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Using Simulated Human Models in Radiologic Technology Education

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USING SIMULATED HUMAN MODELS

IN RADIOLOGIC TECHNOLOGY EDUCATION

by

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ABSTRACT

Using Simulated Human Models in Radiologic Technology Education

One of the challenges of modern medical schools is finding a way for students to practice their patient care skills before they interface with a live patient. Human simulated patients are realistic manikins that act like real patients in both sounds and actions. The technology these manikins offer needs to be supported by a well developed lesson plan that insures a student's transfer of learning. In this project, the researcher provides a scenario based lesson plan that allows the students to practice patient care skills safely, using simulated patients in a realistic environment. The use of such a curriculum allowed students to stop the simulation, ask questions, and receive immediate feedback from a qualified instructor. Also, it provides the students with the opportunity to improve their psychomotor skills since they are allowed as many repetitions as needed until basic skill levels have been attained.

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Chapter 1

INTRODUCTION

As Americans grow older, more and more so-called baby-boomers are beginning to take advantage of the excellent health care services that are available to them in the United States. However, many of these older Americans have found themselves without any kind of health insurance and are unable to make regular doctor visits. Regular or more frequent visits to the doctor could help some Americans remain healthier and possibly have better outcomes when confronted with serious diseases. Consequently, when these people do become sick, they tend to wait longer to go to the doctor or emergency room due to the prohibitive costs involved. Therefore, when these patients are admitted into a hospital, they show up with advanced stages of disease. New graduates from medical schools are expected to take care of these people on the first day of the job. This can be an intimidating situation for a new graduate to experience. To help relieve some of the anxiety new graduates experience, educators are trying to find ways to expose students to acutely ill patients while still in school. Perhaps if students could have a qualified instructor with them, they could experience this stress in a controlled and productive manner. One way to provide a realistic lesson is to use human patient simulators. Human patient simulators are realistic human shaped manikins that act like real patients in voice and actions. They have the sound of a heartbeat and respirations and they can react to students' care for them in a variety of ways. If the students provide poor care, the simulators can have an irregular heartbeat or stop breathing. This is just the type of training that Horan (2009) recommended to help to relieve some of the student's anxiety.

Statement of the Problem

There is no question the stakes are high in the healthcare environment where mistakes made by patient care givers can result in death or debilitated patients. When graduate students enter the healthcare field, they may not have had the opportunity to provide care for acutely ill patients. Regardless, upon their graduation, they are still responsible for a patient's immediate welfare. This immense amount of responsibility, without adequate training, can result in an increased amount of anxiety within the graduate student (Horan, 2009). Recently, researchers (Haskvitz & Koop, 2004; Horan, 2009; MacDowall, 2006) have found that the use of computerized human simulated patients in a realistic environment can provide a rich learning experience that allows the student to practice critical patient care without endangering a patient, which may reduce the anxiety of graduated students. To date, these simulated experiences have been used mostly for medical students and nurses (Domuracki, Moule, Owen, Kostandoff, & Plummer, 2009), but they have not been utilized in instruction for radiology technology. There is a need for a curriculum that will properly prepare Radiology Technology students for the pressures of critical patient care.

Purpose of the Project

The purpose of this project was to develop a scenario based curriculum which allows students to practice patient care skills safely with the use of simulated patients in a realistic environment. The use of such a curriculum will allow students to stop the simulation, ask questions, and receive immediate feedback from a qualified instructor.

Also, it provides the students with the opportunity to improve their psychomotor skills since they are allowed as many repetitions as needed until basic skill levels have been attained.

Chapter Summary

In this chapter, the author described the effect the aging population in the U.S. has on the healthcare system. People wait longer to go to the hospital and are in a poorer state of health when they are admitted. Newly hired healthcare workers may experience high levels of anxiety when they care for these very sick patients. Educators believe, if the students could be exposed to acutely ill patients during school, the additional training would ease the anxious feelings new hires experience. The use of human patient simulators provides a realistic patient for the students to practice on without the result of harm to someone. In Chapter 2, the author discusses the use of human patient simulators, based on current knowledge in the world of healthcare.

Chapter 2

REVIEW OF LITERATURE

A new tool for instruction is available to members of the healthcare education community, and it promises to prepare medical students better than ever. The tool is called a human patient simulator, and it combines state of the art computer technology with a realistic human form (Shiavento, 2009). These models are lifelike manikins, which have the ability to portray real human sickness, both in action and sounds. While artificial human models have been available for some time, they have not been able to speak, go into cardiac arrest, or vomit. At first glance, these models seem to be a great resource that may provide graduating medical students with better patient care skills, but they are only a tool for teaching. Teaching the use of the manikins is slowly evolving into an art form by itself. Across the country, many teachers use the models, which represent a substantial investment, even though there is little research to demonstrate their effectiveness (Alinier, Hunt, & Gordon, 2004). The purpose of this project was to examine some of the more important aspects of the proper use of human patient simulators and to develop lesson plans that can be used to obtain the most benefit for the students.

Definition of Simulation

According to Encarta World Dictionary (2009), one of the definitions of simulation is the reproduction of the essential features of something as an aid to studying, while a second definition describes a computer game that simulates a real activity such as flying. Both of these meanings can be applied to the modern day educational techniques of practice of an event before it happens. According to Schiavento (2009), simulation has been used throughout the ages as a training aid to advance the knowledge of students in many areas, even the military. This method of training allows students to experience situations in a safe environment and perfect their skills without cause of harm to the patient. Some of the newer simulators have begun to include the use of computers and multimedia to enhance the effect and add realism. Within the military, these realistic training sessions have been used to teach everything from fire rescue training to instructions on flying an airplane.

Also, members of the medical industry have found the use of simulation to be beneficial. According to Schiavento (2009), “the military and medical sciences have one need in common, which is safety" (p.390). Learning in a simulated scenario allows students to learn from mistakes and manage errors in a safe environment. Indeed, teachers in the medical sciences have long searched for a way to safely train students in the procedures of healing. Animals have been used extensively for this purpose and have helped surgeons to perfect their techniques before they were attempted on humans. Recently, however, animal experimentation has attracted negative attention from the public, and teachers have worked to find an acceptable alternative.

The use of human patient simulators may provide a safe and effective way for students to hone their patient care skills. These simulators are human like manikins that look and act like real humans in both sounds and actions. The first model was developed at the University of Southern California in the late 1960s, and it was termed Sim One (Good, 2003).

> The simulator had a heartbeat synchronized with temporal and carotid artery pulsations, a measurable blood pressure and spontaneous breathing. The eyes and mouth opened and closed, and through computer program control, the simulator responded to several intravenous anesthesia medications and to inhaled oxygen and nitrous oxide. Sim One was used to educationally help first year anesthesia residents learn the basic skill of intravenously inducing general anesthesia and performing endotracheal intubation. (p.14)

The residents who were trained with the simulator achieved proficiency with fewer trials and in less time than residents who learned exclusively in the operating room. Also, Good noted there appeared to be several noteworthy advantages of learning clinical skills with a patient simulator, which are still relevant today. They are: (a) a planned gradual increase in the difficulty of problems to be solved, (b) unlimited repetition, (c) immediate feedback, and (d) learners can proceed at their own pace.

In the mid 1980s, the faculty of the University of Florida teamed up with Stanford engineers to create an even more complex patient simulator (Good, 2003). This simulator was able to react in much greater detail and allowed senior anesthesiologists to practice rare or extremely complicated patient scenarios. Since that time, these universities have transferred their technology to corporations which continue to manufacture the simulators and make them available to other educational institutions.

It should be noted that, within the medical community, there are basically two types of patient simulators, low fidelity and high fidelity (Lee, Grantham, & Boyd, 2008). Fidelity can be defined as the closeness to realism of a simulation or simulator (Lee et al.). Low fidelity can be defined as a human-like model that does not possess any automatic or programmable functions, such as a rubber arm used to teach venipuncture, while high fidelity is described as a realistic human manikin that possesses extensive human like enhancements which are controlled by a computer. These high fidelity manikins have a heartbeat, pulse, respirations, as well as the capability to vomit or give birth to a baby manikin. Both the clinical and the technological aspects of the human patient simulators are continuing to advance and are now available in a pediatric and baby form. In addition, the computer hardware is more mobile, and the human patient simulators can now be transported to rural locations to provide training outside the hospital setting.

Creating a Quality Lesson Plan

According to Parker and Myrick (2009), "the widespread integration of technology-based educational tools into nursing curricula is raising concerns that technology rather than sound philosophically-based pedagogy is informing nursing education" (p. 322). Schiavento (2009) stated,

> The pursuit of safe patient care and therefore the need to acquire competence in modern medical training has fueled the development and implementation of educational techniques such as simulation, of which human patient simulators is but one application. In contrast, in nursing education, this progression does not seem to be as natural or as succinct. A cohesive ideology is lacking for the very existence of simulation in nursing education. (p. 390)

However, some educators who wanted to find new tools for teaching purchased this technology without much consideration about how they would use it. Several researchers (Horan, 2009; Parker & Myrick, 2009; Schiavento, 2009) now agree that more time needs to be spent on the initial set-up of the lesson to insure students receive a quality experience in order to allow them to internalize their learning. According to Parker and Myrick (2009), scenario based human patient simulator lessons are a powerful tool if properly utilized, but they are only a tool, and they require knowledge of pedagogical principles for proper implementation. In addition, the requisite pedagogy must also be appropriate for the latest generation of learners, such as the Millennial generation. Parker and Myrick described the needs of the Millennial generation as "requiring a pedagogy based on collaboration, familiarity with the process of learning, an increased participation in their own learning and increasingly realistic immersion. They prefer learning experiences that incorporate teamwork and collaboration" (p. 324). The teamwork concept has proven to be useful in hospitals where teams of professionals are needed to care for acutely ill patients. In addition, the Millennial generation is quite comfortable with technology, and they expect it to be part of their training. In fact, Parker and Myrick maintained that technology has had and will have a profound effect on the dissemination of information in the future. Millennial learners have shown themselves to be very comfortable with web-based and virtual reality environments, and they have adopted a type of learning termed, immersion learning, where they live through the experience and construct their own knowledge. Human patient simulators, with their multi-media enhancements, fit well into this scenario.

One of the pedagogical principles that appear to work well in healthcare simulation teaching is the behaviorist strategy. Behaviorist philosophy lends itself well to learning specific skills through repetition (Cohen, 1999, as cited in Parker & Myrick 2009). Many of the skills that medical students need are highly tuned psychomotor skills, which are combined with critical thinking skills to solve rapidly changing patient conditions. When faced with traumatic situations, healthcare staff need to rely on their internalized training to insure all steps are taken, in the proper order, to save lives. Also, immediate feedback and reinforcement of the learner's actions can be beneficial because it keeps the student from the internalization of incorrect behaviors. The students can repeat the lesson again until the desired skill is achieved. However, Parker and Myrick argued the use of repetition in the behaviorist strategy limits the learner's ability to think critically and problem solving becomes simply rote learning. The addition of in-class instruction can be useful in the provision of the theory needed and can fill in the blanks the students may have in regard to the clinical skills.

Another pedagogy worth considering is the constructivist approach to teaching and learning. According to Parker and Myrick (2009), constructivism differs from behaviorist pedagogy in that knowledge is not passed on from teacher to learner, but instead is created within the learner, which allows the student to use his or her own reasoning skills to achieve a desired goal. In this way, they can access information sources independently, think critically and develop their own resolutions. Also, constructionist theory may lend itself to "problem based learning" (p. 526) as described by Winston and Szarek (2005), whereby the students learn to critically think better when they are given a problem to solve in a lifelike situation. They can do this in small collaborative groups and arrive at solutions as they combine input from many areas. This type of learning would serve Millennial learners' needs for collaborative learning.

Scenario Based Lesson Plans

Whether a behaviorist or constructionist pedagogy is used, the question arises: how should the lessons be conducted? Researchers Alinier, Hunt, and Gordon (2004), Childs and Sepples (2006), MacDowall (2006), and Nagle, McHale, and French (2009) agreed the use of a scenario based curricula is the most effective way to teach in a simulated lab. A scenario is defined as an outline or model of an expected or supposed sequence of events (Dictionary.com, 2006). Thus, the educator writes a script for the student that includes a human patient simulator which experiences a traumatic event. The event may start as a routine experience for the student but may escalate into a traumatic event. The student would react based on his or her previous knowledge and skills to bring the patient to an acceptable end. According to Nagel et al., the ideal scenario: (a) is no longer than 40 minutes, (b) has no more than four students, and (c) has at least the same amount of time provided in a debriefing session. In the debriefing session, the instructor helps the students to understand the experience and to see how their actions affected the outcome of the scenario. The students have the opportunity to: (a) to critique themselves, (b) learn from their mistakes, and (c) thus internalize the lesson. The various methods of debriefing discussed by researchers ranged from watching video tapes of the exam, to round table discussions about the outcomes of the case (Nagle et al.). Scenarios can be set up in three ways: (a) use of a real human as an actor, (b) use of a real human for part of the study and a simulator for the remaining part, and (c) finally use a simulator for the entire lesson. Use of a real human actor as a patient has been a staple of medical schools for a long time, and in fact is still being used today. In these scenarios, the actor is given a set of instructions and symptoms and plays the part of a real patient. They act as if they are sick and complain of pain and discomfort; in time, they become agitated and present the student with new complications they must address. Usually, the student is briefed about the patient condition and must gather additional information from the patient. If the student does not ask the right questions, he or she may not obtain enough information to solve the problem. This type of simulation is very realistic except the student cannot perform any procedures on the patient and, thus, their psychomotor skills are not addressed. The second type of simulation setup is to use a real human actor for the first part of the exercise, and then use a low fidelity human patient simulator for the second part. In this scenario, the student asks the real patient about his or her medical condition, which helps the student to determine a course of action, and then proceeds to perform the operation on the manikin. This scenario is a nice blend of critical and deductive reasoning and the psychomotor skills of patient care. The actor provides the realism and, therefore, the intensity in this situation, and the use of the manikin allows the student to fail during a procedure without harm to the patient. The addition of an actor adds an expense piece to the lesson, as they are usually paid for their part. The third way to conduct a scenario based lesson is to use the new high fidelity human patient simulators exclusively. Since these manikins have an internal speaker within them, an instructor can speak to the student through the simulator, like a patient, and give the student the details needed to complete the exam. It is important for the student to gather proper information from the patient so he or she learns to sift through the extraneous information and direct the conversation to solution of the present situation. In these scenarios, an educator would be in another room to watch the student through a one-way mirror or on a video camera. The educator follows a given script and communicates directly to the student through the manikin's speaker as needed. Also, the instructor has the ability to program the reactions of the manikin in conjunction with the student's actions. For example, if the student does not recognize the patient has early signs of a cardiac arrest, the instructor can change the patient's heartbeat and respirations to force the student to react to new information. This scenario can progress to the point that the patient dies from the student's poor decisions and lack of information. Fortunately, the student can then be debriefed on his or her course of action, and the scenario can be played out again, as many times as needed. In follow up cases, the addition of an instructor in the room with the student can provide additional insight as to how to improve the results.

Testing the Effectiveness of the Scenario

In order to test the effectiveness of the scenario, educators can use surveys or tests to obtain the students' feedback, or a blend of both. Some of the researchers (Brannan & Bezanson, 2008; Euliano, 2001; Lee, Gantham, & Boyd, 2008; MacDowall, 2006) used the pretest/posttest design to obtain quantitative results, and surveys to collect qualitative results. Harden and Gleason (1979, as cited in Alinier et al., 2004) had students take a standardized test, such as the Objective Structured Clinical Examination (OSCE), to measure basic to advanced nursing skill levels, and the scores were recorded as a baseline score. Then half of the students went into the simulation lab, while half returned to the classroom and received the same information in the form of a lecture. The classroom students did not receive any additional simulation training. At the end of the test period, all of the nurse participants took the same OSCE test and their scores were recorded. The difference between the presimulation and postsimulation test scores showed the positive overall effect of the additional simulation training. Alinier et al. reported that the nurses who had completed the additional simulated training received higher scores than the ones who did not, sometimes by as much as double the percentage.

In addition to the skills tests, surveys were administered by Alinier et al. (2004) to learn about the students' perspectives of the benefits of simulator training. The two most frequent questions asked were: do you feel you have better skills and understanding in critical care nursing situations, and do you have more confidence in your ability to care for acutely ill patients? The response to the first question was in line with scores on the posttest, the majority of the students reported the use of the simulation lab enhanced their understanding of how to handle acutely ill patients. However, the response to the second question was surprising because the nursing students did not feel the exercise had improved their self-confidence, they still had a great deal of anxiety about working with real patients in the hospital (Brannan et al., 2008). Unable to explain these results, Brannan et al. surmised that, since the student levels of confidence were only measured from one context, either after traditional classroom learning or after the simulation scenarios, no immediate conclusion could be reached as to why they reported anxiety.

Setting Up the Lab Correctly

According to Schiavento (2009), numerous educators rushed to acquire the new technology of human patient simulated manikins; however, they ignored the environment in which they were to be used. Thus, the manikins became nothing more than expensive bed weights. This lack of environment demonstrated the importance of setting up a realistic lab to help the student internalize the experience. Several researchers (Brannan et al., 2008; Macdowall, 2006; Nagel et al., 2009; Winston & Szarek, 2005) agreed that there is value in setting up the simulation lab to be as realistic as possible. The best scenario would be an actual hospital room and bed, with a one way mirror on one wall, so both instructors and students alike could observe the participants. Full size adult simulated model would be in the bed so the students could hone their patient care skills from the bedside. As noted before, the patient simulator has an internal speaker from which an instructor can speak to the students and mimic a real patient's communication. This is an important feature because students retrieve their data from the patient as in real life. Parker and Myrick (2009) noted that, while the physical surrounding of the lab should be real or life like, the addition of extraneous items such as outside noises and interruptions can be a distraction to the student's learning and should be avoided. The students should be able to focus on the particular lesson at hand. One factor that researchers (Brannan et al.; Macdowall; Nagel et al.; Winston & Szarek) were in consensus about was the importance of having qualified instructors conduct the lessons. Poor quality instructors led to confusion and anxiety among the students. Thus, the substantial cost of hiring qualified instructors should be considered a mandatory cost of setting up a simulation lab.

Benefits of Simulated Training

One of the biggest advantages of the use of human patient simulators to train medical students in the critical care of patients is they allow the students to sharpen their psychomotor skills in a safe environment. The student may stop when confused and clarify a course of action. While Harlow and Sportsman (2007) agreed this is indeed a benefit, they feel this can be done as well with a low fidelity patient model. This is especially true for mundane tasks such as starting an IV. Other researchers (Childs & Sepples, 2006; and Doumuracki, Moule, Owen, Kostandoff, & Plummer, 2008; Haskvitz & Koop, 2004; Horan, 2009) maintained that the addition of simulated body functions adds the proper dimension of realism and forces the students to think critically as they react to a patient that is on the verge of dying. The students may stop or fail the exercise without causing harm to a real patient, which allows them to correct their mistakes and try it again until it can be performed it correctly (Euliano, 2001; Good, 2003). The use of behaviorist and constructivist approaches can produce a student who can critically think through each exam and react correctly when the conditions are different (Parker & Myrick, 2009). Davis, Soltani, and Wilkins (2009) noted another advantage of simulation training is the opportunity for a student to experience rare or unusual patient conditions, such as breech presentations in obstetric procedures. Domuracki et al. (2008), and Haskvitz and Koop (2004) noted another advantage, that is, students who need remedial education could benefit from one-on-one time in the lab with an instructor and an interactive patient. The extra time to practice would sharpen their psychomotor skills and help to relieve some of the performance anxiety experienced by students. Haskvitz and Koop identified three things that must be in place before remedial education can have a benefit: (a) the clinical task or objective to be remediated must be one that is amenable to simulation; (b) the goals of remedial simulation work must be clear, measurable, and defined; and (c) the students must have the desire and capacity to change.

The final benefit recognized is that use of human patient simulators can take the place of animal experiments. According to Shiavento (2009), animal anatomical study was used as far back as Galen (129-200 C.E.) and is still used to this day, despite the public's growing opposition to such actions. Doumuracki et al. (2009) noted that the quality of the human patient simulators, which are designed for airway management in anesthesia education, are now so close to real human tissue, that they have become the standard training instrument for new medical students.

Disadvantages of Simulated Training

To obtain a complete picture of human patient simulator training curriculum, one must be aware of the disadvantages of this type of training. According to researchers (Good, 2003; Harlow & Sportsman, 2007; Lee et al., 2008; Schiavento, 2009), one of the major considerations in the use of high fidelity human simulation is the prohibitive cost of the manikins, which are $40,000-$70,000 each. In addition to this cost, the price of the software that operates the manikin can be another $40,000 to $70,000. This cost alone has prevented many teachers from even attempting the endeavor. Another substantial cost frequently overlooked is the need for full time trained faculty to set up and run the labs. Since the administrators of many schools have had to trim costs to remain profitable, it can be difficult to justify the expense of the extra staffing (Alinier et al., 2004). In contrast, Shiavento (2009) maintained that the high cost is not justified, and low fidelity models, which are far less expensive, perform just as well. Currently, educators are still looking for reliable information about whether the benefits justify the costs. Other than company propaganda, there are very few studies that address this concern. One researcher, Alinier et al. provided a high quality analysis to demonstrate the use of simulation does improve the critical thinking skills of graduating nurses, and the benefits do justify the costs.

Future of Simulated Learning

Good (2003) noted that, although simulated learning is not a new concept, the addition of high fidelity technology is. Medical educators now have another tool that can provide the student with an enhanced learning environment that adds a new level of realism, which has never been achieved previously. One exciting aspect of the human patient simulator is the transportability of the units. Instead of having students come to the college for training, the college can go to the students. The worldwide medical community includes many people, in many locations, who could benefit from this advanced training. As an example, mid-wives in third world countries could use the simulators to practice the delivery of complicated births and possibly reduce the infant mortality rate. Still another technology that continues to be enhanced is the ability to inject drugs into the manikin and watch the proper human reaction to an overdose of medication. Students could observe the results without harming a real patient. In addition, pediatric and infant manikins are now being produced to help students learn about the special needs in caring for these patients.

Conclusion

The mere presence of human patient simulators does not add value to medical education. Fundamental teaching principles must be used to make the experience beneficial to the student and ultimately to the patient. According to Schiavento (2009), "the current challenge in nursing education is not the integration of the human patient stimulator in nursing curriculum but rather the recentralization of simulation as a teaching tool encompassing varied methods and a wealth of applications throughout the pre-nursing and nursing curricula" (p.392).

The addition of simulators to traditional methods of teaching creates a whole new experience for the student, one that members of the Millennial generation will value. This research shows that the members of medical education communities value simulated learning environments and are ready to include them in their curricula. Currently, more than one third of all medical schools in the United States use the simulated manikins (Good, 2003). The technology is here to stay; now it needs to be used more effectively.

Chapter Summary

A new teaching tool has emerged in the healthcare education arena and has generated much excitement among teachers and students alike. Human patient simulators are high fidelity manikins which are able to mimic real patients in sounds and actions. The administrators of many educational institutions are considering whether they should be adding this teaching aid to their curriculum. The manikins cost around $40,000-$70,000 and represent a sizable investment for a medical school. Educators want to know whether the benefits of realistic patient simulators justify the high costs. As noted in this chapter, in general, researchers feel like the manikins are a worthwhile investment. However, they caution that teachers should spend more time building a well thought out lesson plan which uses proven pedagogical methods. Also, the researchers feel there is a great deal of existing adult learning science not being used. In this literature review, the author discussed several ways to build a simulation lesson that respects adult learning techniques while allowing the student to build critical thinking skills. Also, there are specific details about how the lab should be set up to gain maximum student benefit. In Chapter 3, this author identifies the target audience, which is a radiology school, organization of the project, and a peer assessment plan.

Chapter 3

METHOD

The new human patient simulators are designed for medical students in all disciplines. When they were first developed, they were tested extensively with medical students as a way to connect theory and practice. Since their induction in the mid 1960s, human patient simulators have shown their usefulness in other areas of medicine, such as nursing, respiratory therapy, and radiology technology. In fact, anywhere that training in hands on patient care is required, simulators can be helpful. The purpose of this project was to develop a scenario based curriculum which allowed students to practice patient care skills safely, using high fidelity simulated patients in a realistic environment. The use of such a curriculum allows students to stop the simulation, ask questions, and receive immediate feedback from a qualified instructor. Also, it provides the students with the opportunity to improve their psychomotor skills, since they are allowed as many repetitions as needed until basic skill levels have been attained.

Target Audience

This curriculum is intended to be used within a radiologic technology school. Radiologic technologists are healthcare professionals who work directly with patients to create the images the doctors need to diagnose disease. They are not medical doctors, and they do not have the extensive training of a radiologist. Their training consists of: (a) human anatomy, (b) patient positioning, (c) patient care, (d) imaging science, and (e) radiation physics. The training program for radiologic technologists is 6 semesters or 24 months long, and they must pass a national test when the program is completed. The ideal participants for this project are radiologic technology students who are enrolled in their 3rd or 6th semester of a two year program. These semesters represent the end of the first year and the end of the second year of the program; these are excellent times for the students to check their skill levels in patient care.

Organization of the Project

This curriculum is designed to help a radiologic technology educator set up a simulation lab that includes a lesson plan based on sound teaching principles. It provides specific information as to: (a) the objectives of the lesson, (b) the resources and materials needed, (c) the lesson sequences and activities, and (d) the assessment of the lesson. This author assumes the educator has access to the high fidelity human patient simulators already, either at their facility or at another shared facility.

Peer Assessment Plan

After completion of this curriculum, the author invited three peers to provide informal feedback. These peers consisted of two nursing educators and one radiology educator. They were asked for informal and verbal recommendations with regard to additions or deletions to the curriculum. Their feedback is discussed in Chapter 5.

Chapter Summary

Summarized in this chapter is a description of the target audience, which is radiology educators, and the training requirements of a radiology student. Also included is the details of a curriculum designed for use in a radiologic technology school. The author specifically addresses the use of human patient simulators in the teaching of critical patient care. The curriculum is presented in Chapter 4.

Chapter 4

RESULTS

Introduction

Previous research suggests that scenario based training can be a benefit to medical students who need to gain experience in psychomotor skills that require critical thinking. An effective lesson plan to educate radiology students on assessing patient's vital signs should include these elements. The use of a human simulated patient works well in this situation, as the students can hone their skills without harming a patient. The ideal lesson plan for this class would include a classroom segment as well as a hands on laboratory segment. The classroom segment would give the students the information they need to understand the data, and the laboratory portion perfects their skills in the collection of that data. The human simulated patients allow the instructor to speak to the student through an internal speaker, and to change the patient's vital signs when needed. In this manner, students would gather all of their data from the patient, much like a regular technologist. Also, working with a simulated patient will help students transfer their skills to a live patient, as the interactions and movements will be close to the same. The following paragraphs describe a two part lesson that prepares the student for interaction with real patients. Lesson 1 describes the classroom portion of the exercise where the students learn the skills of collecting vital signs, and how to interpret this information. Next, lesson 2 gives details about the hands on laboratory assignment and the expectations of the instructor.

Lesson Plan One - The Classroom

Learning Vital Signs

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Title:	Radiologic Technology Education Part 1: Learning Vital Signs.		
Content Area: Patient Care		Grade: First Year Students	Duration: 1 class period or 60 minutes
Standards and Benchmarks:	ASRT (American Society of Radiologic Technologists) curriculum guide (2007). Patient Care section IA., evaluating physical needs; Section IB., Vital signs - ranges and values; Section IC, Acquiring and recording vital signs.		
Objectives:	Upon completion of the lesson, the student will be able to: • Define the 3 components included in patient's vital signs (Knowledge). • List the ranges of normal vital signs (Knowledge) • Demonstrate how to properly collect patient vital signs (Application). • Discuss the implications of abnormal vital sign values on a patient's health (Comprehension). • Summarize the role radiographers' play when a patient's vital signs are abnormal (Comprehension, Evaluation).		
Resources and Materials:	• Textbook: Introduction to Radiologic Sciences and Patient Care, Chapter 15, Vital signs, oxygen, chest tubes, and lines (Moore, 2007). • Dual earpiece stethoscope ensuring that both the student and the instructor can hear a heartbeat, systolic and diastolic numeric, when taking blood pressures. • Blood pressure cuff. • Watch or clock to time respirations and pulse rate. • Handout of normal vital sign ranges for adults and pediatrics (see Appendix A).		
Differentiation:	• Various sizes of blood pressure cuffs, appropriate to different arm sizes. • Amplified stethoscope available for the hearing impaired. • Paper cup to place on patient's chest to watch inspiration and expiration and time respirations.		
Preparing Students for the Lesson: • Transitions • Expected	• Students will listen to the lecture at their desks, and then break up into pairs to determine vital signs. • Students are expected to maintain a quiet environment so as not to disturb others who are taking vital signs and		

Behaviors	follow the directions given by the instructor.
Teaching the Lesson (Lesson Sequence/ Activities): • Motivation/ Anticipatory Set • Pre-Assessment/ Activating Background Knowledge • Teacher Input, Modeling, & Checking for Understanding • Guided Practice • Independent Practice • Closure	Present the following scenario to the students at the beginning of class: As an x-ray technologist, you have an order to perform a chest x-ray of a patient in the radiology department. Upon entering the exam room, you notice immediately that the patient has a gray skin pallor. You initiate conversation with the patient, but the patient only mumbles back to you. You feel something is wrong with the patient. How do you determine what is wrong and if you should call for help? Spend 5 minutes taking suggestions from the class on how to determine what should be done. Write answers on the board. <u>Essential Question</u>: What are some quick measurements of a patient's status we could use to determine if the patient is well enough to perform the x-ray exam, or if we should call for help? List the student's ideas on the board, placing special emphasis on the term- vital signs. <u>Input:</u> 1. Explain to the students they may only have a few minutes to determine if a patient is healthy enough to proceed with the x-ray. 2. Discuss some of the ways they suggested on the board to quickly determine the health of the patient. 3. State that the universal way to quickly determine a patient's health is assess his/her vital signs. 4. Describe what vital signs are and what they measure. 5. List the normal ranges for a patient's vital signs. 6. State what happens to a patient when their vital signs are outside of the normal ranges. 7. Tell the students who they should call for help if a patient's vital signs are out of the normal ranges. <u>Modeling:</u> Demonstrate the proper way to collect vital signs on a volunteer student using the actual equipment. <u>Independent Practice:</u> Have the students get into pairs and practice taking vital signs on each other. The students will be using a dual earpiece stethoscope so the instructor can hear when the student determines the

	patient's heartbeat. The students will then switch roles, and the other student will determine vital signs. Check for Understanding: The instructor will assess the student's ability to correctly acquire vital signs by listening and watching them perform the task on each other. Closure: Have the students return to their assigned seats. Discuss with the class the importance of using vital signs to make quick decisions. Ask the class if there are any questions about how to take vital signs, or who to call if they need help.
Assessment:	A quiz will be given to the students to measure comprehension (see Appendix B). Using the answer key (see Appendix C) a score of 80% or greater will signify adequate retention. Students who score lower than 80% will meet with their instructor to review the material before proceeding to lab portion of the class.
Notes & Reflections:	1. Were the objectives all met? 2. Do the students appreciate the importance of using vital signs to determine a patient's health? 3. Make sure to move around to each pair to answer questions during the guided practice. 4. Ensure the students know when and how to call for help with a distressed patient.

Lesson Plan 2 - The Laboratory

Learning Vital Signs

Name: L. Scott Smith

<table>
<tr><td>Title:</td><td colspan="3">Radiologic Technology: Learning Vital Signs Part 2; Lab Assignment</td></tr>
<tr><td colspan="2">Content Area: Patient Care</td><td>Grade: First Year Students</td><td>Duration: 1 class period or 60 minutes.</td></tr>
<tr><td>Standards and Benchmarks:</td><td colspan="3">ASRT (American Society of Radiologic Technologists) curriculum guide (2007).
Patient Care section IA., evaluating physical needs; Section IB., Vital signs - ranges and values; Section IC, Acquiring and recording vital signs.</td></tr>
<tr><td>Objectives:</td><td colspan="3">Upon completion of the lesson, the student will be able to:
• Assess a patients overall condition upon arrival by appearance and interaction (Evaluation).
• Demonstrate accurate obtainment of vital signs (Application).
• Interpret the vital sign measurements to determine if the patient needs immediate assistance (Application).
• Demonstrate a method for getting help by calling the medical emergency team, or a code blue (Application).</td></tr>
<tr><td>Resources and Materials:</td><td colspan="3">• Reference textbook: Introduction to Radiologic Sciences and Patient Care, Chapter 15, Vital signs, oxygen, chest tubes, and lines. (Moore, 2007)
• Stethoscope.
• Blood pressure cuff.
• Clock or watch to time pulse and respiration rate.
• Handout of normal vital sign ranges for adults and pediatrics (given to student in classroom portion of lesson).
• High fidelity human simulated manikin present in radiology exam room.
• Proper computer equipment needed to operate manikin.</td></tr>
<tr><td>Differentiation:</td><td colspan="3">• Students will be allowed to have their book and handouts with them to review the class information <u>prior</u> to the laboratory session.
• Amplified stethoscope for the hearing impaired.
• Various sizes of blood pressure cuffs, appropriate to different arm sizes.</td></tr>
</table>

Preparing Students for the Lesson: • Transitions • Expected Behaviors	• Students are expected to treat the simulated patient as a real patient at all times. • Students should only speak to the manikin to gain information. • Students should not discuss their lab experience with other students until the debriefing session at the end of the lab.
Teaching the Lesson (Lesson Sequence/ Activities): • Motivation/ Anticipatory Set • Pre-Assessment/ Activating Background Knowledge • Teacher Input, Modeling, & Checking for Understanding • Guided Practice • Independent Practice • Closure	Present the following scenario to the students at the beginning of lab: As an x-ray technologist, you have an order to perform a chest x-ray of a patient in the radiology department. Upon entering the patient's room you notice immediately that the patient has a gray pallor to their skin. You initiate conversation with the patient, but the patient only mumbles back to you. You feel that something is wrong with the patient. You must determine if the patient needs help collecting vital signs. You must interpret the results and determine if you should call for help or continue to take the x-ray. Essential Question: What range of vital sign values is acceptable to continue on with the exam, and who does the student call for help if they are not? Input: The students will receive all of their information from the speaker inside the simulated human patient. The patient's voice will be that of the instructor in the control room directly next to the simulated patient's room. The simulated patient has the technology to allow the students to collect vital signs in the normal fashion with standard blood pressure cuffs and stethoscopes. The instructor has the ability to change the manikins vital signs as needed to challenge the students. Independent Practice: Have the students get into pairs and enter the simulated lab. They will acknowledge the patient and decide if the patient is well enough to proceed. The students may collaborate on their decision as they will both gather vital signs and compare results before making a decision to proceed. Check for Understanding: The instructor will assess the students ability to correctly assess vital signs by listening and watching them perform the task on the manikin.

	<u>Closure:</u> After each of the students has completed a session with the human patient simulator, they will meet in the classroom for a debriefing. The instructor will lead the discussion by asking the following open ended questions: 1. What was your first indication of the status of the patient's health status? 2. What were the values of your patient's vital signs? Were they normal or abnormal? 3. How confident were you in the quality of your data? 4. Did your partner have the same values as you? If not, why did it differ? 5. How many times did you attempt to collect vital signs before you were sure about the results? 6. How did you feel when you entered the room to take the x-ray? 7. How confident would you be telling a medical emergency team the results of your measurements? 8. What would you do different in the future? 9. Do you feel more confident in your ability to handle a distressed patient?
Assessment:	Correct assessment of the patient's vital signs will be shown by the student either calling for help or by continuing to take the x-ray. The instructor will have the correct values in the control room.
Notes & Reflections:	1. Were the objectives all met? 2. Does the student appreciate the importance of using vital signs to determine a patient's health? 3. Did the exercise increase the student's confidence in working with distressed patients?

Chapter Summary

The use of scenario based training provides an exceptional method to blending critical thinking and psychomotor skills in radiologic technology training. In this chapter, the author presented a two part lesson plan that outlines one 60 minute classroom session, and one 60 minute laboratory session. This lesson plan provides a radiologic technology instructor with a well defined method of teaching the class and determining the retention of the students. In Chapter 5 the author provides further discussion on the value of this project, including suggestions from other educators in the healthcare field.

Chapter 5

DISCUSSION

Current research indicates that medical students' critical thinking skills are enhanced when used in a scenario based lesson. Using the scenario method forces the students to apply previous knowledge to present situations. This is critical because healthcare workers are required to do this everyday on real patients. If the healthcare worker makes a mistake, the patient can suffer or even die. The anticipation of making a mistake of this magnitude is a source of great anxiety for medical students. One method of reducing this anxiety is to use simulated human models. They can provide a safe atmosphere in which students can critically think through the exam, and even make mistakes without harming a patient. Also, the simulated patients allow the students to practice as many times as they want, which enhances their psychomotor skills. These enhanced psychomotor skills should translate into better patient care on a real patient.

Contribution of this Project

Many of the medical students now in school are from the Millennial generation. Parker and Myrick (2009) described this generation of learners as "requiring a pedagogy based on collaboration, familiarity with the process of learning, an increased participation in their own learning and increasingly realistic immersion" (p.324). The scenario based lesson plan provides exposure to all of these areas. More importantly, it has the potential to save lives in the hospital setting when school graduates begin taking care of real patients.

Limitations

The major limitation to this lesson plan is that an instructor must have access to simulated human patient models. As stated in Chapter 2, there is a substantial cost involved when adding the realism these models provide. At the time of this writing, these models cost upwards of $70,000 each, and this cost can be prohibitive for smaller medical schools to justify. Another limitation may be acquiring properly trained instructors who are able to teach the class. This is due to the fact that the human patient simulators use technologically advanced software which requires moderate to advanced computer skills. Although these limitations can be significant, current research states the cost is justified. Most importantly, they allow a safe environment for students to practice patient care skills without harming a real patient.

Peer Assessment Results

This scenario based lesson plan was presented to three colleagues for their general review. All three individuals are healthcare educators, two in nursing, and one in radiology. In addition, one of the nurse educators is in charge of the simulated laboratory within the hospital. All three showed enthusiasm for the project and agreed that there was a need for a project of this type. All three educators liked the idea of using the human simulated manikins for the project, creating a safe way to educate students without bringing harm to patients.

The nurse educator liked the idea of teaching concepts in the classroom, and then practicing on the manikin to transfer learning. She felt the exercise would benefit staff radiographers as well. The nurse in charge of the simulation lab provided additional details regarding the debriefing sessions that followed the exercise. Her suggestion was to debrief each of the students as soon as they were done with the exercise to achieve maximum effect. She also suggested that the simulated patient be brought to a radiology room instead of the simulation lab to provide the most realistic scenario possible. She thought the chosen scenario would work and should provide a good learning experience.

The radiology educator liked the fact that students were allowed to practice under direct supervision until they mastered their psychomotor skills. She also liked the idea of teaching the concepts in a classroom and then moving to the lab for demonstration, repetition, rehearsal, and review of the procedure. Some of the radiology educator's concerns included questions about what would happen if the simulator model didn't operate correctly, and how many times the students were allowed to practice before they received additional help.

Overall the educators were pleased with the idea of the project and wanted to move forward with its implementation. The radiology instructor stated that she had been looking for a way to use the simulation lab to enhance the learning of the students. She had noticed that the new students entering x-ray school were very comfortable with technology and even expected it to be part of their training. As a future project, the radiology instructor mentioned that it would be beneficial to have some objectives related to the affective domain of healthcare training. She felt that the affective area of healthcare was frequently ignored, but extremely important.

Recommendations for Further Development

This researcher believes many other patient care scenarios could be developed for other areas of healthcare such as radiology, respiratory therapy, and the operating room. All of these areas require using expert psychomotor skills and critical thinking skills at the same time. Also, since the human patient simulators speak, there may be an opportunity to practice care for individuals who speak other languages and need interpreters. Additional practice benefits technologists and patients alike as the stakes for failure are high.

Project Summary

The purpose of this project was to develop a scenario based curriculum which allowed radiology students to practice patient care skills safely using simulated patients in a realistic environment. An important aspect of this lesson was to introduce the students to a formal lesson plan that provided a structured approach upon which their classroom knowledge could transfer to the clinic. The use of such a curriculum allowed students to stop the simulation, ask questions, and receive immediate feedback from a qualified instructor. Also, it provided the students with the opportunity to improve their psychomotor skills since they were allowed as many repetitions as needed until basic skill levels had been attained. The intention of using the human patient simulators was to provide a bridge to interacting with real patients in the hospital. The repeated skills practice should help to relieve the performance anxiety that is common to new graduates during the first year of their job.

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APPENDIX A

Vital Signs Handout.

Vital Signs Handout

Vital signs as an indicator of pt. status: T, P, RR, and BP are parameters that indicate the status of human functions essential for life; monitoring VS helps evaluate life-threatening conditions, patient's response to therapy and patient's general status.

Temperature: a stable temperature pattern promotes proper function of cells, tissues, and organs; as warm-blooded animals, we function best within a narrow range of temperature

Thermoregulation: the body's thermostat, located in the hypothalamus; way body maintains, generates and loses heat

Measurement:
1. oral: under tongue, good for adults and cooperative children, not babies
2. axillary: in axilla, not as accurate, used for children and babies
3. tympanic: in ear, very fast, great for children and babies, make sure instrument is properly calibrated
4. rectal: most accurate, least preferred

Normal Range: 97.7-99.5F (36.5-37.5C) Axillary/Rectal lower/higher ~ one degree

Significance of abnormalities:
1. Hyperthermia: pyrexia, febrile >99.5F, heat produced due to cellular metabolism or infection; body's initial healing ie: after surgery; pt. may be confused, dizzy or comatose; MIs increase cellular activity; CVAs, cerebral edema, tumor, trauma can cause damage to hypothalamus and cause problems
2. Hypothermia: can be medically caused, ie: OR anesthesia or exposure; babies are less able to maintain their temp so be careful

Respirations: gives general impression of resp functions; look at depth, pattern (reg/irreg), rate

Measurement: observe movement of chest/abd, rise/fall; if very shallow, can put hand on pts' chest but best if pt unaware you are counting

Normal Range: adults:12-20/minute, children: 20-30/minute; can count for 30sec. and multiply by 2, if irregular count for 60 sec.

Significance of abnormalities:
1. Tachypnea: RR>20; may be due to exercise, fever, anxiety, pain, infection, heart failure, chest trauma, CNS disease

2. Bradypnea: RR<12; due to depression of resp. system, ie: drug OD, hypothermia; watch sedated pts. carefully
3. Apnea: ominous sign; no breathing

Pulse: fluid wave created from the flow of blood thru arteries

Measurement: use you fingers, not your thumb as it has its own pulse you can feel; count for 30sec. and multiply by 2; counting for 60 sec. is most accurate and may detect irregularities easier; some irregularities are dangerous so let MD know if pt. c/o palpitations, dizziness or feeling faint when you let him know about irreg.; can get rate from pulse ox, A-line, or EKG machine

Sites:

1. radial:inner wrist
2. brachial:inner elbow; use with infants
3. carotid:neck groove; use if suspect cardiac arrest or if radial is weak
4. apical:apex of heart, need stethoscope to check

Normal values: 60-100bpm for adults; children (<10 yrs old) 75-120bpm

Monitoring:

1. Pulse oximeter: converts light intensity into O2 saturation and pulse; non-invasive; gives an ongoing assessment of O2 sat in arterial blood; pt. movement, misplaced probes, decreased perfusion and nail polish can cause false readings; normal is 90% for adults at altitude

Significance of abnormalities

1. Tachycardia: resting heart rate >100 or 20bpm above normal for pt., may be due to exercise, med., fever, anemia, resp. disorders, CHF, shock, pain, anger, fear, anxiety
2. Bradycardia: resting heart rate <60, may be due to meds, heart problems, end-stage shock; some people who are athletic have heart rate <60 so know your pt.
3. Asystole: no pulse, either heart has stopped or the artery is blocked
4. If radial pulse is weak, check the apical pulse

Blood Pressure: obtained with sphygmomanometer & stethoscope

1. Inflate above the systolic pressure to stop blood flow ~180 then release slowly with pt. arm at heart level
2. 1st sound is systolic; when no longer hear sound is diastolic

Measurement: measures the force exerted by blood on the arterial walls during contraction/relaxation of heart

1. Diastolic: the constant pressure on vessel when heart is relaxed
2. Systolic: peak pressure when heart is contracting

Normal range: 95/60 – 140/90

Significance of abnormalities:

1. Hypertension: persistent elevation above 140/90; increases the work load of the heart and can cause gradual damage; pt. may complain of headache; needs to be treated; some causes: dx, stress, meds, obesity, smoking

Hypotension: BP<95/60; if pt. is healthy and has no c/o, it's okay; it pt. c/o dizziness, confusion, blurred vision, needs to be evaluated; may be caused by meds, shock, orthostatic hypotension; go slow at getting pt. up from lying position especially if have been down for a time

APPENDIX B

Vital Signs Quiz

Vital Signs Quiz

Define the following:

1. Systolic blood pressure

2. Respiration

3. Tachycardia

Multiple choice:

4. The normal range of breathes per minute in an adult is:

    a. 20-30

    b. 12-20

    c. 5-15

    d. 15-25

5. Monitoring vital signs help evaluate:

    a. life-threatening conditions

    b. patient's general status

    c. patient's response to therapy

    d. all of the above

6. The first priority when working with an unconscious patient who is not breathing is:

a. splint the fracture

b. take vital signs

c. control bleeding

d. establish an open airway

7. What is the range for blood pressure keeping in mind hypo/hypertension?

True or false:

8. ______Respirations should be counted for at least 30 seconds.

9. ______Blood pressure should be taken with the patient's arm below heart level.

10. _____The normal heart rate is 60-100 beats per minute.

APPENDIX C

Vital Signs Quiz Answer Key

Vital Signs Quiz Answer Key

Define the following:

1. Systolic blood pressure: Peak pressure when heart is contracting.

2. Respiration: The act of the patient breathing in or out.

3. Tachycardia: Resting heart rate > 100 or 20 bpm above normal for patient may be due to exercise, medications, fever, anemia, respiratory disorders, congestive heart failure, shock, pain, anger, fear or anxiety.

Multiple choice:

4. The normal range of breathes per minute in an adult is:

   a. 20-30

   <u>**b. 12-20**</u>

   c. 5-15

   d. 15-25

5. Monitoring vital signs help evaluate:

   a. life-threatening conditions

   b. patient's general status

   c. patient's response to therapy

   <u>**d. all of the above**</u>

6. The first priority when working with an unconscious patient who is not breathing is:

a. splint the fracture

b. take vital signs

c. control bleeding

d. establish an open airway

7. What is the range for blood pressure keeping in mind hypo/hypertension?

The normal range for blood pressure is 95/60 (hypotension) - 140/90 (hypertension).

True or false:

8. ___T___Respirations should be counted for at least 30 seconds.

9. ___F___Blood pressure should be taken with the patient's arm below heart level.

10. __T___The normal heart rate is 60-100 beats per minute.

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