AERAT: Evaluating the Effectiveness of the Accidental Extubation Risk Assessment Tool in Identifying Level of Risk for Accidental Extubation

Annette Beebe Hayman

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AERAT: EVALUATING THE EFFECTIVENESS OF THE ACCIDENTAL EXTUBATION RISK ASSESSMENT TOOL IN IDENTIFYING LEVEL OF RISK FOR ACCIDENTAL EXTUBATIONS

Annette Beebe Hayman
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Utilization of the endotracheal tube as a mechanism for maintaining control of airway patency and tissue oxygenation has been a standard of practice in modern critical care medicine. Complications can result from the accidental removal of the endotracheal tube from its proper position. This could lead to many severe ill effects including death. As a result, the prevention of accidental extubation becomes a priority for this patient population. The purpose of the study was to determine the effectiveness of the Accidental Extubation Risk Assessment Tool (AERAT) in identifying the level of risk of the ventilated patient for accidental extubation. The two research hypotheses tested were (1) that there is a relationship between the level of risk identified through utilization of the instrument and the incidence of accidental extubation, and (2) that there is a relationship between each identified risk factor and the incidence of accidental extubation. Betty Neuman's Systems Model was employed as a theoretical framework which addresses the goal of nursing as protecting the basic structure of the intubated patient by identifying stressors that would provoke reaction (risk factors), by preventing stressor invasion (accidental extubation & complications), and by removing stressors that exist. The Accidental Extubation Risk Assessment Tool is an original, two part tool consisting of an assessment portion and a risk factor rating portion. It was designed to assess mechanical, physiological, and psychological factors. Unique to this study is the application of a weighted score to each risk factor designed to correlate with the likelihood that it increases the risk for accidental extubation. Content validity was established through review by 4 physicians and 3 critical care nurses. A prospective,
nonexperimental study design using the risk assessment tool was employed. The
population consisted of hospitalized patients admitted to a Medical-Surgical Intensive
Care Unit who required mechanical ventilation and were at least 18 years of age. A
convenience sampling technique was utilized with no controls for sex, race, education
level, socioeconomic status, or diagnosis. The sample size was 55 patients with 60
episodes of ventilation. Prospective data collection was done on ventilated patients
within 24, 48, and 72 hours of intubation and then weekly from the time of intubation
until extubation, tracheotomy, or death. Retrospective data collection was done on
every patient who experienced an accidental extubation. Data analysis included
frequency distribution and chi-square application. The level of significance was set at
p < .05. In testing the relationship between the level of risk identified and the incidence
of accidental extubation, there were no significant differences between the interval
checks in the groups who experienced accidental extubation and the group who did not.
There was a significant difference between the participants who did not experience
accidental extubation and the level of risk assessed retrospectively in the group that did
experience accidental extubation. In testing the relationship between each risk factor
and the incidence of accidental extubation, there was once again no significant
differences between the interval checks in the groups who experienced accidental
extubations and those who did not. There was again significant differences between the
groups who did not experience accidental extubation and the retrospective assessment
of the group who did experience accidental extubation. However, due to the small size
of the sample and the presence of zero frequency in most of the cells, the validity of the
findings are questionable. As a result, one can only suggest that there are differences
as outlined in the level of risk and the incidence of accidental extubation as well as
differences between specific risk factors and the level of risk for accidental extubations.
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by

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Dedication

This thesis is dedicated to my husband and daughter - Lester L. Hayman, Jr, and Jessica Elizabeth Hayman. Your sacrifices have not gone unnoticed and are deeply appreciated. Thank you for your understanding, patience, and support during the course of my graduate studies and research. None of this would have been possible without both of you to give me strength and inspiration.

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Chapter 1: Introduction

Endotracheal intubation has been utilized to save lives since the 10th century A.D. when silver or gold tubes were used by the Arabs (Orlowski, Ellis, Amin, & Crumrine, 1980). Today, endotracheal intubation is one of the most common procedures performed in the high technological environment of intensive care units across the nation (Rashkin & Davis, 1986; Conrardy, Goodman, Lainge, & Singer, 1976; Coppolo & May, 1990). Many patient populations including neonates, children, and adults require endotracheal intubation in order to maintain patency of the airway as well as to assure adequate oxygenation of tissues. Failure to achieve either one of these patient outcomes could result in death or permanent disability which alters quality of life (Scott, Eigen, Moye, Georgitis, & Laughlin, 1985). However, morbidity and mortality have become associated with this supportive intervention of endotracheal intubation (Orlowski, Ellis, Amin, & Crumrine, 1980). Therefore, it is essential that proper placement of the endotracheal tube be maintained in order to facilitate achievement of positive patient outcomes.

Utilization of the endotracheal tube as a mechanism for maintaining control of airway patency and tissue oxygenation has been a standard of practice in modern critical care medicine (Coppolo & May, 1990). The patient with an endotracheal tube is typically dependent on modern technology to sustain life during a period in which he or she is unable to do so. As a result, the endotracheal tube becomes an extension of the patient who may progressively become both physically and psychologically dependent on its existence. Therefore, prevention of complications becomes a priority for this patient population.
Accidental extubation is the unplanned removal of the endotracheal tube from its proper position. Accidental extubation may also be referred to as unplanned extubation. It may be done directly by the patient or occur as a result of spontaneous manipulation of the tube. Complications of accidental extubations include death, respiratory distress, hemorrhage, tracheal/laryngeal injury, hypoxia and subsequent effects on tissue, cardiac dysrhythmias, and hypotension (Scott, Eigen, Moye, Georgitis, & Laughlin, 1985; Coppolo & May, 1990). Any of these complications can result in prolonged hospitalization, prolonged stress for the patient, and increased costs for health care.

Significance

Few nursing studies have been conducted that are related to accidental extubations in the adult population. This is a critical aspect in that it is the nurse who works on a continual basis with the patient in maintaining the endotracheal tube and who through experience in practice has evolved as a clinical expert in its utilization and maintenance. Pursuing the problem of accidental extubations through nursing research will assist in filling the gaps in the existing knowledge base as well as contribute to growth in nursing practice. Furthermore, it will assist the critical care nurse in planning, predicting, and controlling the outcomes of nursing care when caring for patients who have endotracheal tubes in place.

The impact that the study may have on mechanically ventilated patients is that the risk for accidental extubation may be minimized. As a result, the likelihood of experiencing complications related to accidental extubations including death, tracheal rupture, vocal cord damage, aspiration, inadequate oxygenation resulting in permanent damage, and an altered quality of life may be decreased. Decreasing the incidence of accidental extubation may result in a decrease in the complications of therapy and subsequently result in the delivery of a higher level of quality care. Therefore, an impact of the study may be that the standard of care for mechanically ventilated patients will be improved.
Finally, the study could have an impact on the length of mechanical ventilation and hospital stay of patients and therefore affect reimbursement for health care costs. This impact could be significant to facilities where large portions of the patient population are elderly clients and whose health care costs are paid by Medicare which reimburses a predetermined amount of money regardless of the actual cost of care. The results of the study may provide an opportunity for nursing to contribute to decreasing the cost of health care delivery.

Purpose

Although the utilization of technology in health care has impacted life expectancy, it brings great risk to the patient upon which it is used. Any opportunity to decrease risks associated with the use of technology should be seized, studied, and validated. Therefore, the purpose of this study is to determine the effectiveness of an assessment tool in identifying the level of risk of intubated mechanically ventilated adult patients for accidental extubations. It is imperative that this study be conducted so that a mechanism for measuring the risk of accidental extubations can be empirically validated. By identifying the risk level for accidental extubation, the nurse can facilitate interventions that will be effective in preventing accidental extubation.

Theoretical Framework

The Neuman systems model is based on the occurrence of phenomena as a result of the patient interacting with stressors (Mirenda, 1986). According to Neuman (1980), there are three groups of stressors. Extrapersonal stressors are forces that occur externally to the person. Intrapersonal stressors focus on forces within the person and include physiological, psychological, sociocultural, developmental, and spiritual variables. Interpersonal stressors are those that occur as a result of interaction of the person with one or more others.

Neuman views the person as holistic and a composite of five variables - physiological, psychological, sociocultural, developmental, and spiritual. This composite
has a central core structure consisting of basic survival energies that are common to all organisms. The central core is surrounded by three boundaries of (1) lines of resistance (inner most boundary), (2) normal lines of defense, and (3) flexible lines of defense (outer most boundary).

The inner most lines of resistance represent the basic structure and are strengthened by health-oriented prevention measures. If these lines of resistance are not effective, death may occur. The normal line of defense represents adaptation over time. It is the person's steady state and usual state of wellness. It represents the person's baseline status and is used as a standard against which to judge health status at any point in time (Mirenda, 1986). The flexible line of defense is the outermost boundary and is dynamic. This boundary acts as a buffer to stressors that may penetrate through to the normal line of defense. Overall, a person's resistance to any stressor is based on the integrity of the flexible and normal lines of defense, the nature and intensity of the stressor, the internal lines of resistance, and the interrelationship of the five variables (Mirenda, 1986).

Health occurs when the normal lines of defense are stable and the subparts are in harmony with the whole (Lancaster & Whall, 1989). Deviation from normal occurs when illness or wellness results in more energy being expended than stored. As a result, the focus of nursing activities is to help clients conserve energy as they move toward wellness or illness. Neuman's systems model focuses upon two components which are (1) the nature of the person's response to stressors and (2) the reaction (activities) of nursing that promotes response to the stressors (Lancaster & Whall, 1989). Nurses react based on prevention-intervention modes outlined as primary, secondary, and tertiary (Mirenda, 1986).

According to Neuman (1980), the nurse intervenes at any time in which stressors are either suspected or identified. Primary prevention focuses on interventions to retain wellness and strengthen the flexible line of defense. The nurse would carry out a
primary prevention intervention when a reaction had not yet occurred to a stressor but the degree of risk is identified. Secondary prevention focuses on interventions that prioritize and treat symptoms which result in strengthening of the lines of internal resistance. Therefore, a secondary prevention intervention would be carried out following the identification of symptoms due to the stressor. Tertiary prevention occurs after treatment and return of stability. Thus, a tertiary prevention intervention follows the treatment or secondary prevention intervention and involves mobilization and utilization of the patient's energy resources to maintain adaptation (Neuman, 1980). Tertiary interventions maintain the client at the highest possible level of wellness.

Neuman believes that three basic principles must be considered when developing an assessment tool related to the holistic approach. First, a good assessment requires knowledge of all factors that influence the patient. Secondly, the stressor has to have meaning to the patient. Thirdly, the factors which influence the nurse's assessment of the patient's situation must be clear. The accidental extubation risk assessment tool incorporates these principles. Through utilizing the accidental extubation risk assessment tool, the nurse is intervening at the primary prevention level. The tool is utilized to identify the degree of risk or hazard for the stressor of accidental extubation. The goal of nursing focuses on protecting the basic structure (the intubated patient) by identifying stressors that would provoke reaction (risk factors), by preventing stressor invasion (accidental extubation and complications), and by removing stressors that exist (risk factors).

Through this primary prevention intervention, the nurse reacts to strengthen the flexible line of defense in order to prevent the complications of accidental extubations. Through its utilization the tool may assist the nurse in identifying the level of risk for accidental extubation (stressor identification), identifying factors that put the patient at risk (stressor identification), and intervening to remove the risk factor and therefore preventing accidental extubation (stressor invasion).
Research Hypotheses

This study is an investigation of the relationship between (1) the level of risk identified by the assessment tool and incidence of accidental extubation and (2) each risk factor identified and the incidence of accidental extubation. Research hypotheses are:

1. There is a relationship between the level of risk identified through utilization of the instrument and the incidence of accidental extubation.

2. There is a relationship between each identified risk factor and the incidence of accidental extubation.

Operational Definitions

1. Endotracheal Tube: A hollow tube used to provide an airway through the trachea (Tabers, 1981). Proper positioning of the endotracheal tube is verified by (1) chest x-ray films in which the tip of the endotracheal tube is below the level of the vocal cords and (2) there are breath sounds on both sides of chest. The exception is in the case of the patient having a pneumonectomy in which there will be breath sounds only on the side of the lung tissue.

2. Extubation: The removal of the endotracheal tube from its position within the trachea.

3. Intentional Extubation: The planned removal of the endotracheal tube from its proper position.

4. Accidental Extubation: The unplanned removal of the endotracheal tube from its proper position (Coppolo & May, 1990). Removal may be done directly by the patient or occur as a result of spontaneous manipulation of the tube. An extubation has occurred when (1) the endotracheal tube is completely out of the mouth, (2) breath sounds cannot be auscultated in the absence of tracheal shift/pneumothorax, (3) the patient can talk or make sounds despite the
endotracheal tube being in the mouth, and/or (4) the endotracheal tube is determined by chest radiology films to be above the vocal cords.

5. **Mechanical Ventilation**: The use of a machine that takes over the patient's work of breathing by coordinating the entry of positive pressure into the lungs with passive expiration. (Springhouse, 1989).

6. **Positive Pressure Mechanical Ventilation**: The process of using a mechanical ventilator to push air into the lungs (opposite of normal physiological function) and allow passive exhalation at the end of a preset volume or pressure. (Springhouse, 1989).

7. **Agitation**: Excessive restlessness with increased mental and physical activity (Tabers, 1981).


9. **Confused**: The state of diminished consciousness, mental slowness, inattentiveness, dulled perception of environment, and incoherent thought process (Bates, 1983).

10. **Excessive Movement of the Head**: Flexion, extension, or hyperextension of the neck/head to the degree that tension is applied to the endotracheal tube and ventilatory circuit.

11. ** Restrained**: The process of physically confining the movement of the extremities or torso (Tabers, 1981).

12. **Ineffectively Restrained**: The state of being restrained which is characterized by the client being able to remove the restraint and/or being able to manipulate the restraint to the point of grabbing the ventilator tubing or endotracheal tube.

13. **Orally Intubated**: The placement of the endotracheal tube into the trachea by inserting the tube through the oral cavity (Tabers, 1981).
14. **Nasally Intubated**: The placement of the endotracheal tube into the trachea by inserting the tube through the nasal cavity.

17. **Length of Intubation**: The time period of having an endotracheal tube in place from the act of intubation until the present time of data collection.

18. **Manipulation**: The ability of the patient or other to move the endotracheal tube either by hands, tongue, head movement or other mechanism.

19. **Excessive Secretions**: The production of oral or pulmonary mucous to the degree that either (1) endotracheal suctioning is required more often than once every 2 hours; (2) the oral cavity requires suctioning more often that every 15 minutes; (3) the tape securing the endotracheal tube (either orally/nasally) becomes gummy and loose due to the oral/nasal secretions.

20. **PEEP**: An acronym for positive end-expiratory pressure. The application of positive pressure to the baseline pressure during the expiratory phase of respiration. Normally, there is no positive ventilation during exhalation (Springhouse, 1989).

21. **Proper Endotracheal Tube Placement by Chest Roentgenograms**: The distance from the distally inserted tip of the endotracheal tube positioned in the airway to the carina as seen on chest x-ray films. The recommended positions are 3 cm ± 2 with head flexed, 5 cm ± 2 with head in neutral position, and 7 cm ± 2 with head extended (Conrady, Goodman, Lainge, & Singer, 1976).

**Assumptions**

1. All patients who are intubated are at risk for accidental extubations. 

2. The likelihood of a patient experiencing accidental extubation is related to the number of risk factors that the patient exhibits. 

3. It is desirable to prevent accidental extubation.
Limitations

1. **Generalizability of findings will be limited as a result of (1) data collection occurring in one institution, (2) the limited size of the sample, and (3) the differences that may exist between institutions in regards to the standards of care for mechanically ventilated patients.**
Chapter 2: Review of Literature

The literature review encompassed 24 studies that were conducted over a time span of 18 years between 1974 and 1992. Topics searched included accidental extubations, unplanned extubations, spontaneous extubations, complications of mechanical ventilation, endotracheal tubes, and the effect of head position on endotracheal tube position. Groups studied included neonates, pediatrics, and adults with the type of study varying from retrospective to prospective to experimental. The researchers in the studies reviewed were physicians, respiratory therapists, and registered nurses with a majority being physicians.

Complications of Mechanical Ventilation

Zwillich, Pierson, Creagh, Sutton, Schatz, and Petty (1974) studied a diverse population of patients over a five month period for complications due to mechanical ventilation. Accidental extubations occurred in 8.47% of the patient population (30 of 354 patients). Associated with those episodes was an increase in the incidence of nosocomial pneumonia. In the study, the overall survival rate of patients requiring mechanical ventilation was 64%. This demonstrates that patients who require endotracheal tubes are at an increased risk for death due to the nature of their illness and therapy. The occurrence of complications such as accidental extubations could further increase this mortality rate. Although it did not lead to decreased survival, accidental extubations was shown to lead to the necessity of reintubation and the hazards associated with it such as hypoxia, seizures, intubation of the right mainstem bronchus, gastric distention, and tension pneumothoraces.
Stauffer, Olson, & Petty (1981) also studied an adult population. A sample of 150 patients were monitored for complications and consequences of endotracheal intubation and tracheotomy. Adverse consequences occurred in 62% of all endotracheal intubations with the most frequent being excessive cuff pressure, accidental extubation (13%), and inability to seal the airway. The overall findings did not support the value of a tracheotomy over an endotracheal tube when intubation was needed over three weeks. There was no significant relationship between the duration of endotracheal intubation or tracheotomy and the overall amount of laryngotracheal damage.

Orlowski, Ellis, Amin, & Crumrine (1980) studied complications of airway intrusion in pediatric patients. The study focused on complications as a result of the process of intubation. Complications occurred in 12 of the 100 patients followed. Although the study did not address subsequent complications such as accidental extubations, findings regarding prolonged intubation could be applied to principles of preventing accidental extubations. The study demonstrated that nasally inserted endotracheal tubes are more easily anchored, have less extraneous movement, and are better tolerated by most patients. This is significant since other studies have implicated excessive movement of the endotracheal tube as a risk factor for accidental extubation. In addition, if the nasally placed endotracheal tube is better tolerated by the patient, it is suspected that the likelihood of excessive movement may be decreased.

Rashkin and Davis (1986) pursued studies regarding acute complications of endotracheal intubation in an adult population of a medical surgical intensive care unit. Their focus was to relate the complications of intubation to individual risk factors. In a sample of 61 patients intubated for more than 3 days, 52 complications occurred with 30 patients (49%) having at least one complication. Complications included cuff leak, pneumonia, stridor, tube malpositioned, aspiration, pneumothorax, and tracheolaryngeal alterations. Of the patients with complications, 29 (48%) required reintubation. Of the 29 patients who were extubated, there were 38 instances of reintubation. Causes for
reintubation included inability to fix cuff leak (32%), respiratory failure after extubation (26%), accidental extubation (18%), stridor (11%), bronchoscopy (8%) and placement (5%). It was noted that when reintubation was indicated after self-extubation, there was a higher incidence of aspiration and pneumonia. Also, it was implicated that the increased rate of complications in the patients who were reintubated could be related to the failure of the tube, accidental extubation or generally poor condition. The significance of this study is that it reiterates the impact that the risk for accidental extubation has on patient outcome and quality of care.

Benjamin, Thompson, & O'Rourke (1990) looked at the complications of mechanical ventilation in a multidisciplinary intensive care unit in a children's hospital. During a 12 week period, 204 patients ranging in age from newborn to 24 years were prospectively studied by respiratory therapists. Accidental extubation had an incidence of 3 per 100 ventilated patients and 0.6 per 100 ventilated days. The study was limited in that it was simply concerned with quantitative data with little assimilation of findings beyond that.

Endotracheal Tubes

Ripoll, Lindholm, Carroll, & Grenvik (1978) tested experimental polyvinylchloride endotracheal tubes in 18 intubated adult patients. It was discovered that six (33%) of these patients were able to extubate the trachea despite firm fixation of the endotracheal tube. All of these patients were orally intubated. Initially, it was believed that the causes of the extubations included chewing, coughing, moving the head and manipulating the tube with the tongue. Recommendations of the study focused on the nature of the endotracheal tube as the primary causative factor. Ripoll, Lindholm, Carroll, & Grenvik followed up their study by reviewing future cases of accidental extubations. One case studied was a patient who deteriorated after elective surgery and experienced cardiopulmonary arrest and unresponsiveness as a result of accidental extubation. The incident leading to the accidental extubation was concluded to be movement related to
the placement of a film cassette behind the back for radioscopic examination of the chest. The patient died within twelve hours. The study reiterates the critical aspect of identifying predisposing conditions for accidental extubations and intervening in a timely matter to prevent irreversible damage or death.

Based on the findings of the previous study, Ripoll, Lindholm, Carroll, & Grenvik (1978) designed an experimental study using a lung model with a specially designed translucent trachea. The trachea was treated in a fashion that replicated the natural trachea. The group applied intermittent positive-pressure ventilation with a peak inspiratory pressure of 30 cm H₂O. Additional experiments were performed with peak pressures up to 50 cm H₂O as well as with the addition of PEEP up to 20 cm H₂O. Their findings showed that damage to the larynx and trachea occurred as a result of prolonged endotracheal intubation. In addition, it was noted that positive pressure ventilation tended to dislocate modern polyvinylchloride tubes and the risk of spontaneous tube dislocation increased considerably when the endotracheal tube material was too soft. They also discovered that flexion and extension of the neck as well as lateral tilting of the head changed the position of the tip of the endotracheal tube as much as 2 cm closer to or further from the carina. Recommendations from these two studies were that accidental extubations could be prevented by (1) utilizing the nasal route for intubation, (2) vigilant observation of patients during procedures requiring flexion and extension of the neck, (3) making the oral part of the endotracheal tube stiffer, (4) being aware of increasing distances between the endotracheal tube tip and the carina on successive x-ray films, and (5) developing a specific tube for oral intubation that is more specific for the related anatomy.

Conrardy, Goodman, Lainge, & Singer (1980) studied alterations in the endotracheal position with movement of the head in 20 adult patients with an 8.0 mm endotracheal tube. Findings confirmed previously mentioned studies that head movement does significantly change the position of the endotracheal tube. The
endotracheal tube moves down with head flexion and up with head extension. The researchers recommended that the endotracheal tube be placed in the middle third of the trachea with the neck in the neutral position. They also recommend that the distance between the endotracheal tip and the carina on chest radioscopic films be 3 cm ± 2 when the head is flexed, 5 cm ± 2 when the head is neutral, and 7 cm ± 2 when the head is extended. The findings also suggested that accidental extubations may result from changes in head position despite what appears initially to be correct positioning.

In response to an increasing occurrence of accidental extubations in their practice setting, Rehm & Ross (1991) built upon the study of Ripoll, Lindholm, Carrol, & Grenvik (1978) and instituted a protocol utilizing a preshaped, stiff Berman oropharyngeal airway taped to the orotracheal tubes and then to the patient's face. The study was conducted over 37 days. Findings showed that no spontaneous extubations occurred in the 34 patients that the protocol was utilized. However, 3 accidental extubations occurred in 14 patients that did not have the device during the same time frame. Although successful in preventing accidental extubations, three of the patients using the device developed pressure ulcers and therefore resulted in the discontinuation of the device. Recommendations from this study include monitoring placement of endotracheal tube by radioscopic examination, investigating cuff leaks promptly, careful taping methods, and documenting the tube level at the teeth.

Accidental Extubations

Todres, deBros, Kramer, Moylan, & Shannon (1976) studied 16 newborn infants for endotracheal displacement during mechanical ventilation as a result of changes in head position. They recognized that correct placement of the endotracheal tube is critical and any displacement could jeopardize the safety of the newborn. The study documented that simple flexion or extension of the newborn's head was sufficient enough to displace the endotracheal tube and require repositioning. Mortality of the population due to accidental extubation was not discussed. Although the sample was
neonates, these principles of physiology are applicable to the adult population as well. The relevance of this study is that movements which are a routine part of daily activity - head flexion and extension - are critical to the intubated patient and could be the critical difference between achieving and not achieving the desired patient outcome of patent airway and adequate tissue oxygenation.

Scott, Eigen, Moye, Georgitis, & Laughlin (1985) recognized that accidental extubations could be fatal as a result of associated complications. The group, in addressing the critical problem, altered the focus of previous studies and designed a study towards determining the predictability and consequences of accidental extubations. The population studied was pediatric patients. In an eight month period, 204 patients were monitored for eleven risk factors related to accidental extubations. The overall accidental extubation rate was 13.2%. Analysis demonstrated that there were four risk factors that had good discriminating power for accidental extubation versus intentional extubation. Taking these four factors - patient age, amount of secretions, endotracheal tube slippage, and state of consciousness - the group collected data on an additional 45 patients. In this second group, accidental extubations occurred in seven patients (15.5%). The tool identified 100% of these patients as having a high risk of accidental extubation. There was a mortality rate of 12% among patients who extubated themselves. However, none could be directly attributed to the accidental extubation. Level of consciousness was a factor in 52% of the accidental extubations. Medical personnel were at the patients bedside in 67% of the events and patients were restrained in 88% of the events. The study was successful in identifying several risk factors that correlated highly with pediatric patients who experienced accidental extubations. However, subsequent measures for identifying a mechanism to evaluate those risk factors was not pursued.

Brown (1988) recognized that accidental extubations in an ill newborn could result in rapid deterioration and a difficult recovery. Brown performed a prospective
study to compare the rate of extubation in newborns to taping methods and utilization of restraints. In a sample of 206, the incidence of accidental extubations was 32% (94) for the patient population and 4.4 per 100 ventilated days. Mortality for this population was not discussed. Risk factors for accidental extubations in newborns that were identified as a result of this study were the time of intubation, the level of agitation, endotracheal tube suctioning, movement of head, chest physiotherapy, the amount of tube between lip and adapter, and endotracheal tube taping method. The most significant factor predicting extubation was time of intubation (p<.0001) and the next most significant was taping methods (p<.02). Brown recommended that special attention to taping methods could prevent several factors from leading to accidental extubations.

Liu, Sultan, & Caangay (1989) took recommendations of the study by Brown (1988) and retrospectively reviewed 37 neonatal patients undergoing mechanical ventilation to determine if similarities in findings existed in their facility. The incidence of accidental extubations in a two year period in a sample of 37 neonates was 32% (12) or 3.0 extubations per 100 intubated days. Only 4 of the patients accounted for all 12 of the extubations. Findings were consistent with Brown's in that the method of taping the neonate's endotracheal tube was significant in reducing accidental extubations.

Hummel and Kleiber (1989) published two perspectives of a study they conducted. The first perspective was a meta-analysis of studies concerning accidental extubations in neonate populations to discern the special needs and risk factors that contribute to accidental extubations. The analysis discussed route of intubation, complications of endotracheal tubes, study designs, complications of accidental extubations, taping methods for endotracheal tubes, and factors associated with spontaneous extubations. Findings of Hummel and Kleiber's analysis concluded that accidental extubations occurred less often when the nasal route for intubation was employed, that complications of accidental extubations were severe and could be fatal, and that head and neck movement during the period of intubation was significant in the
occurrence of accidental extubations. Also, an analysis of limitations of the studies revealed that accidental extubation was rarely operationally defined, that the relationship of age to incidence was not delineated, that populations were limited in some cases, and that statistics used to identify the incidence of accidental extubations were inconsistent. This analysis by Hummel & Kleiber is significant in guiding the design of future studies in order for generalizability of findings to be increased.

The second perspective by Kleiber & Hummel (1989) was the study that they conducted in a neonate population to describe circumstances accompanying accidental extubations and identify factors that could be used to predict accidental extubations. In a sample of 197 neonates, accidental extubation occurred 53 times (26.9%) or 3.3 per 100 intubated infants. Complications of accidental extubation that occurred were bradycardia (39%) and cardiopulmonary arrest (5.6%). It is also important to note that medical personnel were at the clients bedside in 75% of the events and a patient care procedure was in progress in 53% of the events. Kleiber & Hummel concluded that it is difficult to predict which infants will experience accidental extubation and therefore all intubated infants must be considered to be at risk. Weight, age, activity, position, and oral secretions were not predictors for accidental extubations. Recommendations for future studies included noting the position of the infants head immediately prior to extubation and decreasing the subjectivity of data collection.

Coppolo and May (1990) studied accidental extubations over a 12 month period in an adult population. The overall incidence for accidental extubation was 11% (12) in a sample of 112. Although none of the patients died, 31% experienced complications such as hypoxia, atrial flutter, supraventricular tachycardia, hypotension, myocardial infarction and respiratory failure which could have affect the length of stay and patient outcome. The study compared characteristics of patients who experienced accidental extubations with those who experienced therapeutic extubations. The study did not reveal significant risk factors for accidental extubations. However, 69% of the accidental
extubations were self-induced despite the utilization of sedation and restraints. Also, 70% of the accidental extubations were in patients who had been intubated for less than 48 hours and 31% occurred during episodes of coughing, movement of the head, or repositioning of the patient.

Little, Koenig, & Newth (1990) performed the largest prospective study found on factors affecting accidental extubations in the neonatal and pediatric populations. The study was conducted over three years and had a sample size of 2,200 patients with an incidence of 195 (8.8%) accidental extubations. There were 0.9 accidental extubations per 100 ventilated days. Mortality as a result of accidental extubations was 0.5% (1 in 195). Factors shown to be the most critical to the occurrence of accidental extubations were: (1) sedation not being administered in the two hour period preceding the event (65%), (2) the lack of utilization of two-point or more restraints (58%), and (3) the occurrence of a procedure on the patient (49%). This is the first study to strongly tie the relationship of sedation and restraints to the incidence of accidental extubation.

Pesiri, Stewart, Kobe, & Stewart (1990) were prompted to study the causes of accidental extubations and developed a protocol for prevention. Data were obtained from both chart review and from 17 other regional hospitals related to routines of intubation and intubated patients. During data collection, it was noted that the documentation of the events leading up to accidental extubations was poor. Findings showed that 60% of accidental extubations occurred during the first seven days of intubation. Categories of patients at high risk for accidental extubation identified by the researchers were patients: (1) with apnea, (2) on neuromuscular blockade therapy, (3) on PEEP therapy, (4) who were difficult intubations, and (5) who were highly agitated and confused. Also, inadequate sedation and ineffective restraining methods were identified as causative factors. The incidence of extubation increased when the taping method of securing the endotracheal tube was poor and when it was performed by one person. When the endotracheal tube was longer than two inches beyond the fixation device, it
was likely that the tube acted as a fulcrum which facilitated extubation. Excessive weight of an unsupported ventilator tubing was identified as a source of traction on the endotracheal tube and facilitated extubation. Finally, underinflation of the endotracheal cuff was identified as a factor that increased the potential for increasing extubation. A recommendation of this study was a twelve step protocol for reducing the incidence of accidental extubation that incorporated the forementioned factors.

More recent studies were done by Ellstrom, Brenner, & Williams (1991), Eberts & Taggart (1991), and Bizek, Feeman, Natale, & Kruse (1991). In the study by Ellstrom, Brenner, & Williams, there were 35 (21%) accidental extubations in 170 intubated patients. The patients extubated themselves in 57% of the cases. Greater than 90% of the extubations occurred with the nurse out of the room and 11% occurred during patient care procedures. In the study by Eberts & Taggart, there was a sample of 532 intubated patients in which 31 (5.8%) were accidental extubated. Of these patients, 80% were restrained and 54% were restless. Of those that were restless, 65% had not been sedated within two hours of the accidental extubation. Bizek, Feeman, Natale, & Kruse documented the incidence of accidental extubation in their study as being 290 accidental extubation events during a 29 month period with 39 (13%) of those events being the result of nurse dependent factors which were not defined.

The latest studies completed continue to focus on the potentially life threatening complications that could occur as a result of accidental extubations and the need to discover mechanisms for prevention. O'Neill (1992) studied accidental extubations in patients in an adult Medical-Surgical ICU who had been intubated for more than 48 hours. The sample of 85 patients required 95 intubation episodes and had a mean duration of intubation of 7.5 days. Accidental extubations occurred 10 times in nine patients with an incidence of 10.5% and 1.36 per 100 patient days. The accidental extubations occurred after a mean of 5.5 days on the ventilator. The study revealed no difference between sex, age, duration of ventilation, or time of day in determining if a
patient would experience an accidental extubation. Seven of the 10 patients did require immediate reintubation.

Whelan, Simpson, & Levy (1992) did a two year retrospective study on accidental extubations but did not describe their population. There were 23 accidental extubations in 22 patients. Eighteen of those patients required reintubation. The significance of this study is that the researchers questioned whether or not patients who were accidentally extubated needed to be mandatorily reintubated and discovered that reintubation was not necessary indicated. In addition they recommended that these findings be validated through prospective studies. Brown, Gau & Touleimat (1992) studied the incidence of accidental extubations in a primarily adult population in a Medical-Surgical ICU. It was prospective in nature and occurred over a seven month period. Forty seven accidental extubations occurred in 424 patients with an incidence of 8.7%. Reintubation was required in 55% of the cases. The researchers looked at factors such as level of consciousness and the timeliness of the administration of sedation in relation to the accidental extubation. They recommended that better sedation, improved techniques for taping the endotracheal tube, and closer observation of patient manipulation of the tube be followed as potential ways to decrease the incidence of accidental extubation.

Seudeal, Garner, & Kaye (1992) did a two year prospective study in a Medical Surgical ICU and looked at 1338 ventilated patients. The average ventilation period prior to accidental extubation was 8 days with a median of 5. There were 92 accidental extubations in 68 patients - an incidence reported of 6.9%. Of those, 61 (66%) required reintubation. Of the patients who experienced accidental extubations, 68% occurred between the hours of 6:00 am and 6:00 pm, 71% were restrained, 62% were agitated, and 69% were witnessed. No significant relationship was found between the incidence of accidental extubation and age, gender, Apache score (which rates severity of illness), ventilation day, magnesium levels, phosphorus levels, albumin level or hemoglobin. The significance of this study is that the researchers recommended that a defined standard
of care be established for the ventilated population. The study also documented that there was an increased mortality association with accidental extubation.

Finally, Sessler, Listello, & Nguyen (1992) studied an adult population in a Medical-Surgical ICU and took a slightly different perspective. They reported that 56 patients experienced unplanned extubations. Using this same sample of patients, they looked to determine if reintubation was actually indicated. Common parameters in reintubated patients were identified and included: (1) a lack of improvement in the patient's status since initial intubation, (2) a temperature greater than 101°F, (3) a heart rate greater than 120 beats per minute, (4) a moderate to severe amount of secretions, (5) PaO₂/FIO₂ less than 250 mmHg, (6) an arterial pH greater than 7.45, (7) PEEP levels greater than 5 cm H₂O, and (8) the mode of ventilation being an IMV greater than 4 breaths/minute or inspiratory assist greater than 10 cm H₂O. The researchers concluded that if three or more of the common factors were present then there was a 79% probability that reintubation was indicated. The conclusions supported the need to be more aggressive in weaning patients from the ventilator especially when two or less of these parameters are present which could decrease the incidence of unplanned extubation.

Summary

Numerous studies have been conducted over the last 18 years to assess the complications of ventilatory therapy, the risk factors that predispose the patient with an endotracheal tube to accidental extubations, and potential solutions to prevent accidental extubations. The studies have addressed the neonate, pediatric, and adult mechanically ventilated populations. The studies have been performed primarily by physicians and respiratory therapists. Only a few studies involved nurses. Regardless of their findings, the studies have validated the need to continually assess the mechanically ventilated patient for risk of accidental extubation and to prevent its occurrence.
Although the studies mentioned contribute to the recognition of risk factors for accidental extubations, a mechanism (assessment tool) for routinely assessing those risks is not well documented. In an age where the focus of health care delivery is evolving into a preventive instead of a curative mindframe of action, the time is now to focus on preventive care for patients at risk for accidental extubations.
Chapter 3: Methodology

Methodology for this study evolved as a result of the analysis of the recommendations and limitations of previous studies conducted regarding accidental extubations. More specifically, the study was designed to meet the needs of the patient population in the Medical-Surgical Intensive Care Unit of St. Joseph's Hospital in regard to the demand for quality patient care.

Statement of the Population

The clinical setting for the research study was the Medical-Surgical Intensive Care Unit (ICU) at St. Joseph's Hospital in Savannah, Georgia. This unit maintains a large number of ventilated patients with an average of 159 ventilated patients per year. The facility is located in a metropolitan area with an estimated population of 239,000 (Beebe, Summerlin, Edenfield, & Baker, 1987). It is a private, not-for-profit, Catholic based hospital that is licensed for 305 patient beds. The philosophy of the hospital is consistent with the Catholic belief that humans are images of God and worthy of dignity in life.

Characteristics of the patient population of the Intensive Care Unit are diverse. The age of the patients range from adolescents to elderly. The patients are primarily adults, although there may be an occasional child requiring endotracheal intubation and mechanical ventilation. The unit admits patients regardless of age, race, religion, or ability to pay. Patients that are admitted to the facility generally live within a 100 mile radius of the facility in all directions. The mechanism for reimbursement of patients is approximately 60% Medicare with other sources being private pay, Medicaid, private insurance, and workman's compensation. Typical admitting diagnosis for this patient
population include chronic obstructive pulmonary disease, asthma, respiratory failure, adult respiratory distress syndrome, pneumonia, gastrointestinal bleeding, hepatic encephalopathy, metabolic disorders, peripheral vascular insufficiency, abdominal aneurysm, cardiopulmonary arrest, sepsis, septic shock, renal failure, hypertensive crisis, pulmonary edema, and congestive heart failure. The typical postoperative patient that is admitted to the unit includes thoracotomies, aneurysm repairs, pancreatic surgeries, gastrointestinal surgeries, harrington rod insertions, peripheral vascular bypass surgeries, and any surgery in which the patient is a high risk.

The Intensive Care Unit (ICU) is a ten bed nursing unit that accepts admission of any patient regardless of age with an existing or potential life-threatening medical or surgical condition. Surgical exclusions for admission include postcraniotomy and neurosurgery patients who are admitted to the Neuro Intensive Care Unit and postcoronary artery bypass grafting and heart valve insertion patients who are admitted to the Coronary Care Unit. Medical exclusions for admission include the patient requiring invasive intracranial pressure monitoring or intra-aortic balloon pump therapy. On occasion, patients may be admitted to the ICU for sleep studies with invasive arterial blood pressure monitoring. Such patients are discharged from the unit at the termination of the study.

The ten bed unit is managed jointly by medicine and nursing. The Assistant Vice President of Critical Care oversees all aspects of care and management within the ICU. Participative management in the form of Shared Governance guides decision-making regarding patient care issues in the form of councils of registered nurses that oversee nursing practice, quality, and education. The nursing staff in the ICU includes a Nurse Manager, a Clinician, a Charge Nurse on each shift, Registered Nurses, Nursing Assistants, and Unit Secretaries. The unit is staffed for nurse to patient ratios of 1:1 and 1:2. On occasion, the nurse to patient ratio may be 1:3 providing the acuity of the patients permit such nursing care. A Registered Nurse who is credentialed in critical
care as outlined by the policy on credentialing is responsible for directing patient care at all times. Assignments for patient care are based on the recommendations of the Acuity Information System. It is the responsibility of the ICU Medical Director or his designee to decide if a patient meets the admission criteria for ICU and, when necessary, decide which patients are given priority for admission. The Medical Director or his designee is also responsible to triage the existing utilization of the ICU beds and determine which patients may be transferred out of the ICU to allow admission of other patients.

Therapies performed in the Intensive Care Unit include the continuous administration of vasoactive and antiarrhythmic drugs, dialysis (peritoneal, hemodialysis, and CVVH), and ventilator support. Monitoring includes central venous pressure, pulmonary artery pressure, arterial pressure, electrocardiogram, pulse oximetry, apnea, and noninvasive blood pressure monitoring. The respiratory therapist provides ventilator maintenance, administers respiratory treatments, obtains samples of arterial blood via punctures and analyzes both arterial and venous blood gases.

Physically, the unit is made up of private rooms that are parallel to the nursing station. Patient privacy is provided by doors and blinds. Infection control measures are provided by adhering to universal precautions. There is a sink located immediately inside the door so that hands are washed as one enters and leaves. Isolation is provided for all ten beds by placing isolation materials in a table outside of the doors and both a soiled trash and soiled linen cubicle immediately inside the doors. A syringe disposal box is located next to the sink and is secured by a lock to the wall. In the room there is a toilet for ambulatory patients. A curtain provides privacy when in use.

All rooms have bedside monitors with central monitoring and recording. There are noninvasive blood pressure monitors that can be moved to any of the rooms and used. The wall located behind the head of the bed has three oxygen outlets, two compressed air outlets, and four vacuum outlets. All rooms have emergency backup power. A microshield mouth guard is kept at each bedside to be used during
cardiopulmonary resuscitation. There is also a nurse call system in place for the patient to contact the nurse when needed.

Other available equipment includes ventilators, hemodialysis machines, CVVH machines, hypothermia blankets, cardiac output sets, cardiac chairs, floatation beds, air mattress beds, physiologic amputation set up, intravenous infusion devices, epidural infusion devices, patient controlled analgesic infusion devices, pulse oximeters, Hoyer lift, standing bedside scale, a dual function defibrillator and cardioverter, a cart equipped with emergency drugs and airway equipment, external pacemaker, noninvasive doppler, otoscope, ophthalmoscope, and urine specific gravity monitors. There is also a transport monitor capable of monitoring ECG, invasive pressures, noninvasive pressures, and pulse oximetry. Narcotics, intravenous fluids, and patient supplies are distributed through the computerized Pyxis stations.

Sampling Design

A convenience sampling design was utilized. Criteria for inclusion in the study were that the patient must be receiving positive pressure ventilation via an endotracheal tube and that the patient must be 18 years of age or older. Every patient meeting this criteria was included in the collection of data regarding risk assessment for accidental extubations in mechanically ventilated patients. No attempt was made to control for sex, race, educational level, socioeconomic status, or diagnosis. It was estimated that there would be approximately 130 mechanically ventilated patients and 15 accidental extubations during the data collection time frame.

The patients were intubated either orally or nasally. Intubation was carried out either by a physician or a respiratory therapist utilizing sterile technique. Nurses in this facility were not permitted to intubate. The endotracheal tubes varied in size from 6.0 mm to 8.5 mm. The tubes were made of polyvinylchloride material. Advantages of this material were that it allowed flexibility to mold at body temperature to the anatomy of the airway, it was tissue compatible, and it provided low friction resistance to the passage of
suction catheters (Shapiro, Kacmarek, Cane, Peruzzi, & Hauptman, 1991). The tube was clearly delineated with markings to indicate the length of the tube and to allow the practitioner to identify the level of insertion. In adults, the endotracheal tube had a cuff that was inflated to a low pressure in order to seal off the trachea to provide effective ventilation. For insertion, the patient was typically placed in a supine position with the head elevated on a towel and the neck and head extended until the patient's nose was in a position which resembled sniffing. A laryngoscope was utilized to visualize the glottis and facilitate placement. The patient was given 100% oxygen prior to the insertion attempt which was removed during the insertion attempt. Once inserted, the cuff was inflated with 10 cc of air and the chest auscultated for breath sounds bilaterally. If breath sounds were not heard on auscultation, the tube was removed, oxygen reapplied, and another intubation attempt made. Once placement was verified, an oxygen source was connected at 100% FIO₂ and delivered either by manual administration or ventilator. The tube was then secured in place by a taping method which extended from the tube down the side of the face, around the back of the neck and back up the other side of the face to the endotracheal tube. Placement was then formally verified by chest radioscopic examination.

Study Design

A nonexperimental descriptive study design using a risk assessment instrument was employed. The movement of the study progressed from presumed factors that related to the occurrence of accidental extubations to the incidence of these factors in patients who did experience and did not experience accidental extubations. The study tested whether the identification of patients with specific risk factors would be more likely to accidentally extubate themselves than patients who did not have those factors or who had a lower level of risk based on scoring of those risk factors. The design was feasible for the size of the population studied and the environment in which data were collected. In an effort to decrease extraneous variables, there was a control placed on
the age of the patient that was allowed to participate in the study and data collection was carried out by the same person throughout the study.

Data collection occurred prospectively on participants with endotracheal tubes that met the inclusion criteria. If a participant experienced an accidental extubation, retrospective data were also collected utilizing the same instrument with the purpose of documenting the risk factors present immediately before the accidental extubation occurred. A review of previous literature demonstrated that Scott et al. (1985), Brown (1988), Zwillich et al. (1974), and Stauffer, Olson, & Petty (1981) utilized the prospective approach and achieved significant findings related to their focus. Polit and Hungler (1985) stated that the prospective approach was more appropriate than ex post facto studies in order to increase the validity of findings, decrease ambiguity, and increase the generalizability of the study. The student researcher through past experiences with similar data collection found that multidisciplinary documentation of the situation in the medical record lacked consistency in both completeness and descriptive data surrounding the event.

It should be noted that nurses who work in the Intensive Care Unit were previously educated to perform ongoing assessments of the patient who is mechanically ventilated for factors that increase the risk for accidental extubation. Upon identification of risk factors, the nurse responsible for the care of the participant could have intervened to decrease these risk factors. Any actions taken by the nurse were not the result of manipulation related to this study. The nurses did not have knowledge of the data collected by the student researcher nor intervened as the result of this study.

Instrumentation

The study involved the utilization and validation of the Accidental Extubation Risk Assessment Tool (AERAT) for evaluating the level of risk in mechanically ventilated adult patients for accidental extubation (see Appendix A). The AERAT was a preventive intervention measure in that it promoted assessment of the patient for the risk level
based on the presence of risk factors which could result in preventive intervention measures being carried out by the nurse in collaboration with other health team members. This assessment and potential intervention may prevent accidental extubation. The AERAT was an original assessment tool developed by the student researcher and several staff nurses in the Intensive Care Unit. The development of the AERAT was based on findings of quality assurance activities regarding accidental extubations in the unit as well as a review of literature on accidental extubations. The chosen risk factors were based on empirical validation in previous research studies and clinical judgement of the student researcher. The nursing staff of the Medical-Surgical Intensive Care unit utilized the AERAT in a pilot study to evaluate ventilated patients who experienced accidental extubation. Preliminary findings demonstrated a potential for effectiveness with a decrease in accidental extubations of 50%. A continuation of this evaluation was an essential component in solving the problem and determining if the decrease in the incidence was due to the use of the tool itself or other unidentified factors.

The Accidental Extubation Risk Assessment Tool was used to collect the data upon which the assessment for risk was based. The AERAT is a two part tool consisting of an assessment portion and a rating portion and is designed to assess mechanical, physiological, and psychological factors (see Appendix A). The first section consists of assessment data regarding level of consciousness, psychosocial status, and respiratory status (both oxygenation and equipment). The second section consists of risk factors compiled from literature review and past clinical experiences of the student researcher with accidental extubations. One risk factor was based on the specific geography of the Intensive Care Unit and identified several patient rooms in the unit in which patients were the least visible. This risk factor was identified through quality assurance records that demonstrated that ventilated patients in these rooms experienced accidental extubations more often than ventilated patients in other rooms in the unit. In addition,
the risk factors addressing level of awareness, sedation level, and communication from the patient concerning the desire to be extubated were also identified through quality assurance findings as common characteristics of accidentally extubated patients in the unit.

Unique to this study was the application of a weighted score to each risk factor designed to correlate with the likelihood that it increased the risk for accidental extubation. Previous studies did not mention this practice. The weighted score was determined through an intuitive approach based on experience in the clinical setting with patients who experienced accidental extubation. The higher the number, the more likely the risk factor was felt to contribute to the chance that an accidental extubation would occur. Once the risk section was completed, the weighted scores in the “yes” column were added together. The degree of risk was then assessed based on the score received by comparing the score to the Level of Risk scale on the instrument. The potential scores ranged from the lowest of 0 to the highest possible of 21. The risks were identified as being a moderate risk with a score of 0-3, a high risk with a score of 4-7, and an extreme risk being 8 or greater. This weighted scoring mechanism was proven to effective during the pilot study.

Content validity of both sections of the AERAT was established through review by three pulmonologists specializing in critical care medicine, one anesthesiologist, and three registered nurses who had extensive experience with patients requiring mechanical ventilation and were currently nationally certified in critical care nursing by the American Association of Critical Care Nurses. All agreed that the content of the instrument reflected the major aspects of risk for accidental extubation. The reliability of the AERAT was not established prior to this study.

Protection of Human Rights

Before data collection began, approval for the participation of human subjects was obtained from the Institutional Review Committee (IRC) of St. Joseph’s Hospital and
the Institutional Review Board (IRB) of Georgia Southern University. Consent for participation in the study was obtained from the participant if he/she was competent to do so. If not, consent was obtained from a relative. In the absence of patient competence or a relative, consent was obtained from the physician. This consent procedure was congruent with the current standard at St. Joseph's Hospital of obtaining consent for therapy in the absence of participant competence or relative. A copy of the consent form was given to the appropriate person (i.e. participant/family member if it was the participant consent form or physician if it was the physician consent form).

Areas addressed on the consent form included: (1) voluntary participation, (2) the right to withdraw from the study, (3) the penalty for refusal to participate, (4) the affect that participation in this study would have on treatment, (5) the degree of harm, (6) the anticipation of pain or harm, (7) the benefits of participation, (8) the adverse affects as a result of participation, (9) the alternative procedures to this study, (10) the costs of participation, and (11) the legal or social risks as a result of participation (see Appendix B & C).

The data collected remained anonymous and confidential. Confidentiality was safeguarded through coding mechanisms. Each participant was assigned an identification number known only to the student researcher. The identifying data of each participant was maintained separate from the study data and therefore the participant could not be identified with the information collected nor could the information be traced back to the participant. The identifying code numbers with participant names were kept by the student researcher and all identifying information was destroyed following data analysis. All data were analyzed in a manner in which it was impossible to identify individual participants. Any publications arising from this study will not contain personal identifying information. Results of the study will be made available to anyone who requested them.
Collection of Data

After obtaining IRC/IRB approval, data collection began utilizing the Accidental Extubation Risk Assessment Tool. All physicians with admitting privileges to the Intensive Care Unit were notified by letter that the research study was being conducted (see Appendix D). Data were collected in conjunction with the quality assurance and total quality improvement program currently in place in the Intensive Care Unit. The staff of the Intensive Care Unit were informed of the study and what their roles would be (see Appendix E).

The AERAT was utilized to collect and record data which consisted of chart review, observation, and interview. The data were collected prospectively within 24 hours of admission to the ICU on the ventilator or within 24 hours of being ventilated if already a patient in the ICU. The participant was again assessed for the risk factors and level of risk within 48 hours, 72 hours, and every 7 days thereafter for the duration of intubation with an endotracheal tube. Each of these interval assessments took approximately 30 minutes to complete. Data were collected retrospectively on all participants who experienced accidental extubations to reflect the status of the participant immediately prior to extubation. These assessments took an average of 45 minutes.

A total of 75 intubated patients were treated in the Medical Surgical Intensive Care Unit during the study period which began October 15, 1992 and ended May 31, 1993. There was an average of 10.1 intubation episodes per month with a range of 6 to 14 and a mode of 9. Sixteen participants were not entered into the study due to not meeting the criterion of age or not having an intubation period of at least 24 hours. Therefore data were collected at the designated intervals on 59 participants who experienced 64 episodes of endotracheal intubation with the number of data cases collected dependent on their length of intubation. There was a total of 224 cases of data
collection completed which included prospective data collected at interval checks and retrospective data collected post-accidental extubation.

Of the 59 participants, two were transferred from another unit within the hospital to the ICU with an endotracheal tube already in place. Three participants were transferred to the ICU from outlying hospitals with an endotracheal tube already inserted. Four of these five participants who were transferred were excluded in the data analysis as a result of being endotracheally intubated for longer than 24 hours prior to transfer to the Intensive Care Unit. This was felt to be necessary in order to maintain homogeneity of the sample group. None of the participants who were dropped from the study experienced accidental extubations while a patient in the ICU. One of these patients did experience an accidental extubation in another unit prior to transfer to ICU.

The final group used in data analysis consisted of 55 participants who experienced 60 episodes of intubation and nine episodes of accidental extubation. This accounted for 207 cases of data collection. Of these 207 cases, 198 were interval checks that were completed prospectively and 9 were evaluations of the accidental extubation episode that were completed retrospectively.

Analysis of Data

The data collected from the Accidental Extubation Risk Assessment Tool were coded for ease of computer entry. The AbSurv Statistical Data Analysis Package by Anderson-Bell (1991) was utilized for data analysis. Measurements included frequency distribution of each descriptive variable on the assessment portion, each risk factor on the instrument, and each level of risk. Descriptive statistics were used to analyze specific variables that could not be analyzed using frequency distribution.

To test the hypothesis, chi square was utilized to determine if there were significant differences between the groups of participants who did and did not experience an accidental extubation in relation to each individual risk factor as well as the overall level of risk. The level of significance for this study was set at p<.05 which
meant that a finding would be designated as statistically significant if the result had a probability of occurring less than five times out of 100 by chance. A significant finding indicated that there was a difference between the groups in relation to the two variables. A non-significant finding indicated that there was no difference in the groups regarding the distribution of the variables which meant that the variables occurred independently of each other. It is important to keep in mind that although a study may not have statistically significant findings there is the possibility that clinically significant findings may evolve. By this it is meant that although the analysis fails to meet statistical testing, the finding may have strong implications in the clinical setting. These clinically significant findings are equally important in guiding patient care decisions.
Chapter 4: Analysis and Findings

Introduction

It is the purpose of this chapter to analyze and interpret the statistical results of this study which was designed to determine the effectiveness of the Accidental Extubation Risk Assessment Tool in identifying the level of risk of endotracheally intubated mechanically ventilated adult patients for accidental extubation. Discussion will include an analysis of the data and findings in light of the hypothesis, assumptions, limitations, and other extraneous factors.

Descriptive Statistics of the Sample

The sample for data analysis consisted of 55 participants who accounted for 60 episodes of endotracheal intubation and mechanical ventilation. Of those 15 (27%) expired while receiving mechanical ventilation. Five participants underwent tracheotomies during the period of intubation and were no longer followed from the time of the surgical procedure. One participant was transferred from the ICU to another critical care unit while ventilated and was no longer followed. The length of endotracheal intubation ranged from 1 to 33 days with a mean length of 8.75 days and a mode of 10 days. The length of intubation before a tracheotomy was performed ranged from 21 to 33 days with a mean of 26.8 days and a median of 25 days. The timing of intubation and/or of admission to the ICU with an endotracheal tube in place was greatest on the 3-11 shift with 32 (53%) while the 7-3 shift followed with 15 (25%) and the 11-7 shift with 13 (22%).

The participants were assessed by the student researcher for the level of risk for accidental extubation based on the presence of pre-identified factors believed to
contribute to the occurrence of accidental extubations (see Appendix A). The participants were assessed within 24 hours of admission to the ICU on the ventilator or within 24 hours of being ventilated if already a patient in the ICU. The participant was again assessed for the level of risk for accidental extubation within 48 hours, within 72 hours, and then weekly from the time of intubation until the endotracheal tube was discontinued. These checks were designated as interval checks for discussion. The range of the interval checks was from 24 hours to 28 days. When the participant experienced an accidental extubation, the risk assessment tool was completed to reflect the status of the participant immediately prior to extubation. Table 1 describes the number of participants who were evaluated at each particular interval.

Table 1

<table>
<thead>
<tr>
<th>Interval Check</th>
<th>Participants who did not experience accidental extubation</th>
<th>Participants who did eventually experience accidental extubations</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>24 hours</td>
<td>51</td>
<td>9</td>
<td>60</td>
</tr>
<tr>
<td>48 hours</td>
<td>40</td>
<td>9</td>
<td>49</td>
</tr>
<tr>
<td>72 hours</td>
<td>34</td>
<td>7</td>
<td>41</td>
</tr>
<tr>
<td>7 days</td>
<td>23</td>
<td>4</td>
<td>27</td>
</tr>
<tr>
<td>14 days</td>
<td>8</td>
<td>3</td>
<td>11</td>
</tr>
<tr>
<td>21 days</td>
<td>4</td>
<td>2</td>
<td>6</td>
</tr>
<tr>
<td>28 days</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td><strong>TOTAL CASES</strong></td>
<td><strong>198</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

n = 207 cases in 55 participants

For the purpose of data analysis, the participants were categorized into three groups. Group A consists of all prospective data collected at the interval checks on participants who did not experience accidental extubations. Group B consists of all prospective data collected at the interval checks on the participants who did experience accidental extubation. Group B does not include the retrospective data collected on the
evaluation of the accidental itself. Group C consists of the retrospective data collected
on participants who experienced accidental extubations in order to assess those risk
factors present immediately prior to extubation. The data from Group C were not
included in the interval check discussion. This delineation between the groups B & C is
important to assure the appropriate utilization of chi square discussed later.

There were 51 (85%) episodes of endotracheal intubation in which the
participants did not experience accidental extubation. Nine (15%) episodes of intubation
resulted in accidental extubations. No participant experienced more than one accidental
extubation. Four (44.4%) of the participants who experienced accidental extubations did
not require immediate reintubation although one of those participants was eventually
reintubated seven days later. If a participant experienced an accidental extubation and
required immediate reintubation, the reintubation was not counted as another intubation
episode. An evaluation of the assessment data collected along with the determination of
the level of risk revealed many characteristics of a mechanically ventilated sample. The
following discussion addresses the 198 cases of data collected in order to provide a
summarization of the characteristics of the sample studied. The nine cases of accidental
extubation that were evaluated retrospectively will be discussed in depth later.

Variations in level of consciousness described in the intubated population
included unresponsive (6%), lethargic (9%), drowsy (61%), and alert (24%). Sedatives
that were employed included none at all (9%), Versed (45%), Valium (2%), and Morphine
(13%). In one-third of the cases, a combination of drugs were used which included
Versed & Morphine (26%), Valium & Morphine (0.5%), Morphine, Versed, & Ativan (0.5%),
Morphine & Ativan (1%), Versed & Nubain (1%), Ativan & Versed (1.5%), and Versed &
Valium (1%). Only 4% of the intubated participants received epidural infusions during
their ventilation. Neuromuscular blockers were used in only 8% of the participants and
those drugs consisted of Pavulon (56.25%), Tracrium (37.5%), and Neuromax (6.25%).
Assessment of the psychosocial status of the ventilated participants revealed a broad range of descriptions. Calm (28%) and cooperative (39%) accounted for the two most frequent descriptions. Agitation occurred in 13% of the participants while anxious behaviors were observed in 18%. Participants were described as being combative in less than 1% of the cases and only 1% communicated the desire to be extubated. It is important to note that the timeliness of sedation administration to these observations was not a critical element in this study.

Arterial blood gas measurements were obtained on all 198 cases a minimum of once every 24 hours. Almost half (49%) of the cases had normal partial pressure of oxygen levels and 45% had normal carbon dioxide levels. Blood pH ranged from 7.2 to 7.5 with the majority being 7.4 (61%). The majority of participants experienced no overt signs of respiratory distress (60%). However, 28% had partial pressures of oxygen less than 80 mmHg and were considered to be in a state of cellular hypoxia. Common modes of ventilation employed included Intermittent Mandatory Ventilation (IMV)/Synchronized IMV (18%), assist control (12%), pressure support, pressure control, and reverse inspiratory to expiratory ratios. Most often (70%) it was a combination of the modes that were employed. The most common combinations were IMV, PEEP & pressure support (18%) and IMV & pressure support (18%). Following close behind were assist control & PEEP (13%), IMV and PEEP (9%), and assist control & PEEP & pressure control (3%). Reverse I:E ratios were used in combination with PEEP, pressure support, and/or pressure control in 1.5% of the cases.

Servo ventilators were used in 92% of the cases with the remaining employing the MA-1 ventilator. The route of intubation most commonly seen was oral (62%) versus nasal (38%). The internal diameter of the endotracheal tube varied from 7.0 mm to 8.5 mm with the most common being 7.5 (49%) followed by 8.0 (33%), 7.0 (15%), and 8.5 (3%). The average number of suctions per eight hour shift were between 0 and 2 (70%) with those greater than 4 per shift accounting for only 14%. Adapters used to connect
the ventilator tubing to the endotracheal tube were described as either swivel (33%), stationary (17%), or stationary with an in-line suction device (50%). The time period from the last episode of retaping the endotracheal tube ranged from less than 8 hours (9%) to greater than 336 hours (0.5%). The most common time frame for retaping endotracheal tubes was within 24 to 48 hours (31%) followed by 48 to 72 hours (18%) and 16 to 24 hours (18%).

The frequency of chest radioscopic examination was daily in 97.5% of the cases. In only 2 (1%) cases out of 198 did the participant require adjustment in the placement of the endotracheal tube based on chest x-ray findings. The descriptions that the radiologist used to describe placement of the endotracheal tube varied. Anatomical markings were utilized in only 40 (20%) of the cases. In the remaining 158 (80%) cases, descriptors such as adequate, good, no change, in place, and satisfactory position were used. This had an impact on the study in that the operational definition of proper placement of the endotracheal tube was based on anatomical markings. Due to the small percentage of placements expressed in this fashion the risk factor had to be evaluated differently. Instead of evaluation in terms of anatomical markings, the risk factor was evaluated in terms of whether or not the endotracheal tube required repositioning in the last 24 hours as a result of recommendation by the physician or radiologist.

The frequency of risk factors in this group is shown in Table 2. The level of risk for this population ranged from 0 to 8 with a mean of 3.4, a median of 3, a mode of 2, and a standard deviation of 1.46. Only 23% of the participants with endotracheal tubes requiring mechanical ventilation were admitted to patient rooms 101, 105, 106, and 110. It is important to reiterate that the data presented were a result of combining Groups A (non-accidental extubations) and Group B (accidental extubations) interval checks in order to summarize the characteristics of the sample. The application of chi square to
the data was not possible because the subjects were represented several times within the data which is a violation of assumptions for its use.

Table 2

Frequency of Risk Factors at Interval Checks in Groups A & B Combined

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>In room 101,105,106,110</td>
<td>46 (23%)</td>
<td>152 (77%)</td>
</tr>
<tr>
<td>Agitated, combative, confused,</td>
<td>20 (10%)</td>
<td>178 (90%)</td>
</tr>
<tr>
<td>despite sedation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Agitated, combative, confused and not sedated</td>
<td>0</td>
<td>198 (100%)</td>
</tr>
<tr>
<td>Communicates desire to be extubated</td>
<td>5 (2.5%)</td>
<td>193 (97.5%)</td>
</tr>
<tr>
<td>Moves head excessively</td>
<td>7 (3.5%)</td>
<td>191 (96.5%)</td>
</tr>
<tr>
<td>Ineffectively restrained</td>
<td>1 (0.5%)</td>
<td>197 (99.5%)</td>
</tr>
<tr>
<td>Not restrained</td>
<td>30 (15%)</td>
<td>168 (85%)</td>
</tr>
<tr>
<td>Orally intubated</td>
<td>123 (62%)</td>
<td>75 (38%)</td>
</tr>
<tr>
<td>Length of endotracheal tube is &gt; 2 inches from insertion line</td>
<td>124 (63%)</td>
<td>74 (37%)</td>
</tr>
<tr>
<td>Intubated less than 72 hours</td>
<td>150 (76%)</td>
<td>48 (24%)</td>
</tr>
<tr>
<td>Endotracheal tube can be manipulated</td>
<td>0</td>
<td>198 (100%)</td>
</tr>
<tr>
<td>Excessive oral/nasal secretions</td>
<td>13 (7%)</td>
<td>185 (93%)</td>
</tr>
<tr>
<td>Receiving PEEP therapy</td>
<td>95 (48%)</td>
<td>103 (52%)</td>
</tr>
<tr>
<td>Improper placement of ETT on CXR in last 24 hours</td>
<td>2 (1%)</td>
<td>196 (99%)</td>
</tr>
</tbody>
</table>

n = 198

Descriptive Statistics of the Accidental Extubation Group

A total of nine intubated participants experienced accidental extubations which accounted for an incidence of 15% or 1.7 per 100 intubation days. The dispersion of the events among the months of the study show that accidental extubations occurred during the months of November (44.4%), December (11.1%), January (11.1%), March (22.2%), and May (11.1%). There were no accidental extubation events in October, February, or
April. There was not any change in the frequency of intubation episodes when comparing the months in which accidental extubations occurred and those in which none occurred. All of the participants who experienced an accidental extubation were evaluated retrospectively to ascertain the presence of risk factors immediately prior to the event. Only one participant did not have a baseline interval evaluation to compare to the retrospective study because the participant had been intubated on the night shift only four hours prior to the event. A total of nine cases were reviewed according to the same assessment data that was collected prospectively. There was no more than one accidental extubation per participant and none of the accidental extubation events resulted in death. One participant who had difficulty being reintubated did experience an anoxic brain injury as a result of accidental extubation. This accidental extubation event was intentionally carried out by the participant.

In looking at the timing of accidental extubation, five (55%) events occurred during a change of shift. Of these, three (60%) occurred during the night/day change, one (20%) during the day/evening change, and one (20%) during the evening/night change. Looking at the total distribution among shifts, four (44%) accidental extubations occurred on day shift, three (33%) on evening shift, and two (22%) on night shift. The incidence of accidental extubation was fairly dispersed among three specific days of the week. Three (33% each) accidental extubations occurred each on Wednesday and Thursday and two (22%) occurred on Sunday. One (11%) accidental extubation occurred on Saturday. None occurred on the remaining days of the week. The time interval from intubation until the participant experienced an accidental extubation ranged from 1 hour to 110.75 hours (4.6 days) with a mean of 108.1 hours (4.5 days) and a median of 87 hours (3.6 days). Four (44%) of the accidental extubations occurred within the first 72 hours of ventilation and 7 (77%) occurred within the first seven days of ventilation. The length of endotracheal intubation for the participant who experienced accidental
extubation ranged from 2 to 33 days with a mean length of 10.4 days, a mode of 2 days, and a median of 3 days.

Assessment of the level of consciousness of the participant immediately prior to experiencing accidental extubations revealed that 6 (67%) were alert and 3 (33%) were drowsy. None of the participants were reported to be lethargic or unresponsive immediately prior to the event. Sedatives that were being employed included Versed (44%), Morphine (33%), and a combination of Morphine & Versed (22%). None were receiving epidural analgesics or patient controlled analgesia. The intervals since the last sedative was administered ranged from less than one hour (22%) to greater than 12 hours (11%). The intervals since the last sedative had been administered included within 2 hours (22%), within 4 hours (33%), within 8 hours (55%), and within 12 hours (88%). The frequency of intervals included 3-3.9 hours (11%), 6-6.9 hours (11%), 7-7.9 hours (11%), and 10-11.9 hours (11%). Neuromuscular blockers were not being administered to any of the participants.

The psychosocial status of the participants who experienced accidental extubations were described as cooperative (44%), anxious (11%), agitated and combative (11%), and confused (11%) while 22% communicated the desire to be extubated. Once again it is noted that the relationship of the timing of sedation administration to these observations were not considered. Arterial blood gas measurements were obtained on all but one of the accidentally extubated participants within four hours prior to extubation. Blood pH ranged from 7.2 (11%) to 7.5 (11%) with a majority equally spread between 7.3 (33%) and 7.4 (44%). Over half (55%) of the cases had a partial pressure of oxygen greater than 101 with the others ranging from 50 mmHg to 90 mmHg. The carbon dioxide measurements ranged from 35 mmHg to greater than 55 mmHg with the majority (44%) falling between the 36-54 mmHg range. Four (44%) of the participants were described as not experiencing overt signs of respiratory distress immediately prior to extubation. One participant (11%) was not experiencing overt respiratory distress but
did have several wheezing episodes with bronchospasms for several hours prior to the accidental extubation. One participant (11%) was experiencing labored respirations despite mechanical ventilation and the chest x-ray taken within four hours prior to the event and again following the event revealed a slight tracheal shift due to the presence of severe atelectasis. It is felt that the respiratory distress and the chest x-ray findings were pertinent. Two (22%) of the participants had a partial pressure of oxygen less than 80 mmHg and were considered to be experiencing cellular hypoxia. One (11%) participant had a partial pressure of oxygen less than 90 but was not in overt respiratory distress. These observations are felt to be pertinent in that one can not merely depend on observations of external behavior to ascertain the degree of respiratory distress or tissue hypoxia.

Modes of ventilation used in this group included IMV & PEEP (44%), assist control & PEEP (11%), IMV & PEEP & pressure support (11%), IMV & PEEP (11%), assist control (11%) and IMV/SIMV (11%). Servo ventilators were used in 88% of the cases while MA-1 were only used in 22%. The majority of participants who experienced accidental extubation were intubated by the oral route (56%) versus the nasal route (44%). The size of endotracheal tube in these participants varied from 7.0 mm (33%) to 8.0 mm (22%) with the most commonly used diameter being 7.5 mm (44%). The participants were being suctioned per eight hour shift between 0 and 2 times (88%) and between 3-4 times (12%). Adapters used to connect the ventilator tubing to the endotracheal tube were either swivel (56%) or stationary with in-line suction devices (44%). The time period from the last episode where the endotracheal tube tape was changed ranged from less than 8 hours (11%) to a maximum of 71.9 hours. The most common intervals for retaping of the endotracheal tube were between 16-23.9 (33%) hours and 48-71.9 hours (33%). An assessment of the frequency of chest radioscopic examinations showed that all participants were receiving them daily (100%). None of the cases demonstrated that adjustment of the endotracheal tube placement was necessary.
as a result of radiological findings. The radiologist only used anatomical markings to describe placement in 11% of the cases.

Of the nine accidental extubations, 3 (33%) were witnessed while 6 (66%) were not. Five of the participants were in a semi-fowler's position or higher. Five (55%) of the accidental extubations were due to the participant pulling out the endotracheal tube while 3 (33%) were pulled out during participant movement in the bed. Five (56%) of the patients were restrained while 4 (44%) were not. All of the patients who pulled out their endotracheal tubes were restrained and therefore were considered to be ineffectively restrained (see operational definition of ineffectively restrained). None of the accidental extubations occurred during retaping of the endotracheal tube. Five (55%) of the participants who experienced an accidental extubation required reintubation immediately. One of those four who did not require immediate reintubation was reintubated seven days from the episode of accidental extubation. Table 3 lists the precipitating events surrounding the accidental extubation.

Table 3

<table>
<thead>
<tr>
<th>Event</th>
<th>Frequency</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participant wanted it out</td>
<td>3</td>
<td>33.3%</td>
</tr>
<tr>
<td>Excessive movement</td>
<td>3</td>
<td>33.3%</td>
</tr>
<tr>
<td>Unknown</td>
<td>2</td>
<td>22.2%</td>
</tr>
<tr>
<td>Patient procedure</td>
<td>1</td>
<td>11.1%</td>
</tr>
</tbody>
</table>

n = 9

The group of participants who experienced an accidental extubation were also evaluated on the presence or absence of pertinent risk factors which are identified in Table 4. There was one participant who was not evaluated prior to accidental extubation due to the short interval of time between intubation and the extubation.
Table 4

Frequency of Risk Factors in Participants Who Experienced Accidental Extubation (Group C)

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Yes</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>In room 101,105,106,110</td>
<td>2 (22%)</td>
<td>7 (78%)</td>
</tr>
<tr>
<td>Agitated, combative, confused despite sedation</td>
<td>4 (44%)</td>
<td>5 (56%)</td>
</tr>
<tr>
<td>Agitated, combative, confused &amp; not sedated</td>
<td>1 (11%)</td>
<td>8 (89%)</td>
</tr>
<tr>
<td>Communicates desire to be extubated</td>
<td>4 (44%)</td>
<td>5 (56%)</td>
</tr>
<tr>
<td>Moves head excessively</td>
<td>0</td>
<td>9 (100%)</td>
</tr>
<tr>
<td>Ineffectively restrained</td>
<td>5 (56%)</td>
<td>4 (44%)</td>
</tr>
<tr>
<td>Not restrained</td>
<td>4 (44%)</td>
<td>5 (56%)</td>
</tr>
<tr>
<td>Orally intubated</td>
<td>5 (56%)</td>
<td>4 (44%)</td>
</tr>
<tr>
<td>Length of endotracheal tube is &gt; 2 inches</td>
<td>5 (56%)</td>
<td>4 (44%)</td>
</tr>
<tr>
<td>Intubated less than 72 hours</td>
<td>4 (44%)</td>
<td>5 (56%)</td>
</tr>
<tr>
<td>Endotracheal tube can be manipulated</td>
<td>0</td>
<td>9 (100%)</td>
</tr>
<tr>
<td>Excessive oral/nasal secretions</td>
<td>0</td>
<td>9 (100%)</td>
</tr>
<tr>
<td>Receiving PEEP therapy</td>
<td>3 (33%)</td>
<td>6 (67%)</td>
</tr>
<tr>
<td>Improper placement on CXR in last 24 hours</td>
<td>0</td>
<td>9 (100%)</td>
</tr>
</tbody>
</table>

n = 9

(4 hours). The level of risk for the group who experienced accidental extubation ranged from 3 to 7 with a mean of 4.77, a median of 4, and a mode of 4. In looking at the level of risk that was evaluated at an interval check prior to the accidental extubation, the scores ranged from 1 to 7 with a mean of 3.25, a median of 3, and a mode of 3. Table 5 demonstrates a comparison of the level of risk scores at the interval check preceding the accidental extubation with the level of risk score determined retrospectively. Three (33%) of the levels of risk increased from the interval check prior to the accidental extubation while three (33%) remained unchanged. One (11%) level of risk score decreased which was a result of PEEP therapy being discontinued from the interval to the retrospective check. When the scores of the risk level are categorized into the
levels, 22% of the participants who experienced accidental extubations were moderate risks and 77% were high risks. None of the participants who experienced accidental extubation was categorized as an extreme risk.

Table 5
Pre and Post Extubation Levels of Risk in Participants Experiencing Accidental Extubation (Group C)

<table>
<thead>
<tr>
<th>Assessment Parameter</th>
<th>Participants Level of Risk Score</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Last interval check prior accidental extubation</td>
<td>3</td>
</tr>
<tr>
<td>Immediately before accidental extubation</td>
<td>3</td>
</tr>
</tbody>
</table>

n = 9

Although the differences between the participants who did and did not experience accidental extubation based on the level of risk were not significant (see discussion on testing hypothesis), it is important to note that there was a baseline increase of 33% in the levels of risk which suggests there was a change either in the number of risk factors or in the combination of risk factors present prior to accidental extubation. Table 6 demonstrates a comparison in the number of risk factors present at the interval check preceding the accidental extubation with the number of risk factors number of risk factors from the interval determined retrospectively. The change in the check to the retrospective check ranged from 1 to 3 with an average of 2. In two of these increases, the interval risk factors were still present at the retrospective check. The other increase resulted in totally different risk factors being present in the retrospective evaluation than in the interval check. When reviewing the number of risk factors that resulted in an increased retrospective score, 3 of 4 patients (75%) also had an increase in the number of risk factors. Additionally, the risk factors present at the interval check were also present at the retrospective check. In the one patient whose score increased but did not have an increase in the number of risk factors, only 2 of the
3 risk factors were the same at the interval check as they were at the retrospective evaluation. In reviewing the scores that did not change from the interval check to the retrospective evaluation, none of the patients had a change in either the number of risk factors or the combination of risk factors which made up their scores. However, it does remain possible that although the scores may not change, there may be a change in the actual combination of risk factors that resulted in those scores.

Table 6

Pre and Post Extubation Number of Risk Factors in Participants Experiencing Accidental Extubation (Group C)

<table>
<thead>
<tr>
<th>Level of Risk Parameter</th>
<th>Participant 1</th>
<th>Participant 2</th>
<th>Participant 3</th>
<th>Participant 4</th>
<th>Participant 5</th>
<th>Participant 6</th>
<th>Participant 7</th>
<th>Participant 8</th>
<th>Participant 9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last interval check prior to accidental extubation</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>1</td>
<td>3</td>
<td>-</td>
<td>1</td>
<td>5</td>
<td>3</td>
</tr>
<tr>
<td>Immediately before accidental extubation</td>
<td>2</td>
<td>5</td>
<td>3</td>
<td>4</td>
<td>3</td>
<td>4</td>
<td>2</td>
<td>5</td>
<td>3</td>
</tr>
</tbody>
</table>

n = 9

The comparison of the frequency of risk factors in each group addressed is identified in Table 7. There is a pattern of distinct frequency differences noted in the following risk factors: (1) agitated/combative/confused with sedation, (2) communicates the desire to be extubated, (3) ineffectively restrained, (4) not restrained, and (5) intubated less than 72 hours. Although this may not show statistically significant findings, it is important to identify their presence in greater frequency that other risk factors and therefore become clinically significant. In addition, one must also consider the risk factors in light of the individuality of each participant in relation to their condition and environmental circumstances in order to determine if their situation in combination with the identified risk factors actually put them at risk for accidental extubation.
Table 7
Percentages of Participants Who Demonstrated Presence of Risk Factors By Grouping (Not Interval Checks)

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>Grouping</th>
</tr>
</thead>
<tbody>
<tr>
<td>In room 101,105,106,110</td>
<td>A  B  C</td>
</tr>
<tr>
<td>Agitated, combative, confused despite sedation</td>
<td>11% 5% 44%</td>
</tr>
<tr>
<td>Agitated, combative, confused &amp; not sedated</td>
<td>0% 0% 11%</td>
</tr>
<tr>
<td>Communicates desire to be extubated</td>
<td>2% 11% 44%</td>
</tr>
<tr>
<td>Moves head excessively</td>
<td>4% 0% 0%</td>
</tr>
<tr>
<td>Ineffectively restrained</td>
<td>0.5% 0% 56%</td>
</tr>
<tr>
<td>Not restrained</td>
<td>14% 3% 44%</td>
</tr>
<tr>
<td>Orally intubated</td>
<td>65% 50% 56%</td>
</tr>
<tr>
<td>Length of endotracheal tube is &gt; 2 inches</td>
<td>63% 58% 44%</td>
</tr>
<tr>
<td>Intubated less than 72 hours</td>
<td>77% 69% 44%</td>
</tr>
<tr>
<td>Endotracheal tube can be manipulated</td>
<td>0% 0% 0%</td>
</tr>
<tr>
<td>Excessive oral/nasal secretions</td>
<td>7% 8% 0%</td>
</tr>
<tr>
<td>Receiving PEEP therapy</td>
<td>48% 50% 33%</td>
</tr>
<tr>
<td>Improper placement on CXR in last 24 hours</td>
<td>1% 0% 0%</td>
</tr>
</tbody>
</table>

n = 9

Testing of the Hypothesis

This study investigated the relationship between (1) the level of risk identified by the assessment tool and incidence of accidental extubation and (2) each risk factor identified and the incidence of accidental extubation. Research hypotheses were:

1. There is a relationship between the level of risk identified through utilization of the instrument and the incidence of accidental extubation.
2. There is a relationship between each identified risk factor and the incidence of accidental extubation.
The level of significance was identified at $p<.05$ which means that there would be no more than 5 changes in 100 cases that the findings would occur by chance.

Testing the hypothesis for significant findings involved the application of the chi-square nonparametric statistic. The cases were divided into the respective interval check in relation to whether the participant did (Group A) or did not (Group B) experience accidental extubations. It was necessary to base the chi square application on the interval checks due to the fact that one subject may have several cases in the sample. This would have been a violation of the requirements for the utilization of chi-square. By separating the chi-square analysis into the interval checks, each participant was included in the analysis only once. A disadvantage of this was that the cell size subsequently became smaller which may have affected the validity of the findings. Group C (the retrospective accidental extubation data) was also evaluated against group A (interval check data on those who did not experience accidental extubation) using the chi square statistic.

First, the relationship between the level of risk identified through the utilization of the AERAT and the incidence of accidental extubation was addressed. This was evaluated by using the level of risk variable and the grouping variable. The two variables were assessed at the 24 hour, 48 hour, 72 hour, 7 day, 14 day, 21 day, and 28 day intervals. In Groups A & B, the probabilities of chi-square did not reveal any statistically significant differences between the groups. The seven day interval came close with a $p=.0575$. This means that there was no significant difference between the groups in relation to level of risk and the incidence of accidental extubation. In Groups A & C, the probabilities of chi-square revealed a significant finding of $p=.0346$ at the 7 day interval. This finding must be questioned in the face of a small sample size and the presence of zeros in five of the 16 cells. Ten of the cells had a value less than 5 and one cell had a value of 12. Therefore one can only suggest that there may be a relationship but not be totally confident.
Next, the relationship between each identified risk factor and the incidence of accidental extubation was addressed. This was evaluated by using the level of risk variable and each of the risk factors identified on the tool. This also was carried out at each of the intervals identified earlier. In evaluating Groups A & B, there were no statistically significant findings which indicates that there was no differences between the groups in relation to each of the risk factors and the incidence of accidental extubation. It needs to be noted that chi-square analysis could not be applied to several of the risk factors due to the fact that at several interval checks all of the responses were the same and therefore only a 1 by 2 cell could be formed instead of the 2 x 2. The only risk factors that could be evaluated at every interval were (1) the participant not being restrained, (2) being orally intubated, (3) having an endotracheal tube length greater than 2 inches, (4) receiving PEEP therapy, and (5) actual level of risk.

In evaluating Groups A (non-accidental extubations) and C (accidental extubation), several significant findings were revealed. The risk factor of being agitated, combative, and confused despite sedation was significant at the 72 hour interval (p=.0152) and 7 day interval (p=.0234). The cell sizes for these two findings did not include zero frequencies but did range from 1 to 32. Depending on the statistical philosophy, this may or may not be considered significant. The risk factor of communicating the desire to be extubated was significant at the 24 hour interval (p=.0003), 48 hour interval (p=.0002), 72 hour interval (p=.0388) and 7 day interval (p=.0048). The 24 hour and 7 day interval included one zero in the cell size. Once again, these findings may suggest a relationship but it is hard to ascertain the validity based on cell size.

The risk factor of not being restrained was significant at the 24 hour interval (p=.0295), 48 hour interval (p=.0427), and 72 hour interval (p=.0388). Cell size at all intervals ranged from 3 to 46. Of all the significant findings, this risk factor has the strongest possibility for validity of findings. Finally, the risk factor of being intubated
less than 72 hours was significant at 24 hours (p=.0000), 48 hours (p=.0000), 72 hours (p=.0000), and 7 days (p=.0234). All intervals had cell sizes that included zeros except for the 7 day interval. Again, due to the cell sizes, the validity of these findings are questionable. However, it is felt that the intervals involved are significant in that all participants who did extubated themselves did so prior to day 7.

Limitations of the Study

Several limitations in this study have been identified. The most significant limitation of the study was that the sample was small. Only 55% of the anticipated population was available during the time frame of the study. This resulted in problems with the validity of the chi square analysis. This problem has also been identified repeatedly in the literature using other statistical tests. Second, the geographic location of the study was limited to a single Intensive Care Unit with a diverse population. Combined with the fact that many of the findings were not statistically significant, generalizability is further limited. Third, the difference in standards of care that exist from institution to institution decreased the ability to generalize this study to a larger population. Fourth, the data collected was nominal which limited parametric testing which may have resulted in more pertinent findings. Finally, the interval checks only reflected the participants level of risk at a particular time instead of continuously throughout the 24 hour period. Subsequently, the observation was reflective of only a small portion of the intubation period. Because the observer was not in constant attendance, it was difficult to capture the variance in the participants status over time. Therefore, the assessment may not have been truly reflective of the overall level of risk.

Extraneous variables that were identified after the study was in place again relate to the small sample size obtained. During the time period of data collection, there was a drop in the patient census in the Intensive Care Unit which was related to a shift in admitting behaviors of local physicians as well as the fact that the fall and winter seasons were mild. This means that the typical respiratory failure patients that often
require mechanical ventilation during this seasonal time frame due to exacerbations of their chronic illnesses did not present to the hospital as often or either were not as severely ill as in the past to require mechanical ventilation. An additional extraneous variable was the vagueness employed by the radiologists in the interpretation of endotracheal tube placement on chest radioscopy. This did not allow the student researcher to effectively evaluate the risk factor regarding placement of the endotracheal tube as planned.

Summary

This chapter examined and presented data that were collected for the research study to determine the effectiveness of the AERAT in identifying level of risk for accidental extubation. Frequencies and descriptive data were reported on the sample as a whole and on the portion of the sample that did experience accidental extubations. The chi-square nonparametric statistic was applied to Groups A & B and to Groups A & C based on intervals defined in order to prevent violation of the requirements for utilization of chi-square. The majority of analysis and findings revealed non-significant findings. Although several significant findings were identified, the validity is questionable due to the small cell size resulting from a small sample size. Therefore, it is more meaningful to look at the data in terms of clinical significance that statistical significance in order to identify application of this study to nursing practice.
Chapter 5: Summary

Introduction

The primary purpose of this research was to determine if the Accidental Extubation Risk Assessment Tool (AERAT) was effective in identifying those endotracheally intubated adult patients who would experience an accidental extubation. The data collected for the quantitative descriptive prospective study was collected only by the student researcher with the use of the AERAT. The data were summarized and analyzed using descriptive and nonparametric statistics. It is the purpose of this chapter to discuss the findings, outline the implications that this research has for nursing, and make recommendations for future research.

Discussion

The endotracheal tube is an accepted method for securing airway management in participants who require assistance. Accidental extubation remains a complication of this therapy which could further result in even more detrimental events for the patient. The majority of the literature acknowledges that it is a problem but few studies are aggressive in identifying prevention measures. This study was designed specifically to investigate the incidence as well as risk factors which may exist prior to accidental extubation in order for the nurses to be able to plan, implement, and evaluate a plan of care that would prevent its occurrence.

The incidence of accidental extubation in this study was 15% or 1.7 per 100 patient days. Table 8 demonstrates the incidence of accidental extubation as identified through a literature review. Although this incidence appears to be within the norm previously documented in the literature, every incident that occurs could be potentially
Table 8

Incidence of Accidental Extubations In Previous Studies

<table>
<thead>
<tr>
<th>Study</th>
<th>Studied</th>
<th>Incidence</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zwillich, Pierson, Creagh, Sutton, Schatz, &amp; Petty (1974)</td>
<td>Adults</td>
<td>8.47%</td>
</tr>
<tr>
<td>Stauffer, Olson, &amp; Petty (1981)</td>
<td>Adults</td>
<td>13%</td>
</tr>
<tr>
<td>Scott, Eigen, Moye, Georgitis, &amp; Laughlin (1985)</td>
<td>Pediatrics</td>
<td>13.2%</td>
</tr>
<tr>
<td>Rashkin &amp; Davis (1986)</td>
<td>Adults</td>
<td>18%</td>
</tr>
<tr>
<td>Brown (1988)</td>
<td>Newborns</td>
<td>32%</td>
</tr>
<tr>
<td>Liu, Sultan, &amp; Caangay (1989)</td>
<td>Newborns</td>
<td>32%</td>
</tr>
<tr>
<td>Kleiber &amp; Hummel (1989)</td>
<td>Newborns</td>
<td>26.9%</td>
</tr>
<tr>
<td>Coppollo &amp; May (1990)</td>
<td>Adults</td>
<td>11%</td>
</tr>
<tr>
<td>Benjamin, Thompson, &amp; O'Rourke (1990)</td>
<td>Newborn/Peds</td>
<td>3%</td>
</tr>
<tr>
<td>Little, Koenig &amp; Newth (1990)</td>
<td>Newborn/Peds</td>
<td>8.8%</td>
</tr>
<tr>
<td>Ellstrom, Brenner, &amp; Williams (1991)</td>
<td>Adults</td>
<td>21%</td>
</tr>
<tr>
<td>Eberts &amp; Taggart (1991)</td>
<td>Adults</td>
<td>5.8%</td>
</tr>
<tr>
<td>Bizek, Feeman, Natale, &amp; Kruse (1991)</td>
<td>Not defined</td>
<td>13%</td>
</tr>
<tr>
<td>O'Neill (1992)</td>
<td>Adults</td>
<td>10.5%</td>
</tr>
<tr>
<td>Seudeal (1992)</td>
<td>Not defined</td>
<td>6.9%</td>
</tr>
<tr>
<td>Brown, Gau, &amp; Touleimat (1992)</td>
<td>Adults</td>
<td>8.7%</td>
</tr>
</tbody>
</table>

deadly, and therefore, the goal is to always strive to decrease the occurrence. In addition, it has been identified that there are many mechanisms for measuring the incidence of accidental extubation. Some researchers measure the incidence by each episode of intubation in comparison to the total number of participants intubated while others measure it by the total of each episode in comparison of the total number of participants intubated. Another method is to compare the total number of extubations to the total number of ventilator days of the entire population being studied. Consistency is needed in order to be able to generalize findings and compare findings of various research studies. Also, in the past year and a half the number of studies focused on accidental extubations in the adult population have doubled which subsequently should
contribute resource information for further comparison of research studies in this area. However, those continuing to do research in this area continue to be non-nursing personnel. More studies are needed from a nursing perspective in order to validate not only the existence of risk but the appropriateness of interventions currently being utilized to prevent accidental extubations.

In evaluation of the assumptions of this study, it is felt that all patients with endotracheal tubes are at risk for accidental extubation. Evidence of this is demonstrated through the documentation in the literature of their occurrence as complications of endotracheal tube therapy which are undesired. Although this study did not reveal a definitive relationship between the likelihood of experiencing an accidental extubation and the number of risk factors present, it was evident that the patients who were accidentally extubated did not have just one risk factor. These patients had at least two and as many as six! This lends to the suggestion that there is some kind of relationship that exists between the risk factors and incidence even if it is not the number of them but something else such as the combination of them with other factors. Finally, it remains that it is desirable to prevent accidental extubation. Once again this is supported in previous studies as well as in this study where one participant did experience a permanent injury that subsequently affect both quality of life and cost of care.

Although this study did not reveal statistically significant findings, it is felt that it did provide the researcher with clinically significant information. It identified characteristics of the population and trends within the groups as well as objectively documented that current standard of practice. In comparing this study to those currently in the literature, it is not common to find many statistically significant factors which link a particular population of patients to the incidence of accidental extubations. The most important aspect is that those who are exposed to this knowledge recognize it for what is—a sharing of experiences and information regarding actual clinical events.
that occurred despite not meeting the demands of a probability. Research should continue to expand in this area while being built on past research until the clinical problems are effectively addressed.

Through the application of this tool, the researcher has developed within herself a more keen evaluation mechanism which looks more analytically at the patient receiving care. Looking beyond the actual data towards identifying common themes within the groups assists in developing a sense of awareness accomplished through the application of this tool in the everyday practice setting. It is evident that there are numerous variables/risk factors which may affect a particular population. While no one tool may serve the purpose of identifying all populations at risk for accidental extubation, it is felt that there can be a generic tool developed in order to screen the population and to bring about an awareness on the part of health care providers caring for this population regarding both the risk factors and potential consequences for participants who may experience accidental extubations.

An additional application of the information obtained from this study may evolve in the growing area of case management. Through the application of information obtained in this study such as average length of intubation, standard practices for all ventilated patients, and incidence of complications, nurses can evaluate a clinical situation in regard to cost of care and subsequently develop an efficient and effective critical path for the evaluation of patient progress during the road to recovery. In addition, by trending other various data, the nurse may be able to identify areas for improvement in the delivery of care. By applying the data in this method, an outcome may be that these patients are extubated sooner than before, experience a higher level of care, and be discharged from the hospital in a more appropriate and timely fashion.

Recommendations for Further Research

This descriptive prospective non-experimental study did not demonstrate statistically significant differences between the level of risk and the incidence of
accidental extubation, nor did it demonstrate statistically significant differences between each identified risk factor and the incidence of accidental extubation. The findings merely allow suggestions that a relationship may exist. In order to move from suggestions to definitive relationships, further research is needed. Recommendations for further research are to:

1. Remove the weighted scores from the risk factor scoring and repeat data analysis to determine if there are any significant findings.

2. Design the study with a goal of a particular sample number instead of a time frame. This would promote obtaining an adequate sample size on which to draw stronger conclusions.

3. Take the data that currently exists and reformat into higher level data in order to apply more sophisticated statistical testing. Repeat data analysis on this to see if findings varied.

4. Include a variable which looks at the relationship of sedation used and interval given to the incidence of accidental extubation.

5. Redesign the tool for better flow of data collection and larger spaces for data entry in relation to arterial blood gas findings. In addition, reduce the tool down to one page if possible.

6. Follow more demographic variables if possible in order to link diagnosis, gender, age, and educational background to the incidence of accidental extubation.

7. Include information regarding status of lungs in relation to breath sounds and pre-existing data for a better evaluation of respiratory status.

8. Design a study which looks at the relationship of head position to the incidence of accidental extubation. This study was not able to address this to the extent intended.

9. Extend the study to a larger geographical area in order to increase sample size and therefore the power of the findings.
10. Replicate this study using various patient populations in order to extend its generalizability.

11. Measure the incidence of accidental extubations in both total number of episodes compared to both the total number of episodes of intubation as well as well as the total number of intubation days.

**Implications for Nursing**

Few nursing studies have been conducted that are related to accidental extubations in the adult population. This is a critical aspect in that it is the nurse who works on a continual basis with the patient in maintaining the endotracheal tube and who through experience in practice has evolved as the clinical expert in its utilization and maintenance. Pursuing the problem of accidental extubations through nursing research assists in filling the gaps in the existing knowledge base as well as contributing to growth in nursing practice. Furthermore, it assists the critical care nurse in planning, predicting, and controlling the outcomes of nursing care when caring for patients who have endotracheal tubes in place.

Studies in this area must continue to be carried out by nurses in order to assure an impact on quality care through minimizing accidental extubations. As a result, the likelihood of experiencing complications related to accidental extubations including death, tracheal rupture, vocal cord damage, aspiration, inadequate oxygenation resulting in permanent damage, and an altered quality of life may be decreased. Through refinement of the tool, the incidence of accidental extubation could decrease which may result in a decrease in the complications of therapy and subsequently result in the delivery of a higher level of quality care. It is an opportunity for nursing to take charge and work towards predicting and controlling accidental extubation events in order to improve the standard of care for the mechanically ventilated patient.

Finally, the study provides an opportunity for nursing to impact on the length of ventilation and hospital stay of patients and therefore affect reimbursement for health
care costs. This impact could be significant to facilities where large portions of the patient population are elderly clients whose health care costs are paid by Medicare which results in a fixed amount of reimbursement for health care. It provides an opportunity for nurses to validate the key role that they play in contributing to decreasing the cost of health care delivery.

Conclusions

Although this particular study did not reveal strong statistically significant findings, it did establish a clinical baseline from which to expand and explore methods for revising and improving the tool. There are similar themes in the research about accidental extubation which focus on the concern that risk factors for accidental extubation may not be consistently identified. In other words, the factors that put patients at risk in one population may vary slightly in another population. This is in part due to the uniqueness of each individual who experiences intubation. It is hoped that someone will become as interested as this student researcher in pursuing the development of this tool so that one day it does effectively identify and maybe even predict those unfortunate events. The American Association of Critical Care Nurses has designated studies with ventilator patients a priority for the 1990's. Nursing needs to seize the opportunity set forth to prove the impact that the profession of nursing can have in facilitating the provision of quality and cost efficient patient care.
Appendix A: Instrument

ACCIDENTAL EXTUBATION RISK ASSESSMENT TOOL (AERAT)

DATE ____________ MEDICAL RECORD NUMBER ____________
SUBJECT CODE ____________ TIME OF ACCIDENTAL EXTUBATION ____________

______________________________________________________________

ASSESSMENT OF VARIABLES

I. LEVEL OF CONSCIOUSNESS unresponsive lethargic drowsy alert

II. SEDATION: Time and date of last sedative administered ____________

Name of drug ____________

II. PSYCHOSOCIAL calm cooperative anxious agitated combative

confused communicates the desire to be extubated

III. RESPIRATORY / OXYGENATION

ABG's (most recent): Date/Time _______ pH _______ pO2 _______ pCO2 _______ Sat _______

Pulse oximetry saturation if most recent _______

Respiratory effort: no distress complains of breathing difficulty

labored respirations use accessory muscles

Ventilator Settings: T piece ______ IMV ______ AC ______ PEEP ______ PS ______ PC ______

Type of ventilator ____________

Intubation Route: Nasal Oral Size 7 7.5 8 other ______

Average number of required suctions per shift: 2 4 6 8

Length of intubation: # of vent days ______ # of intubations events ______

(obtain from respiratory ventilator flowsheet)

ETT adapter: Swivel Stationary

Security of ETT: Date/time of last ETT tape change _______ Time Lapse _______

CHEST ROENTGRAM: Date/time of last CXR _______ Head Position _______

Placement of ETT tip in relation to carina _______

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### ASSESSMENT OF ACCIDENTAL EXTUBATION RISK FACTORS

<table>
<thead>
<tr>
<th>Risk Factor</th>
<th>YES</th>
<th>NO</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Patient in room 101, 105, 106, 110.</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>2. Patient is agitated/combative/confused despite receiving sedation</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>3. Patient is agitated/combative/confused and not receiving sedation</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>4. Patient communicates desire to be extubated.</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>5. Patient is moving head excessively.</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>6. Patient is ineffectively restrained.</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>7. Patient is not restrained.</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>8. Patient is orally intubated.</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>9. The length of ETT from gum line to adapter is greater than 2 inches</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>10. The length of intubation is less than 72 hours.</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>11. The ETT can be manipulated despite taping.</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>12. The patient has excessive oral/nasal secretions.</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>13. The patient is receiving PEEP.</td>
<td>1</td>
<td>0</td>
</tr>
<tr>
<td>14. Report of CXR shows improper placement of ETT</td>
<td>2</td>
<td>0</td>
</tr>
</tbody>
</table>

**TOTAL**

**LEVEL OF RISK**

<table>
<thead>
<tr>
<th>Risk Scale</th>
<th>Risk Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 3</td>
<td>Moderate</td>
</tr>
<tr>
<td>4 to 7</td>
<td>High Risk</td>
</tr>
<tr>
<td>8 or &gt;</td>
<td>Extreme Risk</td>
</tr>
</tbody>
</table>

*** Action taken if any: ___________________________________________________________

**UTILIZATION OF THE RISK ASSESSMENT TOOL**

1. Within 24 hours of intubation or of admission to ICU on ventilator
2. At 48 hours and 72 hours after intubation and then weekly thereafter
3. When an accidental extubation occurs
Appendix B: Participant Consent Form for Participation

You are invited to participate in the research study entitled AERAT: EVALUATING THE EFFECTIVENESS OF THE ACCIDENTAL EXTUBATION RISK ASSESSMENT TOOL IN IDENTIFYING LEVEL OF RISK FOR ACCIDENTAL EXTUBATIONS which is being conducted by Annette Hayman, a graduate nursing student at Georgia Southern University. The purpose of the study is to validate an instrument that would identify patients at risk for accidental extubations. As a result, the chances for accidental extubations for patients with endotracheal tubes would be minimized.

All patients who are intubated with an endotracheal tube have a right to participate in this study. Your participation in this study is entirely voluntary. You may withdraw consent at any time during the study. If you refuse to participate in this study, you will not be penalized or experience loss of any benefits. Your participation in this study will not affect the treatment that you receive as a patient in this unit.

You were selected as a participant as a result of being admitted to the Medical Surgical Intensive Care Unit at St. Joseph's Hospital and requiring endotracheal intubation. The number of subjects to be included in this study is based upon the number of patients who meet the criteria listed above between October 1, 1992 and June 30, 1993.

There are no actual or potential risks to you for participating in this study. You will not have any treatment withheld as a result of participating in the study. You will not experience any inconveniences or discomforts as a result of participation. Actual or potential benefits to you for participating in this study are that through identification of risk factors for accidental extubation the nurse can intervene to decrease the risks and decrease your potential for complications of endotracheal tube therapy.

The procedure to be followed during your participation in the study includes observation of your actions, equipment, and environment. The information will be recorded on a form. You will not be able to be identified with the information and therefore confidentiality will be assured. The information can never be traced back to you.

The study offers no alternative procedures that might be beneficial to you. In other words, your care will not be affected by participation in this study. There will be no cost to you as a result of participation in this study. You will receive a copy of this consent form.

Thank you for your consideration. Should you have any other questions, you may contact myself or Dr. Jim McMillan, Chairman of the Georgia Southern University Institutional Review Board:

Annette Hayman
St. Joseph's Hospital
11705 Mercy Boulevard
Savannah, Georgia 31419
912-925-4100 ext. 4040

Dr. Jim McMillan
Georgia Southern University
Landrum Box 8076
Statesboro, Georgia 30460
912-681-0220

_____ I have read the above statements and agree to participate in the study.

_____ I have read the above statements and do not wish to participate in the study

Participants signature_____________________________________________ Date_______

Closest Relative signature___________________________________________ Date_______

(If participant unable to sign or give consent)

Investigators signature_____________________________________________ Date_______
Appendix C: Physician Consent Form for Participation

Your permission is needed for your patient to participate in the research study entitled AERAT: EVALUATING THE EFFECTIVENESS OF THE ACCIDENTAL EXTUBATION RISK ASSESSMENT TOOL IN IDENTIFYING LEVEL OF RISK FOR ACCIDENTAL EXTUBATIONS which is being conducted by Annette Hayman, a graduate nursing student at Georgia Southern University. The purpose of the study is to validate an instrument that would identify patients at risk for accidental extubations. As a result, the chances for accidental extubations for patients with endotracheal tubes would be minimized.

All patients who are intubated with an endotracheal tube have a right to participate in this study. The participation of your patient in this study is entirely voluntary. The patient may withdraw consent at any time during the study. If the patient refuses to participate in this study, he/she will not be penalized or experience loss of any benefits. Participation in this study will not affect the treatment that the patient receives while in the ICU. Your patient was selected as a participant as a result of being admitted to the Medical Surgical Intensive Care Unit at St. Joseph's Hospital and requiring endotracheal intubation. The number of subjects to be included in this study is based upon the number of patients who meet the criteria listed above between October 1, 1992 and June 30, 1993.

There are no actual or potential risks for participating in the study. The patient will not have any treatment withheld as a result of participating in the study. The patient will not experience any inconveniences or discomforts as a result of participation. Actual or potential benefits to the patient for participating in this study are that through identification of risk factors for accidental extubation the nurse can intervene to decrease the risk factors and the potential for complications of endotracheal tube therapy.

The procedure to be followed during participation includes observation of patient actions, equipment, and environment. The data will be recorded on a form. The patient will not be identified with the information and therefore confidentiality will be maintained. The information can never be traced back to the patient.

The study offers no alternative procedures that might be beneficial. In other words, the care of the patient will not be affected by participation in this study. There will be no cost to the patient as a result of participation in this study. The patient will receive a copy of his/her consent form.

Thank you for your consideration. Should you have any other questions, you may contact myself or Dr. Jim McMillan, Chairman of the Georgia Southern University Institutional Review Board:

Annette Hayman  Dr. Jim McMillan
St. Joseph's Hospital  Georgia Southern University
11705 Mercy Boulevard  Landrum Box 8076
Savannah, Georgia 31419  Statesboro, Georgia 30460
912-925-4100 ext. 4040  912-681-0220

I have read the above statements & give consent for patient participation in the study
I have read the above statements & do not wish to consent for participation

Physician Name (print)
Physician Signature

Investigators signature

Date
Appendix D: Letter to the Physicians with Admitting Privileges
to the ICU

TO: Physicians

FROM: Dr. J. Allen Meadows, Medical Director of ICU
      Sherry Danello, RN, Assistant Vice President

DATE: October 15, 1992

SUBJECT: Ongoing Research in the ICU

Annette Hayman, a graduate student at Georgia Southern University, will be collecting research data on patients in the ICU (Rooms 101 through 110) who are mechanically ventilated. Data collection will begin immediately and continue until June 30, 1992. The goal of the research project is to determine the effectiveness of a risk assessment tool in predicting accidental extubations. Data will be collected at intervals on patients who are intubated and who experience an accidental extubation. This study has been approved by the Institutional Review Boards of Georgia Southern University and St. Joseph’s Hospital.

The patient will be asked to give written consent for participation in this study. If the patient is unable to give consent, a relative will be asked to give written consent for participation. If both the patient and relative are not able to give consent, the physician will be approached to give consent for patient participation in the study. A copy of both the patient and physician consent form are attached.

We believe that this study will provide valuable information that can be used to improve the quality of care that patients in the ICU receive. Please join us in supporting this effort!
Appendix E: Letter to the Staff of the Intensive Care Unit

TO: Nurses & Unit Clerks in the ICU
FROM: Annette Hayman, RN, BSN
Graduate Student, GSU
DATE: October 26, 1992
SUBJECT: Research Project on Mechanically Ventilated Patients

I will be collecting research information on patients in the ICU who are mechanically ventilated. Data collection began on October 15, 1992 and will continue until June 30, 1993. The goal of the research project is to determine the effectiveness of a risk assessment tool in predicting accidental extubations.

I need to collect information on mechanically ventilated patients within 24 hours, 48 hours, and 72 hours of intubation. I will then collect information every 7 days on the patient until mechanical ventilation is discontinued. In addition, I need to collect information on all patients who experience an accidental extubation which is defined as "the unplanned removal of the endotracheal tube from its proper position". An extubation is considered to have occurred when (1) the ETT is completely out of the mouth or nose, (2) breath sounds can't be auscultated in the absence of tracheal shift or pneumothorax, (3) the patient can talk/make sounds despite the ETT being in place, and/or (4) the ETT is determined by CXR to be above the vocal cords.

Please notify me when a patient is admitted to the ICU with an endotracheal tube, when a patient in the ICU is intubated, and when a patient in the ICU experiences an accidental extubation. It is important to the validity of my study that I collect data within a certain time frame. You can reach me at ext. 4040 on Monday - Friday from 8:00 - 4:30 p.m.. After hours, you can reach me at home (897-7202). If you can't reach at either of these number, please page me through the hospital system on Beep 472. These numbers are located on a business card on the monitors in the central station as well as in the Rolodex.

Thank you very much for your help with this project. Results of the research project will be available in September of 1993.
References


