ASSESSMENT OF MECHANICAL VENTILATION KNOWLEDGE

By

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Abstract

The purpose of this study was to investigate the relationship between respiratory therapists' knowledge of mechanical ventilation with longevity in the field and acquired type of education. The hypotheses tested were: Respiratory therapists with longevity in the field will achieve higher scores on the written assessment tool than those with fewer years of experience. Respiratory therapy graduates of traditional degreed educational programs will achieve higher scores on the written assessment tool than therapists trained through non-degreed programs. Methods: A 25-question testing instrument assessed mechanical ventilation knowledge. All questions were multiple-choice with four to five single response options. A participant questionnaire was used to ascertain demographic, clinical experience, education, and longevity in data. Informed consent was obtained prior to the administration of the proctored testing instrument at the participant's place of employment. Data were analyzed by regression analysis using SPSS 10.0 for windows (SPSS Inc. Chicago, IL, 1999). Statistical significance was established at $p < 0.05$. Results: A total of 159 of a possible 470 participants (34%) completed the assessment tool and experience survey. A few therapists (7.5%) were completed non-traditional training programs. Longevity ranged from 0 to 29 mean = 8.5 (SD ± 8.7). Test scores ranged from 12 – 96%. The mean test score was 65.9% (SD ± 19%). A statistically significant correlation between longevity in the field and type of education with test score ($p=0.002$, $R^2=0.78$) was found. Conclusions: The quality of patient care cannot be assumed when deficiencies in knowledge and application of mechanical ventilation occur.

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CHAPTER I

INTRODUCTION

The increasing demands for more efficient and readily available preventive care and specialized medical treatment led to the development of numerous health professional categories. An example of a rapidly evolving health care specialty is the profession of respiratory care. Respiratory care practitioners perform a variety of invasive, non-invasive and highly technical skills in a multitude of settings across the spectrum of age ranges. Market dynamics and health care system shifts have prompted the respiratory care practitioner to broaden the practice settings, skills and responsibilities (Gaylin, Shapiro, Mendelson & Levinson, 1999). Many practitioners function independently, in acute and long- term care settings, under practice guidelines and structured protocols (Kollef, Shapiro, Clinkscale, Cracchiolo, Clayton, Wilner & Hossin, 2000). However, the scope of practice has advanced beyond traditional bedside care. Respiratory therapists are intricately involved in discharge planning, health promotion and disease prevention education; they focus on the development and implementation of quality monitoring initiatives, as well as assuming a leadership role in allied health, in order to facilitate change in health care practices and health care policy (McDowell, Chatburn, Myers, O'Riordan, & Kercsmar, 1998).

A metamorphous of the education process occurred over a period of more than fifty years to support the market dynamics and expanding clinical role. Unstructured vocational training programs were replaced with credentialed traditional (college based) and non-traditional (correspondence course) education programs. Minimum degree requirements were established and the educational needs for the expanded scope of practice.

Currently, an associate degree is the entry level requirement for accredited respiratory therapy technology programs. However, the inception and continued growth of baccalaureate degree programs provided the opportunity to broaden the practitioner's knowledge base and keep pace with the continued evolution of the profession's scope of practice.

This groundwork is fundamental to populating the medical environment with qualified, well trained practitioners. However, there are few mechanisms in place to assure the continued competency of these health practitioners beyond the state licensure or national credentialing examinations (Mishoe, 1980). A concerted effort to address the assessment of key concepts and practice standards is needed to ensure continued competency of credentialed respiratory care professionals. The need to ensue competency is essential when therapists participate in the administration complex treatment modalities, such as the initiation, management and discontinuation of mechanical ventilation.

Statement of the Research Problem

The advent of knowledge gaps for medical personnel may facilitate medical judgment errors, compromise patient care or both. The result may contribute to escalating medical expenditures, and poor patient outcomes in terms of disease related morbidity and mortality. In an effort to ensure the delivery of quality medical services, a need exists to address the continued competency for respiratory care professionals.

Statement of Purpose

The purpose of this study is to investigate the relationship between a respiratory therapists' knowledge of mechanical ventilation with longevity in the field and acquired type of education.

Hypothesis

The hypotheses to be tested are: (1) Respiratory therapists with longevity in the field will achieve higher scores on the written assessment tool than those with fewer years of experience. (2) Respiratory therapy graduates of traditional degreed education programs will achieve higher scores on the written assessment tool than therapists trained through non-degreed programs.

Delimitations of Study

The study was delimited to: (1) licensed respiratory therapists and respiratory therapy students holding a temporary respiratory care permit, (2) the state of Ohio, (3) male and female gender, (4) ages 18 years and older, (5) all races (6) degree and non-degreed respiratory care practitioners.

Limitations of the Study

The limitations of this study were inclusive of respiratory care practitioners that:

1. Currently work with patients requiring mechanical ventilation.
2. Were associated with randomly selected facilities that agreed to participate in this research endeavor.
3. Were issued a temporary permit or license by the State of Ohio.
4. Voluntarily agreed to participation in this research endeavor.

Assumptions of the Study

Relative to this proposed study, the following assumptions are made:

1. All practitioners graduated from accredited respiratory therapy programs.
2. Respiratory care practitioners met the minimum requirements for competency upon receipt of the national credential, state license or both.

3. Respiratory care practitioners would consent to participation in competency-based research.
4. Department directors and or facility administrators would have a willingness to consent to conducting competency-based research at acute care, long-term care or academic based respiratory care programs.

Operational Definitions

Registered respiratory therapist (RRT) – the advanced practice credential for practitioners in the field of respiratory care, awarded to individuals receiving a passing score on both the written registry and clinical simulation examinations (Chuntz, 1978).

Certified respiratory therapist (CRT) – the entry level credential for the respiratory care practitioners, awarded after successful completion of the certification credentialing examination (O'Donohue, 1978).

Mechanical ventilator - a simple machine designed to alter, transmit and direct applied energy a predetermined manner to perform useful work (Aston, 1995).

Mode of ventilation – the manner in which mechanical ventilation is employed. There are three mechanical ventilation modes: controlled, assisted, and spontaneous (Chatburn, 1992).

Pressure control ventilation (PCV)- refers to the delivery of a pressure limited breath at a set breath rate. The tidal volume is variable and a function of the preset pressure limit. Inspiratory time can be directly set and manipulated to minimize gas trapping, and achieve even distribution of ventilation. Pressure control ventilation is often used successfully in disease states inflicting noncompliant lung units (long time constants). Gas distribution in pressure control is like dropping a glass of water on the floor: the water trickles into every nook and cranny (Chatburn, Volsko, & El-Katib, 1994).

Volume control ventilation (VCV)– refers to the control variable of a breath. Volume control ventilation offers the safety of a pre-set volume of gas delivered with a pre-set breath rate. Clinicians are required to appropriately set the inspiratory flow, flow waveform, and inspiratory time. During volume control ventilation, the volume of gas delivered in each mechanical breath is constant. Airway pressure will increase in response to reduced compliance, increased resistance, or active exhalation which may elevate the risk of ventilator-induced lung injury (Sinha, & Donn, 2001).

Assist – Control (A/C) - a controlled mode of ventilation. The mechanical ventilator delivers a preset volume of gas or tidal volume to the patient at a predetermined breath rate. This mode of ventilation is the closest one to completely resting the respiratory muscles. The patient can initiate a breath, but can not alter the volume of gas delivered to the lungs. The volume is predetermined and manipulated by the operator (Shelledy, Rau, & Thomas-Goodfellow, 1995).

Synchronized Intermittent Mandatory Ventilation (SIMV)– an assisted mode of ventilation. The mechanical ventilator delivers a preset volume of gas to the patient at a predetermined breath rate. However, when the patient initiates a breath, the volume of gas delivered to the patient is determined by the patient, not the machine. This mode is often used when attempting to liberate a patient from mechanical ventilatory support (Cameron, & Oh, 1986).

Pressure Support (PSV) - a spontaneous mode of mechanical ventilation. The patient's breath aided by a predetermined amount of positive airway pressure. The inspiratory pressure is set and the patient determines the tidal volume (Vt) and the inspiratory flow rates. This mode of ventilation is associated with improved patient comfort on mechanical ventilation. An overall decreased work of breathing, and decreased airway resistance by increasing flow during inspiration have been realized with the use of this mode of ventilation (Prinianakis, Kondili, & Georgopoulos, 2003).

Positive End Expiratory Pressure (PEEP) - the application of pressure at the end of expiration and is associated with an improvement in oxygenation and increased lung volumes. The application of PEEP in patients with unilateral lung disease may be detrimental if PEEP hyperinflates normal lung regions, thus directing blood flow to diseased regions of the lungs. The application of PEEP in patients with flow limitations decreases inspiratory effort needed to initiate a ventilator assisted breath; therefore the patient's breathing work load is decreased (Suwanvanichkij, & Curtis, 2004).

Summary

Respiratory care practitioners perform many functions from routine bedside care to complex invasive procedures. Their role expands beyond the scope of traditional bedside care and encompasses discharge planning, quality monitoring initiatives, and health promotion activities. Assessment of essential skills and informational aptitude of key concepts of respiratory care may reduce errors in medical judgment and lead to improved quality of patient care.

Chapter II provides a review of the literature revealing the consequences of knowledge gaps and rationale for competency-based assessments.

Chapter III presents the study design, sample and tools used to assess knowledge of mechanical ventilation.

Chapter IV reveals the results of the data analysis in addition to a discussion of the relationship between the participant's score, educational level and longevity in the field of respiratory care.

Chapter V discusses the summary of the study, the findings, limitations and implications. Recommendations for future research are detailed in this chapter.

CHAPTER II

LITERATURE REVIEW

The purpose of this study was to investigate the relationship between a respiratory therapists' knowledge of mechanical ventilation with longevity in the field and acquired type of education. This chapter contains a comprehensive review of the literature specific to competency-based assessment of medical professionals. Subtopics discussed include an overview of the rationale for competency-based assessment, the relationship between type of education and competency, function of credentialing examinations and their relationship to competency determination, the role of the respiratory therapist and need for continued competency of credentialed or licensed practitioners, and the overall consequences of knowledge deficits.

Overview of the Rationale for Competency-based Assessment

The art and science of medical practice was a very dynamic process. The approach to the medical management of disease processes evolved throughout the years. Procedures or therapies that were once state of the art have been replaced by new approaches to the treatment of disease processes. Therefore, it was important for medical personnel to build upon their baseline knowledge and acquire new or improved skills to ensure the provision of quality patient care (Rodgers, Jacob, Rashwan & Pinsky, 2001).

A significant factor affecting baseline knowledge was educational level. Although structured educational programs underwent a rigorous accreditation process, many practitioners have not mastered key medical procedures during training. (Wigton, Blank, Nicholas & Tape, 1989). Researchers have documented these disparities in medical and surgical procedural skill performance among practicing physicians and physicians in residency training (Mandell, Rich, Luxenberg, Spilane, Kern & Parino, 1988). However, there was little evidence in the literature to evaluate similar issues for non-physician medical personnel.

Over recent years educational theorists published several models to describe the development of knowledge and the educational processes involved in achieving competence. Miller applied these theoretical constructs to the development of clinical competence. Miller's model defined the assessment of knowledge in terms of stages. He divided knowledge assessment into 4 stages. Typically, his theoretical construct was displayed as a pyramid and termed Miller's triangle, Figure 1.

Traditional assessment tools, including written and oral tests, were utilized in stages 1 and 2 (Glavin & Maran, 2002). Stages 3 and 4 assessed clinical reasoning, often through structured complex case studies, or clinical examinations (Veloski, Rabinowitz, Robeson, & Young, 1999). This model recognized the importance of assessing core knowledge as a component of competence. The triangular representation of this model identified four stages of development that an individual would progress through in the learning process. The model commenced with the acquisition of knowledge needed to per]form a task or skill and convened with actual performance of the task. The first three levels of this model encompassed the components of competence. A clear delineation was made between competence and performance. This model assumed that competence predicted performance. However, in the practice of clinical medicine, knowing and knowing how, and demonstrating or showing how to perform a skill or procedure in a simulated situation, does not always extrapolate to application of knowledge in the workplace or clinical performance. Many extraneous variables have influenced clinical performance. Researchers demonstrated the ill-effects of overtime, in terms of impaired cognitive performance in the areas of attention, and executive function (Proctor, White, Robins, Echeverria & Rocskay, 1996). Increased feelings of depression, fatigue and confusion were associated with increased overtime work. However, these debilitating effects of stress on the job performance of competent medical personnel have been underappreciated (Flin, Fletcher, McGeorge, Sutherland & Patey, 2003). Clinical performance was also affected by the individual's state of physical health and well-being. Illness, even minor ailments had a negative effect on performance (DeLisa, 2000). Competence did not assure that the health care professional would perform the skill or task in the appropriate manner each time. However, competency assessments established quality standards for professional workplace training and development, benchmarks for the assessment of professionals as well as benchmarks for the measurement of quality care (Travis, 2002). This process was important in the determination of individual acquired knowledge. Additionally, the assessment of an individual's application of clinical reasoning to solve problems, and possessed the ability to perform skills was critical to the job function.

Relationship between Level of Education and Competency

The formal education process for respiratory care practitioners evolved throughout the years. In the early 1960's the entry-level requirement for respiratory care training was an apprenticeship training program. These inhalation therapy programs were predominately hospital-based and certificates of completion were awarded in the absence of formalized curriculum (Pierson, 1988). By the mid-1960's new formal training programs began. Vocational-technical schools and the community colleges became the primary sites for respiratory care education and training. Credentialed educational programs evolved in the form of traditional or non-traditional (correspondence course) programs at community and technical colleges in an attempt to fill the demand for therapists during years of unprecedented growth. This evolution continued well into the 1980's. As the educational requirements of new therapists increased, the need for expanded curriculum shifted the responsibility for professional preparation of therapists to colleges and universities that awarded academic credit and degrees (Farrell, 1986). Throughout this period, the demand for therapists exceeded the supply, and the pressure to meet workforce needs may have contributed to an artificially short course of study with artificially low academic awards as compared to other health professions.

Recognizing the need to plan for future change, during the 1990s the American Association for Respiratory Care (AARC) organized educational consensus conferences and supported research on the future scope of practice and education of therapists. (O'Daniel, Cullen, Douce, Ellis, Mikles, Wiezalis, Johnson, Lorance & Rinker, 1992). These efforts contributed to the growing recognition of the need for an associate degree minimum academic preparation for entry-level therapists for 2002. Currently, an associate degree is the present entry level requirement and the base requirement for the advanced practice credential of registered respiratory therapist (RRT).

The white paper from the AARC steering committee of the coalition for baccalaureate and graduate respiratory therapy recognized the acceleration of expectations for the profession. Since the profession of respiratory care is a highly complex occupation, the need existed to expand curriculums to include critical thinking and decision making skills, in addition to a detail of new and rapidly emerging technologies. The expanded curriculum was necessary to prepare future therapists for current clinical demands (Mishoe, 2002). This white paper addressed the requirement for a detailed knowledge of diagnostic procedures, application of therapeutic modalities and refined assessment skills to achieve competence and adapt to the expanding role of the respiratory therapist (Development of Baccalaureate and Graduate Degrees in Respiratory Care, 2003). Role expansion incorporated the components of patient needs assessment, plan for the provision of complex care, effective participation on professional interdisciplinary teams, and provision of patient and caregiver education. The opportunities for baccalaureate and graduate education became apparent as the role of the respiratory care practitioner expanded (Douce, 1999). As a result, respiratory care educational programs at the baccalaureate level have increased in number by 75% with 57 accredited programs of study identified in 2002. A recent study showed the value of expanded education in relation to hiring preferences. In a survey of 1,444 respiratory care managers, 70% preferred to hire experienced registered respiratory therapists with baccalaureate degrees. The survey also assessed manager's attitudes towards advanced or graduate level education. The managers polled supported graduate degrees in the field of respiratory care for key advanced practice positions, specifically managers, clinical specialists, educators and supervisors (Becker, 2003).

Function of Credentialing Examinations and their Relationship to Competency Determination

Within the profession of respiratory care, the credentialing process was directed by the National Board for Respiratory Care (NBRC). This credentialing agency established the minimum requirements for the determination of initial competency. The Certified Respiratory Therapist (CRT), also know as the entry level credential, was adopted by most states as the minimum level of competency a therapist must demonstrate to obtain recognition by the government of that state as a licensed practitioner. Currently, the CRT examination is administered in the aforementioned capacity in the 46 states that regulated the profession under a licensure or practice act.

This examination's intent was to objectively measure essential knowledge, skills and abilities required for the provision of the fundamental elements of respiratory care. One hundred-sixty multiple-choice questions (140 scored items and 20 pretest items) were incorporated in this competency-based examination. Questions are distributed among three major content areas: clinical data, equipment and therapeutic procedures. The examination is time limited with a three hours maximum allotment for exam completion (O'Donohue, 1982).

The Registered Respiratory Therapist (RRT) credential was the tool adopted as an industry standard for measuring knowledge, verifying competence as an advanced practitioner and demonstrated parity with other credentialed health care professionals. Therapists completing advanced-level respiratory therapy programs fulfilled education and training requirements that provided them with knowledge and clinical expertise to meet the requirements for the aforementioned aspects of role expansion. The written and clinical simulation components of the RRT exam were documented attainment of the additional knowledge. The CRT credential was a prerequisite for admission to the registry examination. The RRT examination consisted of a written portion and a clinical simulation portion. The two portions of the RRT examination were administered in separate testing sessions. The Written Registry Examination consisted of 115 multiple-choice questions (100 scored and 15 pretest items) covering the recall, application and analysis of clinical data, equipment and therapeutic procedures. Candidates were allotted two hours to complete the examination (Dunne, 1983).

The second portion of the examination, Clinical Simulation Examination (CSE), consisted of eleven separate patient management problems; ten scored problems and one non-scored pretest problem. The clinical setting and patient situation for each problem were designed to simulate reality and be relevant to the clinical practice of respiratory care. Candidates were permitted four hours for completion of the CSE. A graduate of an advanced-level program failing to complete the examinations and earn the RRT credential has not documented the acquisition of the knowledge and skills necessary to meet the demands of the professions expanded scope of practice. This situation was analogous to a physician completing a residency program in a medical specialty and listing his or her credentials as Board Eligible in the respective subspecialty rather than completing certification and obtaining Board Certification. The completion of the credentialing process demonstrated achievement of the competency at that given point in time. Currently, there are no formal mandates for recredentialing or demonstrating continued competence. The use of this process for continued competency was expensive in terms of the cost of the examination and the time and effort dedicated to remediation. Self-assessment examinations were also available through the NBRC. Self-assessment examinations provided a criterion-based testing module that mirrored their respective examination (CRT, written registry, clinical simulation). The tool was available in computerized format as well as pencil and paper. In both cases, after the tool was completed and graded by the NBRC staff, the practitioner received feedback regarding their test score, and a detailed report of each question, answer as well as the rationale and reference for each response. The advantage to the computerized format was the availability of immediate feedback, often within minutes of test completion. Although a very scientific and thorough process, the cost to the participant for this type of test was approximately two-hundred dollars. The use of this type of assessment tool was prohibitive on a cost basis, especially if the intent was to administer the tool yearly. This standardized testing tool provided a global assessment of the participant's knowledge of respiratory care. The content included measurement of all aspects of patient care. Therefore, it was not possible to target on one specific content area or skill set with this tool.

The Role of the Respiratory Therapist and Need for Continued Competency of Credentialed or Licensed Practitioners

Researchers, however, supported the need for ongoing continuing education and training, beyond fundamental or advanced knowledge of treatment modalities. The need for continuing education was attributed to the expanded scope of practice for respiratory care practitioners, which included the detailed therapist driven protocols, complex algorithms for care and the operation of complicated medical machinery (Pierson, 2001). It is also necessary, in today's health care environment, for respiratory therapists to actively participate in the multidisciplinary team process and contribute to the development of individual patient care plans. Registered respiratory care practitioners must select and tailor therapeutic modalities to meet individual patient care plan requirements, be cognizant of age-related issues, and adapt clinical practice guidelines across the continuum of care through a variety of settings; from prehospital, acute care, subacute care to home or long-term care (Kester & Stoller, 1996).

Perhaps one of the most complex treatment modalities a respiratory therapist administered was the initiation and management of mechanical ventilation. The objective of mechanical ventilation was to ensure that the patient receives the appropriate volume of air and oxygen percentage to satisfy respiratory needs while preventing lung damage, circulation impairment and maximizing comfort (Chatburn & Volsko, 2000). Technological advances in the form of new complex modes of mechanical ventilation and numerous ventilator options posed barriers due to knowledge gaps. Although the aim of manufacturers in the development of new technologies was to improve patient-ventilator interaction and facilitate matching the appropriate mode and level of support with patient need, the desire to produce a unique product reigned. The result was lack of standardized terminology by ventilator manufacturers which prevented clinicians from fully understanding the therapies they administered (Chatburn & Primiano, 2001). These knowledge deficiencies may have compromised the delivery of quality patient care, and yield results contrary to the intent of therapy (Navalesi & Costa, 2003).

Overall Consequences of Knowledge Deficits

The advent of knowledge gaps may have resulted in medical judgment errors, compromised patient care or both. The cost can be tremendous and reflected in increased morbidity, mortality, and health care costs (Dickens, 2003). Health care expenditures associated with knowledge gaps were particularly important when practitioners are engaged in complex or multidimensional skills or procedures, such as the initiation and management of mechanically ventilated patients (Scheinhorn, Chao, Stearn-Hassenpflug, & Wallace. 2001). Competency assessment and training programs may address this critical issue. These programs can assess key skill, procedural, and cognitive abilities and lay the groundwork for remediation without the cost associated with recredentialing examinations (Holmboe & Hawkins, 1998).

Summary

Competency assessment was a critical component in establishing and maintaining a minimum standard of performance and knowledge level of health professionals. The literature supported an overwhelming need for competency assessment to be multidimensional. Therefore, it was essential to assess skill, procedural and informational aptitude of health care providers. In light of budget constraints it was important to tailor the assessment to key or critical job related components or concepts that are instrumental in the provision of quality patient care.

Chapter III presents the study design, sample and tools used to assess knowledge of mechanical ventilation.

Chapter IV reveals the results of the data analysis in addition to a discussion of the relationship between the participant's score, type of education and longevity in the field of respiratory care.

Chapter V discusses the summary of the study, the findings, limitations and implications. Recommendations for future research are detailed in this chapter.

CHAPTER III

PROCEDURES

The purpose of this study was to investigate the relationship between a respiratory therapists' knowledge of mechanical ventilation with longevity in the field and acquired type of education. Chapter III provides a description of the methodology used in this research endeavor to determine the effects that longevity and type of education have on the knowledge a respiratory therapist has regarding mechanical ventilation. An explanation of the research design, instrument, validation of the instrument, selection of subjects, treatment of subjects and data collection are discussed.

Research Design

A prospective, randomized study was conducted to assess mechanical ventilation knowledge acquired by respiratory therapists. The key objective of this initiative was to develop and implement a testing instrument that provided a reliable way of evaluating key content areas with respect to the theory and application of mechanical ventilation. The names of all health care organizations and respiratory therapy technology programs were placed into and selected from a random numbers table. The researchers sought to implement the testing instrument with 470 respiratory therapists with varied educational levels, and longevity in the field from the randomly selected organizations. Data were collected from January 1, 2004 – March 31, 2004 from a sample of therapists at the randomly selected health care organizations. All respiratory care practitioners at the participating sites were invited to participate in this research study.

Instrument

The testing instrument, Appendix A, was a combination of case vignettes featuring patients with commonly encountered potential indications for mechanical ventilation and questions directed toward the theory and application of mechanical ventilators. Six content areas were addressed within the twenty-five question instrument. The first content area evaluated was mechanical ventilator type. A thorough understanding of the design and classification or type was needed in order for a respiratory therapist to safely and effectively initiate and manage a mechanical ventilator. This dovetailed into the second content area or how ventilators work, which assessed knowledge of basic ventilator mechanics. The third content area addressed the indications for mechanical ventilation, and the fourth content area, cardiopulmonary physiology or normal function of the heart and lungs. The third content area in concert wit the forth, evaluated the understanding of the disease processes which impaired breathing in addition to the effect disease processes had on the duration of mechanical ventilatory support. Modes of mechanical ventilation comprised the fifth content area, which addressed the principles involved in the different ways a breath was delivered through a mechanical ventilator. Comprehension of the rationale for and use of the different modes may have permeated knowledge gaps, attributed to terminology barriers imposed by ventilator manufacturers. The sixth and final content area facilitated an understanding of the manner in which the patient and ventilator interacted to assist with the breathing process and provide life support.

The six aforementioned content areas coincided with the content outline specified by the National Board for Respiratory Care for the CRT (entry level) and RRT (advanced practitioner) national credentialing examinations (National Board for Respiratory Care, 2004). However, the limited number of questions on the testing instrument prohibited sub-analysis in any of the content areas. All questions were of the multiple-choice variety and with four to five single response options. Instrument validation transpired prior to the initiation of this research endeavor. The validation study tested for construct and content validity.

In addition to the testing instrument, each participant was instructed to complete a participant questionnaire, Appendix B. The participant questionnaire consisted of an 8-question survey which evaluated the respondent's clinical experience, education and training, as well as ascertained longevity in the field of respiratory care after the completion of an accredited respiratory therapy technology program. Two demographic variables were included to facilitate sample description, specifically gender and date of birth.

Validation of the Instrument

Prior to the initiation of this research project validation of the testing instrument was performed. A total of six organizations (three acute care facilities, two long-term care facilities and one university based respiratory therapy technology program) provided a combined sample of 105 respiratory care practitioners for the validation study. Informed consent was obtained by each participant prior to the administration of the proctored assessment tool. Data from completed forms (testing instrument and five question participant survey) were analyzed in Statistical Package for the Social Sciences (SPSS) Version 9.0 for windows (SPSS, Inc., Chicago, IL, 1999). The main outcome variable was percentage of correct answers on the assessment tool. Statistical significance was established at $p<0.05$. Criterion validity was evaluated by testing for an empirical association between assessment tool scores and type of education using one-way analysis of variance (ANOVA). Spearmen's rho was used to assess construct validity through the correlation with the assessment tool score, employment site and tenure in the field. A total of 50 of a possible 105 participants completed the validation study, yielding a 48% response rate. Forty-eight of the fifty respiratory care practitioners were trained in a traditional setting (college or university). Participants had varying degrees of longevity which ranged from less than one to twenty-nine years of work experience as a respiratory therapist, mean = 10.84 (SD $\pm$ 9.1). The mean assessment tool score was 55.1% [(range 30 – 76%, (SD $\pm$ 13.2)]. Fourteen therapists (28%) answered less than 50% of the questions correctly. The comparison of assessment tool scores varied with the level of formal education completed. Higher test scores were associated with participants achieving advanced formal degrees ($p=0.031$). There was a statistically significant but weak correlation between longevity in the field and assessment tool score ($p=0.029$, $R^2 = 0.16$). Performance on individual test questions was analyzed and noted in Table 1.

Questions with correct response rates of less than 40% were reviewed for clarity. The stem, correct response or distracters were revised. A subset of the validation study group was recruited to take the revised assessment tool. A total of three organizations (one acute care, one long-term care and one university based respiratory therapy technology program) participated. Twenty-five respiratory care practitioners completed the assessment tool. The results of the revised questions are listed in Table 2.

Selection of Subjects

The sample consisted of participants with diverse academic affiliations and various employment settings, including respiratory therapists working in acute or long-term care settings in addition to respiratory therapy technology students from accredited university and community college-based programs. All academic, acute and long-term care organizations were placed in a random number table. Random sampling was used in order to obtain representativeness of the population of interest. The researchers sought to recruit a minimum of 300 participants. Once an organization was randomly selected, the number of respiratory personnel employed at or enrolled in the organization was determined. The researchers continued to randomly select organizations until the cumulative number, of staff members and/or respiratory therapy technology students, calculated exceeded 300 participants. Six organizations selected from the random table agreed to participate, Appendix C. All 470 respiratory care practitioners from the participating organizations were invited to participate. The study sample consisted of a sample of respiratory care practitioners from the six organizations. A power analysis was used to determine the sample size. A sample of at least 300 participants was needed to achieve statistical significance and obtain an alpha of 0.5. Two organizations were accredited college based respiratory therapy technology programs. One program offered an associates degree and the other a baccalaureate degree. Three organizations were acute care facilities. Respiratory therapists functioned in a variety of settings within these organizations including general care, emergency room, adult, pediatric and neonatal intensive care units. The final organization provided respiratory therapists and therapy services in highly skilled nursing facilities. Although the corporate office was located in Hudson, Ohio, therapists contracted to work at skilled nursing facilities throughout the state, including, Medina, Columbus, Ashtabula, Andover, Canton, Akron, Louisville and Wadsworth. Before the research was conducted, each organization was required to consent to participation. Credentialed therapists and students with training and experience with mechanical ventilation were given the opportunity to participate in this research endeavor.

Treatment of Subjects

Prior to participation in this research endeavor, the director or chair of the respiratory department selected a representative from the participating organization to function as the study coordinator. The study coordinators selected for this research project functioned in a leadership role (lead therapist, educator, supervisor, department manager) within the participating organization. The study coordinator was provided with an in depth narrative of this research, a copy of the study proposal, and a copy of the letter of approval from the human subjects committee at Youngstown State University, Appendix D. The study coordinator was responsible for contacting the Institutional Review Board (IRB) at the respective facility and obtaining approval for the conduction of this study at that site. Approval was verified by the receipt of a signed site agreement form by the researcher, Appendix E.

Once the facility consent form and permission from the IRB was on file the researcher explained the procedure for administering the tool to the study coordinator. The study coordinator was informed about the purpose of this research. The procedures for obtaining informed consent administering the testing instrument were reviewed. This detailed review ensured consistency with the application of this research endeavor. The study coordinator or researcher explained the voluntary nature of participation, and right to withdraw from the process at any time, without fear of repercussion to the staff respiratory therapists, at the respective site. Prior to participation, each respiratory care practitioner was given the informed consent form, and an opportunity to ask any questions pertinent to the study. Each participant signed informed consent prior to participation, Appendix F.

Once the participant returned the signed consent form to the study coordinator, he or she received a research packet containing the 8-question survey, the testing instrument and envelope to return the completed forms. The proctored process occurred at the participant's place of employment. The study participants were given 60 minutes to complete the process. Upon completion of the process, the applicant placed the aforementioned forms in the envelope provided in the study packet. The participant sealed the envelope and submitted it to the study coordinator. Then the study coordinator visually inspected the envelope for proper closure. The study coordinator was instructed not to accept unsealed envelopes. In the event that an envelope was not sealed, the study coordinator asked the participant to seal the packet, and then submit it. If a participant chose not to complete the process, the incomplete testing instrument and survey were placed in the envelope provided, sealed by the participant and returned to the study coordinator. The study coordinator was unaware if the study packet contained complete or incomplete forms.

The study coordinator also elicited reasons for nonparticipation at the respective site. This was an informal process conducted to elicit the barriers for participation in this research endeavor. Each study coordinator submitted a handwritten list of reasons communicated to them by the therapists at their respective site for non-participation.

Data Collection

Completed study packets (test and questionnaire placed in the sealed envelope) were sent to the researcher in a self addressed Fed Ex mailing packet, provided to each of the participating institutions. Data were entered into a database (Microsoft Access, Microsoft Corporation, 2001). Only the researcher and thesis committee advisor had access to the data.

Summary

Chapter III identified the research methodology used to determine the effects of type of education and tenure on a respiratory therapist's knowledge of mechanical ventilation. A detailed description of the testing instrument and participant survey was provided. The procedure used to validate the testing instrument was outlined. This chapter also provided a detail of methods used in sample selection. The procedure for data collection was also outlined.

The statistical methods mentioned in this chapter are presented comprehensively in addition to the study results in Chapter IV.

Further summarization and conclusion of research findings are presented in Chapter V. This final chapter elaborates on the implications of this academic endeavor and recommendations for further research.

CHAPTER IV

ANALYSIS OF DATA

The purpose of this study was to determine the correlation between a respiratory therapist's knowledge of mechanical ventilation, longevity in the field and acquired type of education. The data were analyzed to test the research hypotheses: Respiratory therapists with longevity in the field will achieve higher scores on the written testing instrument than those with fewer years of experience. Respiratory therapy graduates of traditional degreed education programs will achieve higher scores on the written assessment tool than therapists trained through non-degreed programs.

Chapter IV provides a description of the data analysis, demographic profile of the sample population, and correlation between knowledge of mechanical ventilation, longevity on the field and type of education.

Data Analysis

The data were analyzed in The Statistical Package for the Social Sciences (SPSS) Version 9.0 for Windows. The main outcome variable (variable of interest) was knowledge of mechanical ventilation measured as the percentage of correct answers on the testing instrument. Statistical significance was established at $p < 0.05$. The hypotheses were evaluated by testing for an empirical association between test scores, longevity in the field and acquired type of education using regression analysis.

Demographic Profile of the Sample Population

A total of 159 from a possible 470 participants (34%) consented to participation in this study. All participants completed the testing instrument and participant questionnaire. The mean age of participants was 34.2 years, (SD $\pm$ 9.1). Participants ranged in age from 23 to 60 years of age. Thirty-five percent of the subjects were male. A majority of the population sampled (93%) received respiratory therapy technology training through a traditional or college based accredited program. Only a few of the respiratory therapists sampled were graduates of a baccalaureate degree program in respiratory therapy technology (5.7%). However, 25 of the 159 participants were students enrolled in accredited respiratory therapy technology programs. Of the 25 students sampled, 15 were enrolled in an accredited baccalaureate degree respiratory therapy technology program.

All participants in this study were employed. Nearly two-thirds of the respiratory therapists sampled maintained full-time employment (67.3%). Nearly two-thirds (53.4%) of the study population achieved more than one credential. The advanced practice credential, (RRT) was earned by 45.3% of the study participants. All therapists earning the RRT credential received training through traditional college or university based programs. Specialty credentials were also earned. Only 8.1% of participants achieved the specialty credentials of either certified pulmonary function technician (CPFT), registered pulmonary function technician (RPFT) or neonatal pediatric specialty practitioner (NPS).

The participants had varying degrees of longevity, defined as the number of years the respiratory therapist worked in the field after completion of an accredited respiratory therapy technology program. Zero years indicated that the participant was a student that had not completed the accredited respiratory therapy technology program. Longevity ranged from 0 to 29 years in the field. The mean number of years worked was 8.5, (SD $\pm$ 8.7). Table 3 summarized the demographic profile of the study sample. All of the participants had clinical experience with mechanical ventilation in the field. However, varying degrees of experience were noted. Eighty-nine percent of the population sampled made ventilator changes based upon some type of protocol (weaning or ventilator management). Table 4 provided a detail of the study group's clinical experience with mechanical ventilation.

A limited number of respiratory therapists completed respiratory therapy training in a non-traditional manner or through a correspondence course (7.5 %). The participants within this subset of the study population were less diverse. All participants were at least 50 years of age, mean 53.2, (SD ± 3.2). More than one-half (64%) were female. Of the 159 participants sampled, the non-traditionally trained therapists had the most longevity in the field. All non-traditionally trained participants had more than 24 years of experience working in the field of respiratory care, mean 26.4 years (SD ± 2.4). All participants within this subset of the study population achieved only the entry level credential, the CRT.

Correlation between Knowledge of Mechanical Ventilation, Longevity and Type of Education

The mean test score on the testing instrument was 65.9% (SD ± 19%). Scores ranged from 12 – 96%. Thirty-one therapists (19.5%) answered less than fifty percent of the questions correctly. A respiratory therapists knowledge of mechanical ventilation as reflected in testing instrument score was shown in Table 5.

Twenty –four percent of the participants did not recognize the cause of or corrective action needed when mechanical ventilation is not tolerated. Questions one and two of the testing instrument evaluated this component of applied clinical knowledge. Forty percent of participants did not recognize the clinical indications for and selection of ventilator settings during the weaning process. Question three assessed this aspect of applied clinical knowledge.

Two levels of comparison were used in the hypothesis testing. Pearsons Correlation (2-tailed) was utilized in the bivariate analysis of testing instrument scores with longevity in the field and level of education. Least squares regression analysis was used to help explain the relationships among testing instrument score, longevity and type of education. Statistical significance was established at $p < 0.05$. A statistically significant correlation between longevity in the field and test score ($p = 0.003$) was found. Testing instrument scores were not associated with level of education ($p = 0.767$) with this level of analysis, Table 6. However, multivariate analysis facilitated an analysis of effect of level of education while longevity was controlled for. Analysis on this multivariate level revealed a statistically significant correlation between longevity in the field and type of education with testing instrument score ($p = 0.002$, R Square 0.78), Table 7.

Summary

A total of 159 credentialed respiratory therapists and respiratory therapy students completed the testing instrument and participant questionnaire. Therefore, a participation rate of 34% was realized. The mean age of the subjects was 34 years of age. Although participants ages ranged from 23 to 60 years, more women (64.2%) participated in this study than men (35.8%). A majority of the population sampled (93%) received respiratory therapy technology training through a traditional or college based accredited program. However, only 5.7% were graduates of a baccalaureate degree program in respiratory therapy technology. More than one-half (53.4%) of the study population achieved more than one credential. The advanced practice credential, (RRT) was earned by 45.3% of the study participants.

All participants of this study were employed, 67.3% of which maintained full-time status. The participants had varying degrees of longevity, defined as the number of years the respiratory therapist worked in the field after completion of an accredited respiratory therapy technology program. Longevity ranged from 0 to 29 years in the field. The mean number of years worked in clinical practice was 8.5 years, (SD ± 8.7).

The mean test score on the testing instrument was 65.9% (SD ± 19%). Scores ranged from 12 – 96%. Thirty-one therapists (19.5%) answered less than fifty percent of the questions correctly.

Two levels of comparison were used in the hypothesis testing. Pearson's Correlation (2-tailed) was utilized in the bivariate analysis and least squares regression analysis was used in the multivariate analysis of testing instrument score, with longevity and level of education. The bivariate level of analysis revealed only statistically significant correlation, specifically, the correlation between longevity in the field and test score ($p = 0.003$). However, multivariate analysis revealed a statistically significant correlation between longevity in the field and level of education with testing instrument score ($p = 0.002$, R Square 0.78).

The study was further summarized in Chapter V. Conclusions of the study, as well as recommendations for further research are presented.

CHAPTER V

SUMMARY, CONCLUSIONS AND RECOMMENDATIONS

Summary

Respiratory care was a multidimensional health care profession which underwent a metamorphous over the last five decades. This growth facilitated the performance of numerous invasive, non-invasive and highly technical skills, across a spectrum of age ranges, in a multitude of settings. Market dynamics and health care system shifts prompted this broadened scope of practice, accompanied by the need for added skills and expanded responsibilities. However, a need existed to assure that respiratory care professionals possessed the necessary knowledge and skills for the provision of quality patient care. Technological advances in the form of new complex modes of mechanical ventilation and numerous ventilator options accompanied the professional growth and resulted in carriers to care, due to gaps in knowledge. Knowledge gaps contributed to the occurrence of medical judgment errors, compromised patient care or both. This potentated an escalation of medical expenditures and poor patient outcomes in terms of disease related morbidity and mortality.

Competency assessment was a critical component in the establishment and maintenance of a minimum standard of performance and knowledge level of health professionals. The literature supported an overwhelming need for multidimensional competency assessment. This type of comprehensive competency assessment addressed the skills, procedural and informational aptitude needed to overcome the problems associated with knowledge gaps.

However, the financial resources needed to employ multidimensional competency testing are not unlimited. Therefore, it was important to tailor the assessment to key or critical job related components or concepts that were instrumental in the provision of quality patient care. The evaluation of factual knowledge and problem-solving skills through the use of a multiple choice question assessment tool offered a viable option for the assessment of context and clinical reasoning.

The purpose of this study was to determine the relationship between a respiratory therapists' knowledge of mechanical ventilation with longevity in the field and acquired type of education. A validated twenty-five question testing instrument was used to assess respiratory therapists' knowledge of mechanical ventilation. While a brief participant survey gathered key demographic, education and longevity data.

The hypothetical approach to this research endeavor was that respiratory therapists with longevity in the field would achieve higher scores on the written assessment tool than those with fewer years of experience. Additionally, respiratory therapy graduates of with traditional degreed education programs will achieve higher scores on the written assessment tool than therapists trained through non-degreed programs.

Data obtained from a sample of respiratory therapists employed at or enrolled in randomly selected organizations or accredited college-based respiratory therapy programs provided data. These data were used to determine the effects of longevity and level of education on knowledge of mechanical ventilation. The prospective, randomized design of this study allowed the researchers to obtain representiveness within the population of interest.

Many of the therapists who did not participate in the study volunteered reasons for non-participation. The most common reason among respiratory therapy students for not participating in this study were lack of study incentives. The students viewed the inability to obtain bonus or extra credit points for study participation as a disincentive. Respiratory therapists who lacked student status cited fear based reasons for nonparticipation. Fear of signing the informed consent, which associated their name with a score on the testing instrument, was their primary reason for lack of participation. Many therapists cited an additional fear that their individual test score would be revealed to their employer and negative job-related repercussions imposed upon them for poor performance. Others fears poor performance.

Conclusions

Information obtained from the study revealed the following:

- A total of 159 credentialed respiratory therapists and respiratory therapy students completed the testing instrument and participant questionnaire and yielded a 34% response rate to the competency assessment instrument.
- Participation in this research endeavor was limited due to the perceived fear of poor performance, along with the assumption that the confidential nature of this research would be violated and performance based disciplinary action imposed on poor performing participants.
- Therapists that received traditional training were more likely to achieve the advanced practice credential of RRT (43.3%) than those trained in a non-traditional manner (0%).
- Therapists achieving an advanced credential reported more autonomous experiences with mechanical ventilation than respiratory care students or practitioners with entry level credentials. This coincided with the attitudes and beliefs cited in the literature supporting the attributes of the advanced level credential and the benefits of receiving higher levels of education.

- Knowledge of mechanical ventilation, as assessed through test score, was average as evidenced by a test score on the testing instrument of 65.9% (SD ± 0.19).
- Longevity in the field had a statistically significant effect on a therapist's knowledge of mechanical ventilation, ($p = 0.003$), as demonstrated by bivariate and multivariate analyses. However, the effect of type of education on a respiratory therapist's knowledge of mechanical ventilation was not determined until the effect of longevity was controlled for ($p = 0.002$, $r^2 = 0.78$).

Implications

The findings of this research demonstrated the ability to assess key skill, procedural, and cognitive abilities of respiratory care practitioners associated with the initiation, use and discontinuation of mechanical ventilation. Despite training and clinical experience derived form longevity in the field, this group of therapists displayed deficiencies in knowledge and application of mechanical ventilation. It was evidenced by the mediocre nature of the scores obtained by study participants. Gaps in knowledge occurred with the study sample even though participants completed rigorous training provided by accredited respiratory therapy technology programs and acquired information through clinical experience gained from longevity in the field. Although, avenues for continued learning, such as the clinical information and experience gained by longevity in the field and the attainment of high levels of education enabled participants to perform better than participants with fewer years of work experience and non-traditional forms of education.

Further evidence in knowledge and application deficiencies were seen with poor performance on questions assessing the indications for and settings associated with weaning from mechanical ventilatory support. Sixty-one percent of participants reported making ventilator changes under the auspices of weaning protocols. However, forty-one percent of participants provided incorrect responses to questions on the testing instrument addressing the indications for weaning. Furthermore and additional twenty-four percent of participants failed to recognize the indications or corrective action to be taken for patient's not tolerating mechanical ventilation.

Yet the degree to which the aforementioned factors influence skill, procedural, and cognitive abilities can not be ascertained without a competency-based assessment tool. The multiple-choice testing instrument utilized in this study provided a basis for the assessment of knowledge related to the initiation, use and discontinuation of mechanical ventilation. It is in the identification of knowledge gaps that a foundation for remedial education can be built. When knowledge gaps are dealt with in a supportive learning environment, the fear based barriers that limit participation in this type of evaluation are less likely to occur. The findings of research suggested that the quality of patient care cannot be assumed and that continued professional staff development was important.

Recommendations for Further Research

Additional studies to determine the effects of level of education on mechanical ventilation knowledge with respect to the practice of respiratory care nationallyl are warranted. A more comprehensive, randomized, multi-state study may determine if knowledge of mechanical ventilation is affected the level of education provided by accredited respiratory therapy technology programs. This would entail a comparison of associate degree and baccalaureate degree programs in the students' final semester of the accredited program. An analysis of program curriculum and clinical hours required for program completion are needed to sub-analyze the variables that impact the acquisition of academic knowledge. Practitioner participation may be enhanced if the study design addressed fear and incentive based barriers.

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Table 1.

Summary of Participant Responses Obtained during Validation Study of Testing Instrument

Question number and description	Correct responses n (%)
1. Cause of hypotension in a manually ventilated patient	38 (76)
2. Treatment of hypotension in a manually ventilated patient	36 (72)
3. Selection of initial ventilator settings	39 (78)
4. Selection of ventilator settings during weaning	30 (60)
5. Calculation of spontaneous tidal volume during PSV	40 (80)
6. Classification of mechanical breath type	41 (82)
7. Determination of ventilator monitor functions	38 (76)
8. Definition of compliance	33 (66)
9. Calculation of total compliance of the respiratory system	3 (06)
10. Calculation of resistance in an intubated patient	22 (44)
11. Selection of characteristics associated with PEEP	26 (52)
12. Definition of a ventilator assisted breath	30 (60)
13. Description of mode of ventilation	11 (22)
14. Rationale for use of time constants	14 (28)
15. Selection of control variable	4 (08)
16. Definition of trigger variable	47 (94)
17. Determination of limit variable	33 (66)
18. Determination of cycle variable	28 (56)
19. Factors that influence the initiation of a spontaneous breath.	9 (18)

Table 1. (continued)

Summary of Participant Responses Obtained during Validation Study of Testing Instrument

Question number and description	Correct responses n (%)
20. Definition of anatomical dead space	46 (92)
21. Rationale for use of humidification during mechanical ventilation	40 (80)
22. Determine cardiopulmonary effects of SIMV and A/C	35 (70)
23. Determine characteristics of pressure control ventilation	11 (22)
24. Determination of volutrauma causes	25 (50)
25. Selection of spontaneous modes of ventilation	14 (28)

Table 2.

Participant Responses to Revised Testing Instrument during Validation Study

Question Number	Correct responses n (%)
9. Calculation of total compliance of the respiratory system	15 (60)
15. Selection of control variable	11 (44)
19. Factors that influence the initiation of a spontaneous breath	19 (76)
23. Determine characteristics of pressure control ventilation	18 (72)
25. Selection of spontaneous modes of ventilation	12 (48)

Table 3.

Demographic Data for Enrolled Respiratory Therapists

Variable	n	Percent (%)
Age		
21 – 25	33	20.8
26 – 30	37	23.9
31 – 35	24	15.1
36 – 40	23	14.5
41 – 45	17	10.7
46 - 50	15	9.5
51 – 55	7	4.3
56 – 60	2	1.2
Gender		
Male	57	35.8
Female	102	64.2
Employment Status		
Full-time	107	67.3
Part-time	52	32.7
Level of Education		
Traditional college-based	147	92.5
Correspondence course	12	7.5

Table 3. (continued)

Demographic Data for Enrolled Respiratory Therapists

Variable	n	Percent (%)
Degree received		
None, student status	25	15.7
1 year certificate of completion	13	8.2
Associate Degree	112	70.4
Baccalaureate Degree	9	5.7
Credentials		
Certified Respiratory Therapist (CRT)	127	79.9
Certified Pulmonary Function Technician (CPFT)	5	3.1
Registered Respiratory Therapist (RRT)	72	45.3
Registered Pulmonary Function Technician (RPFT)	1	0.6
Neonatal Pediatric Specialist (NPS)	7	4.4
Longevity in the field (years)		
0 - 5	83	52.0
6 – 10	16	10.0
11 – 15	25	15.7

Table 3. (continued)

Demographic Data for Respiratory Therapists Enrolled in the Study

Variable	n	Percent (%)
Longevity in the field (years)		
16 – 20	15	9.5
21 – 25	15	9.5
26 – 30	5	3.3

* Credentials category contained data that were not mutually exclusive. Participants may have more than one credential.

Table 4.

Levels of Mechanical Ventilation Clinical Experience with Respect to Highest Credential Earned

Description of experience	Number of participants stratified by credential earned			
	SRT	CRT	RRT	Total
Made physician ordered changes	8	2	2	12
Made ventilator changes under the auspices of weaning protocols	12	49	36	97
Initiated and discontinued mechanical ventilation within ventilator management protocols	0	11	34	45
Did not make ventilator adjustments	5	0	0	5

Table 5.

Knowledge of Mechanical Ventilation Exemplified by Percent of Correct Responses on the Testing Instrument

Percent correct	n (%)
10 – 20	3 (1.9)
21 – 30	4 (2.5)
31 – 40	10 (6.2)
41 – 50	14 (12.6)
51 – 60	40 (25.1)
61 – 70	23 (14.4)
71 – 80	11 (6.9)
81 – 90	25 (15.7)
91 – 100	21 (13.2)

Table 6.

Bivariate Analysis of Mechanical Ventilation Knowledge, Assessed by Testing Instrument Score with Longevity and Educational Level

Variable	Pearson Correlation	p value
Longevity	0.234**	0.003
Level of Education	0.024	0.767

** Correlation is significant at the 0.01 level (2-tailed).

Table 7.

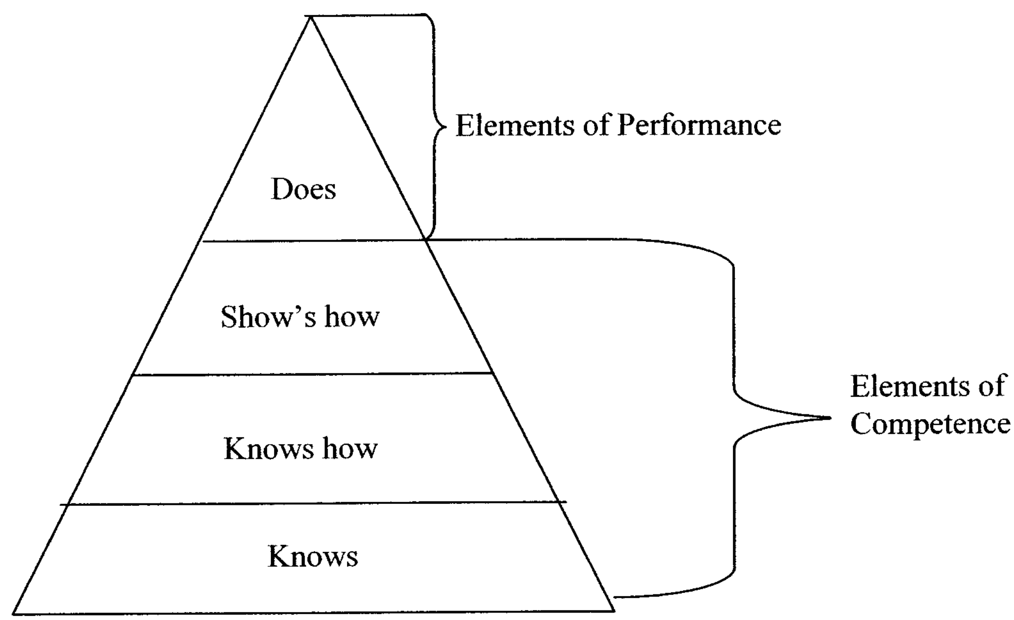
Multivariate Analysis of Mechanical Ventilation Knowledge, Assessed by Testing Instrument Score with Longevity and Educational Level

Variable	Unstandardized Coefficients		Standardized Coefficients	t	p value
	B	Std. Error	Beta		
(Constant)	0.736	0.064		11.580	0.000
Longevity	0.007	0.002	0.318	3.631	0.000
Level of Education	0.127	0.063	0.176	2.008	0.046

Figure 1.

Miller Triangle Assessment of Knowledge

Figure 1. Miller's Triangle Assessment of Knowledge



APPENDIX A

Testing Instrument

Testing Instrument

Clinical Scenario # 1

A 64 year old female with a history of COPD is currently on room air with supplemental humidity via a tracheostomy mask. She is a resident of a long term care facility with respiratory personnel on staff. Over the past week, her exercise tolerance has been decreasing, and she is now dyspneic at rest despite frequent use of her beta agonist therapy. She has a strong cough, productive for a moderate amount of clear to white colored odorless secretions.

Upon physical examination, she is in moderate respiratory distress, but alert and appropriately responsive. Temperature is 38 degrees C, heart rate (HR) 110 beats per minute and blood pressure (B/P) 110/70 mmHg. She is using accessory muscles to breathe but can't complete short sentences. Decreased breath sounds are present bilaterally and prolonged expiration is noted. Heart sounds are distant but regular and the abdomen is unremarkable.

A portable chest radiograph reveals hyperinflation and decreased lung markings throughout both lung fields. The patient was placed on 30% oxygen via tracheostomy mask. An arterial blood gas (ABG) performed 60 minutes after the administration of supplemental oxygen reveals: pH 7.30, pCO_2 60 mm Hg, PaO_2 58 mm Hg, SaO_2 88%. The physician request that she be placed on mechanical ventilatory support. The RN is manually ventilating the patient at 25 breaths per minute with a resuscitation bag connected to an oxygen source. Immediately after manual ventilation was started, the patient's blood pressure is observed to be 70/40 mmHg.

1. What is the MOST likely cause of the hypotension?
    a. Sepsis
    b. Pneumothorax
    c. Increased intrathoracic pressure from auto PEEP
    d. Myocardial infarction

2. The most appropriate first intervention is to:
    a. Increase IV fluids.
    b. Place a 16 gauge needle in the left anterior second intercostals space
    c. Stop bagging and allow the patient to exhale
    d. Begin dopamine at 5 mcg/kg/min

3. B/P improves to 100/65. The physician asks you to decide what ventilator settings would be set for the patient. She weighs 60 kg. You select:

a. Volume controlled ventilation.
   Mode: assist control
   Respiratory rate: 22
   Tidal Volume 400 mL
   PEEP 5 cm H_2O
   F_IO_2: 1.0
b. Volume controlled ventilation.
   Mode: assist control
   Respiratory rate: 12
   Tidal Volume 500 mL
   PEEP 5 cm H_2O
   F_IO_2: 0.6
c. Volume controlled ventilation.
   Mode: assist control
   Respiratory rate: 20
   Tidal Volume 700 mL
   PEEP 5 cm H_2O
   F_IO_2: 0.6
d. Pressure controlled ventilation.
   Mode: assist control
   Respiratory rate: 15
   Inspiratory pressure 25 cmH_2O
   PEEP 5 cm H_2O
   F_IO_2: 1.0
   I:E: 1:1

Clinical Scenario # 2
You are asked to wean a 37 year-old patient with Guillian-Barre syndrome from the ventilator. He is currently on a partial support mode of ventilation (VC-IMV). Current ventilator settings are as follows:

Tidal volume: 1.2 L
Frequency: 8 breaths per minute
Inspiratory flow rate: 70 L/M
F_IO_2: 45
Pressure support: 25 cm H_2O
PEEP: 5 cmH_2O

He has spontaneous respiratory efforts, and a total breath rate of 14 breaths per minute. His minute ventilation is 16.8 L/m

4. What set ventilator parameter would you change to wean this patient?
    a. The IMV rate
    b. The PEEP
    c. The pressure support
    d. No change recommended, the patient is not ready to wean.

5. Calculate the patient's current spontaneous tidal volume on the set level of pressure support.
    a. 1.8L/breath
    b. .90L/breath
    c. 1.2L/breath
    d. .76L/breath

6. All of the following types of breaths are classified as mandatory **<u>except</u>**
    a. When the patient starts and stops the breath
    b. The patient starts the breath and the ventilator stops the breath
    c. The ventilator starts the breath but the patient stops the breath
    d. The ventilator starts and stops the breath.

7. Ventilator monitors perform all of the following functions **<u>except</u>**
    a. Alert the operator if the patient becomes disconnected
    b. Control the size and frequency of the breath.
    c. Display pressure, volume and flow waveforms.
    d. Allow the operator to assess how well the ventilator interacts with the patient.

8. Compliance is defined as
    a. Δ volume/Δ pressure
    b. Δ pressure/Δ volume
    c. Δ flow/Δ pressure
    d. Δ flow/Δ volume

9. The compliance of the lungs is 0.2 L/cmH_2O and that of the chest wall is also 0.2L/cmH_2O. What is the total compliance of the respiratory system?
    a. 0.4 L/cmH_2O
    b. 0. 2 L/cmH_2O
    c. 0.1 L/cmH_2O
    d. Insufficient information given, unable to calculate respiratory system compliance.

10. The resistance of the endotracheal tube is 10 cmH_2O/L/s. What is the total resistance of the respiratory system is 5.0 cmH_2O/L/s. What is the total resistance of the respiratory patient?
    a. 5 cmH_2O/L/s
    b. 15 cmH_2O/L/s
    c. 3.3 cmH_2O/L/s
    d. Insufficient information given, unable to calculate respiratory system compliance.

11. All of the following are true about auto PEEP **except**
   a. It places an extra burden on the inspiratory muscles.
   b. It adds to the triggering pressure, decreasing the effective sensitivity of the ventilator.
   c. It may prevent successful weaning
   d. It can be avoided by increasing the inspiratory time.

12. A ventilator assisted breath is one for which:
   a. The patient triggers inspiratory flow from the ventilator.
   b. Inspiration is patient triggered and machine cycled.
   c. The patient breathes on CPAP
   d. All or part of the inspiratory or expiratory flow is generated by the ventilator doing the work for the patient.

13. A complete specification or description of a mode consists of the:
   a. Ventilator name, mode name and breathing pattern
   b. Mode name, breathing pattern, and operational logic
   c. Control strategy, breathing pattern and phase variables
   d. Breathing pattern, control type and control strategy.

14. Knowledge of time constants is useful for all of the following **except**
   a. Predicting inspiratory volume during pressure controlled ventilation.
   b. Predicting gas trapping.
   c. Understanding lung protective strategies.
   d. Calculating peak inspiratory flow during pressure control ventilation.

A ventilator is connected to a lung simulator and a particular mode of ventilation is selected. As the resistance and compliance of the simulator is changed, you notice that the tidal volume remains constant but airway pressure changes.

15. You conclude the following that the ventilator is a:
   a. Pressure controller
   b. Time controller
   c. Flow controller
   d. None of the above

16. The trigger variable:
   a. Starts inspiration
   b. Determines peak pressure during inspiration
   c. Starts expiration
   d. Determines baseline pressure

17. The limit variable:
    a. Starts inspiration
    b. Determines peak pressure during inspiration
    c. Starts expiration
    d. Determines baseline pressure

18. The cycle variable:
    a. Starts inspiration
    b. Determines peak pressure during inspiration
    c. Starts expiration
    d. Determines baseline pressure

19. What condition must be present in order to generate inspiration?
    a) Lung pressure must be higher than pressure at the airway opening.
    b) Airway pressure must be higher than body surface pressure.
    c) Body surface pressure must be higher than the pressure at the airway opening.
    d) Body surface pressure must be lower than lung pressure.

20. Anatomical dead space is defined as:
    a) A positive pressure maintained throughout a spontaneous breathing cycle.
    b) The volume of gas entering or leaving the lungs in a given amount of time.
    c) A positive pressure maintained during expiration; usually associated with assisted ventilation.
    d) The volume of the conducting airways in the lungs that does not participate in gas exchange.

21. Humidifiers are used during invasive mechanical ventilation for all of the following reasons **except**:
    a. To reduce the effects of delivered dry compressed gas to the airway.
    b. To compensate for bypassing the nose, which would normally heat and humidify the airway
    c. To reduce the risk of retained secretions.
    d. To filter out dust particles.

22. The difference between CMV and SIMV in terms of cardiopulmonary effects is:
    a. There is no difference because SIMV provides respiratory muscle rest during spontaneous breaths and exercise during mandatory breaths.
    b. There is no difference because they both provide mandatory breaths at a set rate.
    c. SIMV will result a lower mean intrathoracic pressure than CMV, which can yield a higher cardiac output.
    d. SIMV will result a higher mean intrathoracic pressure than CMV, which can yield a lower cardiac output.

23. Which of the following is **true** for pressure control ventilation?
    a. The rectangular waveform opens alveoli earlier in the inspiratory phase during PC-CMV and results in a higher mean airway pressure.
    b. The rectangular waveform opens alveoli later in the inspiratory phase during PC-CMV and results in a lower mean airway pressure.
    c. The peak flow must be adjusted in order to allow for sufficient expiratory time, especially when higher mandatory breath rates are needed (30 – 60 breaths per minute)
    d. Improvements in patient effort and lung compliance can reduce the volume delivery to the patient in this mode of ventilation.

24. Volutrauma can be caused by all of the following **except**:
    a. A large set tidal volume
    b. A normal tidal volume with too large of an end-expiratory volume (due to too much PEEP)
    c. High transalveolar pressure
    d. Low pulmonary compliance

25. All of the following are spontaneous modes of ventilation **except**
    a. Continuous positive airway pressure
    b. Pressure support
    c. Positive end expiratory pressure
    d. Proportional assist ventilation
    e. Automatic tube compensation.

APPENDIX B

Participant Questionnaire

Participant Questionnaire

Circle the response that best applies:

1. I received my respiratory training from:
    a. An accredited respiratory program at a community college or university
    b. A correspondence course such as California College for Health Sciences

2. I have earned the following formal training that pertains to respiratory therapy technology:
    (Circle all that apply)
    a. No degree earned current respiratory therapy student
    b. No degree earned, completed a 1 year certification program in respiratory therapy technology
    c. Associates in Respiratory Therapy Technology
    d. Baccalaureate in Respiratory Therapy Technology

3. I have earned the following credentials
    (Circle all that apply)
    a. SRT (student) in a baccalaureate degree respiratory therapy program
    b. SRT (student) in an associates degree respiratory therapy program
    c. CRT
    d. CPFT
    e. RRT
    f. RPFT
    g. NPS (perinatal-pediatric specialty exam)

4. I am currently employed
    a. Full time (36 – 40 hours/week)
    b. Part time (35 hours per week or less)

5. I have been working in the field for ________ years post graduation.

6. My gender is
    a. Male
    b. Female

7. My birth date is ________/_________/__________ (mm/dd/yy)

8. My experience with mechanical ventilation is:
    (Select the best response)
    a. I make physician ordered changes
    b. I make ventilator changes under physician approved weaning protocols.
    c. I initiate and discontinue mechanical ventilation under physician approved ventilator management protocols.
    d. I do not make ventilator adjustments.

APPENDIX C

Participating Organizations

Participating Organizations

Ohio State University Hospital, Columbus, Ohio

Ohio State University Respiratory Therapy Technology Program, Columbus, Ohio

Fairview Hospital, Cleveland, Ohio

Dayton Children's Hospital, Cleveland, Ohio

Cuyahoga Community College Respiratory Therapy Technology Program, Cleveland, Ohio

Advanced Health Systems, Inc, Hudson, Ohio
Satellite facilities in Akron, Columbus, Louisville, Andover, Canton, Ashtabula, Wadsworth and Medina.

APPENDIX D

Ethical Considerations / Human Subjects Protection/Letter of Permission

Youngstown State University / One University Plaza / Youngstown, Ohio 44555-0001
Dean of Graduate Studies
330-941-3091
FAX 330-941-1580
E-Mail: graduateschool@cc.ysu.edu

December 1, 2003

Dr. Carol Mikanowicz, Principal Investigator
Ms. Teresa Volsko, Co-investigator
Department of Health Professions

RE: HSRC Protocol #77-2003 Amendment

Dear Dr. Mikanowicz and Ms. Volsko:

The Human Subjects Research Committee has reviewed the aforementioned amendment to your protocol titled "Effectiveness of Education and Practice in Knowledge of Mechanical Ventilation," and determined that the addition of sites to expand your project will not affect the previous determination of exempt from full committee review under DHHS Category 2. Therefore, I am pleased to inform you that your project has been fully approved.

Please note that your project is approved for one year. If your project extends beyond one year, you must submit a project Update form at that time.

Any changes in your research activity should be promptly reported to the Human Subjects Research Committee and may not be initiated without HSRC approval except where necessary to eliminate hazard to human subjects. Any unanticipated problems involving risks to subjects should also be promptly reported to the Human Subjects Research Committee.

The HSRC would like to extend its best wishes to you in the conduct of this study.

Sincerely,

Peter J. Kasvinsky
Dean, School of Graduate Studies and Research
Research Compliance Officer

PJK:cc

c: Mr. Joseph Mistovich, Chair
Department of Health Professions

APPENDIX E

Site Agreement

Site Agreement

Site Agreement for participation in a study evaluating the effectiveness of education and training on a respiratory therapist's knowledge of mechanical ventilation

I ____________________________________ as a representative of
Print name

____, in the city of
Healthcare institution

______________, in the state of Ohio agree to be a participating site for the study evaluating the effectiveness of therapist training and experience on the knowledge of mechanical ventilation.

I understand that the study was approved by the IRB at Youngstown State University, Youngstown, Ohio. I have discussed this study with a representative of the IRB at the aforementioned institution. I was advised that I do/do not need to submit a proposal to the
Circle appropriate answer
IRB at the aforementioned institution prior to participation in this study.

I understand that I may call Carol Mickanowicz, PhD, RN at 330-942-3658 or Terry Volsko, BS, RRT, FAARC at 1-800-628-1441 with questions or concerns.

____

Signature/Title Date

APPENDIX F
Informed Consent

Youngstown State University
Human Subjects Research Committee

Informed Consent

Dear Respiratory Care Practitioner:

We are conducting a study to evaluate the effectiveness of therapist training and experience on their knowledge of mechanical ventilation. In this study you will be asked to take a proctored self assessment exam and complete a brief questionnaire. Your participation should take approximately 30 – 45 minutes. There are no risks to you.

The self assessment is anonymous, and all information will be handled in a strictly confidential manner, so that no one will be able to identify you when the results are recorded and/or reported.

Your participation in this study is totally voluntary and you may withdraw at any time without negative consequences. If you wish to withdraw at any time during the study simply call Carol Mikanowicz, PhD, RN Program Director for the Masters in Health and Human Services, Youngstown State University at 330-941-3658 or Terry Volsko, BS, RRT, FAARC, Director of Respiratory Services, Advanced Health Systems, Inc. at 1-800-628-1441 extension 7445.

Please feel free to contact Dr. Mikanowicz at 330-941-3658 or Terry Volsko at 1-800-628-1441 extension 7445 if you have any questions about the study.

I understand the study described above and have been given a copy of the description as outlined above. I am 18 years of age or older and I agree to participate.

____

Signature of Participant Date