaning protocol group for VAP on the trauma service ($p = 0.119$) (Marelich et al., 2000).

This study showed the effectiveness and the feasibility of a ventilator weaning protocol in decreasing the duration of mechanical ventilation in ICU patients. The median duration of mechanical ventilation was decreased by 2.33 days. The protocol was also linked with a reduction in the frequency of VAP and was implemented without extra staff and minimal education (Marelich et al., 2000).

The study had some limitations because it was randomized and controlled but was not blinded. Another limitation, although not obviously detected, could have been bias from nurses and respiratory care practitioners to be more motivated in their weaning on the protocol group patient. The study used a clinical definition of VAP instead of a pathologic or invasive sampling method to diagnosis VAP. The last limitation discussed was a physician's order was still needed for extubation. In the end the physician decided when a patient was going to be extubated (Marelich et al., 2000).

Marelich et al.'s research study was reviewed for this study because it showed that the use of a standardized nurse-respiratory care practitioner weaning protocol does reduce time spent on mechanical ventilation. It also showed a decrease in the incidence of VAP if a protocol is used to wean patients. This study helps support the scientific aims of this study. It provides statistical evidence to help strengthen this author's hypothesis that weaning protocols reduce the frequency of VAP.

Roy's nursing model is based on the adaptation of humans. When patients are in the hospital and mechanically ventilated they are living in a comprised level of adaptation. It is the nurses' role to help their patients adapt and return to an integrated adaptation level. Marelich et al.'s research study showed one way nurses can accomplish their goal of helping patients. It provided a nursing intervention that can be used to decrease their patient's time spent on the ventilator and decreased their chance of being infected with a potentially deadly disease. The next study also demonstrated how nurses can help their patients adapt and go from a comprised adaptation level to an integrated level.

Kollef et al. (1997) saw there were no consensuses on how a patient was weaned from mechanical ventilation, so they conducted a study to assess the efficacy of using protocols to wean patients. The researchers compared protocol weaning by nurses and respiratory therapists to physician-directed weaning. The hypothesis was that nurses and respiratory therapists could safely and effectively wean most patients from mechanical ventilation using protocol guidelines.

The research sites were two teaching hospitals: Barnes Hospital and Jewish Hospital during a four month period (July 1995 to October 1995). The medical and surgical ICUs from both hospitals were used as the setting for the study. Patients were considered eligible to be in the study if they were more than 18 years old and required mechanical ventilation. Patients were excluded for any of the following reasons: (1) transfer from other hospital with prior mechanical ventilation; (2) brain death; or (3) head/face burns or trauma (Kollef et al., 1997).

When patients were admitted to one of the ICUs, they were randomly assigned to receive protocol-directed weaning or physician-directed weaning from mechanical ventilation. Stratification randomization was used to ensure equal distribution of patients from the four ICUs in the two study groups. In the physician-directed group the onset of weaning and extubation was determined by the house-staff physicians. These physicians weaned the patients according to their own preferences and biases. Patients in the protocol-directed group entered a weaning protocol when their underlying need for mechanical ventilation had resolved. Criteria to be considered ready for weaning included: (1) PaO_2/FiO_2 ratio > 200; (2) Positive end-expiratory pressure $\leq$ 5 cm H_2O; (3) respiration rate $\leq$ 35 breaths/minute; (4) heart rate < 140 beats/minute; (5) not requiring inotropic or vasoactive agents; and (6) mental status of awake and oriented.

Patients in the protocol group in ICUs one and four received daily spontaneous breathing trials. If the patients could breathe between one to two hours without meeting the criteria for weaning failure, they were extubated. Patients in ICU two received pressure support ventilation titrated to attain a ventilatory rate less than 1.2 times their baseline. In ICU three, patients in the protocol group received intermittent mandatory ventilation, with a rate set at half or less than half their baseline. When patients tolerated a rate of $\leq$ 4 breathes/minute, they were placed on a rate of zero for a half hour to one hour. If patients tolerated this, they were extubated (Kollef et al., 1997).

All study variables were collected prospectively and were recorded in collection books maintained at each of the hospitals. Variables included the following: (1) age; (2) gender; (3) ethnicity; (4) indication for mechanical ventilation; (5) Organ System Failure

Index; (6) APACHE II score; (7) development of acute respiratory distress syndrome (ARDS); (7) presence of chronic obstructive pulmonary disease (COPD); (8) mode of ventilation prior to weaning; and (9) weaning strategy. Respiratory therapists measured respiratory function before the beginning of the weaning process (Kollef et al., 1997).

An α-error of 0.05 and a standard deviation of 3 days for mechanical ventilation were used based on previous investigations. Student's *t*-test was used to compare continuous variables that were normally distributed and for non-normally distributed variables the Wilcoxon's rank sum test was used. To compare categorical variables, chi-square test was used. The Kaplan-Meir method was used to show the probability of successful weaning over time for each treatment group and was compared by the Wilcoxon and log-rank tests (Kollef et al., 1997).

A total of 357 patients were randomized and analyzed, 179 received protocol-directed weaning and 178 received physician-directed weaning. The average duration of mechanical ventilation for the study population was 85.6 $\pm$ 148.8 hours. In the protocol-directed weaning group, the mean duration of ventilation was shorter ($p = 0.029$) compared with patients in the physician-directed group. The survival functions between the two group, favoring a shorter duration of mechanical ventilation for the protocol patients ($x^2 = 3.63$, $p = 0.057$, log-rank test). The adjusted rate of successful weaning was statistically higher in the protocol group than the physician group (risk ratio 1.31; 95% confidence interval 1.15 to 1.50; $p = 0.039$) (Kollef et al., 1997).

Data supported the researcher's hypothesis that nurses and respiratory therapists could safely and effectively wean patients from mechanical ventilation. The study

showed a decrease in the time spent on mechanical ventilation. The study also showed the hospital length of stay, total hospital costs, and hospital mortality rate were less in the protocol-directed weaning group, although not statistically significant ($p \geq 0.417$). A savings of $42,960 in hospital costs were seen in patients in the protocol-directed group compared to the physician-directed group. The implementation of protocol-directed weaning resulted in a more expeditious progression of weaning to the point of extubation. The study's results shows that health-care workers can improve patient outcomes without added costs (Kollef et al., 1997).

Several limitations were found in this study. The first was that it was performed at two hospitals where physicians-in-training are used. Another limitation was that different weaning protocols were used; this limitation was minimized by stratifying randomization. Compliance with the weaning protocol and bias form the nurses and respiratory therapist were also limitations in this study.

This research study was reviewed because it supported this study's specific aims. The study supports the statement that nurses and respiratory therapists can effectively wean mechanically ventilated patient in a shorter time than using physician orders. The use of protocol improves patient outcomes by reducing the effects of mechanical ventilation.

Although a framework was not used in this study, Roy's adaptation model does fit this study. Patients in the protocol-directed group were able to be weaned faster from mechanical ventilation than the physician-directed group. The patients in the protocol group adapted to their environment and were able to achieve the goal of going from a

compromised adaptation level back to their integrated adaptation level.

The next study reviewed was by Tonnelier et al. (2005) who studied the use of a nurses' protocol-directed weaning procedure on patients who required mechanical ventilation for longer than 48 hours. The researchers found that weaning from mechanical ventilation took up a large portion of time spent on the ventilator. The aim of their study was to determine if a nurse-directed weaning protocol was associated with decreasing the duration of mechanical ventilation and ICU stay.

The study was conducted using a prospective research design with a 1:1 matched historical database. The research was done at a 12-bed ICU in a European teaching hospital in 2002-2003. The historical group was selected from patients in the same ICU in 1999-2001. The subjects were selected using a convenience sampling design. The control group was selected by matching the following criteria with the prospective group: Simplified Acute Physiology Score (SAPS) II, age, sex, and diagnosis. A total of 208 subjects were included in the research: 104 in the prospective nurse's protocol weaning group and 104 in the historical physician-directed weaning group (Tonnelier et al., 2005).

Physician's individual preferences on mode of weaning were used on the control group. Criteria for weaning were not monitored daily and the decision to extubate was made by the physician. The weaning protocol was developed for nurses to use and physician's orders were not required for breathing trials, only for extubation. The criteria for spontaneous breathing trials were: fractional inspired oxygen < 50%; positive end-expiratory pressure < 5 cmH_2O; no sedative agent infusion; follows simple orders; and no

vasopressor infusion. If criteria were met, a 90 minute spontaneous breathing trial was done. If a patient could breathe for 90 minutes on their own, the physician was asked for approval of extubation. If patients failed the 90 minute breathing trial, then the patient was placed back on the previous ventilator settings and rescreened the next day (Tonnelier et al., 2005).

Continuous variables were expressed as mean $\pm$ standard deviation and categorical variables as percentages. A level of significance of 0.05 or less was considered statistically significant in this study. Percentages were compared using x^2 test and means were compared using Student's *t* test. To determine the likelihood of remaining ventilated during the overall ICU length of stay Kaplan-Meier curves were used. The curves were compared using a log rank test (Tonnelier et al., 2005).

The overall mechanical ventilation duration in the nurse's protocol group was 16.6 $\pm$ 13 days and 22.5 $\pm$ 21 days in the control group ($p = 0.02$). The length of stay in the ICU was 21.6 $\pm$ 14.3 days in the protocol group and 27.6 $\pm$ 21.7 days in the control ($p = 0.02$). A positive trend toward a reduction in ventilator-associated pneumonia incidence was seen in the protocol group (20.2% compared to 31%, $p = 0.12$) (Tonnelier et al., 2005).

The study demonstrated the efficacy of a nurse's weaning protocol. It showed a reduction in the time spent on mechanical ventilation and the overall length of stay in the ICU in patients who were mechanically ventilated for greater than 48 hours. The researchers found this protocol was easily implemented. One key message from this study is a nurse's weaning protocol is safe and promotes major clinical benefits for

patients. The researchers stated that a weaning protocol should be used in all ICUs (Tonnelier et al., 2005).

This study had some limitations, one being the sampling design. This study was nonrandomized. The researchers tried to control for this by matching the groups 1:1. Another limitation discussed was evolution of medical care during the study period. The fundamentals of routine patient care did not change but some ventilatory settings may have (Tonnelier et al., 2005).

This research study was chosen to support this study's aim that a weaning protocol will decrease the duration of mechanical ventilation. The study also showed a positive trend of decreasing VAP with the use of a weaning protocol. This also supports the specific aim of this study.

Tonnelier's et al. study fits into Roy's Adaptation Model. The study showed that if the duration of a stimulus (mechanical ventilation) is reduced, a patient can adapt to the environment better (decrease in VAP). The nurse helps to bring about this adaptation by implementing this simple protocol. The next research study does not discuss a weaning protocol but showed how VAP and the duration of mechanical ventilation effects patient adaptation.

Hugonnet et al. (2004) researched the effects of ventilator-associated pneumonia on morbidity, mortality, and resource utilization. They found that the extra cost generated from VAP had not been adequately studied, so they developed a matched retrospective cohort study based on prospectively collected data. Data were collected from October 1995 to November 1997 to compare patients with VAP (case-patients) with matched

patients receiving mechanical ventilation without pneumonia (control-patients). The study took place in an 18-bed medical ICU. Patients who were mechanically ventilated for 48 hours or more and remained free of pneumonia during their ICU stay were eligible to be in the control group. Case-patients were matched with one control patient on a 2-point scale scoring system for optimal matching. Pairs with a score of 15/20 or greater were used in the study.

Continuous variables were expressed as ranges, inter-quartile ranges or medians. Significance tests were performed using Student's *t* test. The McNemar method was used to test whether the attributable mortality rate differed from zero. A level of significance of 0.05 or less was considered statistically significant and all tests were two-tailed (Hugonnet et al., 2004).

The ICU length of stay was greater among case patients by a mean of 7.2 days ($p < 0.001$) and the duration of mechanical ventilation was also greater by a mean of 5.1 days ($p < 0.001$). The median costs amount the total population were $20,941 and significantly higher in case-patients, resulting in mean cost of $10,450 per episode of VAP. The mortality rate in the ICU was 28.4%. The case-fatality rate among control-patients was 24.7% and 32.0% for case-patients, resulting in an attributable mortality rate of 7.3% (Hugonnet et al., 2004).

This study showed that patients that acquired VAP had an ICU stay that was about four times longer than patients who did not develop a nosocomial infection. The incidence of VAP was shown to cause prolongation on mechanical ventilation (5.1days). The research study showed that VAP has negative affects on patient outcomes and

represents a considerable burden on ICU and hospital resources. Two recommendations by the authors were the need for more research on the effects of VAP and implementation of preventive strategies. Limitations of this study include the use of surveillance definitions to define VAP which is not specific. The matching process is also a limitation due to the matching criteria and the possibility of insufficient or over-matching (Hugonnet et al., 2004).

This research study was chosen to show the affects of VAP on the ICU resources and patients. The study showed the need to prevent VAP so that patient outcomes will be better. A standardized weaning protocol may help decrease the duration of mechanical ventilation and decrease the incidence of VAP.

The Roy Adaptation Model can be applied to this research study because it discussed patient's lack of adaptation to illness. The case-patients were unable to adapt to the stimuli in their environment and developed VAP. These patients stayed in the compromised adaptation level. The control-patients were able to adapt to their environment and reach the integrated adaptation level.

The goal of Roy's model is for nurses to help patients adapt to their environment and all the stimuli in their lives during the compromised level. One way for nurses to achieve this goal is using a standardized weaning protocol. Previous studies (Marelich, 2005; Kollef, 1997; Tonnelier, 2005) suggest that using a standardized weaning protocol decreases duration of mechanical ventilation and incidence of VAP. These results show that nurses can improve patient outcomes and accomplish Roy's goal.

Chapter Three

Methodology

This section of the research describes how the research study was carried out. It includes the research and sampling designs, setting procedures, instruments, data analysis and limitations of the study.

Research Design

The research was a quantitative non-experimental, two group longitudinal exploratory study. The purpose of the study was to look at the differences between the two groups on the duration of mechanical ventilation and the incidence of VAP. The research was done in two parts. The first part of the research was done by using a historical group. In retrospective designs, the researcher is concerned in a current outcome and strives to determine antecedent factors that produced it (Polit & Beck, 2004). Patient's charts from October 2006 through December 2006 were reviewed looking for the duration of mechanical ventilation and the incidence of VAP. The second part of the research used a prospective design. This type of design begins with an assumed cause and then goes forward in time to the assumed outcome (Polit & Beck, 2004). The time frame for this step of the research took place from October 2007 through December 2007. The researcher wanted to determine if the use of an established nurse-respiratory driven weaning protocol decreases the duration of mechanical ventilation and the incidence of VAP. A copy of the weaning protocol is included in Appendix A.

Ex post facto study designs have both strengths and weakness, both will be discussed. A strongpoint of this type of design is that it can focus on understanding causal

relationships. Correlational research is also efficient in collecting a large amount of data about a problem where experimental research concentrates on only one or two variables at a time. Limitations of this type of design include their susceptibility to faulty interpretations. This exists because in correlational studies, the researcher self-selects groups instead of using randomization. Another limitation is that it is hard to interpret correlational findings because in real life, characteristics, states, attitudes, and behaviors are correlated in complex ways. There may be alternative reasons, not the reasons being studied, why something happened (Polit & Beck, 2004).

This design was chosen because it allows for comparison of two groups. The researcher wanted to determine if a nurse-respiratory driven weaning protocol decreases time spent on the ventilator and the incidence of ventilator-associated pneumonia. An ex post facto research design allows for this comparison. A retrospective chart review was preformed to establish a historical group where physician orders were used to wean patients off the ventilator. A prospective study was preformed to compare data collected on the historical group with cases were a weaning protocol was used.

Sampling Design/Subjects

The variables being studied were weaning protocol (independent variable), duration of mechanical ventilation (dependent variable), and incidence of VAP (dependent variable). Extraneous variables, both internal and external, are contaminating factors in a research study (Polit & Beck, 2004). Internal extraneous variables in this study included anxiety of the subject, co-morbidities of the patient, the patient's age, and the acuity level of the patient. Some of these variables were controlled. The anxiety was

controlled by relaxation techniques, allowing family members to be present when weaning trials are started, and anti-anxiety medication. The weaning trials were not started until the acuity level the patient had decreased. External extraneous variables in this study were the environment, experience of the nurse and respiratory therapist, physician adherence to the protocol, and not using the same nurse and respiratory therapist daily. The nurse may have controlled for the environment by decreasing the noise in the patient's room and allowing family to be at bedside. Physician adherence was difficult to control. In the unit where the study took place, resident physicians were rotated through the unit once a month. It was difficult to educate all of them on the use of the weaning protocol utilized in the unit. The researcher tried to educate and re-enforce the use of the protocol to the attending physicians and the residents.

Subjects were selected from the population of a sixteen-bed adult Intensive Care Unit at hospital in southern West Virginia. A convenience sampling design was used to obtain subjects. Patients who were admitted to this unit were eligible for the study if they were at least 18 years old, mechanically ventilated for at least 48 hours, first time being intubated this admission, weaned during the months of the study, were not ventilator-dependent at home, and were not considered terminal extubation.. A demographic survey was used to collect some of this data (See Appendix B).

Confidentiality was maintained by not using identifying factors of the participants. Informed consent was waived since the researcher only reviewed charts and there was no intervention. The data will be kept in a locked file cabinet in the researcher's home for at least five years then will be shredded. The researcher will be the

only one to have access to the data.

Setting

The study took place in a sixteen-bed ICU in southern West Virginia. In this unit, the patient-nurse ratio is usually 2:1 and the patient-respiratory ratio is 16:1. The unit has four pulmonary intensivists and four surgery attendings. The hospital also uses resident physicians who are on call 24 hours a day. The historical group was pulled from patients admitted during October 2006 to December 2006. The time frame for the prospective part of the study was October 2007 to December 2007.

Procedures

The Institutional Review Board approved the study in July 2007. The study was done by auditing patient's charts. The researcher looked for the following: duration of mechanical ventilation, use of physician's orders or nurse-respiratory weaning protocol, signs of VAP. See Appendix C for complete data collection flow sheet.

The retrospective part of this study took place first. The researcher worked with the clinical coordinator of the ICU to get a list of patients who were mechanically ventilated during October 2006 through December 2006. Then a list of patients who developed VAP during that time period was obtained from the ICU nurse manager. After compiling a complete list, those charts were pulled and analyzed data that is described in Appendix C.

The prospective part of the study was done in October 2007 thru December 2007. The first thing that was done was a meeting with the nursing staff, respiratory therapist, physicians, and residents about the purpose of the study and reminding them to use the

protocol. Then the researcher collected data by reviewing charts of patients that are admitted to the ICU. The researcher looked through the chart for nurse's notes, respiratory care notes, lab values, vital signs, radiology reports and physician's orders and notes. After both parts of the study were complete, data analysis was done. A Gantt chart is included in Appendix D describing the time frame of the whole research study.

Instruments

A demographic survey was used to collect information on the subjects. The survey was comprised of several questions developed by the researcher. A data collection flow sheet was used by the researcher to collect data on all patients. The flow sheet consists of data describing the characteristics of VAP, duration of mechanical ventilation, co-morbidities, APACHE II score, and type of weaning used. See Appendix C for complete data collection flow sheet. APACHE (Acute Physiology and Chronic Health Evaluation) II is used as a classification system for patients in the ICU. Patients are assessed by physiologic scores and evaluation of chronic health status. The results are used to predict the mortality rate for patients in the ICU (Institute for Algorithmic Medicine, 2007). APACHE II score sheet is included in Appendix E.

Data Analysis

For the purpose of this study, the level of significance was set at $p < 0.05$. Descriptive statistics were used to characterize the sample. These types of statistics include the mean and standard deviation and summarize the data (Polit & Beck, 2004). Univariate analysis of the data was done to show the distribution of the different variables. The historical and weaning protocol groups were compared on the incidence of

VAP by using cross tabulation. The independent *t*-test was used for testing differences in group means (Polit & Beck, 2004). Independent t-test were used to see if there were any differences between the groups APACHE II scores and total number of ICU days. Variables from the demographic survey included age, gender, ethnicity, marital status, employment status, and diagnosis. The APACHE II scores, presence of VAP, weaning protocol used, and total number of hours on ventilator are all variables that are found on the data collection flow sheet.

Chapter Four

The final chapter of this thesis includes the analysis of the data collected and discussion of the results of the study. This chapter also includes the implications of nursing practice and the need for further research.

Data Analysis

The data from the demographic questionnaire and the data flow sheet were entered into a computer database and analyzed using Statistical Package for the Social Sciences (SPSS) computer program version 13.0 for Windows. The data were analyzed to accomplish the specific aims of this study. A total of 186 charts were reviewed. After the charts were reviewed only 81 subjects were eligible for the study. The number of subjects in the 2006 historical group was 37 (n = 37) and for the 2007 group was 44 (n = 44).

Demographic Data

Demographic data were obtained by using a questionnaire that the researcher made for the purpose of this study. Information for the demographics was gathered when the chart was reviewed. The data is reported in Table 1. The majority of the subjects were 51-70 years of age (n = 41, 51%), male (n = 42), and Caucasian (n = 79). Thirty-one subjects were married, twenty-one single, fifteen divorced, and fourteen widowed. Most subjects were unemployed (n = 54); with fifteen subjects employed and twelve retired. The number of subjects by diagnosis was as follows: Pulmonary (n = 56), Neurological (n = 10), Trauma (n = 7), Surgical (n = 6), and Cardiac (n = 2).

Table 1: Demographic Data

Age Years	N (%)	Gender	N	Ethnicity	N	Marital Status	N	Employment	N	Diagnosis	N
18-30	7 (9%)	Male	42	White Caucasian	79	Single	21	Unemployed	54	Pulmonary	56
31-50	20 (25%)	Female	39	African American	1	Married	31	Employed	15	Cardiac	2
51-70	41 (51%)			Other	1	Widow	14	Retired	12	Trauma	7
71 or >	13 (16%					Divorced	15			Surgical	6
										Neurological	10
Total	81		81		81		81		81		81

Results

Results of this study provided information on the use of a nurse-respiratory weaning protocol on the incidence of ventilator-associated pneumonia and the duration of mechanical ventilation at in one ICU at a southern West Virginia hospital. The two specific aims of this study will be discussed in the following paragraphs. Ancillary findings will also be discussed later in this section.

Effectiveness of Timely Extubation

Independent *t* test showed no significance differences (p = >0.05) between Group 2006 and Group 2007 on the number of hours intubated (Table 2). In the 2006 historical group (n = 37) a mean of 191 hours with a standard deviation of 24 was found. The 2007 group (n = 44) the mean number of hours intubated was 234 with a standard deviation of 31.

Table 2: Comparison of Number of Hours Intubated by Group

Group	N	Mean	SD
2006	37	191	24
2007	44	234	31

Incidence of Ventilator-associated Pneumonia

Cross tabulation was done to compare the groups on the incidence of VAP. No statistical significance was shown when the data were analyzed (Table 3). In 2006 the weaning protocol was not used and eight subjects developed VAP and 29 did not. In 2007, four subjects developed VAP and the weaning protocol was used compared to three developing VAP when the weaning protocol was not used. Fifteen subjects in 2007 were weaned using the weaning protocol and did not develop VAP and 22 were weaned not using the protocol and did not develop VAP.

Table 3: Cross tabulation VAP and Protocol

Group		Protocol	No Protocol	Total
2006	VAP	0	8	8
	No VAP		29	29
2007	VAP	4	3	7
	No VAP	15	22	37
Total		19	25	44

Ancillary Findings

The researcher also looked at comparing the APACHE II scores by group using independent *t* test (Table 4). When the data were analyzed, it showed no significance difference ($p = >0.05$) between the groups. In 2006, the APACHE II score was 17.35 with a mean of 5.44. In 2007, the score was 17.50 with a mean of 7.37.

Table 4: Comparison of APACHE II Scores by Group

APACHE II Group	APACHE II	Mean	SD
2006 (N=37)	17.35	5.44	0.894
2007 (N=44)	17.50	7.37	1.111

When the data were analyzed using independent *t* test for the comparison of the number of days the subjects stayed in the Intensive Care Unit, no statistical significance difference (p = > 0.05) was shown. The mean number of days spent in the ICU by subjects in 2006 was 13 and 14 in 2007.

Table 5: Comparison of Number of Days in ICU by Group

Group	N	Mean	SD
2006	37	13	7.0
2007	44	14	8.0

The researcher also looked at the correlation of APACHE II scores and the number of days spent in the ICU for the whole study by using Pearson r two tailed test (Table 6). The test showed a level of significance (p = 0.045). A positive correlation between APACHE II scores and number of days in the ICU were shown. For both groups (N = 81) a mean APACHE II score of 17 and the mean number of days 13 was shown. The study revealed that as APACHE II scores increased, the number of days in the ICU increased for both groups.

Table 6: Correlation of APACHE II Scores and Number of Days in ICU

APACHE II Scores	N=81	Mean Score=17	Minimum Score= 4 Maximum Score=33
ICU Days	N=81	Mean Days =13	Minimum Days=3 Maximum Days=34

Discussion

The purpose of this study was to show that using a nurse-respiratory driven weaning protocol would decrease the duration of time patients spent on mechanical ventilation and the incidence of VAP. The study did not show statistical significant differences in the duration of time spent on the ventilator and the incidence of VAP; however, it is important to nursing. It is important to nursing because nurses can feel a level of satisfaction by helping their patients. It also can provide an interest for nurse researchers to study this topic in other hospitals. When the data were reviewed in 2007, one less VAP was shown. This may not be statistically significant, but it is clinically. One less VAP means health-care costs are lowered and nurses have helped a patient adapt to their environment and heal quicker. The patient will be able to achieve Roy's integrated adaptation level and meet their own needs without depending on machines.

Limitations

Several limitations of this study existed. One limitation of this study was the type of design. This study was not a true experimental study and could only show a relationship not causation. Another limitation was that chart reviews were done. The researcher had to assume what was documented was correct and what was not documented was not done. A third limitation was the sampling design. The sampling design was convenience which in general is not the preferred approach. This type of design does not allow for randomization.

The acceptance of using the nurse-respiratory weaning protocol was a big limitation to this study. Physicians and residents would rather write their own weaning

orders than use this protocol. Also some nurses did not make the residents use the weaning protocol and followed different orders. The last limitation the researcher found was this study can not be generalized due to the small size of the subjects and that the study only took place in one ICU in one hospital.

Implications for Nursing Practice and Further Research

This study may not be statistically significant but is clinically important in future testing of the duration of mechanical ventilation and incidence of ventilator-associated pneumonia. Increased duration of mechanical ventilation and the incidence of VAP are linked with increased health-care costs, length of stay, and mortality. A reduction of ventilation time, any amount, could improve outcomes of these patients. Patients will be able to adapt faster to their environment and go from being in a comprised level to the integrated level quicker.

The use of a structured weaning protocol may also decrease clinical judgment bias. The hospital where the study took place experienced a change in resident physician staff every month. The consistent use of a weaning protocol could assist new residents to develop a more structured approach to the ventilator weaning process.

Since the use of the weaning protocol was not adhered to during this research, education to the staff and physicians is needed on the importance of using a standardized weaning protocol. McLean et al. (2006) developed the Model for Accelerating Improvement to improve the adherence to the hospital's weaning protocol. After the study was implemented adherence to the use of the weaning protocol went from 1.6% to 21.2%. This program could be used in the researcher's hospital to improve the use of the

weaning protocol.

This study was a non-experimental research study. Further research is warranted. True experimental studies are needed to strongly support the hypothesis that weaning protocols decrease the duration of mechanical ventilation and incidence of VAP. Future research could also study to see if the use of a standardized weaning protocol decreases other variables. Research could be done to see if the use of a weaning protocol decreased health-care costs related to ICU stay, lab cost, and hospital stay. Another variable that could be researched is the incidence of pressure ulcers. Patients on mechanical ventilation are not being mobilized due to sedation. Prolonged ventilation leads to pressure ulcers. Research on weaning protocols and the incidence of pressure ulcers would be beneficial to nurses and to patients. Patient's mortality and morbidity on mechanical ventilation could also be researched. The research could compare patient's mortality and morbidity rates on being weaned with and without a standardized weaning protocol. According to Guentner et al. (2006) mortality rates of patients who require prolonged mechanical ventilation are 33% to 44% during the 12 months after they are discharged from the ICU. Research guided by Roy's Adaptation theory would be warranted to see if patients go from the comprised level to the integrated level quicker with the use of a weaning protocol.

Nurses at the bedside could use this research to improve patient and family satisfaction. With the increasing knowledge of patients and family members on which is the "best" hospital to go to, nurses using research to guide their practice can help to improve satisfaction. This would be done by helping patients adapt faster and reduce the

time spent on mechanical ventilation. Patients and family members will be happier if complications such as VAP are not contracted by the patient.

Conclusion

Mechanical ventilation is a common intervention used in critical care areas for patients who develop respiratory distress or failure. Unfortunately, ventilator-associated pneumonia is a frequent occurrence in patients who are mechanically ventilated. Previous research has shown the costly and sometimes deadly effects of VAP. Fortunately, research also shows how to reduce the incidence of VAP. One way is to use a weaning protocol to decrease ventilation days.

This study was designed to show the efficacy of a nurse-respiratory weaning protocol in a southern West Virginia ICU. The study integrated Roy's Adaptation Model to show that adaptation of the patient is vital if VAP is to be reduced. A patient can not adapt to the situation and environment if they are critically ill. Nurses will be able to assist patients in their time of illness adapt from a compromised level to an integrated level of health by understanding that using a standardized weaning protocol is beneficial to their patients.

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Appendix A

Weaning Protocol

Cabell Huntington Hospital

Weaning of Mechanical Ventilation: Routine Orders for Adult Patients

Directions: 1. **Mark through the item you do not wish to order**
2. **Indicate choice when options are available by placing a check (√) in the parenthesis**

Weaning of Mechanical Ventilation: Routine Orders for Adult Patients
1. Ventilator Settings: Begin Trial with most recent orders for settings OR ( ) Change Ventilator Settings to those below:
Mode:_____ Rate:_____ Tidal Volume:_____ FIO_2:_____ PEEP:_____ Pressure Support:_____
2. Monitoring: VS every 15 minutes through 1 hour after weaning trial, then routine for unit
3. Activity: Continue Bedrest with HOB elevated 45 degrees; Stop Passive ROM until after Weaning Trial
4. Oral Care: Mouth care and oral suctioning prior to starting Weaning Trial
5. Respiratory Care: If Nebulized medication is ordered, administer prior to starting Weaning Trial
Nursing or Respiratory Care to suction as needed for congestion or secretions (maintaining closed system)
Ventilator weaning parameters and lung mechanics, measured during sedation vacation*
6. Nutrition:
Stop tube feedings until after Weaning Trial. Resume 1 hour after failed Trial or get new orders for extubated patient
Nasogastric tube to low intermittent suction during Weaning Trial **OR**
Aspirate Nasoduodenal tube for residual and clamp until Weaning Trial completed
7. Diagnostic Studies:
Arterial blood gases at start of Weaning Trial (unless ABGs from today available on same settings)
Arterial blood gases after 30 minutes of mechanical ventilation and PRN for change in status
8. Medications: Stop Sedation at least one hour before beginning weaning trial until patient is able to cooperate
Continue indicated Pain Medications for adequate pain control
9. Modified t-piece Trial: CPAP 5cm, pressure support 5cm, inspired oxygen to maintain saturation of at least 92%
Stop Weaning Trial and resume previous ventilator settings if patient fails by protocol criteria below.
Obtain arterial blood gases after 30 minutes of spontaneous breathing. Notify physician of results.
10. Weaning Trial Failure: If patient fails the Weaning Trial by protocol criteria, resume previous ventilator settings.
If patient doesn't fail, but looks marginal, request that the physician order another 30 minute breathing trial
11. Weaning Trial Success: If patient meets protocol criteria for success, request physician order for extubation
Assemble equipment and supplies for re-intubation at bedside.
If patient appears stable, request a physician order, suction and extubate patient
12. Post-extubation Orders:
Place on appropriate O_2 device and titrate by 1 liter per minute or 5% increments until O_2 sat is 95% or greater
Continue any nebulized medication treatments
Stop previous orders for sedation, pain medication and paralytics and request that any required meds be re-ordered
Continue close observation for signs of fatigue or ventilatory failure and notify physician of any significant changes

( ) Verbal Order Verification

Physician's Signature:_____ Date/Time:_____

***Criteria for Modified t-piece Trial of Spontaneous Breathing**
Negative inspiratory force of 20cm or more
Spontaneous respiratory rate of less than 30 breaths per minute
Spontaneous tidal volume or 300ml or over 5ml/kg
Vital capacity over 10ml/kg
Minute ventilation less than 15 liters per minute resting
Inspired oxygen requirement 50% or less
Positive end expiratory pressure 5cm or less
Glasgow coma scale of 8 or greater
Cough or gag reflex present
PO2:FiO2 ration greater than 200
Rapid shallow breathing index of 100 or less
Hemodynamically stable off pressors
Primary breathing disorder stable or improving

Weaning Trial Protocol Criteria for Failure
Signs and symptoms of respiratory distress
Respiratory rate greater than 30 per minute
Heart rate greater than 120 or less than 50 per minute
Change in blood pressure of 20mm systolic or 10mm diastolic
Inspired oxygen requirement greater than 60%
Carbon dioxide retention of 45mm Hg or above baseline

Patient Identification

CHH-1275
Originated: 5/2006

Appendix B

Demographic Survey

Please circle the answer that most applies to you:

Age
18-30 years old
31-50 years old
51-70 years old
71 years or older

Gender
Male
Female

Ethnicity
Caucasian
African American
Other

Marital Status
Single
Married
Widow
Divorced

Current employment status
Unemployed
Employed
Retired

Diagnosis
Pulmonary disorder
Cardiac disorder
Trauma
Surgical diagnosis
Neurological disorder

Appendix C

Data Collection Tool

ID #	
Attending physician	
Apache II score	
Admitting Diagnosis	
Reason for intubation	
Date/Time intubated	
Date/Time extubated	
Total # of hours	
Airway type/size	
Co-Morbidities	
Smoker Y/N	
Packs per day	
Presence of pneumonia/infection	
at time of intubation	
WBC count	
culture	
Xray	
Temperature	
Antibiotic used Y/N	
Name of Antibiotic	
Start Date	
End Date	
Presence of pneumonia/infection	
at time of extubation	
WBC count	
culture	

Xray	
Temperature	
Ventilator Settings time after intubation	
Setting at start of weaning	
Weaning Protocol used: Y/N	
Weaning Parameters	
NIF	
Resp.rate	
Tidal Volume	
Vital Capacity	
Minute ventilation	
Rapid shallow index	
Oxygen requirement	
T-Piece trial Y/N	
Glasgow coma score	
ABG results before extubation	
ABG results after extubation	
Weaning Trial Success Y/N	
Number of times Weaning attempted	
Planned vs Self Extubation	
Total # days in ICU	

Appendix D

Gnatt Chart

Tasks	January - July 2007	September- August 2008	August – October 2008
1. Obtain IRB approval 2. Identify problem, review Literature, Choose Framework and instruments, 3. Complete ch. 1 and 2.	**X**		
1. Collect retrospective/prospective research data 2. Record data on flow sheet		**X**	
1. Code data 2. Complete statistical analysis 3. Complete ch. 3 and 4			**X**

Appendix E

APACHE II Criteria	Patient Results
Age in Years	
History of severe organ insufficiency/	
Immunocompromised	
Temperature (Celsius)	
Mean arterial pressure (mmHg)	
Heart rate	
Respiratory rate	
Oxygenation	
Arterial pH	
Serum Sodium (mMol/L)	
Serum potassium (mMol/L)	
Serum Creatinine (mg/100ml)/ARF, CRF	
Serum BUN	
Hematocrit (%)	
White Blood count (total/cubic mm in 1000's)	
Serum Glucose	
Serum Albumin	
Serum Bilrubun	
24hr Urine Output	
Glasgow Coma Score	

APACHE II Score Sheet

Assessment
0-4 ~ 4% death rate
5-9 ~ 8% death rate
10-14 ~ 15% death rate
15-19 ~ 25% death rate
20-24 ~ 40% death rate
25-29 ~ 55% death rate
30-34 ~ 75% death rate
>34 ~ 85% death rate

Age in years
0 = under 44
2 = 45-54
3 = 55-64
5 = 65-74
6 = over 74

History of severe organ insufficiency or immunocompromised?
5 = Yes, and non-operative or emergency post-op patient
2 = Yes, and elective post-op patient
0 = No

Temperature (Celsius)
4 = over 40.9
3 = 39 – 40.9
1 = 38.5-38.9
0 = 36-38.4
1 = 34-35.9
2 = 32-33.9
3 = 30-31.9
4 = below 30

Mean arterial pressure (mmHg)
4 = over 159
3= 130-159
2 = 110-129
0 = 70-109
2 = 50-69
4 = below 50

Heart rate
4 = over 179
3 = 140-179
2 = 110-139
0 = 70-109
2 = 55-69
3 = 40-54
4= below 40

Respiratory rate
4 = over 49
3 = 35-49
1 = 25-34
0 = 12-24
1 = 10-11
2 = 6-9
4 = below 6

Oxygenation (use PaO2 if FiO2 is less than 50% otherwise use A-a gradient)
4 = A-a gradient over 499
3 = A-a gradient 350-499
2 = A-a gradient 200-349
0 = A-a below 200 (if Fio2 over 49% or pO2 more than 70 if FiO2 less than 50%
1 = pO2 61-70
3 = pO2 55-60
4 = pO2 below 55

Arterial pH
4 = over 7.69
3 = 7.60-7.69
1 = 7.50-7.59
0 = 7.33-7.49
2 = 7.25-7.32
3 = 7.15-7.24
4 = below 7.15

Serum Sodium (mMol/L
4 = over 179
3 = 160-179
1 = 155-159
0 = 130-149
2 = 120-129
3 = 111-119
4 = below 111

Serum potassium (mMol/L)
4 = over 6.9
3 = 6-6.9
1 = 5.5-5.9
0 = 3.5 – 5.4
1 = 3-3.4
2 = 2.5- 2.9
4 = below 2.5

Serum Creatinine (mg/100ml)
8 = over 3.4 and Acute renal failure
6 = 2.0-3.4 and Acute renal failure
4 = over 3.4 and Chronic renal failure
4 = 1.5-1.9 and Acute renal failure
3 = 2.0-3.4 and Chronic renal failure
2 = 1.5-1.9 and Chronic renal failure
0 = 0.6-1.4
2 = below 0.6

Hematocrit (%)
4 = over 59.9
2 = 50-59.9
1 = 46-49.9
0 = 30-45.9
2 = 20-29.9
4 = below 20

White Blood count (total/cubic mm in 1000's)
4 = over 39.9
2 = 20-39.9
1 = 15-19.9
0 = 3-14.9
2 = 1-2.9
4 = below 1.0

15 minus the Glasgow Coma Score _____

Total Score _____

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Education

June 2006 – present Marshall University Huntington, WV

Obtaining a **Master of Science in Nursing Education**

Jan. 2000 – May 2004 Marshall University Huntington, WV

Bachelor of Science in Nursing

- Graduated Magna Cum Laude
- President's Dean's List
- Historian of the Student Nurse's Association

Professional experience

June 2004 – present Cabell Huntington Hospital Huntington, WV

Registered Nurse

- Staff nurse in the Adult Intensive Care Unit
- Relief Charge nurse

July 2008 – present St. Mary's Hospital Huntington, WV

- Per diem staff nurse in the Medical Intensive Care Unit

June 2005 – Aug 2005 Mountain State University Beckley, WV

Clinical Instructor

- Intensive Care Clinical Instructor

Additional professional activities

Verification in Trauma Nursing Care Course

Certification in Advanced Life Support

Certification in Advanced Burn Life Support

Member of Code Blue Committee at Cabell Huntington Hospital

Preceptor for Graduate Nurses at Cabell ICU

Professional memberships

Sigma Theta Tau International Honor Society of Nursing

American Association of Critical-Care Nurses

Reference

Available on request