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Abstract

Students in healthcare education settings are hearing about and experiencing simulation-based learning material. Allowing the opportunity to use this equipment is important to incorporate in the students' learning experience. The Respiratory Therapist Program at Western Technical College has this opportunity and applying it with a more lecture-based class like Respiratory Disease is ideal. Connecting the assessment skills from the pulmonary exam and the respiratory diseases that can be concluded from those assessments, is an opportunity to be practiced with an integrated simulation mannequin. This safe practice can then be applied to the clinical setting on live patients. This study will examine the process applied from simulation to clinical in order to determine validity of the method and mannequin itself in relation to the pulmonary exam and the respiratory disease course. Decision making through assessment collection will be measured and further investigated based on student choices after a respiratory disease is diagnosed.

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Chapter I: Introduction

The path towards a career in Respiratory Therapy begins with either a four or two-year degree. Whether a Bachelor of Science or Associate of Applied Science pathway is chosen, the student will experience a variety of teaching methods that are specific to the career field. The primary methods revolve around the traditional classroom setting, laboratory practice, and clinical site application. The Commission on Accreditation for Respiratory Care (CoARC) oversees Respiratory Therapist Program standards regarding the required credit hours and clinical site experience hours (CoARC, 2015). This learning structure is like most healthcare profession programs that are patient care related. Nursing education follows this same structure and includes many hours in places like hospitals, clinics, and nursing homes in addition to a classroom setting (Kuznar, 2005). Considering the nature of working with actual patients, the goal of the learning process is to ensure safety to the actual patient when that encounter takes place. Creating a safe environment beforehand allows skills to be modified and practiced without any hazards to an actual patient.

The modern technologies of today continue to develop and have found their place in the classroom setting. These advancements include a variety of equipment, but specifically revolve around integrated simulation-based learning that relates to respiratory therapy and other patient care related skill sets. Healthcare simulation attempts to replicate a patient circumstance or scenario with different imitations of what could be encountered. These simulation devices include but aren’t limited to a full body mannequin, a limb, an upper body, or any body part that may be intervened with in the healthcare setting. The technology incorporated with simulation devices range from intricate to none. Learning complex skills with simulations have become closely related to real-world scenarios because of increasing levels of sophistication with these devices (Rauen, 2004). The integrated simulation experience falls between the traditional laboratory setting and clinical site experience. However, in integrated simulations, the classroom material is being applied with a hands-on approach.

The Respiratory Therapist Program at Western Technical College (WTC) has an abundance of material and course competencies that need to be covered. The teaching strategies have better academic outcomes when they align with the students' different learning preferences (Tulbure, 2011). Having a variety of delivery methods is beneficial and should allow for meeting a variety of needs from the student perspective. Integrated simulation learning can support different learning styles and the technology-enhanced application can benefit active learning, with visual appeal and greater student feedback based on the experience (Petty, 2013). Student understanding of the material they learn involves receiving different delivery approaches and assessment techniques. Simulation-based learning has become more popular as an experiential learning technique and health care education tool (Qayumi, Pachev, Zheng, Ziv, Koval, Badiei, & Cheng, 2014).

WTC respiratory therapist students are encountering an accelerated program that requires them to receive a significant amount of information in a short amount of time. The respiratory disease course is delivered at the beginning of the second year, right before the students attend their first clinical session at the local hospitals. Understanding disease concepts related to obstructive and restrictive pulmonary components is important, as is recognizing the related signs and symptoms through patient assessment. The pulmonary information collected from the assessment is then used to better treat the patient with proper medications or lung expansion therapies. Finally, being able to educate the patient and/or their family of the disease condition allows for a complete patient encounter. Practicing these assessments, diagnoses, treatment options, and education is something that can be incorporated with the respiratory disease course and the use of integrated simulation mannequins before exposing the students to a clinical patient.

Simulation learning with mannequins is aiding students in acquiring knowledge, skills, and attitudes, in addition to keeping the patient safe from unnecessary risks (Lateef, 2010). A supplementary learning method like learning with simulation mannequins will result in helping the live clinical setting patient. Educating and preparing the future healthcare professional is a serious task for the educator. Having a varied approach with simulation included is an ideal model. Simulation-based education has recorded benefits in relation to improved knowledge, skills, and behaviors (Cook, 2013).

A better understanding of integrated simulation and how it can be added to the respiratory therapy teaching methods specific to a respiratory disease course, will help enhance the credibility of the modern program and allow for an additional avenue for the student to apply the course objectives to the clinical setting.

Statement of the Problem

In the Respiratory Therapist Program at WTC, student performance in the respiratory disease course is currently completed without the use of integrated simulation mannequin experiences. This leaves a possible void of understanding that can directly affect the students' decision making during their clinical time with actual patients. The purpose of this study will be to measure students' decision making and assessment effectiveness in a clinical setting following the application of the integrated simulation experiences in the respiratory disease course. Additionally, student feedback may reflect the changes and understanding of respiratory disease with this new approach.

Five Research Questions will be Addressed in This Paper

Is there a difference in Respiratory Disease Encounter (Appendix D) assessment items chosen by the students between the integrated simulation mannequin and the clinical setting?

1. Is there a difference between simulation and clinical setting when determining the correct restrictive or obstructive respiratory disease category?
2. Is there a difference between simulation and clinical setting when determining the specific respiratory disease diagnosis?
3. Upon determining a disease state in the clinical setting, how well do students apply their knowledge of respiratory therapy-based care? This includes measuring the students' decisions to include possible respiratory therapies, medication options, and education opportunities for the patient and/or family members.
4. What are students' perceptions regarding their respiratory disease course and their clinical experience?

Definition of Terms

The following terms are to assist understanding for this study.

Acute respiratory distress syndrome (ARDS). Categorized as a restrictive disease for this study.

Arterial blood gas (ABG). Blood values used to determine oxygenation and ventilation.

Assessment. Items collected by the student while performing a pulmonary exam.

Chest x-ray (CXR). For the purpose of this study, spirometry is a diagnostic examination used to help determine lung conditions and respiratory diseases.

Chronic obstructive pulmonary disease (COPD). Categorized as an obstructive disease for this study.

Clinical setting. This relates to a live patient in the hospital setting versus the mannequin used in the simulation lab setting.

Debriefing. A discussion between student and instructor that allows all avenues of discussion related to either the simulation or clinical experience.

Education opportunities. These will include overview to the respiratory diseases, the medications and their proper usage, the advantage of any respiratory therapies, and the ability to help manage a patient's respiratory disease process.

Medication options. These will include respiratory medication choices relating to the restrictive and obstructive diseases presented.

Neoplastic lung disease. Categorized as a restrictive disease for this study.

Neuromuscular lung disease. Categorized as a restrictive disease for this study.

Obstructive lung disease. For the purpose of this study, the obstructive diseases presented with an integrated simulation will be COPD, emphysema, chronic bronchitis, and asthma.

Pulmonary exam. The pulmonary exam is a series of hands-on assessments that the student or healthcare professional can collect from a patient. They include, auscultation, percussion, vibration, and tactile fremitus.

Respiratory therapies. For the purpose of this study, these will include the general use of lung expansion techniques.

Restrictive lung disease. For the purpose of this study, the restrictive diseases presented with an integrated simulation will be Acute Respiratory Distress Syndrome (ARDS) and pulmonary fibrosis.

Spirometry. For the purpose of this study, spirometry is a diagnostic examination used to help determine lung conditions and respiratory diseases.

Student performance. The evaluation results from observing the student performance with both the integrated simulation and clinical setting.

Therapy options. For the purpose of this study, the therapy options included lung expansion techniques, coughing techniques, and other secretion clearance techniques.

Chapter II: Literature Review

The purpose of this study is to measure the student decision making and assessment effectiveness in a clinical setting following the application of the integrated simulation experiences in the respiratory disease course. It will examine how well students apply their patient assessment skills from the integrated simulation lab to the hospital setting. Observation will include students' experience recognizing possible disease states with the mannequins versus the clinical setting. Furthermore, students will relate their disease diagnosis to knowledge of patient treatment with respiratory medication, therapies, as well as, education opportunities.

This review of literature will look at the possible outcomes from applying integrated simulation scenarios to the respiratory disease course before encountering clinical patients.

Advantages may include the students' preparation for a patient encounter in a safe laboratory environment. This allows students an opportunity to practice their assessment skills and apply their respiratory disease knowledge in a less stressful environment compared to the hospital. Repetition and practice in the simulation environment may lead to a systematic approach that includes available resources of knowledge the students have studied through the disease coursework. This type of preparation may present suitable decision making from the students regarding the respiratory disease at hand. Finally, an overall debriefing from the simulation experience could suggest opportunities for improvement and further knowledge base moving forward into the clinical setting.

Theory Base

Integrated simulation has been used in different fields of practices to assess learning, allow for instruction, and hone learners' techniques. Such simulations are used in the military, aviation industry, the space program, and medical care. Healthcare simulation has advanced a great deal from its earliest form of simulator mannequins. Sim One, which was available in the late 1960s, could simulate breathes, heart beats, pulses, and blood pressure. The technology at the time allowed Sim One to respond to four administered drugs and two inhaled gases (Bradley, 2006). The ability to use such a device while training healthcare providers was in its infancy compared to how integrated simulation mannequins can be used today.

Integrated simulation mannequin use has gained momentum with the advancement of technology. They have become extremely sophisticated with their abilities. Interest and appeal for these mannequins in healthcare education is abundant, but empirical support is lacking. Despite a large amount of research, the outcomes remain vague because of the difficulty interpreting results separately. Narrow inclusion criteria, not accounting for complete studies, incomplete study quality, or lack of best estimates, the previous research is limited (Cook et al., 2011). Investigation has included comparing low fidelity simulators (LFS) with high fidelity simulators (HFS). Although HFS are becoming more technologically advanced, they aren't necessarily superior to the learning achieved from a LFS. Making an informed purchase decision with simulators is important. Comparing the benefits of the products with their purchase price is challenging (Norman, Dore, & Gierson, 2012). The advanced technology may not improve student learning. Further research should help add clarity towards advantages and disadvantages of using modern simulation mannequins.

Some research into the use of integrated simulation are positive in nature. Studies range from simply supporting the hypotheses that simulation experiences have advantages compared to the absences of such experiences. Additionally, encouraging the use of integrated simulation mannequins supports safe and ethical ways of gaining skills (Dawe et al., 2014).

Experiential learning theories are helpful to note when it comes to using a simulation mannequin. Ord (2012) looked closely at how Dewey's experiential learning theories involved a "transaction" that involved both the learner and the environment of learning (p 60). Dewey believed that the experiences of the individual were shaped by the environment (Ord, 2012). Together the two components of learner and setting develop what's retained from the experience itself.

Kolb derived theories concerning experiential learning from Dewy (David, 2007). Experiences themselves evolve into the knowledge we have. Separating experience into further stages allowed Kolb to reach an array of learning styles or preferences. Together, experience, reflection, thought, and preparation, form a cycle that builds upon itself form any point (David, 2007). The cycle wouldn't be as effective without any one component, but certainly it is stabilized by experiences. Using simulators contributes to learning environments and experiences to further shape student knowledge.

Piaget takes experiential learning further by looking at the thought process rather than an end-graded assessment. Although his studies were children-based, his theories relate to simulation encounters and how the learner develops their thought process versus a graded item or allowing this practice to occur on live patients (McLeod, 2018). A stored pattern of behaviors or "schema" as Piaget (McLeod, 2018) referred to it, seems to be a possible outcome as students build upon their experiences with the simulation encounters.

Student Applications: Simulation versus Clinical

The independent variables in this study branch from how the respiratory therapy students will manage their assessment skills with both the simulation and clinical patients. Thorough assessment and the gathering of signs and symptoms will be of more value in treating the respiratory disease than an incomplete assessment which misses valuable pieces of data. Building scenarios with different ranges of difficulties will help improve students' patient assessment process and encourage the students to cover all aspects of the pulmonary exam despite the difficulty level of simulated or the actual disease process. Progressively increasing the amount of patient data students collect should provide a viable opportunity for skill advancement (Motola et al., 2013). This foundational learning process will improve how students collect patient data through assessment. They begin with just observing the patient, up to subtle and perhaps overlooked information.

A summer-enrolled WTC Respiratory Therapist Student doesn't have any patient care experience in the respiratory therapy scope of practice. The pulmonary exam is a foundational item that can only be taken so far on paper or in the textbook. Applying this knowledge to the clinical realm in which they aren't familiar with ties to Vygotsky's zone of proximal development (ZPD). The process from what's learned to applying that learning further requires guidance and then further learning (McLeod, 2012). The actual skills of the pulmonary exam require practice and assessment from applying the skills to a simulation mannequin or live patient. Once the skill is completed, further reflection and thought is needed for a student to connect the relevance of the information gathered with a disease process and specific disease. Using the simulation mannequins is a type of "scaffolding" that supports activities within students' ZPD (McLeod, 2012). The repetition of the pulmonary exam on the simulation mannequins will act as a scaffolding measure for assessment, adjustments, and reinforcements.

Students will be practicing their pulmonary exam techniques with the SimMan3G (https://www.laerdal.com/us/doc/85/SimMan-3G) integrated simulation mannequin from Laerdal. The SimMan3G can present a varied amount of patient symptoms which include airway features, circulation, blood pressure/pulses, breathing, and vocal sounds (Laerdal, n.d.). These features are equivalent to what will be used for this research study.

These integrated simulation mannequins are considered high fidelity and can properly simulate the desired respiratory diseases. Students will be able to apply their pulmonary exam skills, in addition to their other assessment gathering skills, to the simulation. Upon use of the simulation mannequins, students will have valid opinions whether the experience was helpful or realistic once compared to their encounter with live patients with similar respiratory diseases. Some research has determined participants feel there’s a lack of realism despite whether they have a history in the nursing profession or not (Nehring & Lashley, 2010).

Applying knowledge to a simulation scenario can be associated with patient benefits compared to student with no simulation involvement (Zendehas, Brydges, Wang, & Cook, 2013). Evidence does support transfer of knowledge and skills from simulation to patient (Dawe et al., 2014). This helps further support the application of allowing students to practice techniques on simulation mannequins first and encouraging this use of skills practice before meeting with a patient. Students may feel nervous meeting with patients the first time but interacting with simulation mannequins first may decrease this student anxiety. Certain behaviors can be predicted from the simulation experiences and how students may react in the live encounter with patients (Kerr & Bradley, 2010).

Systematic Assessment

Decision making with patients in a hospital setting can be difficult when based on a lack of knowledge of the circumstance at hand. Efficiently making decisions on how to best treat a patient involves knowing which protocol to follow and/or communicating with the Doctor of Medicine (MD) or Physician Assistant (PA) to recommend treatment orders. Accomplishing this practice involves experience. If lacking experience, proper training and education could be equally as effective.

Improving the information gathering through patient assessment and the subsequent decision making is necessary based on studies suggesting that 35% of new graduate registered nurses possess the critical thinking abilities expected of an entry-level nurse (Guhde, 2010). These same outcomes may relate to other healthcare professions, including respiratory therapy. To improve students' entry level skills and their decision-making process, more focus should be made on assessments related to real time clinical patients and their circumstances. The pulmonary exam can be used to gather signs and symptoms with patient assessments. Additional information can be gathered through further diagnostic assessments recorded in the patients' chart. Together the information can be deciphered to determine respiratory disease categories and specific diseases. Doing so efficiently may lead to a better outcome for the patients' knowledge, medication, and therapies for the disease.

The thought process involved with patient care decisions are either internal or involve brainstorming between two or more healthcare professionals. This type of real-time decision-making lacks stability and precision. Prior to entering the healthcare profession, instructional strategies can be used to help students achieve learning objectives such as, "deciding how to care for someone's disease process based on the patient assessment". Simulation mannequins can be used in preparation for these experiences and even magnify the circumstances in a guided way. This type of deliberate opportunity allows for reflection that can improve future assessments without causing the delay of care with an actual patient (Anderson & Warren, 2011). Practicing may not make perfect, but with patient care, practicing beforehand should help students improve their decision-making skills.

A systematic assessment towards patient care with a high-fidelity simulation mannequin should lead towards improved patient outcomes by the nature of the safe practice setting. Incorporating the pulmonary exam assessment with simulation mannequins may present a transition from knowledge and comprehension to critical thinking decision making with efficiently timed interventions (Zigmont, Kappus, & Sudikoff, 2011). A transition from learning content to applying action based on that content is a skill that is typically learned with experience, as well as trial and error. Patient care in a hospital setting doesn't always allow time for these experiences. Patients deserve the best care that can be provided and preparing the healthcare professionals appropriately should result in excellent care.

This all relates closely to the experiential learning approach that allows safe practice for students in a classroom laboratory setting. Simulation-based learning is being incorporated more than lecture-based models, allowing the students to become engaged and active in their learning (A Vision for Teaching, 2015). By using simulations, the student has the opportunity to apply her/his knowledge directly to the situation that was discussed in a lecture setting. Patient assessment via a textbook, or any similar method, isn't completed until it is directly applied to the hospital patient themselves. Allowing an integrated simulation experience before applying ideas to a hospital patient will supplement the study process with practical application. Perhaps allowing students to more thoroughly think about the data they've collected.

Finding fluidity with decision making based on resources students obtain is based on experience that students wouldn't normally have. Incorporating the integrated simulation experience to learning allows this experience. These experiences motivate students to obtain new knowledge (Kerr & Bradley, 2010). Comprehending the circumstances in a controlled simulation environment should help the students develop decision making knowledge through the collection of material during their rehearsals in the lab.

Diagnosis Decision Making

This research study involves the decision-making efficiency of a respiratory therapy student in relation to the respiratory diseases of their patients. The decision-making process in the clinical setting improves the patients' outcome if interventions and students' education is applicable to the respiratory disease involved. Classroom education methods build knowledge for these circumstances. Adding high-fidelity simulation mannequin approaches should enhance students' application of the knowledge learned. Simulation training is related to improved healthcare outcomes when compared to no simulation experience at all (Cook et al., 2011).

Students may come to make clear and understandable decisions in the classroom setting during written exam-based assessments but transferring the knowledge to the clinical setting can be different. Clinical decision making can be difficult for students until a connection can be made with the material and situation (Bowen, 2006). Reasoning can be different for all students and they each have processed the classroom material differently. A varied number of circumstances should be given to access the different reasoning connections for students. Doing so in a simulation setting first is ideal and creating opportunities for students prior to the clinical setting should stimulate the clinical thought process prior to the actual encounters.

Exposing student to integrated simulation mannequin scenarios not only allows a safe environment that carries no risk to a live patient. It also allows the student to feel less pressure to make the right decisions during the learning phase. Additionally, this learning environment helps inspire a more detailed reflection of what's just occurred (Bradley, 2006). Allowing a debriefing period to analyze the process and results of a simulated patient scenario should enhance the students' knowledge-to-application connection. Students' decision making has the potential to become more natural with time and safe experiences by using the simulators.

Clear respiratory disease indications and goals are necessary for the students to best approach the simulations and patients. Observation and student responses are primary components of the respiratory disease simulation. Creating clear expectations for both is important, but the reliability of the responses measured is usually greater than just the observation itself (McGaghie, Issenberg, Petrusa, & Scalese, 2009). Preparing students in the classroom for appropriate responses and decisions to respiratory diseases will be important to transition learning objective, to integrated simulations.

Better understanding their decision making based on their assessment, the students can gain confidence in their actions from the simulation training. Building confidence with oneself, the student can better create trusting relations with hospital personnel who will be observing the decision-making skills and patient interactions. This confidence resonates to the patient. A feeling of safety and assurance of the care delivered allows the patient to feel everything is being handled appropriately (Cass, Crofts, & Draycott, 2011). Allowing the student interaction with the patient and other healthcare providers extend to this point of trust should not only promote patient satisfaction, but also trigger a sense of accomplishment in the student which may encourage their continued learning process.

Debriefing Possibilities

Further value from this research study involves how the students reflect upon the simulation scenarios. Proper debriefing and discussion would be important for students to be making the ideal connections between learning and actual decision making. The instructor, as the simulation director, requires assessment processes that help direct discussion, retention, and opportunities for change and improvements for students' future experiences (Zigmont, Kappus, & Sudikoff, 2011). This examination for reflection from the students should help support respiratory disease understanding and the pulmonary exam assessments that lead to diagnosing the disease. These discussions may indicate to the students that they may have just needed one or two more assessments to easily make an accurate respiratory diagnosis.

The debriefing helps create a collaborative effort of learning from both the student and instructor. Students' experiential learning is stimulated further with the reflection of what's happened, and the knowledge discussed. Discussing results and outcomes is related to the complete process of what's occurred with the pulmonary exam, the results, the outcome determinations, and where this all occurred. Students' support can be layered with each experience and the instructor can guide the student in the right direction during the simulation and later step back and allow the student to work more efficiently with the patient encounter (Kerr & Bradley, 2010). The support of the students' thought process helps adjust student patterns for future encounters.

Transferring the simulation experience to the clinical setting requires analyzing the scenario. The simulation can lead to student emotions of excitement and/or anxiety. Letting the learners speak their mind, helps the student analyze what really happened (Nehring & Lashley, 2010). This analyzation becomes the first step at looking back at what just happened within simulation or clinical settings. Whether recognizing obvious mistakes, things they might have missed, or appreciating the things they discovered, students should gradually be able to take an appropriate perspective on their delivery of care.

A major goal of debriefing after a simulation is to reinforce objectives (Nehring & Lashley, 2010). This allows the student learning that occurred in the classroom to be fine-tuned and perfected in the simulation itself. Learning from mistakes and better recognizing what should be accomplished during a patient encounter should make the actual clinical encounter more manageable for the inexperienced student.

Debriefing allows the opportunity for students to consider the simulation afterwards and recognize the decision-making process more accurately (Nehring & Lashley, 2010). This helps reinforce other components of the simulation experience and the goal of including integrated simulation training to further develop the clinical performance skills. Enhancing a student's ability to completely assess a patient and repeating circumstances to create accurate decision-making, will typically be involved with the debriefing portion of the encounters whether they be simulation or clinical based.

Summary

The review of literature in supporting the use and opportunities that come with using integrated simulation in a respiratory disease course appears to be constant. Allowing the student, a chance to apply their respiratory disease knowledge from the classroom, to the simulation lab, and then to the hospital setting, includes valuable teaching lessons.

Literature supports that there's more room to explore the use of integrated simulation. This study can further that exploration with how simulation compares to the patient encounter in relation to assessment procedures, resourcefulness of gathering data, decision making, and possibilities gained from debriefing.

The review of literature also appears to support each question that comes from the initial problem statement regarding the absence of integrated simulation use in the WTC Respiratory Disease course. This paper will continue to explore study results and student opinion through the application of the integrated simulations.

Monitoring the progress from lab to clinical experiences will further construct knowledge of:

- Differences between the assessment techniques from the simulation patient encounter to the clinical encounter.
- Differences between the assessment gathering and consequential disease determination from the simulation patient to the clinical encounter.
- How the student uses their knowledge to treat the diagnosed respiratory disease with medication, therapies, and patient education.
- How debriefing will help the student make proper adjustments to better serve the patient.

Chapter III: Methodology

The purpose of this study was to measure student decision making and assess effectiveness in a clinical setting following the application of integrated simulation experiences in the Respiratory Disease course at Western Technical College. The study examined how well students applied their patient assessment skills from the integrated simulation lab to the clinical setting using four research questions as follows:

1. Is there a difference in Respiratory Disease Encounter (Appendix D) assessment items chosen by the students between the integrated simulation mannequin and the clinical setting?

   H_0: There is not a statistically significant difference between students' Respiratory Disease Encounter assessment item scores using simulation mannequins and their pulmonary exam scores in a clinical setting. (significance level= 0.5)

   H_a: There is a statistically significant difference between students' Respiratory Disease Encounter assessment item scores using simulation mannequins and their pulmonary exam scores in a clinical setting. (significance level= 0.5)

2. Is there a difference between simulation and clinical setting when determining the correct restrictive or obstructive respiratory disease category?

   H_0: There is not a statistically significant difference between simulation and clinical setting when determining the correct restrictive or obstructive respiratory disease category. (significance level= 0.5)

   H_a: There is a statistically significant difference between simulation and clinical setting when determining the correct restrictive or obstructive respiratory disease category. (significance level= 0.5)

3. Is there a difference between simulation and clinical setting when determining the specific respiratory disease diagnosis?

   H_0: There is not a statistically significant difference between simulation and clinical setting when determining the correct specific respiratory disease diagnosis. (significance level= 0.5)

   H_a: There is a statistically significant difference between simulation and clinical setting when determining the correct specific respiratory disease diagnosis. (significance level= 0.5)

4. Upon determining a disease state in the clinical setting, how well do students apply their knowledge of respiratory therapy-based care? This includes measuring the students' decisions to include possible respiratory therapies, medication options, and education opportunities for the patient and/or family members.
5. What are students' perceptions regarding their respiratory disease course and their clinical experience?

Research Design

This was a mixed method action research study that included classroom instruction, integrating simulation mannequin use, followed by a clinical setting with live patients. The study used quantitative checklists and quantitative reasoning scores based on the Respiratory Disease Encounter in Appendix D, the Medication and Therapy Options in Appendix E, and the Educational Opportunity in Appendix F. Together these checklists and scores were used to evaluate the outcomes of the first four research questions. Additional debriefing questions, found in Appendix G, were answered by the students to obtain qualitative feedback of the experience and answer the fifth research question.

WTC Respiratory Therapist Program students, -who were enrolled in the Respiratory Disease course, were the participants in this research study.

Classroom instruction. The study was conducted by the instructor for the WTC Respiratory Disease and Respiratory Clinical 1 course. The researcher has a 12-year history of working in the respiratory field, is the Director of Clinical Education in the Respiratory Therapist Program at WTC for over two years and is a Registered Respiratory Therapist and Neonatal Pediatric Specialist as determined by the National Board for Respiratory Care (NBRC).

The Respiratory Disease and Respiratory Clinical 1 course followed course competencies that were determined by all the Respiratory Therapist Programs within the Wisconsin Technical College System (WTCS) and approved by the Commission on Accreditation for Respiratory Care (CoARC). This instructor had the ability to manage the course schedule and agenda if they included the course competencies.

Course instruction included the students' ability to satisfactory perform a pulmonary exam (Appendix B). The pulmonary exam covered five main patient assessment items; preparation, inspection, palpation, percussion, and auscultation. Twelve of these items were listed in the Respiratory Disease Encounter evaluation tool in Appendix D. Seven of the twelve items were considered critical to determining a respiratory disease and the other five as supporting items to help narrow down a diagnosis.

To better understand restrictive and obstructive respiratory diseases, the students used the course textbook, Egan's Fundamentals of Respiratory Care (Kacmarek, Stoller, & Heuer, 2017) to complete disease summary sheets (Appendix A). The sheets covered the inspection, palpation, percussion, and auscultation pieces of the pulmonary exam, which each had certain characteristics to a certain respiratory disease. Supportive material such as arterial blood gas

(ABG), chest x-ray (CXR), medication, therapy options, and educational points were also completed on each disease summary sheet. As students performed the pulmonary exam on the simulations and clinical patient, they were encouraged to refer to the knowledge obtained with the disease summary sheets to help make disease diagnosis decisions.

Classroom Instruction
Disease Summary Sheet (Appendix A) • Completed inspection, palpation, percussion, auscultation, ABG, CXR, and treatment items for each obstructive and restrictive respiratory disease.
Pulmonary Exam (Appendix B) • Satisfactorily performed preparation, inspection, palpation, percussion, and auscultation.
Application of Classroom Instruction (Simulation and Clinical Setting)
Respiratory Disease Encounter (Appendix D) • Twelve pulmonary exam items performed to obtain respiratory disease information related to the completed disease summary sheet information.
Medication and Therapy Options (Appendix E) & Educational Opportunity (Appendix F) • Applied additional disease summary sheet information to the specific obstructive or restrictive respiratory disease.

Figure 1. Classroom instruction and application of classroom instruction.

Prior to this course the students had minimal knowledge of respiratory diseases, as no other course to this point had discussed them in detail. The study examined student understanding of respiratory diseases and how to systematically predict which disease is present through a pulmonary exam and other assessments.

Figure 1, on the previous page, summarizes the content of the Respiratory Disease classroom instruction and how the students' applied the knowledge to the simulation mannequins and clinical setting patient.

Simulation. The researcher created integrated simulation mannequin scenarios representing obstructive and restrictive respiratory diseases. The conditions for simulations can be found in Appendix C: Obstructive and Restrictive Respiratory Diseases, and were limited to: emphysema, chronic obstructive pulmonary disease (COPD), chronic bronchitis, asthma, acute respiratory distress syndrome (ARDS), and pulmonary fibrosis. The scenarios were created based on the disease process items learned within the WTC Respiratory Disease course and the completed disease summary sheets (Appendix A). The students were presented with the disease states via the simulation mannequin. After the students performed a Pulmonary Exam (Appendix B), they were asked which disease state the mannequin represented.

After this initial diagnosis, the student continued by treating that disease state with medications and therapies that relate. Finally, the student educated the patient and/or family members about all things related to the disease, therapies, and medications. Students' interactions with the simulated patient were records for further student reflection and analysis.

Accuracy of the evaluation checklists and scores during the simulation encounter were verified by viewing the video recordings. The mannequin training simulation was also viewed by the students to help them better understand how they approached the Respiratory Disease Encounter (Appendix D), the dialogue they created, and to help them answer debriefing discussion/interview questions (Appendix G, Debriefing Discussion/Interview).

Clinical. Upon completion of the respiratory disease course, the students entered the hospital setting and began four weeks of Respiratory Clinical 1 (RC1). RC1 involved 112 hours of hospital clinical experience following along with the respiratory therapy department at two different hospitals. This is the first time in WTC's Respiratory Therapist Program that the students applied any of their knowledge with live patients. Expectations involved completing six competencies. These included vital signs, hand washing, pulse oximetry, a pulmonary exam, and computer charting at both clinical locations which each have the same charting program but with different formats.

What the students have learned in the classroom and simulation setting is applied to the hospital respiratory patient. The students conducted a pulmonary exam assessment (Appendix B) and they weren't allowed any previous knowledge of the patients' history other than identification items (name and date of birth). They were asked to analyze their documentation and make an initial diagnosis. If the diagnosis was correct, based on the Medical Doctor (M.D.) history and physical within the charting, the students continued to review the patient's situation for proper medications and therapies. The medications and therapies were also compared to what had been ordered for the patient. Finally, students met with the patient and/or family to discuss the respiratory disease state and educate the patient on the proper use of the breathing medications prescribed and how to cope with symptoms of their respiratory disease. If the students' initial diagnosis was incorrect they were asked to choose another until the correct disease diagnosis was determined.

Documentation and scoring sheets found in Appendix D, E, F, and G were used by the instructor to document the skills of the students with the simulation and clinical encounter. The simulation encounter was used to present all 12 students with the same two diseases on two separate days. The clinical setting diseases were based on the availability of patients currently hospitalized and accessible for the pulmonary exam research study. Three clinical days were chosen by the researcher to conduct pulmonary exams. Five students completed their pulmonary exams on the first day, four on the second day, and three on the third day. The respiratory disease patients available those three days were used for the students' clinical encounter. These diseases included asthma, COPD, emphysema, chronic bronchitis, pulmonary fibrosis, and ARDS. The clinical setting encounter was observed by the researcher, and documentation occurred in real time to maintain accuracy of the checklists and scores.

Simulation and clinical. The instructor completed the documentation and scoring sheets (Appendix D) as the student conducted their pulmonary exam. The documentation continued as the student determined a respiratory disease category, specific diagnosis, possible therapies, possible medication, and education to the patient regarding the disease itself, possible therapies and medications. The reasoning score was then completed based on the encounter. Students completed the debriefing questions after watching the video recorded during the simulation. Students completed the same debriefing questions after the live clinical encounter. The instructor reviewed all the video recordings from the simulation once to clarify any possible concerns with the reasoning scores to verify accuracy and remove potential bias.

The student participants had minimal previous knowledge of respiratory diseases, as no other course to this point had discussed them in detail. The study examined student understanding of respiratory diseases and how to systematically predict which disease were present through a pulmonary exam and other assessments. The understanding these students gained in the classroom using simulation mannequins may have allowed them to better apply decision making in the clinical setting.

Setting and Subjects

The setting and subjects incorporated both the classroom and clinical curriculum and the number of students enrolled in these courses.

Setting. The WTC Respiratory Disease course was a 3-credit course and held primarily in the classroom setting. The pulmonary exam simulation disease encounters occurred in the integrated simulation lab. Occasional group work took place in the classroom and mini-labs connected to the classroom.

The respiratory disease course was eight weeks long and was held on Monday and Wednesday from 0800 until 1120 (military time). The course included four units that covered patient assessment, chest imaging, spirometry, sleep disorders, cardiovascular disease, acute trauma, and neoplastic, neuromuscular, infectious, restrictive, and obstructive lung disease.

The study was conducted in the campus simulation labs and followed upon in the hospital setting during the clinical courses. The campus simulation lab included a full body mannequin in a hospital bed, a vital sign monitor, hand sanitizer, alcohol swabs, and a torso mannequin for access to the posterior side which can't be easily accessed with the full mannequin. The full mannequin presented with lung sounds pertaining to a specific disease, eye blinks, palpable pulses, and chest rise and fall.

The hospital room in the clinical setting included the previously mentioned items except for a live patient in place of the full mannequin and torso model. The hospital room also included a computer charting system to record patient information. The simulation lab can be seen in Figure 2 on the next page.

Figure 2. WTC integrated simulation lab.

The hospitals used for the clinical setting included Gundersen Health System (GHS) and Mayo of La Crosse. During the research study, the inpatient population ranged approximately from 100 to 240 patients. The number of pulmonary related patients requiring respiratory therapy was random and couldn't be predicted. At any given time, respiratory therapist at GHS had up to 25 patients on their workload and up to 10 on their workload at Mayo of La Crosse. Staffing included 7-8 respiratory therapists at GHS and 4-5 at Mayo of La Crosse.

Subjects. The subjects for this study involved WTC, second year (two-year associate degree program) Respiratory Therapist Program students that were enrolled in one respiratory disease course. The class consisted of twelve students ranging in age from 20 to 41. Six of the twelve students have had previous patient care experience ranging from one to five years. One of the twelve student had a bachelor's degree. The class information is filed with the Respiratory Therapist program director.

Instrumentation

The Respiratory Disease Encounter assessment tools (Appendix D) were used to evaluate students on the following points.

- Which of the 12 items (hand hygiene, introduction, history gathered, vital signs, percussion, palpation, cough strength, tactile fremitus, auscultation, chest x-ray [CXR], arterial blood gas [ABG], shortness of breath [SOB]) did the students complete during their simulation and clinical pulmonary exam? Seven of these were considered critical for the pulmonary exam and were noted as such in the Appendix D assessment evaluation. The other five were considered supporting items to better determine a diagnosis.
- Which disease category (restrictive or obstructive) and specific diagnosis did the student determine after completing their pulmonary exam?
- The reasoning (based on the pulmonary exam assessments) or explanation upon choosing the disease category and diagnosis.
- A reasoning score (see Respiratory Disease Encounter in Appendix D) between 0-5 on a sliding scale (0- not acceptable, 2.5-acceptable, 5- highly acceptable as reference points on the sliding scale) was applied that considered the encounter itself, assessments completed, disease category, specific diagnosis, and student reasoning for choosing the category and diagnosis.

The Medication and Therapy Options assessment tool (Appendix E) was used to evaluate students on the following points.

- A reasoning score between 0-5 on a sliding scale (0- not acceptable, 2.5-acceptable, 5- highly acceptable as reference points on the sliding scale) was applied that considered how the students made further decisions regarding possible respiratory therapies and respiratory medications for this disease determined. The scores were based on the number of options the student could suggest and reasoning behind the options they chose.

The Educational Opportunity assessment tool (Appendix F) was used to evaluate students on the following points.

- An education score between 0-5 on a sliding scale (0- not acceptable, 2.5-acceptable, 5- highly acceptable as reference points on the sliding scale) was applied that considered how the student explained and educated the patient and/or family regarding the disease, possible medications, and possible therapies. The scores were based on opportunities applied and description of those opportunities.

The Debriefing Discussion/Interview assessment tool (Appendix G) was used to evaluate students on the following points.

- Participants' feedback was noted through debriefing discussion/interview questions post patient encounter and upon watching the video recordings from their simulation encounters. A series of questions are listed for the students to answer regarding the encounters.

Since the researcher/instructor was the only individual who gathered data in this study, bias may be present. Bias during the data collection period and interviewer bias from the recording process was best minimized by the evaluation tools in Appendixes D, E, F, and G. The instructor reviewed all the video recordings from the simulation once to clarify any possible concerns with the reasoning scores to verify accuracy and remove potential bias. These evaluation tools helped prevent bias by allowing the researcher to watch for specific items and actions during the Respiratory Disease Encounter (Appendix D), Medication and Therapy Options (Appendix E), and Educational Opportunity (Appendix F). The researcher made specific selections and notes in the evaluation tools based on each student separately.

Data Collection

The researcher gathered data in the simulation and clinical setting using evaluation devices in Appendixes D, E, F, and G. No data was gathered from the classroom for this research study. The simulation encounters included the Respiratory Disease Encounter (Appendix D). The hospital encounter included the Respiratory Disease Encounter (Appendix D), the Medication and Therapy Options (Appendix E), and the Educational Opportunities (Appendix F). Both simulation and hospital encounters included the debriefing questions in Appendix G.

Quantitative. The Respiratory Disease Encounter (Appendix D) involved three assessments that included the following.

- A 12-point checklist of items students demonstrated. Seven of these 12 items are deemed critical for a pulmonary exam. These include: hand hygiene, introduction, vital signs, percussion, palpation, tactile fremitus, and auscultation. The other five items are supportive and may further lead to a respiratory diagnosis. These include: history gathered, cough strength, CXR, ABG, and SOB.
- A potential diagnosis chosen by the student versus the actual diagnosis. These diagnoses include choosing obstructive or restrictive categories in addition to a specific respiratory disease covered in the respiratory disease course. These specific diseases include: COPD, chronic bronchitis, emphysema, asthma, ARDS, and pulmonary fibrosis.

- A reasoning score on a sliding scale of 0 to 5. (0- not acceptable, 2.5-acceptable, 5-highly acceptable as reference points on the sliding scale)

Figure 3, beginning on page 40, provides and overview of how the assessments from Appendix D, E, and F were used to address the first four quantitative research questions.

Research question 1. Check marks from the student checklist in the Respiratory Disease Encounter evaluation tool (Appendix D) was tallied and entered as a dependent variable when comparing student performance between the simulations and clinical setting. Results from a Wilcoxson signed rank test helped answer research questions one: Is there a difference in Respiratory Disease Encounter (Appendix D) assessment items chosen by the students between the integrated simulation mannequin and the clinical setting?

The students were rated on a sliding scale of 0 (not acceptable) to 5 (highly acceptable) on their reasoning behind the chosen diagnoses score. Students' rating scores were entered as a dependent variable when comparing student performance between simulations and clinical settings in a Wilcoxson signed-rank test. Results from this analysis helped answer research questions one: Is there a difference in Respiratory Disease Encounter (Appendix D) assessment items chosen by the students between the integrated simulation mannequin and the clinical setting?

Research question 2. The respiratory disease category (restrictive or obstructive) was selected by the instructor/researcher and written in the space available after *Respiratory Disease State Presented* (Appendix D). Through patient assessment, students first identified the respiratory disease state presented in the Respiratory Disease Encounter (Appendix D). Students' correct diagnoses results were tallied and used to compare student performance between simulations and a clinical setting. Results from a chi-square test helped answer research question two: Is there a difference between simulation and clinical setting when determining the correct restrictive or obstructive respiratory disease category?

Research question 3. The specific respiratory disease (COPD, chronic bronchitis, emphysema, asthma, ARDS, and pulmonary fibrosis) was selected by the instructor/researcher and circled in the *Options* section (Appendix D). Through patient assessment, the students next identified the specific respiratory disease presented in the Respiratory Disease Encounter (Appendix D). Students' correct responses were tallied and used to compare student performance between simulations and a clinical setting. Results from a chi-square test helped answer research question three: Is there a difference between simulation and clinical setting when determining the specific respiratory disease diagnosis?

Research question 4. Two assessments were used to answer research question 4: Upon determining a disease state in the clinical setting, how well do students apply their knowledge of respiratory therapy-based care? This includes measuring the students' decisions to include possible respiratory therapies, medication options, and education opportunities for the patient and/or family members.

The Medication and Therapy Options Assessment (Appendix E) measured students' reasoning behind chosen medications and reasoning behind chosen therapies. Students' performance was rated on a sliding scale from zero to five (0 = not acceptable, 5 = highly acceptable).

The Educational Opportunities Assessment (Appendix F) scored students on disease education and on medication education. Students' scores ranged from zero to five on a sliding scale (0 = not acceptable, 5 = highly acceptable). Data for descriptive statistics was collected in the clinical setting.

Figure 3 below, illustrates the data gathered and supporting material from that data.

Research Question 1	Assessment	Independent Variables	Dependent Variable	Statistical Test
1. Is there a difference in Respiratory Disease Encounter (Appendix D) assessment items chosen by the students between the integrated simulation mannequin and the clinical setting?	Respiratory Disease Encounter (Appendix D) Student Checklist: Hand Hygiene* Introduction* Vital Signs* Percussion* Palpation* Tactile Fremitus* Auscultation* History Gathered Cough Strength CXR ABG SOB *Critical Reasoning Behind Chosen Diagnoses Scores: 0 to 5 Reference Points 0- Not Acceptable 5- Highly Acceptable	Learning environment: Simulation Clinical Setting	Student Checklists Reasoning Scores	*Wilcoxon Signed Ranked Test Central Tendency
Research Question 2	Assessment	Independent Variables	Dependent Variable	Statistical Test
2. Is there a difference between simulation and clinical setting when determining the correct restrictive or obstructive	Respiratory Disease Encounter (Appendix D) Respiratory disease state presented: Restrictive Obstructive (chosen by instructor/researcher before encounter)	Learning environment: Simulation Clinical Setting	Respiratory disease state presented: Correct or Incorrect	+Chi-Square Test

respiratory disease category?				
Research Question 3	Assessment	Independent Variables	Dependent Variable	Statistical Test
3. Is there a difference between simulation and clinical setting when determining the specific respiratory disease diagnosis?	Respiratory Disease Encounter (Appendix D) Specific respiratory disease state presented. OPTIONS: COPD Chronic Bronchitis Emphysema Asthma ARDS Pulmonary Fibrosis	Learning environment: Simulation Clinical Setting	Specific respiratory disease state option: Correct or Incorrect	+Chi-Square Test
Research Question 4	Assessment	Independent Variables	Dependent Variable	Statistical Test
4. Upon determining a disease state in the clinical setting, how well do students apply their knowledge of respiratory therapy-based care? This includes measuring the students' decisions to include possible respiratory therapies, medication options, and education opportunities for the patient and/or family	Medication and Therapy Options (Appendix E) Reasoning Behind Medication & Reasoning Behind Therapy Scores Sliding Scale: 0 to 5 Reference Points 0- Not Acceptable 5- Highly Acceptable Educational Opportunity (Appendix F) Disease Education & Medication Education Scores Sliding Scale: 0 to 5 0- Not Acceptable 5- Highly			Descriptive Statistics for Clinical Setting Only Central Tendency

members.	Acceptable			
Research Question 5	Assessment	Qualitative Analysis		
5. What are students' perceptions regarding their respiratory disease course and their clinical experience?	Debriefing Discussion/Interview Questions (Appendix G) Part A-Six questions after simulation. Part B-Four questions after watching the video recording of the simulation. Debriefing Discussion/Interview Questions (Appendix G) – Clinical Part A- Seven questions after clinical setting.	Thematic Content Analysis Procedure • Reading and re-reading student responses. • Coding the student responses. Realism (R) Pace/Flow (PF) Information Gathering (IG) Communication (C) Preparation (P) Mannequin Experience (M) Other Comments (O) • Determining themes based on coding. Reality of the simulation encounter Pace and flow of the simulation encounter Assessment item gathering Poor communication with patient Preparation leading up to clinical setting Differences of the clinical setting compared to the simulation Other non-category comments		
*Wilcoxon Signed Rank Test Calculations completed with test calculator found at: https://www.socscistatistics.com/tests/signedranks/Default2.aspx +Chi Square Test Calculations completed with test calculator found at: https://www.socscistatistics.com/tests/chisquare/Default2.aspx				

Figure 3. Data gathered from the simulation and clinical pulmonary exam encounters.

Research question 5. A qualitative approach used the Debriefing Discussion/Interview questions from Appendix G**.** This included Part A questions one through seven and Part B questions one through four, which were answered by the students after the simulation. Part A questions, one through seven, were answered by students in the clinical setting after they completed the Respiratory Disease Encounter (Appendix D). Part A had seven Debriefing Discussion/Interview questions which included:

1. How do you feel that went?

2. What portions were completed positively?
3. What portions could've been completed better?
4. Do you feel confident in your decisions?
5. How do you believe the patient and/or family responded to your education?
6. What assessments results stood out to you the most, as evident of the respiratory disease you decided upon?
7. How do you feel the integrated simulation mannequin experience helped you with this live encounter of the respiratory disease? (Clinical Setting Only)

Part B questions, one through four, were answered by the students after watching the video recorded simulation where they implemented their Respiratory Disease Encounter (Appendix D). Part B had four Debriefing Discussion/Interview questions which included:

1. List 10 things that you did that were fundamental to your assessment.
2. List 3 things you noticed you didn't do or didn't do well in your opinion.
3. Was there anything from this encounter that you recall specifically one way, but observed it differently upon viewing?
4. How would you have altered your encounter after viewing the recording?

The students were verbally asked the Debriefing Discussion/Interview (Appendix G) questions in a structured pattern beginning with the first question and moving downward on the list in Part A and Part B of the Debriefing Discussion/Interview evaluation (Appendix G) in the simulation setting. The students were asked the Debriefing Discussion/Interview questions in Part A in the clinical setting. The researcher wrote the responses to the questions as they were answered by the student. The interview process involved no prompting by the researcher asking the questions. The students were asked the questions and had an unlimited amount of time to respond. The students also had the questions given to them on a piece of paper to continue to reflect without asking for the question to be repeated. Answers were recorded verbatim and the researcher didn't include any opinion based on participant observation. This strategy helped prevent bias.

Student responses were analyzed by thematic content. The researcher read and then re-read all the students' answers to the Debriefing Discussion/Interview evaluation questions (Appendix G). After first reading the responses the researcher made note of recurrent categories. These categories included: realism, pace/flow, information gathering, communication, preparation, mannequin experience, and other responses that were single answers not repeated by other students. During the second reading of the responses the categories were coded as "R" (realism), "P" (pace/flow), "IG" (information gathering), "C" (communication), "P" (preparation), "M" (mannequin experience), and "O" (other responses).

The coded answers were grouped together to form detailed themes. They included the following:

- Reality of the simulation encounter
- Pace and flow of the simulation encounter
- Assessment item gathering
- Poor communication with patient
- Preparation leading up to clinical setting
- Differences of the clinical setting compared to the simulation
- Other non-category comments

Results from this analysis helped answer research questions five: What are students' perceptions regarding their respiratory disease course and their clinical experience?

Chapter IV: Results

This study investigated the use of a simulation mannequin in WTC's Respiratory Disease course. Students' decision making and assessment effectiveness in a clinical setting, following the application of the integrated simulation experiences was evaluated. Students practiced their assessment skills in order to apply them to patients' pulmonary disease states. Students' assessments were observed as they experienced recognizing possible disease states with mannequins and compared their success recognizing disease states with clinical patients. Students' then related their integrated simulation experience to treating the patient with possible medication, treatments, as well as, patient education opportunities.

Data Analysis

The students' knowledge obtained throughout the Respiratory Disease course, the pulmonary exams performed with the integrated simulation mannequin, and in clinical settings helped answer the following research questions.

Research question one: Is there a difference in respiratory disease encounter (Appendix D) assessment items chosen by the students between the integrated simulation mannequin and the clinical setting? The Respiratory Disease Encounter assessment included 12 total items. Seven critical items and five additional assessment items helped students determine the respiratory disease category (restrictive or obstructive) and the specific disease within that category. A null hypothesis was generated for the first research question. Null hypothesis 1: There is not a statistically significant difference between students' Respiratory Disease Encounter assessment scores using simulation mannequins and their scores in a clinical setting. A confidence level of 95% ($p < 0.5$) was used to determine statistical significance.

The categorical independent variable was the testing environments in either the Simulation (S) or Clinical Setting (CS). The dependent variable was the number of assessment items that students correctly completed on the Respiratory Disease Encounter in the simulation or clinical setting. A data analysis was run to compare the students' responses to the seven critical items in the simulation and the clinical settings. The data analysis was run a second time to compare students' responses on all twelve items on the Respiratory Disease Encounter in the simulation and clinical settings.

During the simulation mannequin encounters, the students correctly completed an average of 6.17 out of 7 of the critical items on the Respiratory Disease Encounter assessment. The students correctly completed an average of 7 out of 7 on the critical items on the Respiratory Disease Encounter assessment items during the clinical experience.

Students' correctly completed an average of 7.75 out of 12 items on the Respiratory Disease Encounter in the simulation and 9.08 out of 12 during the clinical experience.

Table 1 below, shows the comparison between the pulmonary exam skills exhibited with the simulation mannequin versus the clinical patient encounter for both the seven critical items and all 12 items in the Respiratory Disease encounter.

Table 1

Assessment Item Averages in Simulation and Clinical Setting

Difference in Exhibiting Respiratory Disease Encounter Assessment Items		
	Simulation	Clinical Patient
Critical Respiratory Disease Encounter Assessment Items N = 7	6.17	7
Total Respiratory Disease Encounter Assessment Items N = 12	7.75	9.08

Further statistical analysis used Social Science Statistics' online Wilcoxon Signed-Rank test calculator (https://www.socscistatistics.com/tests/signedranks/Default2.aspx). Two separate Wilcoxon Signed-Rank tests were run. The first used the seven critical item scores on the Respiratory Disease Encounter assessment. The second test comprised all 12 Respiratory Disease Encounter assessment items. Because students completed four different simulations they had four different simulation scores. The scores from the four different simulations were averaged to obtain one single simulation score for each student. This average simulation score was used to compare students' performance between the simulated and clinical settings. The clinical setting scores for each student were entered based on their one clinical setting Respiratory Disease Encounter.

Results for the seven critical items from the Respiratory Disease Encounter assessment items showed a mean difference score between students' simulation score (6.17) and students' clinical setting score (7.00) was 0.83. The Wilcoxson signed rank test indicated that students' scores in the clinical setting was higher than scores in the simulation setting ($z = -3.059$, $p = 0.002$). Students scored higher on the Respiratory Disease Encounter assessment in the clinical setting than they did in the simulations at a statistically significant level.

Results for the 12 total Respiratory Disease Encounter assessment items determined the mean difference between students' simulation score (7.75) and their clinical setting score (9.08) was 1.33. The Wilcoxson signed rank test indicated that students' scores in the clinical setting was higher than scores in the simulation setting ($z = -2.25$, $p = 0.014$). The students scored higher on the Respiratory Disease Encounter assessment in the clinical setting than in the simulation setting at a statistically significant level.

A final analysis was conducted for the students' Respiratory Disease Encounter reasoning scores (Appendix D). The clinical setting reasoning scores for each student were entered based on their one respiratory disease encounter with a patient in a clinical setting. Students' average Respiratory Disease Encounter score for the simulations was 2.34 while the average score for all students from the clinical setting was 3.45. This was a mean difference of 1.11 with students scoring higher on average in the clinical setting.

Social Science Statistics' online Wilcoxon signed rank test (https://www.socscistatistics.com/tests/signedranks/Default2.aspx) for the Respiratory Disease Encounter reasoning scores returned a score of -3.059 ($p = 0.002$). The students scored higher on the Respiratory Disease Encounter reasoning scores in the clinical setting than they did in the simulation setting at a statistically significant level.

Research question two: Is there a difference between simulation and clinical setting when determining the correct restrictive or obstructive respiratory disease category? A null hypothesis was generated for the second research question. Null hypothesis: There is not a statistically significant difference between simulation and clinical setting when determining the correct restrictive or obstructive respiratory disease category. A confidence level of 95% ($p < 0.5$) was used to determine statistical significance. The categorical independent variable was simulation and clinical setting. The dependent variable was if the students were correct or incorrect with their respiratory disease category.

Three of the students' five respiratory disease encounters (Appendix D) incorporated a respiratory disease category (obstructive or restrictive) for the students to decide upon. Students chose from these disease categories during two respiratory disease encounters with a simulation mannequin and one respiratory disease encounter with a patient in a clinical setting.

The respiratory disease category for simulation 1 was restrictive. Ten students chose the disease category correctly. Two students did not choose the disease category correctly.

The respiratory disease category for simulation 2 was obstructive. Eleven students chose the disease category correctly. One student did not choose the correct disease category.

The respiratory disease category in the clinical setting was either restrictive or obstructive. All twelve students chose the correct respiratory disease category they observed in the clinical setting on the Respiratory Disease Encounter assessment (Appendix D).

Figure 4, shown below, indicates the number of students who chose the correct disease category (obstructive or restrictive) in the simulations and clinical setting. The left bar indicates the number of students who chose correctly in simulation one. The middle bar indicates the number of students who chose correctly in simulation two. The right bar indicates the number of students who chose correctly in the clinical setting.

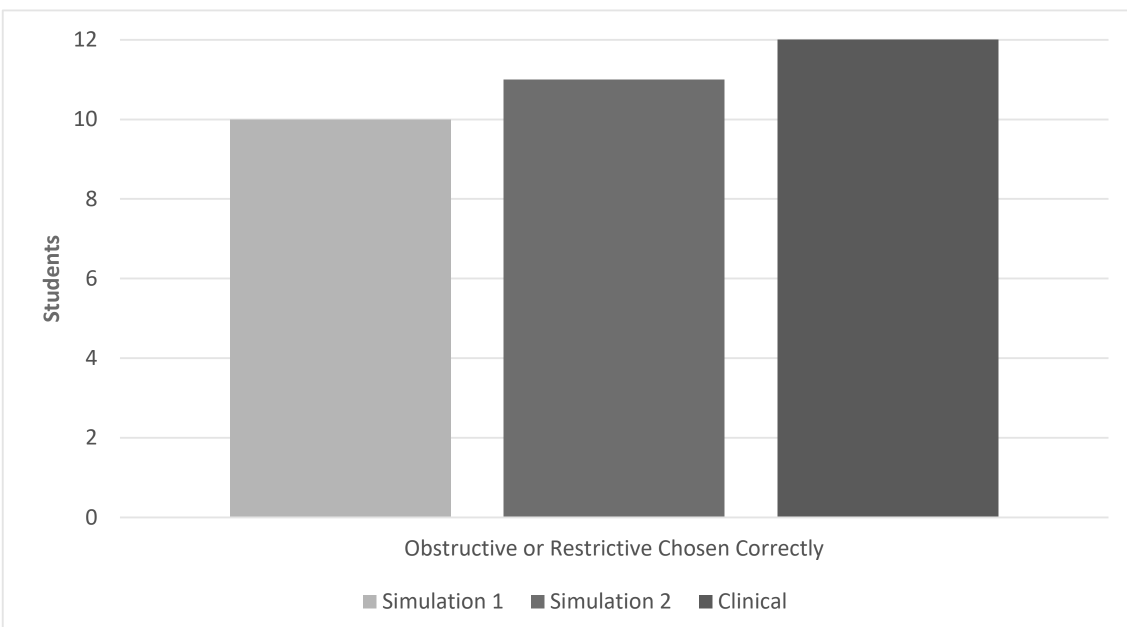

Figure 4. Correct respiratory disease category chosen.

A chi-square test using Social Science Statistics' online calculator (https://www.socscistatistics.com/tests/chisquare/Default2.aspx) was run to evaluate students' performance differences between the simulation and clinical settings. The number of correct and incorrect respiratory disease categories was entered for the simulations and clinical setting

Results for the students' simulation and clinical setting respiratory disease category decisions could not be calculated for this research question. The clinical setting results had a value of zero incorrect answers. A chi-square test could not be determined. The number of students correctly choosing obstructive or restrictive increased with each subsequent attempt. This trend suggested that student performance may have improved over time as they gained experience.

Research question three: Is there a difference between simulation and clinical setting when determining the specific respiratory disease diagnosis? Three of the students' five respiratory disease encounters (Appendix D) incorporated a specific respiratory disease diagnosis for the students to decide upon. The options available to students were: COPD, Chronic Bronchitis, Emphysema, Asthma, ARDS, and Pulmonary Fibrosis. Students chose from the listed respiratory disease diagnoses during two simulations using a mannequin and one patient in the clinical setting. During the two simulation encounters, twelve students had the opportunity to diagnose a total of 24 respiratory diseases correctly (12 students x 2 simulation encounters = 24 total diagnoses). During the clinical setting the students diagnosed diseases presented by patients that included COPD, Chronic Bronchitis, Emphysema, Asthma, ARDS, and Pulmonary Fibrosis. A null hypothesis was generated for the third research question. Null hypothesis 1: There is not a statistically significant difference between simulation and clinical setting when determining the specific respiratory disease diagnosis ($p < 0.5$). The categorical independent variable was learning setting (simulation or clinical). The categorical dependent variable was the students' answers (correct or incorrect) with their specific respiratory disease diagnosis.

The specific respiratory disease for simulation 1 was ARDS. Three students chose the specific respiratory disease diagnosis. Nine students did not choose the specific respiratory disease correctly.

The specific respiratory disease for simulation 2 was Chronic Bronchitis. Six students chose the specific respiratory disease correctly. Six students did not choose the specific respiratory disease correctly.

The specific respiratory diseases to choose from in the clinical setting included: COPD, Chronic Bronchitis, Emphysema, Asthma, ARDS, and Pulmonary Fibrosis. Four students chose the specific respiratory disease correctly. Eight students did not choose the specific respiratory disease correctly.

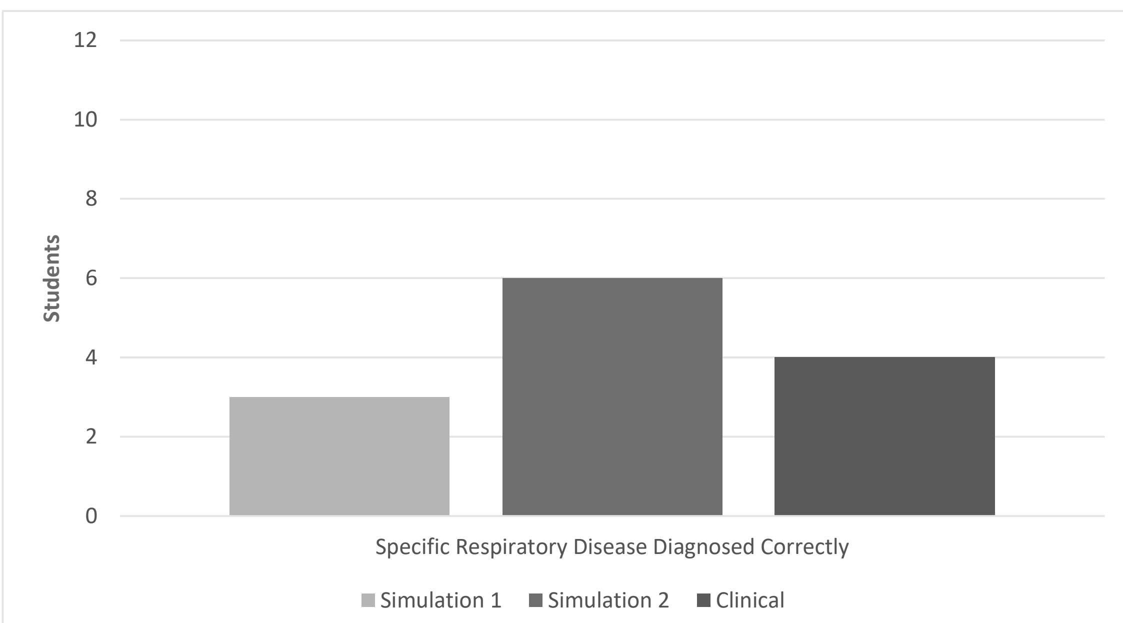

Figure 5. Correct respiratory disease diagnosis chosen.

Figure 5, shown on the previous page, indicates the number of students who chose the specific respiratory disease correctly in the simulations and clinical setting. The left bar indicates the number of students who chose correctly in simulation one. The middle bar indicates the number of students who chose correctly in simulation two. The right bar indicates the number of students who chose correctly in the clinical setting.

A chi-square test was run using Social Science Statistics' online Chi-Square Test Calculator (https://www.socscistatistics.com/tests/chisquare2/default2.aspx). The number of students correct and incorrect specific respiratory disease diagnoses in the simulations and clinical setting were used for the comparison.

A 2 x 3 contingency table used students' correct/incorrect scores from simulation 1, simulation 2, and clinical 1 condition. The chi-square statistic was 1.6856. The $p = 0.4304$ was not statistically significant ($p < 0.5$) in this case. The students' ability to correctly identify respiratory diseases in simulation and clinical setting when determining the specific respiratory disease diagnosis was not statistically significant.

Research question four: Upon determining a disease state in the clinical setting, how well do students apply their knowledge of respiratory therapy-based care? This includes measuring the students' decisions to include possible respiratory therapies, medication options, and education opportunities for the patient and/or family members. During the simulation encounters the students were continuing to build their medication knowledge from the respiratory pharmacology course. During both simulation and clinical encounters, the students had limited knowledge of therapies based on their curriculum schedules and when material is covered. The respiratory therapy education students provided to the clinical patients was also based on limited knowledge that had been taught up to this point. The students' disease process knowledge was the strongest for the patient education based on the recently completed respiratory disease course.

Data for research question four came only from the clinical setting. The students were scored with the Medication and Therapy Options instrument in Appendix E. The students decided if medication and/or therapies could be added based on the respiratory disease of the clinical setting patient. Students' chose up to 3 options for medications. Students also chose up to 3 options for respiratory therapy. The medication and therapy option the students chose were separately ranked by the researcher using a reasoning score on a sliding scale (0- not acceptable, 5- highly acceptable).

The students' abilities to expand on their respiratory therapy knowledge was also measured using the three subscales (Disease Education, Medication Education, and Therapy Education) of the Educational Opportunity instrument in Appendix F. The students discussed disease, medication, and therapy education relating to the clinical patients' respiratory disease. The students were scored on a scale of one (not acceptable) to five (highly acceptable) based on how well their disease education provided patients with a respiratory disease overview, a diagnosis, and further specifics (see Disease Education in Appendix F). Students' ability to provide medication education to patients was scored on a scale of one (not acceptable) to five (highly acceptable) based on their ability to introduce the medication plan and manage the teach-back from the patient. Therapy education was scored from one (not acceptable) to five (highly acceptable) based on students' ability to provide patients with therapy options, procedures, and potential outcomes.

Scores of the 12 students for Medication and Therapy Options assessments (Appendix E) and the Disease Education, Medication Education and Therapy Education subscales from the

Education Opportunity Assessment (Appendix F) were examined as an indication of how well students could apply respiratory-disease knowledge to a patient's therapy care. The range of scores and number of students who achieved an acceptable or higher rating on each assessment item are summarized in Table 2 below.

Table 2

Medication and Therapy Options and Educational Opportunity Scores

Assessment	High Score	Low Score	Number at acceptable or higher?
Medication	4	2	10
Therapy Options	4	1	5
Disease Education	4	2.5	12
Medication Education	5	2.5	11
Therapy Education	4	1	7

N = 12

Students' highest and lowest assessment scores, as shown in Table 2, ranged from one to five on assessments scales that ranged from 0 to five. The range of scores for the students' Medication assessment was two to four with 10 of the 12 students reaching an "acceptable" level score of 2.5 or higher. The range of scores for the students' Therapy Options assessment was one to four with five of the 12 students reaching the "acceptable" level score of 2.5 or higher. The range of scores for the students' Disease Education assessment was 2.5 to 4 with all 12 of the students reaching the "acceptable" level score of 2.5 or higher. The range of scores for the students' Medication Education assessment was 2.5 to 5 with 11 of the 12 students reaching the "acceptable" level score of 2.5 or higher. The range of scores for the students' Therapy

Education assessment was one to four with seven of the 12 students reaching the "acceptable" level score of 2.5 or higher.

Figure 6, below, designates average scores of the 12 students for Medication and Therapy Options assessments (Appendix E), and the Disease Education, Medication Education and Therapy Education subscales from the Educational Opportunity Assessment (Appendix F). All assessments occurred in the clinical setting as previously indicated.

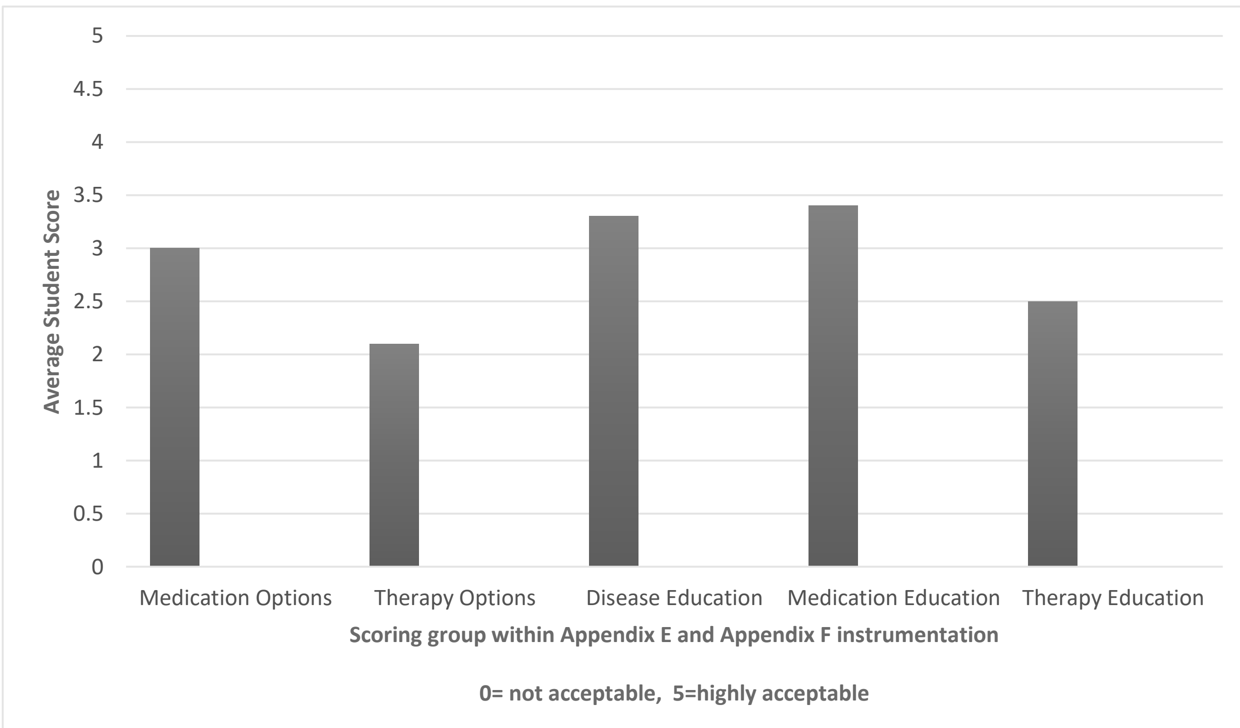

Figure 6. Medication and therapy options and educational opportunity- mean scores.

These descriptive statistics present average values of how well the students applied their knowledge from the simulation to further respiratory therapy-based care. This included the students' decisions to deliver possible respiratory therapies, medication options, and education opportunities for the patient and/or family members. Students' average score were highest on the medication education assessment (mean = 3.4), disease education assessment (mean = 3.3), and medication education assessment (mean = 3) items. These three scores were above the acceptable score of 2.5. Students' mean therapy education score (2.5) was at the acceptable level. Students' mean therapy options score (2.1) was below the acceptable score of 2.5.

Results in Figure 6 show assessments where 10 or more of the 12 students achieved acceptable or higher scores on the Disease Education items (12), the Medication Education items (11), and the Medication Options (10). These are the same assessment items, shown in Figure 4, where students' scores averaged higher than the required 2.5 "acceptable level" threshold. The range in students' scores, (Disease Education = 2, Medication Education = 1.5, Medication Options = 2.5) from Table 4, along with the mean number of students achieving above average scores (see Figure 4) indicates that there were only three students with scores of less than the "acceptable" score of 2.5. These assessment scores occurred after the students had recently completed their Respiratory Disease and Respiratory Pharmacology courses. The above average scores in these areas indicate that the material was retained and applied to the clinical setting.

Figure 6 indicates that students' average score for therapy education was right at the "acceptable" level. Table 2 indicates that seven of the 12 students, slightly over half, had "acceptable" or higher scores with a high amount of variability with scores ranging from one to four. Students' below average scores for the therapy options result from five students meeting the "acceptable" level of competence with a high amount of variability (range = 3) as shown in Table 2. Seven students did not meet the acceptable level resulting in students' average score of the therapy options below the acceptable level (see Table 2). At the time of this clinical assessment, students had little knowledge of respiratory therapies as the courses pertaining to therapies occur after this clinical rotation. Below average scores are therefore not surprising for this group of students.

Research question five: What are students' perceptions regarding their respiratory disease course and their clinical experience? The students' abilities to assess their own performance in simulation and clinical settings was determined using the questions found in the Debriefing Discussion/Interview A and Debriefing Discussion/Interview B forms found in Appendix G. Ten debriefing questions (6 items in assessment A and 4 in assessment B = 10 total questions) were asked of each of the students after their two simulation encounters. This provided a total of 20 responses for each of the 12 students and a total of 240 responses available for analysis. Seven questions found in the debriefing Discussion/Interview A form were asked after the clinical setting encounter. This provided a total of seven responses for each of the 12 students (84 total responses) that could be analyzed.

The students' responses to the open-ended questions were read by the researcher and categorized with a letter-based coding system. The categories that emerged were: realism (R), pace/flow (PF), information gathering (IG), communication (C), preparation (P), mannequin experience (M), and other comments (O). These categories represented seven themes from the students' 320 Debriefing Discussion/Interview responses.

Themes collected from research question five. Two themes emerged after students watched videos of their performance that were recorded while they completed a respiratory disease encounter using the simulation mannequins.

The first theme related to students' difficulties working with the mannequin. The simulation involved students using a mannequin to practice a skill such as the Pulmonary Exam (Appendix B). Interaction with the mannequin was necessary to complete the Pulmonary Exam and the Respiratory Disease Encounter (Appendix D). Students had no previous experience with the simulation mannequin and using a simulated patient was foreign to them as summarized in Figure 7.

Student Responses
So hard to do with the mannequin.
Weird with the mannequin and difficult to imagine.
More realistic with people.
Hard to pretend and give heartfelt responses when it’s not an actual patient.
I was more nervous with the mannequin than a real person.

Figure 7. Difficulty working with the mannequin.

The second theme students identified was a result of reflection on their own performance. The theme was the pace and flow at which they worked during the simulation encounter. The video recording allowed the students to assess their own performance and skills. These assessments included making note of future improvements for themselves and perceptions of the actual experience after watching the recording. See Figure 8 on the next page for the simulation encounter pace and flow reflections.

Two themes emerged from the students’ responses for both the simulation and clinical settings after they completed their Respiratory Disease Encounter (Appendix D). The first included assessment item gathering. The second theme was poor communication with the patient. The rest of the reflection items students submitted were categorized as “other non-category” comments.

Student Responses
I need to slow down.
I need to transition more smoothly.
It was not as fluid as I thought it should be.
I felt like I went slowly, but I rushed through it.
I thought it took less time than it actually did.
I thought I was quick, but I slowed down a lot.

Figure 8. Pace and flow after video recording reflection.

The first theme, assessment item gathering, occurred after completing the Respiratory Disease Encounters in both the simulation setting and with patients in a clinical setting. When reflection on their performance, the students recognized their inconsistencies and missed opportunities when assessing patients. Student comments are indicated in Figure 9 below.

Student Responses
I need to ask the patient how they are doing more often.
I need to ask the patient more questions.
I need to get more patient history.
I need to check vitals and look at the monitor.
I always feel like I’m forgetting a lot but not really.

Figure 9. Assessment item gathering.

Poor communication with patients was a second theme students identified in both simulation and clinical settings. The communication with the patient was specifically noted by students reflecting on the importance of explaining to the patient what's occurring and what the respiratory therapy student is doing. Students wanted to improve the patients' experience by providing more information as indicated in Figure 10 below.

Student Responses
I could've given a better explanation of things to the patient.
I could've taken more time to explain to the patient the diagnosis that I came up with.
I could've been better explaining the pulmonary exam.

Figure 10. Poor communication with the patient.

The other comments that couldn't be categorized into themes involved yes or no answers that couldn't be considered usable data. The other comments in this category were single responses that weren't repeated by other students. These included specific items that allowed the student to decide upon the disease, actions the student did, and items the students forgot to do.

Two themes from the students' responses emerged from feedback after their respiratory disease encounter in a clinical setting. These first theme included students' preparation leading up to the clinical setting and the differences of the clinical setting compared to the simulation mannequins.

The students found themselves prepared going into the clinical setting. Student feedback focusing on preparation included comments shown in Figure 11 on the next page.

The second theme students identified was the differences between the clinical setting compared to the simulation setting. Students' comments focused on the limitations of the simulation mannequin as shown in Figure 12 on the next page.

Student Responses
It (simulation mannequin) helped a lot to prepare.
The mannequin helped me develop confidence.
It was helpful watching video recordings to continue to improve on the process.
From simulation to clinical, automatically most things were the same.
It helped me develop a script.
It helped getting comfortable with the skills.
Just the repetition helped.

Figure 11. Clinical preparation from simulation.

Student Responses
The real patient was much better for practice than the mannequin.
It was a little harder to get comfortable on the mannequin than a real patient.

Figure 12. Clinical setting versus simulation setting.

Chapter V: Summary, Conclusion and Recommendation

Using simulation mannequins for training health care workers when the technology is provided by an educational facility is a reasonable consideration. However, incorporating this technology requires reasoning and justification that the technology will provide positive learning outcomes. The use of technology through integrated simulation mannequins and the learning benefits for students requires research and data to justify its use in the classroom/lab setting prior to clinical settings.

Restatement of the Problem

In the Respiratory Therapist Program at WTC, student performance in the respiratory disease course is currently completed without the use of integrated simulation mannequins. This leaves a possible void of understanding that can directly affect the students' decision making process during their clinical time with actual patients.

This study was completed to determine if simulation mannequins could be successfully incorporated a respiratory disease course at WTC. Determining successful incorporation involved measuring students' decision making in both simulation and clinical environments and assessing students' effectiveness using a pulmonary exam to decide a patient's respiratory condition. Data from the application of the pulmonary exam in the Respiratory Disease Encounter (Appendix D) was measured in both the simulation lab and the clinical setting. Appendixes D, E, and F, explored the students' knowledge of pulmonary diseases, medication and therapies related to such diseases. The collected data helped this researcher determine the effectiveness of mannequin simulations in preparing students for the clinical setting. Together, the research items used in this study supported the use and incorporation of simulation mannequins in the respiratory disease course at WTC. Furthermore, the simulation usage in the respiratory disease course allowed the students' to better prepare for the clinical setting and complete their pulmonary exam in respiratory disease encounters.

Major Findings

The research questions for this study helped address whether including simulation activities within the respiratory disease course were beneficial.

Research question one asked, "Is there a difference in Respiratory Disease Encounter assessment items chosen by the students between the integrated simulation mannequin and the clinical setting." The findings determined that students' average scores improved from the simulation to the clinical setting.

Students' scores on the seven critical items in the Respiratory Disease Encounter assessment improved from the simulation to the clinical setting at a statistically significant level ($z = 2.25$, $p = 0.014$). Gathering information about these critical factors was an important learning point that the students needed to make to help them in their decision-making process. Students' improved scores and the statistical significance from simulation to clinical settings support the use of the simulation-based education in the Respiratory Disease course.

The students' performance on all twelve items on the Respiratory Disease Encounter also improved at a statistically significant level from the simulation to clinical setting ($z = 2.25$, $p = 0.014$). It should be noted that the average number of assessment items students collected in the clinical setting was 9.08 (Table 3, p. 46). This leaves an average of almost three assessment items the student didn't collect to help them determine the patients' disease diagnosis. The students may not have shown a full urgency to have all the information necessary or perhaps simply couldn't remember to do everything. The simulation setting practice allowed for a safe environment for assessment items to be missed or forgotten. Practicing these methods in the simulation setting allowed students to improve upon each attempt and allowed less risk of important items being missed in the clinical setting with actual patients.

Students' reasoning scores for the Respiratory Disease Encounter (Appendix D) allowed the researcher to analyze the overall actions of the students within the simulation settings and the clinical encounter. The students scored higher with their reasoning scores in the clinical setting when compared to the simulation setting at a statistically significant level ($z = -3.059$, $p = 0.002$). Assessment effectiveness may have been improved by students' practicing during the simulation experiences that were incorporated into the Respiratory Disease course.

Data from the research may indicate that the continuous repetition of the pulmonary exam on the simulation mannequin may have provided the practice students needed to do well in their clinical setting. The students may have continued to recognize the importance of having a complete assessment to accurately determine a specific disease diagnosis. The use of the simulation experience allowed for repetition that wouldn't have occurred with the absence of the simulation mannequin. Students' experience with the simulations allowed for a safe environment to build knowledge and provide a "realistic" experience. The simulation experiences allowed for a course of action that otherwise would have begun with a live patient had the simulation mannequin not been used. Simulations were designed to avoid this very type of practicing with live patients.

Research question two explored differences between simulation and clinical settings when students determined the correct restrictive or obstructive respiratory disease category. As the students chose whether their patients presented a restrictive or obstructive disease they ultimately had only two choices and a 50% chance of choosing the correct answer. Most students (10 of 12) entered the study with the ability to differentiate between restrictive or obstructive diseases. The two simulation encounters allowed students to practice their skills and students increased in correctly identifying the correct disease category in the simulation settings (from 10 to 11). All 12 students chose the correct disease category in the clinical setting. A null hypothesis could not be generated based on the zero values incorporated with each of the three Respiratory Disease Encounters. Due to the high number of correct responses, it is unlikely the students found themselves guessing between one and the other disease categories during the simulations. The simulations did allow students to practice so, eventually they had an understanding into the clinical setting based on the 12 of 12 correct answers in the clinical setting. The reinforcement of the knowledge within the simulation activities and the respiratory disease course demonstrates how simulations allow students to continue to improve upon their understanding of restrictive and obstructive disease categories. Healthcare outcomes are based on both textbook knowledge and hands-on application of such knowledge. The outcomes will be more positively affected by addressing both textbook and application knowledge versus only focusing on one or the other. Supplementing the coursework with the obstructive and restrictive simulation encounters allows for more practice and thus more accurate decision making.

The repetition of the simulation assessment allowed for a layering of knowledge that provided continuous formative and summative assessments through discussion and exams. Reinforcement measures may have increased the transfer of students' obstructive and restrictive disease knowledge to help them make more confident decisions between the two diseases.

Research question three investigated whether there's a difference between simulation and clinical settings when determining the specific respiratory disease diagnosis. This involved more thought from the students as they had to decide upon six different respiratory diseases. The students had two simulation respiratory disease encounters that presented a specific respiratory disease. They had one disease encounter in the clinical setting. The correct decision making of the students varied from simulation one having three students correctly identify a specific respiratory disease, to simulation two having six students correctly identify a specific respiratory disease, and four students correctly identify diseases in the clinical setting. The increase in students' correct answers from the simulations to the clinical setting was not statistically significant. The students' knowledge of the respiratory diseases may have been improving, but it's still difficult to gain and maintain all the details necessary to distinguish certain respiratory diseases during a pulmonary exam and a respiratory disease encounter. Observing the respiratory diseases with a real person in the clinical setting may have also been more difficult due to the subtle nature of certain respiratory disease specifics. The simulation scenarios may have made these clearer and slightly easier to interpret.

The Respiratory Disease course covered more than ten obstructive and restrictive diseases. Narrowing these down to the six diseases presented in the simulation and clinical settings for this study helped limit the students' focus. The complexities of six respiratory diseases could still be difficult for students to understand let alone apply to a simulation or clinical patient. The transfer of knowledge would become even more complex as a clinical patient would make for an even more complex presentation of their assessment items.

Students' performance during the two simulations covering specific diseases showed a 50% improvement which may have continued to grow had students been given more practice and specific disease examples. Further simulation practice may have helped students decipher each specific disease and better transfer that knowledge to the clinical setting.

Research question four explored how well the students applied their knowledge from the simulated encounters to respiratory therapy-based care for patients in clinical settings. This included measuring the students' decisions to include possible respiratory therapies, medication options, and education opportunities for real patients and/or family members. The students applied their knowledge beyond a diagnosis in an acceptable manner. Since they had studied the specific restrictive and obstructive diseases, most students scored above the "acceptable" level with their ability to provide education to their clinical patient about the specific respiratory diseases. On average students also scored above the "acceptable" level on their medication choices and education assessment items. The respiratory pharmacology course coincided with the respiratory disease course. Most students scored below an "acceptable" level on the therapy options and education assessments. It should be noted that at this time in the students' program they had learned very little regarding specific respiratory therapies. The course that explores therapies in more detail takes place in the fall term and after respiratory clinical 1.

The simulation encounters allowed students to practice identifying medication options, therapy options, providing disease education, medication education and therapy education identified in research question 4. Beyond the simulation, the classroom courses were the primary preparation method used to move students into their clinical experience and the specific diseases they encountered. The encounter with the clinical patient was likely less intimidating due to the simulation practice and confidence built through repetition of the skills. The confidence the students had from the simulation preparation allowed for a more comfortable interaction with the clinical patient. The skills students acquired through the pulmonary exam assessment may have helped build patient student trust. Clinical patients' choices of therapies, medications, and the related education was likely received more positively from a student with simulation experience than a clinical patient encountering a student who wasn't sure what they were doing when it comes to assessment gathering. Students' transfer of knowledge wasn't direct from the simulation to the clinical experience for research question four, but the preparation from the simulations and classroom knowledge helped present a more self-assured student for the patient to interact with.

Research question five analyzed students' perceptions regarding their respiratory disease course and their clinical experience. Student feedback occurred after the Respiratory Disease Encounter assessment (Appendix D) was administered during two simulations and one clinical setting. The Debriefing Discussion/Interview is found in Appendix G and involves 11 total questions. From the students' responses seven themes were categorized to better understand common collective thoughts. The themes were categorized into two main concepts:

1. Students' comparison of the simulation mannequin to clinical setting.
2. Simulations impacting student understandings.

Category one included the themes that related to the students' difficulties working with a mannequin and how the clinical setting was compared to the simulation setting.

The students' reflections from formulating comparisons of the simulation to the clinical setting emphasized that it's difficult to compare the experiences. The simulation mannequin itself was foreign to them and trying to pretend to care for the mannequin was difficult. Though the simulation mannequins led to this type of feedback, students were still experiencing a clinical like assessment. They still needed to prepare for the simulation experience with thought and reflection of what to do to complete the assessment. The repetition of which created a cycle of learning despite the unusual perspective of the mannequin from the students' viewpoint. Upon entering the clinical setting the students better appreciated the chance to work with live patients and apply their knowledge in a natural setting. Students' comfort level was strengthened from the simulation preparation and simply being able to genuinely care for an individual and not a mannequin.

Simulations impacting students' understanding, the second category included themes that related to the clinical preparation from simulations, students' abilities to gather assessment items from simulations to clinical experiences, poor patient communication during simulations, and the pace and flow at which students felt they worked.

The students' reflections focused on the benefit of the simulations preparing them for the actual clinical encounter. The simulations helped the students develop their knowledge and improve skills. The assessment process became more automatic for students as they participated in the simulation practice that allowed for a smooth transition into the clinical setting. Observing their communication from the simulations allowed the students to better prepare their dialogue with patients and helped students recognize how they could better explain things to the clinical patient when that time came.

Students' further development emerged from self-reflection of how they were doing with the simulations. Students were able to find areas of improvement that would benefit themselves, the patient, and the patient outcome. They recognized their patient interaction tempo based on their initial nerves and comfortability. This recognition allowed students to seek personal improvements for the next encounter with the simulation or clinical patient.

Students' transfer of knowledge was again evident from these reflections of their simulations. Research questions one and three point to the positive outcomes of the simulation experiences transferring into positive knowledge in the clinical setting. The improved decision making from the simulation preparation will positively serve the patient and the collaborative efforts in healthcare. Seeking more assessment information to better determine a respiratory disease state was transferred from the simulation to the clinical setting. Students' experience was gained in the simulations without any harm to a patient or the patient receiving care from an unsure student. The confidence the students built during the simulations transferred to their more effective and efficient care giving in the clinical setting.

Recommendations Related to this Study

Managing the simulation opportunities was time consuming and placed the learning focus on one student at a time. There may be value in determining a way to create an automated simulation experience that does not take the instructor away from the classroom setting and guiding other students' learning. Automating simulations may help put students more at ease during simulations without the instructor watching and directing the process. This would be challenging as the integrated simulation mannequin is not able to mimic certain critical steps of the pulmonary exam and respiratory disease encounters. It was also determined that during the study the students inaccurately heard lung sounds compared to the intended sounds the mannequin was to deliver. Future studies may benefit from researching similar research questions as those that were posed during this study but using a low fidelity simulator (LFS). Further research could provide data to support cost analysis efforts when simulation mannequins are being purchased.

Extreme value may come from finding a way to incorporate more live patients or actors in place of the mannequin. Teaming with local acting companies or other colleges to have acting students simulate the patient would help improve the experience based on the students' comments. This would directly address student feedback from this study indicating how students felt uncomfortable with the simulation mannequins.

Although difficult to incorporate into the current scheduled curriculum in WTC's Respiratory Therapist Program, it would be helpful to present a more thorough introduction to respiratory therapies so that the students have a better understanding of making the choices and delivering education about respiratory therapies. This is an area for improvement. Other programs could research the same questions as posed in this study but see different results with more student input in the areas of therapy and therapy education.

Recommendations for Further Study

Based on experiential learning theory, there seems to be further opportunities to incorporate and study integrated simulation mannequins in other respiratory therapy courses. Determining more appropriate uses of a simulation mannequins to best recreate the realism of a patient interaction would be valuable.

Further investigation to compare HFS versus LFS would be advantageous. Perhaps the more expensive mannequins are not meeting their expectations in the eyes of the students. This may be especially true if the lack of realism continues to be an issue.

Conclusions

Following this research study, the WTC respiratory disease course will continue to incorporate the integrated simulation mannequin into the lessons. Although the amount of simulation respiratory disease encounters will need to be reduced from four to two, the benefits of using mannequins in students' preparation for a clinical setting should still be somewhat evident. These simulations may move away from simulation mannequins and use live patients. Former students who are local employees may be willing to donate their time to allow for this type of learning experience. Doing so would remediate the students' opinions of the mannequins.

Incorporating this type of learning to other WTC Respiratory Therapist Program courses may be explored in the future. The true challenge may be from moving beyond the knowledge gained of students' learning from simple repetition, to students' more thorough understanding of respiratory therapy concepts from the simulation experiences themselves.

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Appendix A: Disease Summary Sheet

Disease/Disorder:

Pathology (what's gone wrong)	**Etiology** (what caused it)

Inspection:
(VS, HEENT, neck, thorax, abdomen, extremities)
WOB:
Pain: **Acute or Chronic**
LOC:
Overall health: **Age:**
Cough: Sputum:

Palpation

- **Trachea** Midline Shifted to Shifted away
- **Chest wall**
- **Expansion**
  - Normal Decreased
  - Symmetrical Asymmetrical
- **Fremitus** (tactile or vocal)

  Normal Increased Decreased

Percussion

- Resonant
- Dull / Flat
- Hyperresonant / Tympanic

Auscultation

- **Breath sound** Vesicular Diminished Tubular
- **Adventitious sounds**
  - None
  - **Crackles** Coarse Fine
  - **Wheezes** Inspiratory Expiratory
- **Voice sounds** Normal Increased

ABGs

- Oxygenation: high normal low
- Acid/base balance:

PFT

- **Vital Capacity** Normal Decreased Vary
- **Exp Flows** Normal Decreased Vary
- **FEV_1/FVC ratio** Normal Decreased
- **Diffusing Capacity** Normal Decreased
- **Pattern** Obstructive Restrictive

CXR

- **Density** Normal Increased Decreased

Treatment:

How is it diagnosed:

How to monitor:

Other Findings:

Appendix B: Pulmonary Exam Competency Scoring Sheet

	Pulmonary Exam – Actual	Clinical	Required

		C	Description	First test S	First test U	First test Ø	First test na	Retest S	Retest U	Retest Ø	Retest na
			Start time								
Preparation	1.		Review chart for relevant information								
	2.		Gather necessary equipment Stethoscope, alcohol pad								
	3.		Clean earpieces, bell/diaphragm as needed								
	4.	C	Wash/Decontaminate hands, apply standard precautions								
	5.	C	Identify patient, introduce self								
	6.	C	Explain procedure								
	7.		Position patient and ensure privacy								
Inspection	8.	C	Inspect patient for overall appearance Age, sex, weight, general health, tubes/equipment								
	9.		Inspect skin color and condition Cyanosis, pallor, mottling, diaphoresis, swelling, bruises, erythema								
	10.	C	Inspect chest shape and appearance Bony deformities, incisions/scars, tubes, etc								
	11.		Observe chest expansion Symmetrical, paradoxical, unequal…								
	12.	C	Observe respiratory pattern Rate, pattern, regularity, depth, accessory muscle use								
	13.		Observe work of breathing Body position, retractions, pursed lip breathing, etc								
	14.		Palpate extremities Peripheral pulses, capillary refill, clubbing, dependent edema								
Palpation	15.	C	Palpate tracheal position								
	16.		Palpate chest/neck surface Subcutaneous emphysema, tenderness, bony deformities								
	17.	C	Palpate chest expansion								
	18.	C	Palpate for tactile fremitus: Patient says '99'								
Percussion	19.	C	Perform diagnostic percussion of chest (posterior only) Compare bilaterally								
	20.		Percuss lung/liver border								
	21.		Estimate diaphragm excursion								
Auscultation	22.	C	Instruct patient to breathe slowly and deeply through mouth								
	23.	C	Auscultate anterior chest At least six positions, comparing bilaterally								
	24.		Auscultate lateral chest bilaterally								
	25.	C	Auscultate posterior chest At least ten positions, comparing bilaterally								
	26.	C	Assure patient safety and comfort throughout procedure								
	27.		Properly identify sounds								
	28.		Return equipment to proper location								
	29.	C	Wash/Decontaminate hands								

End Time	First test	Retest

Please complete back page

Overall	C	**Skill:** Performs skill competently, manages time efficiently	Yes	No	Yes	No
	C	**Equipment:** Handles equipment effectively and confidently	Yes	No	Yes	No
	C	**Safety:** Maintains asepsis, assures patient safety	Yes	No	Yes	No
	C	**Communication:** Communicates clearly and courteously	Yes	No	Yes	No
	C	**Documentation:** Documents accurately and appropriately	Yes	No	Yes	No

SATISFACTORY

- ✓ **All critical C steps (front and back) completed satisfactorily S.**
- ✓ No more than **2** noncritical errors U or omissions Ø.
- ✓ Self-corrections do not endanger patient or compromise care.
- ✓ Patient safety and therapy effectiveness assured at all times.
- ✓ **Satisfactory performance on each 'OVERALL' category.**
- ✓ **Ready for clinical application with minimal supervision.**

UNSATISFACTORY

***MINOR* Unsatisfactory**

- Error made in a step that does not directly involve patient (such as calculating tidal volume, reading a respirometer or assembling a device) and can be retested simply without involving a patient.
- Patient safety assured at all times.

✓ **Student must retest on deficiency only before progressing to next level.**

***MAJOR* Unsatisfactory**

- Error made in a step that directly involves the patient, compromised patient safety, or overall performance indicates student needs more supervised practice.

✓ **Must complete re-evaluation of entire procedure** before progressing to next level.

Pt Assessment	**Pulmonary Exam**	**Clinical**	**Required**
Student			
Date	**Evaluator**	**Satisfactory**	**Unsatisfactory:** □ **Minor** □ **MAJOR**
Comments			
Date	**Evaluator**	**Satisfactory**	**Unsatisfactory:** □ **Minor** □ **MAJOR**
Comments			

Appendix C: Obstructive and Restrictive Respiratory Diseases

1. **Obstructive--- Emphysema**

Inspection: Normal RR and breath, but still AMU Digital Clubbing, Barrel Chest, No Cough (Sats 89% on RA)
Palpation: Trachea Midline, Expansion slightly decreased (symmetrical), Decreased Fremitus
Percussion: Hyperresonant/Tympanic
Auscultation: diminished
Diaphragmatic Excursion: >2'' (normal >2'')

Hx: (if they ask) "I smoke."
CXR: Decreased density--- after interpreted by MD → bullous lesions and blebs beginning
ABG: 7.37-55-78-25 Fully compensated resp. acidosis w/ mild hypoxemia on RA

2. **Obstructive--- COPD Combination of emphysema and chronic bronchitis symptoms. If they get specific on your cough just say it's been productive for years.**

Inspection: Increased HR, RR, AMU, WOB Barrel chested, digital clubbing, cyanotic Chronic Productive Cough (Sats 89% on 3L)
Palpation: Trachea Midline, Expansion normal, Decreased Fremitus
Percussion: Hyperresonant/Tympanic
Auscultation: diminished, scattered expiratory wheezes
Diaphragmatic Excursion: (normal >2'')

Hx: (if they ask) "Smoked my whole life." Ask them pack year. 2 PPD for 50 years= 100 pack year
CXR: decreased density--- after interpreted by MD → hyperinflated, flattened diaphragm, increase A-P diameter
ABG: 7.37-55-59-29 Fully compensated resp. acidosis w/ moderate hypoxemia on 3L

3. **Obstructive- Chronic Bronchitis**

Inspection: Increased RR, AMU, WOB slightly overweight, cyanotic, Extremely Productive Cough (more sputum in the morning), smoker (Sats 88% on 2L)
Palpation: Trachea Midline, slightly decreased (symmetrical), Normal Fremitus (not increased or decreased)
Percussion: Resonant (normal)
Auscultation: coarse crackles
Diaphragmatic Excursion: >2'' (normal >2'')
Hx: (if they ask) "Productive cough for the past 4 months. Seemed to happen like this last year too."
CXR: slightly decreased density, (not significant in early disease)
ABG: 7.37-37-90-25 Normal ABG, w/ no Hypoxemia on 2L

4. **Obstructive-- Asthma**

Inspection: Increased HR, RR, AMU, diaphoretic, SOB Recurrent Cough (Sats 92% on 1L) "Chest feeling tight."
Palpation: Trachea Midline, Expansion normal (symmetrical), Decreased Fremitus
Percussion: hyperresonant/tympanic
Auscultation: diminished inspiratory and expiratory wheezes
Diaphragmatic Excursion: >2'' (normal >2'')

Hx: "Went to my friends new apartment. His roommate has two cats who appear like they get to lay all over the furniture. Stayed the weekend. Slept on the couch."
CXR: Decreased density, hyperinflation, flattened diaphragms
ABG: 7.45-33-81-29 Fully compensated resp. alkalosis w/ no hypoxemia on 1L

5. **Restrictive-- ARDS**

Inspection: Increased HR, RR, AMU, WOB No Cough (Sats 86% on 80% high flow) refractory hypoxemia??
Palpation: Trachea Midline, Expansion decreased (symmetrical), Increased Fremitus
Percussion: Dull/Flat
Auscultation: bilateral fine crackles
Diaphragmatic Excursion: 1'' (normal >2'')

Hx: (if they ask) "Not sure what happened. Felt kind of sick lately and hospitalized yesterday and now this came on strong."
CXR: increased density--- after interpreted by MD → bilateral fluffy infiltrates
ABG: 7.34-55-61-29 Acute partially compensated resp. acidosis w/ mild hypoxemia on 85%

6. **Restrictive- Pulmonary Fibrosis**

Inspection: Increased RR, HR, BP – non-productive cough, pitting edema, digital clubbing, distended neck veins (Sats 90% on 4L)
Palpation: Trachea midline, Expansion decreased (symmetrical), Increased Fremitus
Percussion: Dull/Flat
Auscultation: Crackles (coarse and fine)
Diaphragmatic Excursion: 1'' (normal >2'')

Hx: (if they ask) "Just getting ready to retire from farming. Been somewhat SOB for years."
CXR: Increased density--- after interpreted by MD → honeycombing, ground glass, cavity formation (just name one)
ABG: 7.33-57-61-29 Acute partially compensated resp. acidosis w/ mild hypoxemia on 4L

Appendix D: Respiratory Disease Encounter

RESPIRATORY DISEASE ENCOUNTER

Student:____________________ Date:____________ Location: Integrated Simulation Lab OR Clinical Site Patient

Respiratory Disease State Presented: _____________________

OPTIONS: COPD, Chronic Bronchitis, Emphysema, Asthma, ARDS, Pulmonary Fibrosis, No Respiratory Condition Diagnosed

STUDENT ASSESSMENT INCLUDES (check all completed):

Hand Hygiene -Critical		Percussion -Critical		Auscultation -Critical	
Introduction -Critical		Palpation -Critical		CXR	
History Gathered		Cough Strength		ABG	
Vital Signs -Critical		Tactile Fremitus -Critical		SOB	

POTENTIAL DIAGNOSIS CHOSEN BY STUDENT: ________________ACTUAL DIAGNOSIS (if provided): _____________

REASONING BEHIND CHOSEN DIAGNOSIS:

____

Highly Acceptable-5 Acceptable 2.5 Not Acceptable 0 REASONING Score: _________________

|------------------|----------------|----------------|----------------|--------------------|
5 4 3 2 1 0

INSTRUCTOR NOTES

Appendix E: Medication and Therapy Options

MEDICATION AND THERAPY OPTIONS (check those covered and include response):

Medications | Therapies

Medications		Therapies	
Medication Option 1 discussed		Therapy Option 1 discussed	
Medication Option 2 discussed		Therapy Option 2 discussed	
Medication Option 3 discussed		Therapy Option 3 discussed (if applicable)	

REASONING BEHIND CHOSEN MEDICATION:

___

Highly
Acceptable Acceptable Not Acceptable Reasoning Score: ______________
|------------------|----------------|----------------|----------------|--------------------|
5 4 3 2 1 0

REASONING BEHIND CHOSEN THERAPIES:

___

Highly
Acceptable Acceptable Not Acceptable Reasoning Score: ______________
|------------------|----------------|----------------|----------------|--------------------|
5 4 3 2 1 0

Appendix F: Educational Opportunity

INSTRUCTOR NOTES:

EDUCATIONAL OPPORTUNITY (check those that apply and include description):

Disease:

Disease been discussed with the patient previously: Yes OR No	
Overview of Disease discussed: Name, Obstructive vs. Restrictive, Potential Cause, Reversibility or Non-Reversibility	
How diagnosis is determined: Patient assessment, previous lab work, pulmonary function exam	
More specifics of disease discussed: Statistics, Outcomes, Alternatives, Areas of Improvement	

DISEASE EDUCATION SCORING:

Highly
Acceptable   Acceptable   Not Acceptable   Education Score: _________________

|-------------------|----------------|----------------|----------------|--------------------|

5   4   3   2   1   0

INSTRUCTOR NOTES:

Medications:

Medication previously ordered: Yes OR No	
Medication introduction or review: Proper use, timing, symptoms recognized, prevention or rescue, etc…	
Medication teach-back from patient, reinforcement required, discussion:	

MEDIATION EDUCATION SCORING:

Highly
Acceptable Acceptable Not Acceptable Education Score: ________________

|-------------------|-----------------|-----------------|-----------------|---------------------|
5 4 3 2 1 0

INSTRUCTOR NOTES:

Therapies:

Therapy choices currently ordered: Yes OR No	
Therapy choice options: Cough and Deep Breathing, Incentive Spirometer, Meta-Neb, Ez-PAP, etc….	
Therapy procedures and potential outcomes discussed:	

THERAPY EDUCATION SCORING:

Highly
Acceptable   Acceptable   Not Acceptable   Education Score: _______________

|-------------------|-----------------|-----------------|-----------------|---------------------|

5   4   3   2   1   0

____
____
____

REASONING SCORE:_______________________________

INSTRUCTOR NOTES:

Appendix G: Debriefing Discussion/Interview

A-DEBRIEFING DISCUSSION/INTERVIEW (student will complete immediately following either encounter):

1. How do you feel that went?

2. What portions were completed positively?

3. What portions could've been completed better?

4. Do you feel confident in your decisions?
   Respiratory Disease-

   Medications-

   Therapies-

5. How do you believe the patient and/or family responded to your education?

6. What assessments results stood out to you the most, as evident of the respiratory disease you decided upon?

7. *CLINICAL SETTING ONLY*: How do you feel the integrated simulation mannequin experience helped you with this live encounter of the respiratory disease?

B-DEBRIEFING DISCUSSION/INTERVIEW (after watching the video recording of the simulation encounter):

After watching your simulation mannequin encounter.

1. List 10 things that you did that were fundamental to your assessment.

2. List 3 things you noticed you didn’t do or didn’t do well in your opinion.

3. Was there anything from this encounter that you recall specifically one way, but observed it differently upon viewing?

4. How would you have altered your encounter after viewing the recording?