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Designing high fidelity simulation to maximize student registered nursing decision-making ability

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DESIGNING HIGH FIDELITY SIMULATION TO MAXIMIZE STUDENT REGISTERED NURSING DECISION-MAKING ABILITY

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DEDICATION

You don't understand anything until you learn it more than one way.

~Marvin Minsky

Education is what remains after one has forgotten what one has learned in school.

~Albert Einstein

That one is learned who has reduced his learning to practice.

~Proverbs

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VITA

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ABSTRACT

The current healthcare environment is a complex system of patients, procedures, and equipment that strives to deliver safe and effective medical care. High fidelity simulation provides healthcare educators with a tool to create safety conscious practitioners utilizing an environment that replicates practice without risk to patients. Using HFS learning opportunities to refine a learner's clinical decision-making skills under time pressure and high stakes outcomes could provide new opportunities for training the healthcare workforce of the future.

This design based research project explored how to structure HFS training to facilitate the development of decision-making in second semester Registered Nursing learners. Borrowing from the research base of aviation and the military, a framework of Situation Awareness was used to define decision-making skills. Using a naturalistic decision-making approach, the research sought to understand how the design of the HFS learning event impacted the ability of participants to demonstrate behaviors of Situation Awareness.

Findings of this study demonstrated that design based research is a powerful tool to create a rich understanding of the high fidelity simulation learning experience. The results also supported the work of Jeffries (2005) reiterating that HFS simulation design must be created using strong pedagogical principles that support specific learning outcomes. Particular attention should be focused on maintenance of fidelity, understanding complexity and scaffolding learning opportunities through a multi-phased

approach that minimally includes debriefing. The research related to this small group suggests that the briefing stage of HFS learning should be further explored for its influence on learning in HFS. The influence of the facilitator/faculty on the HFS was emphasized in this research suggesting that faculty development would be important for use of this new tool. Additional implications of the research suggest that high fidelity simulation has a role in team training and development of communication skills.

Chapter 1: Introduction

Improving Nurses' Decision-Making Using High Fidelity Simulation

The current healthcare environment has evolved into a complex system of patients, procedures, and equipment as it strives to deliver safe, efficient and effective medical care. This complexity of care is embedded within a resource scarce environment that creates pressure toward achieving our "ideal" of healthcare delivery. Healthcare educators are under intense pressure to produce caregivers that can adapt quickly to the practice environment. Governmental regulators such as the Joint Commission of Accreditation of Hospitals (JCAHO), Medicare, and the Board of Registered Nursing (BRN) are universally concerned with monitoring for safe practitioners.

The majority of nursing education traditionally takes place within the acute hospital. This environment presents unique challenges for educators to overcome while indoctrinating new professionals into practice. The embedded challenges of patient safety, managing complex patients, and the nursing shortage have potential to negatively impact the learner's ability to assimilate into the role of professional nurse.

Error Reduction

Patient safety is the ultimate goal of health care training requiring that practitioners are able to manage multiple tasks with competing priorities within a narrow margin of error. In 1999, the Institute of Medicine (IOM) issued a report that shocked the nation by indicating that between 44,000-98,000 people die annually as a result of medical errors during hospitalization. This staggering statistic did not include nor explore morbidity of those that survive these errors (IOM, 2004). System issues such as shortened lengths of stay, communication breakdowns between healthcare providers and a culture that spends little time and education focusing on the prevention of errors were identified as key areas for reform.

Other studies have identified the integral role that the Registered Nurse (RN) plays in maintaining patient safety (IOM, 2001, 2004). The RN's ability to prevent errors depends upon his/her ability to recognize changes and the need to alter the plan of care in a timely manner. Aviation studies have demonstrated that the ability to maintain accurate situation awareness is critical to the quality of decision-making that ultimately impacts safety (Rodgers, Mogford, & Strauch, 2000). Training needs to highlight strategies that augment the nurse's ability to assess and reprioritize in order to improve patient safety outcomes within the hospital.

Given the new patient safety atmosphere since the landmark "To Err is Human report" (IOM, 1999), the old paradigm of learning on patients by "trial and error" through an apprenticeship model must be re-examined. Heightened consumerism requires that health care educators must consider the ethical limitations of using "real" patients as a primary mode of practice for skill acquisition (IOM, 2001). Evidence shows that technical and psychomotor competency can be improved using high fidelity simulation (Eaves & Flagg, 2001; Issenberg et al., 1999; McGaghie, Issenberg, Petrusa, & Scalese, 2006).

Complex Patients

The complexity of patients is a major factor impacting the training of nursing students in today's hospitals. By the year 2020 the population will increase by 9.8 million, with 6.3 million in the age group of 65 years or older (IOM, 2008). This population will consume a larger portion of the healthcare resources; specifically hospitalization because of their predisposition to multiple chronic diseases.

The current apprenticeship model used for healthcare training does not provide all learners with equal opportunity for developing critical thinking skills and expertise related to the inconsistent nature of practice-based learning (Scalese, Obeseo & Issenberg, 2007). It is imperative that education for nursing includes opportunities to practice on complex, high risk, and low frequency patient types to be able to transition safely into nursing practice. A nursing workforce that has the capacity to integrate knowledge and expertise into clinical practice is needed. The Commission on Collegiate Nursing Education (1998) recommended the use of simulation to expand clinical capacity in light of diminishing instructor and training site resources in hope of improving access and leveling educational opportunities for students.

The Nursing Shortage

Lastly, the nursing shortage has forced nursing schools to increase their enrollment in order to meet the nation's growing need for nurses (California Nurse Education Initiative [CNEI], 2006). California ranks 50th, as the state with the worst shortage, with a projected shortage of 47, 6000 RN’s by 2010 and 116,600 by 2020. This has also negatively affected the availability of qualified nursing instructors. The Board of Registered Nursing (BRN) has recognized this crisis and has responded by allowing learning to take place in non-traditional ways.

Call to Action

Governmental regulators, such as the Healthcare Professions Education Summit, identified that health educators need to rethink training methodologies in order to be able to better assess proficiency during training (IOM, 2004). The recommendations from this summit created the foundation for the Quality and Safety Education for Nurses (QSEN) project, which validated the need for nurses to develop multidimensional competencies that emphasize development of the knowledge, skills, and attitudes necessary to participate as an interdisciplinary team member, using evidence-based practice to provide quality and safe patient care (Cronenwett et al., 2007). Nursing education that embodies these three dimensions should result in the provision of a higher quality of patient safety in our care delivery system.

Benner's landmark research on the state of nursing education identified many of the same barriers within our current nursing education systems and challenged that nursing education is currently “in a position of opportunity and responsibility to expand and improve" (Benner, Sutphen, Leonard, & Day, 2010, p. 5). Nursing education has long valued the theory-practice link to socialize nurses into the practice of nursing using small groups, preceptor arrangements, and supervised, facilitated instruction (Benner, Tanner, & Chelsa, 1996).

The ambiguity in the current healthcare environment necessitates that nurse educators teach with a focus on developing a sense of salience (priority setting), clinical imagination (flexibility), and formation of professional identity (morale and ethical duty) (Benner et al., 2010). Decision-making that matches knowledge to specific situations, identifies levels of priority, and considers exceptions to the "usual" are no longer optional outcomes for nursing education.

Critical thinking and clinical judgment have long been indicators demonstrating a progressing expertise level in nursing practice (Benner, 1984; Tanner, 2006). Nurses must have well developed decision-making skills to be prepared for the complexity of patient care management that they will experience in hospital environments. Research informs us that development of this type of expertise is accomplished through experiential practice (Benner, 1984; Chi, Feltovich, & Glaser, 1981; Dreyfus, 1997; Tanner, 2006).

High fidelity simulation (HFS) provides a learning environment where nurses can integrate complex, cognitive, affective, and psychomotor skills to transition from student to nurse (Wilford & Doyle, 2006). Nehring and Lashley (2001) define HFS as “a computerized, full body mannequin that is able to provide real time physiological and pharmacological parameters of persons of both genders, varying ages with different health conditions” (p. 195). Pedagogies of contextualization, such as HFS, assist learners to determine "what", "how" and "when" intervention should take place while providing a dynamically changing environment that must be managed under time pressure and high stakes outcomes (Benner et al., 2010). The following excerpt from a nursing student's post simulation journal helps highlight the benefits of learning with this modality:

> The Sim Lab experience was very helpful for me. Some things I’m taking away from the experience are remembering to assess constantly, looking at the bigger picture, and what to do in an emergency situation. Being in nursing school, I think I’m absorbing things one thing at a time, so putting everything together is difficult. This simulation definitely put multi-tasking and using resources into perspective, while also being in a controlled, safe environment...During the process of setting up the IV bag and tubing correctly I forgot about the patient. This practice in the Sim Lab really put into perspective that I’m not just doing one task. I have to be able to multi-task, while constantly assessing the patient...during the intense 30-second downward spiral where the patient was having an anaphylactic reaction to the blood transfusion, I could not pull it together. So many things came crashing at one time; I forgot what were the main priorities or even how to “fix” things. I forgot what to do in treating a patient enduring an anaphylactic reaction to a blood transfusion (despite reviewing the material last night and just prior to the simulation). When the monitor was beeping out of

> control, patient was complaining and worrying about death, daughter coming in terrified that her mother was going to die, and having two other nurses freaking out with me, all of my knowledge went out the window...I loved that we got to pretend that we were real nurses on the floor. It gave me the opportunity to see what I would do in times of intense pressure, without feeling inadequate...after the simulation, I was surprised at how much it affected me. I blanked out during times of intensity and was not able to think critically. Although I didn't expect to endure these feelings and reaction to the patient's condition, the simulation made me gather my thoughts about what I need to practice and work on. (M. Coelho, personal communication, December, 5, 2008)

Situation Awareness, a model of decision-making developed by Endsley (1997) provides a framework and pedagogy that can be applied within nursing and specifically with HFS to monitor and measure development of priority setting and clinical imagination. Research in other disciplines outside of healthcare have had some success in utilizing techniques to promote development of situation awareness that include simulation as a venue for learning (Kaempf, Klein, Thorsden, & Wolf, 1996; Kaempf & Osasanu, 1997; Lipshitz & Shaul, 1997; Means & Gott, 1988; Miller, Wolf, Thorsden, & Klein, 1992; Robertson & Endsley, 1995). Improving situation awareness has been noted to be key in improving decision-making in other disciplines; namely aviation and military (DiBello, 1997; Klein, 1993; Lipshitz, 1997; Orasanu & Connolly, 1993; Stokes, Kemper, & Kite, 1997; Waag & Bell, 1997).

This research study set out to explore how to structure HFS training to facilitate development of expertise in decision-making – specifically improvement of situation awareness. It assumed that there was more to development of expertise than just time on task. It was believed that specific instructional techniques would be necessary to develop learner's skills in clinical judgment, continuous assessment, and facile decision-making.

A framework for defining and measuring decision-making ability was superimposed over the entire learning experience.

HFS provides healthcare educators with a tool to create safety conscious practitioners in an environment that replicates actual practice without risk to actual patients. This paper argues that these types of learning experiences can be equally important to the development of expertise and decision-making in novice nurses and should be leveraged to improve clinical nursing education. HFS can provide nursing education with a consistent, standardized learning environment for the development of nursing role identity – specifically decision-making ability. It is hypothesized that using simulation in a problem based learning structure helps develop a nurse's knowledge, skills, and attitudes through situated experience. It is reasonable to assert that this type of training could result in a nurse who is ready for clinical practice faster, feels more confident in his/her role, and provide return on investment by saving on costly and lengthy orientation into practice.

Chapter 2: Literature Review

In order to understand how learning occurs within HFS it is necessary to understand the theoretical context of learning as a concept for this study. Understanding expertise development will be explored since it is the premise of this paper that nursing decision-making improves as expertise improves and expertise is a by-product of learning over time. Nursing is a practice that is based on decision-making ability. Understanding decision-making using a naturalistic view will be discussed because of its applicability to this particular setting. Situation awareness is used as a framework to understand how decision-making occurs within a dynamically changing environment with competing priorities. Additionally it is important to understand, specific to nursing development, how expertise in decision-making can be developed through the use of HFS.

HFS gives us a new tool to explore how decision-making can be improved for nursing practitioners. HFS also provides us with a venue to understand how decisions are made in context within the environment of practice. This research project combines situative learning and naturalistic decision-making to gain valuable insight on how to structure the learning activity during HFS. It is believed that by utilizing a specific structure for use with HFS, coupled with deliberate practice in a contextual situation the nursing learner can develop skills of situation awareness that will improve their decision-making capability and overall professional development. To date, the literature base has not combined these factors together in the field of nursing practice.

Learning

A Social-Cultural Process

Knowledge utilizing a situative (Brown, 1992; Lave & Wenger, 1991) and distributed framework is conceived as a process that occurs within an activity, situated within a sociocultural environment and distributed across time, people and tools. It is predicated by the belief that knowing and context cannot be separated from each other (Barab & Hay, 2000) and learning is dependent upon and created within the practice environment (Benner, 1984; Lave, 1993).

Traditional nursing learning utilizes an apprenticeship model characterized by novice enculturation in conjunction with an experienced expert through a sociocultural community of practice (Benner, 1984; Lave & Wenger, 1991). This results in a progressive engagement with the practice resulting in movement from the periphery to centrality (Lave & Wenger, 1991). During this transition, the learner transforms through the practice of nursing and gains knowledge and expertise through experience with the context, tools and social practices he/she has encountered (Benner, 1984; Lave & Wenger, 1991). The learning is part of the richness of practice and is developed and changed by the interaction itself. This type of learning traditionally takes place over years as the learner gains experience based on naturally occurring interactions with patients, disease processes, and situations within the hospital environment.

Nursing learning is shaped by and through individual patient interactions (Benner, 2000; Kim, 1999). The knowledge of nursing is embedded within the practice and improves with time and experience as one practices within the contextually based practice setting. (Benner, 1984; Lave & Wenger, 1991). This description of skill acquisition and identity formation has its foundations in legitimate peripheral practice as presented by Lave and Wenger and is consistent with the theoretical framework for this project regarding learning as a concept.

Nursing learning is not a linear application of theory to practice. It is a complex process that requires individualization and modification of knowledge to meet specific clinical situations and to respond to the specific context (Benner, 1984, 1991; Kim, 1999; Schon, 1991). Individualized care must also be balanced with many routine tasks that nurses can conduct in their sleep with very little active thought utilized to manage them. In some cases it is this routine part of nursing that creates potential for patient harm (Kim, 1999). Studies within other disciplines that have highly routinized jobs have found that there is an even greater need for accurate situation awareness in these routinized/procedural jobs to maintain safety (Kaempf & Orasanu, 1997; Roth, 1997; Stokes et al., 1997). Both types of care require the skill of situation awareness for decision-making.

A Reflective Process

Nursing as a profession requires practitioners to continuously use their experiences to improve their skills. Reflective practice is one of the tools used by the nursing profession to promote a continual focus on life-long learning (Kim, 1999; Ruth-Sahd, 2003). The nursing literature reviewed on reflection presents a robust and consistent view regarding its definition and process (Atkins & Murphy, 1993; Ruth-Sahd, 2003; Schon, 1991). Ruth-Sahd (2003), after a comprehensive review of the literature, defines reflection as a "means of self examination that reviews past practice with the intent of improving practice and understanding self." (p. 488). She adds that it is a “creative, non-linear, imaginative process” (p. 488). Neilsen, Stragnell, and Jester (2007) expand the definition by suggesting “it is the ability to challenge habit of thought and action and question the validity of meaning” (p. 513). It is widely agreed that the reflective process results in a change in behavior due to learning (Dewey, 1933; Neilsen et al., 2007; Schon, 1991).

Schon (1991), expanding upon Dewey’s previous work, describes a three-part model of reflection that outlines different activities for each type of reflection. Reflection-in-Action is described as the intuitive process that takes place during nursing care. Reflection-on-Action is the conscious process that occurs to understand past action with the intent of improving future practice. Reflection-for-Action identifies future strategies for clinical practice through understanding the conflict between values versus practice; intent versus action; and patient need versus nursing need (Kim, 1999). Each type of reflection has been identified as an important way to improve clinical practice and nursing learning (Kim, 1999; Ruth-Sahd, 2003).

The process of reflection follows three key steps: (a) self-awareness; (b) critical analysis of action, knowledge, and feelings; and (c) development of a new perspective resulting in a behavior change (Atkins & Murphy, 1993; Boud, 1985; Ruth-Sahd, 2003; Schon 1991). Kim (1999) describes this process as critical reflective inquiry and notes that there are three ultimate goals: (a) to understand practice in the context of a practitioner, (b) to correct and improve practice, and (c) to generate models of “good” practice. This study proposes that these three goals and the practice of critical reflective inquiry should be an integral part of the HFS design. The improvement in decision-making skill is dependent upon the ability to practice these three skills in order to build accurate mental models to scaffold future learning.

Reflective practice techniques work well with HFS learning to bring out judgments and decisions required by the specific situation. The focus of the reflection should highlight the specific cues, patterns, inferences, and information that were required to make the decisions. Understanding how to decompose complex tasks into basic elements is difficult for the novice to do on their own since their experiential base may not allow them to understand the subtlety of the situation because of their reliance on rules based knowledge (Benner, 1984; Dreyfus, 1997). This study proposes that the deliberate practice of reflection skills during HFS training reinforces the learning that takes place within the context of the situation. Additionally, it provides opportunity to develop expertise in the practice of reflection that will one day result in faster decision-making by being able to reflect-in-action.

Situated Within Context

HFS provides an immersive and dynamic environment for intentional learning within a real-world context. This type of learning helps create necessary relationships between context, meaning, identity, and practice that result in transformative expertise (Barab, Hay, & Yamagata-Lynch, 2001; Barab & Duffy, 2000; Benner, 1984; Lave, 1993; Lave & Wenger, 1991). HFS introduces clinical learning opportunities for the nursing student by embedding them in a cultural context similar to an experience that one might encounter as a nurse. The situated patient cases are complex scenarios that have multiple possibilities for problem solving. There is no, one right way to solve the problem, but there is an optimal outcome to strive for. It is the process of learning through problem solving that result in a novice practitioner gaining valuable expertise that is transferable in continued practice.

The environmental context of the simulation room set up is that of a “real” hospital room. The equipment that is found is exactly what the caregiver would find in the hospital allowing them more time to interact with the actual artifacts that one might encounter in actual practice. The degree of realism provided by the environment maximizes the contextualization, allowing the student to suspend disbelief during the problem-based learning scenario.

Simulation teaches the learner by integrating theory, psychomotor skills, clinical decision-making and emotional engagement (Barach, Satish, & Streufert, 2001; Eaves & Flagg, 2001; Lasater, 2007). It has been demonstrated that participation in contextually meaningful experiences helps develop assessment skills that improve the participant’s ability to understand current and project future needs to guide practice actions (Endsley, 1997; Means, Salas, Crandall, & Jacobs, 1993). HFS is the perfect medium for nursing students to practice their skills (both knowledge and psychomotor) within a contextually based situation.

Simulation is traditionally delivered as a two-part process. The actual performance of the problem based scenario and the group debriefing afterwards (Seropian, Brown, Gavilanes & Driggers, 2004). Analysis during the debriefing stage allows for diversity of problem solving to emerge while reflecting on and providing feedback regarding the action of the group during the simulation (McGaghie et al., 2006). Debriefing allows the instructor to evaluate the learner’s ability to synthesize knowledge and apply technical skills (Nehring & Lashley, 2001). Studies in nursing and medicine have shown that students value debriefing as key to the development of their clinical judgment skills (Lasater, 2007; McGaghie et al., 2006).

Simulation as a learning experience highlights the process of decision-making. The simulation experience provides the learner with a vast array of resources, data, and tools to analyze and assemble into working goals to serve as the guiding ideas for the care of the patient. Without formulation of these goals, the work of caring for a patient is nothing more than a “to do list” of tasks that needs to be accomplished. Identification of the goal helps the nurse to organize and prioritize what data in the environment should be attended to in order to provide directed action to solve the patient’s presenting needs. Nursing practice relies on the nursing process as a framework to guide actions and decisions. The steps of assessment, planning, intervention, and evaluation are consistent with the situation awareness model that is proposed for this research.

In simulation, the learner is allowed to test decision-making in a safe environment, which is not always available when learning in an apprenticeship model on “real” patients (Barach et al., 2001; Issenberg et al., 2005; McDonald, 1987; McGaghie et al., 2006). Even though the decisions made during simulation do not always result in the intended outcome; the experience of trying out the hypothesis does provide the student with a new level of expertise and experiential learning that can be "saved" for another situation. It has also been found that the group learning utilized in HFS provides a safe environment for learner’s to develop responsibility for their own learning (Lasater, 2005).

HFS creates a contextual environment for nurses to practice and develop their decision-making skills. This environment creates the right amount of ambiguity between data observed and goals chosen to challenge the nurse under time and consequence pressure to match their situation awareness against their decision-making practices. The skill of continuous assessment facilitates the development of flexibility and rapid decision-making capability and is a perfect fit for deliberate practice within the HFS. Domain-specific expertise is developed by developing stored mental models based on the experiential learning that takes place within the HFS (Endsley, 1997; Klein, 1997).

Expertise

Development Over Time with Experience

Patricia Benner's Novice to Expert Model (1984) explains how experiential learning creates a hierarchy of practitioner levels based on their ability to apply knowledge in the clinical setting. As expertise is gained, a nursing practitioner changes the way he/she thinks and applies skills in three distinctive ways: (a) reliance on concrete, experience based paradigms instead of abstract principles; (b) ability to view the event holistically, instead of as distinct, concrete parts; and (c) the movement into care as an active practitioner instead of a detached observer.

Because learning in nursing is a socially embedded and shaped practice, it follows that the knowledge, skills and tools taught are vetted by the professional culture and specialty specific sub-cultures within the practice (Benner, 2000; Benner, Tanner & Chelsa, 1997; Kim, 1999). "Common meanings" of what is "good" and "right" come from this social culture and become part of the nurse's guiding value system that influences clinical decision-making. The individual practitioner's "lived experience" creates an internal data bank of personal knowledge that is shared through narratives within the larger culture to promote learning. Caring and clinical knowledge is embedded in the pooled expertise and power of multiple perspectives modeled by the preceptors. The active modeling process contributes to the shared vision of excellence and the bond of relationship building that becomes part of the learning experience so much so that it formulates a shared emotional climate of trust and a sense of possibility (Benner, 2000).

High fidelity simulation has the potential to create this same type of learning environment in the laboratory setting to develop this type of expertise. Using simulation with small groups of students enhances the distributed knowledge of the group lending itself to a pooling of novice level expertise. The role of the instructor in simulation is that of facilitator; in the pre-briefing and debriefing phases. The facilitation role in this setting should focus on encouraging active participation by all members, promoting group analysis and evaluation of performance, and recognition of goal attainment by using expertise to guide the group to recognize what cues/patterns were missed (McDonnell, Jobe, & Dismukes, 1997).

Role in Decision-Making

Expert decision-making is about situational understanding of the world through matching patterns and taking action (Bogner, 1997; DeGroot, 1965; Dreyfus, 1997; Schraagen, 1997). Experts spend the majority of decision-making time in the assessment and classification of the current situation – making situation awareness a key feature in dictating the success of real world decisions (Endsley, Bolte, & Jones, 2003). Expert practitioners have situation awareness skills that allow them to recognize and determine significance of cues and patterns more rapidly than novice – leading to effective decision-making (Klein, 1993; Lipshitz & Shaul, 1997; Orasanu & Connolly, 1993). This can be done because of their storage of knowledge into goal-oriented templates that can be easily accessed using pattern recognition/matching skills, allowing for more rapid decision-making. Experts also utilize metacognitive skills to monitor their own processes during decision-making (Cannon-Bowers & Bell, 1997; Dewey, 1933; Schon, 1991). Reflection-in-action is more difficult for the novice to accomplish because of their simplistic and rule based mental models. The health care industry needs educational institutions to create decision makers that can think fast on their feet and adapt to the environment and patient specific situation. Unfortunately, this type of expertise takes years of time to develop using the current teaching techniques of apprentice learning. This research project proposes that HFS can be structured to provide deliberate practice of this skill that could improve decision-making practice in practitioners faster than the trial and error methods of the past.

Lia DiBello (1997) conducted research looking at the differences between expert and novice decision makers in a materials management setting. Her results support the previous work of Dreyfus and Benner by showing that experts utilize their experience rather than rule based knowledge to facilitate decision-making. Her findings underscore that classroom instruction is less effective for developing the kind of flexibility and mastery needed for domain specific decision-making. Furthermore, DiBello identified two specific strategies for training that facilitate decision-making expertise. Constructive activity training is an activity that focuses on reorganizing knowledge rather than adding new knowledge. The focus is on improving the stored mental schema by highlighting cues, patterns, and decisions that should be grouped together. Deconstruction in reflection is the other training technique that shows promise in development of better situation assessment and mental models. This technique highlights the individual's ability to perform reflection-on-action and then examine how a different approach might have accomplished the same goal or improved upon the original decision. These techniques have applicability to training utilizing HFS.

Decision-making

Traditional Theory

The foundations of classical decision-making theory are focused on logic and entrenched in risk/benefit models and economic traditions (Beach & Lipshitz, 1993; Orasanu & Connolly, 1993). Rule based, optimizing of decisions has been the main focus. Traditional decision-making theory focuses on the actual decision-making event. Specifically it is about the deliberate analysis of choices in order to obtain the optimal decision. This type of decision-making requires substantial time in order to determine the "optimal" alternative for action. Research methodology for traditional decision-making focuses on controlled experimental settings, detached from contextual settings. This allows for the researcher to focus on the decision as an optimal outcome rather than a process that is influenced by the environment. Education and training based on this theoretical approach has been focused on utilizing rule-based systems to guide decision-making with the focus being on choosing the "best" outcome.

While this traditional approach gives specific insight into a well prepared, analytical method of making decisions – in practice it is often abandoned for alternative decision-making processes. Research shows that decision makers within a domain of practice often abandon traditional decision-making techniques to go with their "gut" (Beach, 1990; Carroll, 1995; Isenberg, 1986; Janis & Mann, 1977; Klein, Calderwood, & Clinton-Cirrocco, 1985). Numerous studies across different domains (military, aviation, chess, business) show that expertise allows decision makers to utilize their first option for action and that it usually results in a satisfactory outcome (Kaempf et al., 1996; Klein, Wolf, Militello, & Zsambok, 1995; Stokes, Belger, & Zhang, 1990).

Critical Thinking and Clinical Judgment

Critical thinking and clinical judgment are terms that are used in nursing education to characterize decision-making ability. A student's ability to make decisions by demonstrating the ability to problem solve is used as a measurement tool to determine how well a student is progressing through the program. Problem solving ability in general and individualized for specific situations is highly linked to the student's behavioral demonstration of evolving expertise. It is important that nursing education looks to development of this expertise as a behavioral outcome of learning in clinical practice.

Critical thinking in nursing practice has been a long-standing, valued outcome of nursing education and training. The standards of practice and licensing examinations set by accreditation agencies in nursing place a high value on this skill (Commission on Collegiate Nursing Education, 1998; National League for Nursing Accreditation Commission, 2004). The licensing examination board for registered nursing (NCLEX-RN) has identified that there are significant differences in general critical thinking between those who pass and those who fail the licensure exam (Tanner, 2005). The literature supports a mature definition of critical thinking; a concept that has been explored for over two decades (Turner, 2005). Critical thinking in nursing is "purposeful, self-regulatory judgment associated in some way with clinical decision-making, diagnostic reasoning, the nursing process, clinical judgment, and problem solving. It is characterized by analysis, reasoning, inference, interpretation, knowledge" (Turner, 2005, p. 276). Note that the key elements of critical thinking are that it is a reflective process that requires active inquiry. Clinical decision-making, diagnostic reasoning, problem solving are several surrogate terms that are often used interchangeably with critical thinking (Turner, 2005).

There is little consensus in the literature regarding what needs to be in place to promote critical thinking and what the result of being able to critically think looks like. This ambiguity and lack of clarity negatively impacts the nurse educator's ability to create sound educational experiences that develop this skill in nursing students. Literature from 1992-2002 suggests a beginning consensus of what the appropriate antecedents and consequences of critical thinking might be, but there needs to be more research done in this area to validate this construct (Turner, 2005). Turner's synthesis of the literature surmises that critical thinking "requires knowledge of the area about which one is thinking and results in safe, competent practice and improved decision-making, clinical judgments, and problem solving" (p. 276).

Unfortunately, the results of research on critical thinking have not been able to show a consistent relationship between critical thinking and clinical decision-making (Hicks, 2001; Staib, 2003). Inconsistent or undeveloped teaching strategies and measurement tools not sensitive enough to test for these skills have been offered as a hypothesis to explain this discrepancy (Turner, 2005). This research study is proposing that the teaching strategy of HFS could help bridge this gap in nursing education-practice.

Clinical judgment is considered to be a more sensitive measurement of nursing knowledge. Nielsen et al. (2007) describe clinical judgment as an ongoing assessment of the complexity of the patient to understand and be able to provide optimal patient care. It is the complexity of patient care and the influences and processes that go on within that nurse-patient relationship that limits the concept of critical thinking as an adequate description of how nurses make clinical decisions (Tanner, 2006). Christine Tanner's Clinical Judgment Model (2006) defines clinical judgment as "an interpretation or conclusion regarding patient needs, concerns, or health problems and the decision to take action (or not), use or modify standard approaches, or improvise new ones as deemed appropriate by the patient's response" (p. 2004).

The process of clinical judgment requires various types of knowledge in order to perform nursing care competently. It is informed by science and theory, experience, abstractions, context and is often tacit (Benner, 1984; Benner et al., 1996; Benner et al., 1997; Tanner, 2006). Within this model, the influences of prior experience and inherent values, context and culture of the setting of practice, and the situated engagement of "knowing the patient" are introduced and expanded upon to provide a more complete view of what happens during the application of theory to practice in nursing learning. Reflection-on-practice as discussed previously is a key factor in the development of knowledge and improvement of clinical reasoning within this model (Tanner, 2006). While critical thinking is a component of this process (as evidenced by the necessity for analytical thought, based on a body of scientific knowledge) it doesn't address the concepts of intuition based on experience, and reflection-on-practice to understand the opportunities to improve individual nature of nursing practice (Benner, 1984; Benner et al., 1996, 1997). Tanner's model promotes the idea of an experiential learning journey that is informed by practice and transformed by the interaction between expert practitioners within the practice (Lave & Wenger, 1991). The Clinical Judgment Model proposed by Tanner (2006), portrays a model that is dependent upon numerous feedback loops influenced by the changes brought about in the learning process noted above. The stages include noticing, interpretation, responding, and evaluation. Each phase of the clinical judgment process is influenced by the learner's previous experience, values, and cultural background. Tanner suggests that in order to "think like a nurse" one must practice using an approach that understands clinical judgment within this context. This study proposes that in order to practice using this approach we must educate using it. A tool that seems well suited to developing these skills is HFS.

It is clear from the literature reviewed in nursing practice and other disciplines that decision-making is linked to the ability to reflect, is dependent upon domain specific experience, and evolves as a result of interaction in the practice. While nursing research has not found a definitive connection between critical thinking and clinical judgment, other areas of research have been able to link domain specific expertise with improved decision-making (Chase & Simon, 1973; Schraagen, 1997; Serfaty, MacMillan, Entin & Entin, 1997; Stokes et al., 1997).

Naturalistic Decision-Making (NDM) Theory

While the traditional views of decision-making as a logical, progressive process bear merit and have application during the learning phases of professional practice, they don't explain the intuitive decision-making that takes place in "real life" -particularly in health care settings. In order to move toward the dynamic and adaptive practitioner that is needed in this setting, it appears necessary that alternative teaching methods and theories be explored to augment the new skill set required to flourish.

Zsambok (1997) defines Naturalistic Decision-making (NDM) as:

> how experienced people, working as individuals or groups in dynamic, uncertain, and often fast paced environments, identify and assess their situation, make decisions, and take actions whose consequences are meaningful to them and to the larger organization in which they operate. (p. 5)

This approach to decision-making focuses on the process of decision-making as it is embedded within a contextual practice (Beach & Lipshitz, 1993; Cohen, 1993; Orasanu & Connolly, 1993). Decisions are a function of knowledge, expertise, and features of the specific task itself (Cannon-Bowers & Bell, 1997; Orasanu & Connolly, 1993). Naturalistic decision-making focuses on time spent trying to understand the situation rather than generating a set of options to choose from. NDM emphasizes that expertise is the key to decision-making that is done through the adaptation of mental models that are already in place. It is the process of matching (or closely approximate) those stored models to fit the current situation (Yates, 2001) that drives decision-making within this model.

Orasanu and Connolly (1993) are credited with defining the eight characteristics consistent with a naturalistic decision-making environment: ill structured problems, uncertain/dynamic environments, shifting/ill-defined and/or competing goals, action/feedback loops, time stress and high stakes, multiple players, and organizational goals and norms. These characteristics certainly describe the health care environment of nursing practice. It is well known among researchers and lay people alike that the time – stress characteristic of health care decision-making is a key factor in the safety of patient care. Another factor is the ongoing emphasis to reduce health care costs that impacts decision-making in the practice setting. This focus on cost has become an organizational norm that factors into the decision-making process often times as a competing goal of practice. Every decision made at the bedside impacts another in the care of the patient. The nurse must continually reassess to make sure that the problem, environment or decision hasn't changed to create a new decision-making situation. HFS allows us to mimic this type of healthcare environment during training to include most, if not all of the eight characteristics of a naturalistic environment.

The traditional research community identifies that current naturalistic decision-making research is limited to specific ethnographic domains, relies on expertise as the standard of practice for performance, and has had difficulty in the reliability and validity arena (Beach, Chi, Michelene, Klein, Smith & Vincente, 1997; Howell, 1997). This makes generalizing the findings and reproducing them in future research arenas difficult.

NDM research has a long history in the aviation and military domains. These domains have done extensive research to understand what goes into decision-making and are now beginning to utilize that knowledge to create decision centered training. This type of training focuses on development of situation awareness, pattern and cue matching, mental model construction, and utilization of cognitive feedback to improve performance specific to contextual situations. Additionally, designers of monitoring equipment have been interested in using this type of research to optimize the HCI interface to promote optimal decision-making.

As noted previously within this literature review, decision-making in the nursing practice domain is consistent with the environmental characteristics of naturalistic decision-making. Health care decision-making "has a restorative orientation, reactive approach, non-negotiable time stress, often with major personal consequences" (Bogner, 1997, p. 67). Using a decision-making practice of multiple variant analysis of courses of action is not practical in the nursing practice environment. The necessity of balancing multiple goals that are continuously shifting in priority makes situated decision-making more like "a continuous state of affairs in a dynamic environment" than resolution of separate conflicts (Rasmussen, 1993, p. 158). Brehmer (as cited in Pennington & Hastie, 1993) viewed medical decision-making using a social judgment paradigm. It was discovered that in the physician work setting, the contextual environment shaped the decision-making (i.e. formulation of a diagnosis) so much so that the actual decision was interconnected with the data collection in a continuous feedback loop. Brehmer described medical decision-making as "not a linear sequence, but a complex communication network. Tasks cannot be attended simultaneously but have to be considered on a time sharing basis according to a service strategy depending on the nature of the tasks" (p. 164). In other words, decision-making is an activity through time, which depends on the continuous updating of tacit knowledge (Rasmussen, 1993). This analysis of medical decision-making can be generalized to nursing practice, as evidenced by research done by Crandall and Getchell-Reiter (1993) showcasing NICU nursing.

Crandall and Getchell-Reiter (1993) examined the decision-making processes of expert Neonatal Intensive Care Unit (NICU) nurses and their care of septic infants. The findings indicated that the decision-making process of the nurse resulted in the ability to diagnosis septic infants prior to the confirmation with diagnostic tests. When retrospectively queried about how the nurses arrived at their decisions, Crandall and Getchell-Reiter (1993) identified three areas of focus: (a) recognition of cues and patterns, (b) matching of these cues and patterns to a normative model, and (c) utilization of information sharing to refine and create mental models for action. One of the bigger picture discoveries here was the fact that these expert nurses made decisions based on tacit information that was only discovered upon retrospective probing, thus giving credence to Klein's (1993) recognition primed decision model.

Recognition Primed Decision-Making (RPD)

Gary Klein's (1993) recognition primed decision model (RPD) focuses on adaptive decision-making as behavior that utilizes expertise as part of decision-making. The focus of decision-making in this model hinges on understanding the situation and judging its familiarity by matching with mental models of normative patterns to find a solution. Key tenants of this model assume ambiguity or incompleteness of situation understanding, time pressure, high stakes consequences, and expertise/tacit knowledge (Drillings & Serfaty, 1997; Klein, 1993). The RPD model supports that expertise leads directly to accurate decision-making with no deterioration of performance under time pressure and no need to contrast/compare decision choices (Endsley, 1995; Klein, 1993; Lipshitz, 1997).

As expertise develops within a particular domain, decision-making becomes more tacit and automatic based on experience and previously developed mental models (Figure 1). Pattern matching based on a review of cues is done without formal analysis and deliberation. This matching occurs more as a stimulus response pattern than a deliberative process. Chi et al. (1981) identified that experts know things differently than novices and that knowledge is generally tacit. Experts were seen to have the ability to chunk domain specific knowledge into high procedure models where action was linked to conditions of applicability based on assessment data. This type of memory storage allows for faster decision-making ability since it creates less drain on working memory. As expertise develops and experts experience individualized situations that are not exactly as before or like the norm, decision-making becomes a rapid process of matching cues, taking action, and evaluation of outcomes (Figure 2). This process is part of the RPD model and is defined as mental simulation. These mental simulations are usually the first and only option considered to solve the problem and generally result in high quality outcomes (Kaempf et al., 1996; Klein et al., 1995; Stokes et al., 1990). Klein has applied his RPD theory of decision-making to the domains of firefighting, aviation air traffic control, the military, and chess. It seems reasonable to assume that the profession of nursing would be a domain that uses the RPD model of decision-making as expertise is developed. Benner's book *From Novice to Expert* (1984) describes this process in rich descriptive detail as she chronicles the development of nurses at different levels of their careers.

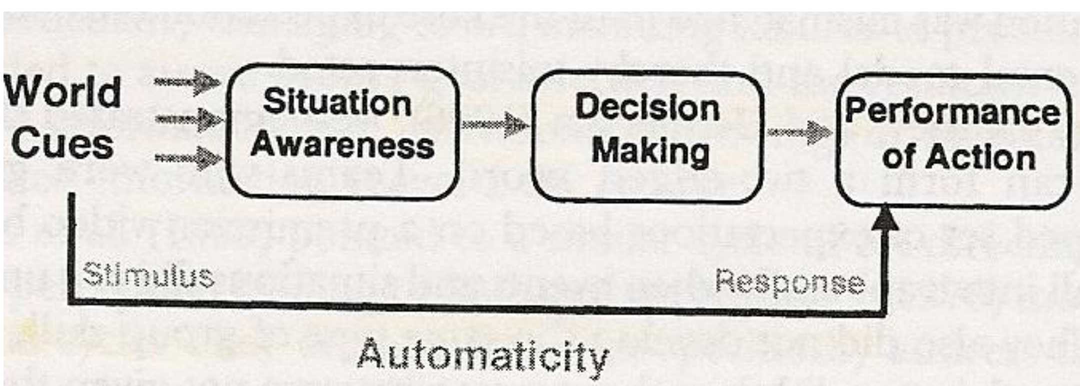

Figure 1. World cues and automaticity. Reprinted from "Theoretical underpinnings of situation awareness: A critical review," by M. R. Endsley, in M.R. Endsley & D.J. Garland (Eds.), *Situation awareness analysis and measurement* (p. 22). Mahwah, NJ: Lawrence Erlbaum Associates. Reprinted with permission.

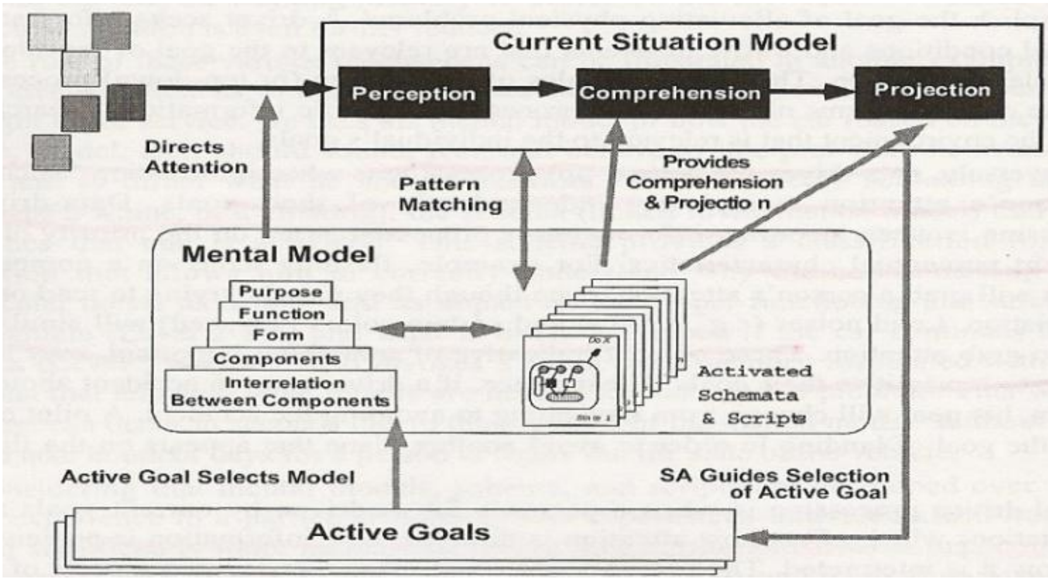

Figure 2. Situation awareness model. Reprinted from “Theoretical underpinnings of situation awareness: A critical review,” by M. R. Endsley, in M.R. Endsley & D.J. Garland (Eds.), *Situation awareness analysis and measurement* (p. 16). Mahwah, NJ: Lawrence Erlbaum Associates. Reprinted with permission.

This research proposal was concerned with maximizing experiential learning to develop capacity for expert decision-making. Because this research was conducted with learners of nursing, it was believed that using HFS should enhance the development of situation awareness and building experientially based mental models since these two factors were consistent with expert practice within a domain. This was consistent with the research that has been done to date in the domains of aviation and the military (Means et al., 1993; Schraagen, 1997).

Situation Awareness

The Model

Naturalistic decision skills training moves away from the system approach to training using policies and procedures as the foundation for teaching and suggests that efforts should be focused in the areas of situation awareness, pattern matching, cue learning, typical versus anomaly, mental model development, and managing uncertainty and time pressure (Klein, 1997). This research proposal suggests that the elements of managing uncertainty and time pressure are inherently present with the use of HFS. The other elements of situation awareness, pattern matching and cue learning using a normative mental model format must be maximized by the instructor during the HFS learning scenario in order to maximize the learner's decision-making ability.

Mica Endsley (1997), the founder of Situation Awareness theory, defines situation awareness (SA) as "being aware of what is happening around you and understanding what that information means to you now and in the future" (p. 13). SA is defined by a domain specific goal and is context specific: changing as the environment changes. Endsley defined three different levels of SA:

1. Level 1 SA – Perception: collection of data within the environment
2. Level 2 SA – Comprehension: synthesis of disjointed data points in light of a goal to create understanding.
3. Level 3 SA – Projection: the ability to project future actions based on understood meaning.

Development of domain specific expertise improves the ability to attain level 2 and 3 SA by utilizing good mental models of knowledge in order to interpret disparate data points. Decision-making in the SA model is guided by the development of goals, which provides the impetus for choosing the appropriate mental model to begin care from. In the case of nursing practice, the nurse has a normative mental model of the particular disease process according to the disease pathophysiology. This mental model allows the nurse to understand what types of data to pay attention to while conducting an assessment on the patient to render care. The mental model chosen also helps the nurse prioritize what data points would be predictive to indicate that there was a potential problem with the patient, as well as what data points are not relevant to the situation (Figure 2).

Basic information processing identifies how short and long term memory affects decision-making ability. Our ability to perceive stimulus in the environment is limited by our finite attention capability. Short term or working memory can only actively work on about 7 chunks of information at a time. The deterioration rate of information in short term memory is rapid, which again requires that information must be continuously focused on to keep from deteriorating. A foundational premise of the SA and RPD models of decision-making is that one must have good mental models stored in long-term memory to allow for information sampling based on pattern recognition to assist with the limitations of working memory.

This research study proposes that the structure of HFS learning experiences should enhance the development of the mental models in the long run, by focusing the learning outcome of matching goal achievement with attention to specific patterns and cues. It is this deliberate deconstruction of the nursing tasks that allows for better information chunking ability. SA is the ability to acquire the data in a continuous manner, while prioritizing it against the identified goals for accomplishment

SA is data driven and goal driven. This means that it is influenced by the data gathered in the environment as well as by the goals selected for the situation. This process involves a continuous reprioritization based on the matching with normal schema. This continuous reprioritization can be negatively impacted by factors such as stress, workload, complexity, and automation. The immersive and contextual features of HFS incorporate these realities into the practice situation, which enhances the experience. The participant's ability to identify factors that negatively impact their decision-making capability is a key-learning outcome of HFS that makes it a highly valuable tool.

Situation Awareness and Decision-Making

Aviation has been used as a domain for the study of decision-making for years. Research in this domain has documented that decision-making skills can be trained and that proficiency can be improved (Means & Gott, 1988; Robertson & Endsley, 1995). Decision makers in highly procedural domains such as air traffic control and nuclear power plants spend 90% of their time processing information rather than focusing of what procedure to employ – pointing to SA as a key skill in decision-making (Kaempf & Orasanu, 1997; Roth, 1997).   It has been found through this type of research that the common decision-making errors can be grouped into two categories: (a) ability to recognize cues but failed to make a decision, and (b) failure to recognize the impact of one decision on the bigger picture. Both of these aspects highlight the importance of SA in the decision-making process.

Because we will be working with nursing learners in this research study, it is essential that the HFS practice focus on understanding patterns and cues related to decision-making points. The expertise in HFS is in the role of the instructor/facilitator of the simulation. Novice decision-making traditionally follows a rule-based process to help the decision maker from overlooking something (Benner, 1984; Dreyfus, 1997). Robertson and Endsley (1995) suggest that context driven training can enhance the development of SA skills that are necessary for effective decision-making. The goal in utilizing NDM principles to improve training suggests that the instructor role should support processes that accelerate proficiency. HFS allows for contextually based deliberate practice that can experientially illustrate the links necessary to highlight SA patterns and cues to improve schema storage in long term memory. The instructor must utilize specific techniques such as goal directed task analysis, crew resource management principles, and guided reflection techniques in order to illustrate the SA necessary for correct decision-making. Making these connections is necessary to formulate good mental models for long-term memory storage. It is this storage of schema that is later utilized for mental simulation and pattern matching of the expert practitioner. Well-indexed and stored schema leads to reduced decision-making time and improved quality in contextually stressed situations (Cannon-Bowers & Bell, 1997).

Cannon-Bowers and Bell's (1997) research identified characteristics of effective decision makers as:

1. Flexible – able to cope with ambiguous, rapidly changing and complex environments in response to environmental cues
2. Quick – able to make rapid decisions in the face of severe consequences

3. Resilient – mitigates stress in decision-making with no deterioration of performance
4. Adaptive – engages in continual process of assessment and modulation
5. Risk Taking – conducts active risk assessment as part of decision-making
6. Accurate – reaches expected goals as projected.

These six characteristics describe the caregiver of the future in the hospital setting. Cannon-Bowers and Bell further suggest that training for effective decision makers should focus on matching appropriate training techniques to enhance these necessary skills. Training skills should be focused on: mental simulation, SA, knowledge organization, and reflective practice in order to enhance decision-making capability. HFS, if designed with purposeful intent can meet these requirements. Furthermore, Cannon-Bowers and Bell suggest that methods to improve training for effective decision-making should utilize the techniques of simulation with guided practice and cue/strategy-associated feedback.

The foundation of this research project boils down to decision-making in practice. The goal of teaching nursing learners in a BSN program is to develop and/or improve that decision-making ability. Decision-making in nursing is directly related to critical thinking and clinical judgment and improves over time as the individual gains more experience. As discussed throughout this literature review, the methodological approaches utilized to study this decision-making and HFS have been deemed suspect when trying to generalize the research findings to the larger population.

This project proposes to utilize a framework of SA to study decision-making. It is hoped that by using a framework that has significant theoretical foundation, albeit not in nursing, that it will improve the ability to generalize the findings. In support of traditional viewpoints on nursing decision-making - critical thinking and clinical judgment constructs have been mapped to the different phases of the SA model for purposes of illustrating the conceptual similarities (Table 1).

Table 1.

Table Matching Models of Decision-making Attributes

Situation Awareness (Endsley, 1989)	Phases of Reflective Learning (Dewey, 1933)	Clinical Judgment (Tanner, 2006)
SA Level 1 Perception Data collection	Problem identification Studying the conditions, formulating a working hypothesis	Noticing
SA Level II Comprehension	Reasoning, making the connections, testing the hypothesis by action	Interpreting & Responding
SA Level III Projection	Analysis and evaluation of the hypothesis & action	Reflection

High Fidelity Simulation

Simulation: The Ultimate PBL Tool

The goals of problem based learning focus on the learner's ability to adapt to situations, use critical and creative thought to develop solutions, appreciate diversity of thought, promote self-directed learning, and improve leadership and communication skills through practice (Barrows & Tamblyn, 1980). It is the well-rounded balance of how HFS takes all of these elements, some of them tacit, and creates an environment where students can be successful in their endeavors to assume the identity of the RN caregiver.

Simulation as a learning tool has been around in professional practice for over 30 years (Issenberg, McGaghie, Petrusa, Gordon, & Scalese, 2005; Nehring & Lashley, 2001). The military, aviation, and anesthesia professionals have incorporated simulation into their curriculum with positive results in psychomotor skill performance, critical thinking and confidence levels of practitioners (Eaves & Flagg, 2001; Gordon, Issenberg, Mayer & Felner, 1999). In 2006, Jeffries and Rizzolo published a project summary report of their findings from an eight site, three-year project on simulation design. This project, sponsored by the National League of Nursing and Laerdal Medical, studied over 400 nurses in their first medical surgical course using three different types of simulation learning techniques (pencil/paper case study, low fidelity, and high fidelity). The results indicated that learning took place in each type of simulation; however the use of HFS promoted learning using a high sense of reality, provided opportunities for problem solving, and allowed for active and diverse ways of learning. As with other HFS studies, students rated satisfaction with learning and confidence levels higher when using HFS.

Additional results of the experiment created a design model for simulation that indicated HFS should be guided by objectives and allow for problem solving. The importance of student support, demonstrated in this study as prompt and directed feedback by an expert practitioner as part of a debriefing process, was highlighted as a seminal discovery of this research. According to McDonnell et al. (1997) this debriefing should promote participant self-assessment along with critical thinking and analysis. The debriefing process should focus on relating practice to standards of care and goals rather than individual participant's performance (Scherer, Bruce, Graves, & Erdley, 2003). While all these studies have pointed to the importance of a debriefing process post simulation performance, this is not universally considered a required part of the simulation learning process. This research proposal believes that it is an essential component of the high fidelity learning experience. It is proposed that the actual design of the debriefing process is essential to the development of important SA and reflection-on-action skills.

It is widely agreed that simulation will not take the place of human patient care, but instead provide a realistic alternative that may help deal with some of the gaps noted previously in the training environments of nurses (Gordon et al., 1999; Issenberg et al., 2005; Lasater, 2007). Eaves and Flagg (2001) add that it is the possibility of unique outcomes based on the consequences of the learner's actions that provides value as a learning experience. The ability to suspend disbelief and allow the learner to engage in the professional role using the tools of the profession to creatively problem solve differentiates a simulation learning experience from that of role play (Lowenstein, 2007). Providing problem based learning embedded within context to create more realistic simulation of SA and pattern recognition makes HFS a perfect tool for training naturalistic decision-making. The simulation environment creates action feedback loops that must be evaluated based on the series of choices that are made by the decision maker (Means et al., 1993).

Naturalistic decision-making strategies for training encourage the use of simulation to recreate conditions of practice – specifically time constraints, variability, and stress (Drillings & Serfaty, 1997). The ability to control conditions using simulation improves the structure of training providing an immediacy and complexity that imitates real practice (Drillings & Serfaty, 1997; Waag & Bell, 1997). Debriefing after the simulation adds an additional valuable source for training (Drillings & Serfaty, 1997). Chase and Simon (1973) analyzed information processing, a key aspect of being able to develop higher levels of SA, across different domains to reveal that:

1. Experts organize knowledge about their domain into complex semantically meaningful units in long term memory differently than novices allowing for "seeing" the future better (Schraagen, 1997; Serfaty et al., 1997).
2. Expert knowledge in long term memory is pattern indexed for ease of retrieval and use related to domain specific goals (Schraagen, 1997; Serfaty et al., 1997).
3. SA can be trained to maximize pattern recognition and matching, and development of mental models for manipulation (Serfaty et al., 1997; Waag & Bell, 1997).

The use of HFS as a tool for learning has a vastly differentiated practice. Based on the findings of this literature review it seems clear that the tool itself holds promise for development of expertise to enhance decision-making skills of practitioners. Specifically in nursing practice this would involve the development of critical thinking and clinical judgment. It is not enough in the literature and from exploration of the practical use of HFS the "must have" components of simulation in order to elicit these types of learning outcomes. Thus the focus of this research study will be to create a design of HFS to maximize the development of SA. It is believed that by utilizing the techniques of goal directed task analysis, crew resource management (CRM), and guided reflective practice as essential parts of the simulation process the learning experience will be maximized for the development of SA.

Design Based Research: Studying Simulation for Learning in Nursing

Design-based research utilizes a process that designs a learning environment for study to understand the situated learning that takes place during the process and uses the information learned to modify and improve the designed process. It is a collaborative approach that will require initial and continuous communication with the stakeholders in the process. For the purpose of this research stakeholders will include the students, and instructors. It will exclude the administrative and legislative stakeholders, but does acknowledge that these two stakeholders have potential impact on the usability of HFS as a curriculum adjunct in an authentic setting.

It is hypothesized that by focusing on how to improve HFS to achieve maximum impact on the learning process, the potential barriers and limitations posed by these excluded stakeholders will be easier to address. In design-based research, the outcomes are important at a local level and a larger theoretical level. This research proposes to further the understanding of how HFS contributes to the acquisition of decision-making skills that enhance clinical judgment in nursing practice. Understanding how to structure the HFS environment is important to the profession of nursing as well as other professions that choose to use simulation as a methodology for learning. Additionally, it proposes to provide a new methodological practice to review nursing learning as observed within a dynamic learning environment.

Unlike the positivist research approach utilized by most nursing and medical research, the researcher is an integral participant in design-based research. The process of examining knowledge creation as it is happening is modulated by the researcher as a participant and is intentionally used to help shape the learning environment (Barab & Duffy, 2000; Barab & Squire, 2004). The collection of data and provision of feedback to the learning environment provides an iterative design process that evolves continuously and collaboratively throughout the research period.

Significance of Research

The development of HFS technology allows for the re-creation of a learning environment that captures the contextual, social and complexity of apprenticeship learning. This dynamic, interactive environment allows for a real-world immersion with the complexity of a hospital environment where the learner can engage in knowledge construction relative to the practice of nursing in order to carry out socially negotiated tasks (Barab & Duffy, 2000; Barab & Squire, 2004; Hay & Barab, 2001). Additionally, it provides a mechanism to standardize curriculum/learning experiences that could potentially allow for expertise development in a more systematic and expedient manner than the apprenticeship approach.

The current literature and research on HFS focus on the outcomes of this type of learning utilizing the lens of a positivist framework. While the research has yielded some key outcome data regarding improvement in psychomotor skills and interpersonal and team communication skills, it has been disappointingly inconclusive overall. Intuitively, the professions of nursing and medicine have continued to utilize HFS to augment real-world learning based on anecdotal and self-reported evidence. Unfortunately, only the most progressive institutions can afford to proceed with such expensive tools based on intuition alone. This research can be instrumental in providing practical evidence for investments into HFS technology.

This study is prepared to review HFS using a constructivist and participatory model of learning to understand how it can improve clinical decision-making. The focus is on collecting data that will help the designer improve the quality and effectiveness of the designed simulation. The construct pieces that will be under investigation as part of this HFS design are: perception, comprehension, and projection. These constructs come from Endsley's (1997) SA model.

Upon completion of this study, a better understanding of the critical elements that impact the effectiveness of the HFS case scenario will be obtained. Minimally, the development of methods for conducting HFS learning to maximize SA performance will be produced. It is believed that by having a richer understanding of the learning process during HFS, systematic improvements in the design of contextual learning experiences can be provided to the medical/nursing community. Such improvements in curricular design could be supportive of more widespread use of simulation as a valuable learning environment.

Design Framework

It is important to have a strong understanding of the theoretical framework of how learning occurs in order to understand how the process of this research will be conducted. This study believes in a participatory framework where the learner creates and controls the learning process while the teacher functions as a facilitator/mentor. March and Smith (1995) propose that there are four general outputs from design research: constructs, models, methods, and instantiations. This study will focus on determining a method of learning trying to understand the relationships of the simulation and how they contribute to development of clinical judgment. The outcome of this research will be to try to identify a method that recognizes the best way to use simulation to promote SA skill demonstration. Having this understanding will help determine when simulation should be used in clinical learning and why it is a necessary adjunct to current learning practices.

Summary

The current and future healthcare environment mandates that nurse educators become demonstrably responsible for creating RNs that can practice safely. Due to the inconsistent correlation between general critical thinking and clinical practice outcomes in the review of literature, it appears that there is a need to deepen our understanding about what contributes to the development of decision-making during clinical learning. The military and aviation research bases have already shown that development of SA improves the likelihood of good decision-making. The aviation industry's exploration of "black box" incidents indicates that the adverse outcomes are related to varying levels of SA prior to the decision-making process). It seems reasonable to assume that the same is occurring in the healthcare field – hence the emergence of "root cause analysis" of adverse events. Unfortunately the litigious environment of healthcare prevents the dissemination and aggregation of learning discovered within these explorations, thus negatively impacting the industry's ability to rapidly improve. The industry has decided to place the emphasis on developing practitioner's that have attitudes that emphasize a continuous improvement mentality (Cronenwett et al., 2007).

This research study proposes to try to design HFSs to facilitate development of SA as a guiding skill in decision-making. The study will borrow from the theoretical frameworks of naturalistic decision-making using Endsley's (1997) SA model to create an environment to study decision-making within the domain of nursing practice. It is believed that there is some transferred applicability of how improvement of SA improves decision-making that can be demonstrated using HFS as the medium. This type of explorative research is imperative in order to justify the expense and time investments in HFS labs. It is also critical to producing nursing providers that are able to make accurate, timely decisions in our chaotic health care environment.

Understanding how HFS works as a knowledge building and knowledge using process is one desired outcome of this research project. Because nursing is a practice that generates and accumulates knowledge through action, utilizing a research methodology that captures the embodied nature of clinical judgment development in its natural environment is appropriate.

A four-step process of pre-planning, briefing, simulation, and debriefing and reflection will be utilized to maximize the simulation experience to produce experiential learning. HFS is not just about the practice of psychomotor skills or the "experience" of a certain type of patient. This study believes that HFS can contribute to better decision-making by creating the learning environment that involves the identification of goals, cues, and patterns to formulate working mental models. This improvement of SA should develop the expertise of nursing students faster in order to make a more optimal transition to the "real" health care setting. The point of HFS is not just to frontload the practitioner with experience and a place to practice, but to maximize this experience to facilitate the decision-making capability of a much more seasoned practitioner without the years of practice.

Chapter 3: Methodology

The nurse's responsibility for patient care in today's healthcare environment has become increasingly complex. The scope, depth, and complexity of patient care require that the bedside nurse possesses the ability to think quickly and adapt to change. A strong focus on maintaining patient safety is one of the ultimate outcomes of nursing care. The standard model of teaching nursing practice for the last four decades has not varied -utilizing the traditional lecture to teach didactic knowledge and clinical to apply psychomotor skill acquisition using an apprenticeship model (Tanner, 2006). Gaining the expertise necessary to navigate the fast pace and ever-changing focus of today's healthcare environment takes years to accumulate. Research demonstrates that new graduate nurses are not prepared to practice in this environment (Benner et al., 2002; Del Bueno, 2001, 2005). Deficits have been documented in the skills of communication and collaboration. New graduates have difficulty recognizing the early manifestations of disease complications and demonstrate an inability to practice outside of proceduralized rituals (Del Bueno, 2001, 2005). Rule based practice, although important, is not enough to get by in today's health care practice environment. Preparing nurses with experiential practice utilizing HFS must facilitate their ability to make decisions with ambiguous or incomplete information, under time pressure, and with high stakes outcomes. It is imperative that the nursing profession takes action to assure that there are ongoing research efforts to explore how teaching with HFS can address these issues.

Social learning theory suggests the value of context in learning. Fortunately, HFS provides a tool that is touted to speed up the pace of developing expertise while providing concrete practice to make it applicable in the real world setting. Finding the best way to utilize this tool to maximize the nurse's decision-making capability is an important research agenda for the profession. This qualitative research study proposed to provide data that would assist the nurse educator in creating a learning environment using HFS that maximized a student's ability for decision-making. Since the technology of HFS is relatively new and the existence of a standardized framework for conducting HFS is still emerging practice, a design experiment was used to create the most effective learning approach to achieve the goal of improved decision-making. The study proposed a standardized framework to utilize in conjunction with HFS. A four-step framework was created employing specific instructional techniques at each step to create a learning environment that enhanced the development of SA. As demonstrated in the literature review focusing on naturalistic decision-making, developing SA is a key skill to improve decision-making in complex and changing environments. The study focused on refining the ability of participants to demonstrate perception and comprehension SA during the HFS.

Research Purpose

The basic premise of this research was to gain a deeper understanding of how the structure of HFS teaching could be altered to improve SA and decision-making in second semester baccalaureate nursing students. Design-based research recognizes that the initial assumptions of the research design may change during the implementation phase of the research. Additions and deletions to the selected instructional methods utilized were based on findings that emerged during the actual research experience. Preliminary research questions that were used to inform the data analysis included:

1. How does the process of high fidelity simulation contribute to situation awareness acquisition, specifically Level 1 and Level 2?
2. What changes in the teaching strategies employed during the high fidelity simulation improve the impact of simulation on the acquisition of these skills?
3. What specific instructional techniques may be implemented or included by faculty to emphasize development of the perception and comprehension skills of nursing students?

Methods

In keeping with the theoretical premise regarding contextual learning, a primarily qualitative method was utilized to provide the richness of data necessary to describe and understand learning in a HFS environment. This naturalist inquiry methodology allowed the researcher to explore the impact of environment, identity formation, and social processes to gain a holistic view of the learning process during HFS.

It was believed that the design for teaching utilizing HFS could produce better decision-making among the participants. The NLN study conducted by Jeffries and Rizzolo (2005) concluded that the general premise of goal directed learning set within a problem based context, debriefing, and providing expert feedback were necessary characteristics of simulation design. This research study took the foundational premise of that work and tried to further refine the best methods for conducting HFS to guide toward an outcome of improved SA.

Using a design based research approach, this study will utilize a two-phased approach. It is believed that the evolutionary process of data collection and analysis will create a deeper understanding regarding the design of HFS. Phase two will be conducted upon completion of the data analysis from Phase I. The hope is to utilize the observations, reflections, and experience gathered from Phase I to improve the design of the second iteration of the research.

Context of Research

Setting

University X, a public, state university in Southern California subscribed to the use of HFS within the nursing curriculum. University X has three different tracts to obtain a RN license: the traditional program (a three year program, summers off); the trimester program (a two year program); and an accelerated program for students who have already attained a previous degree called the entry-level masters program (ELM) (an 18 month compressed schedule). The time over which curriculum is delivered was the major difference between the three tracts. Each tract used HFS as a tool to augment learning. The trimester program integrated HFS consistently throughout the first four semesters; therefore the students enrolled in this program were utilized to provide the sample population for the study. Demographic data, including but not limited to gender, age, race/ethnicity, English language status, and grade point average (GPA), was collected to understand the variables that could impact the data (Appendix A).

Sample

Students who had completed the second semester of nursing school in the trimester program track were recruited as participants for the study. The second semester nursing curriculum centers on basic medical surgical nursing skills and knowledge. During this semester there is a significant amount of didactic knowledge provided to students to guide their clinical practice. Content presented during this semester lays the foundation for clinical judgment development. It was assumed that a minimal level of decision-making competency was achieved when the student received a passing grade of "C" in this semester of work.

Twenty one students participated on a voluntary basis to formulate the sample for the study. The total trimester student population at this semester at the time of study consisted of 44 students. Because faculty and students from the trimester program were experienced in the use of HFS it was not necessary to provide a detailed orientation to the process of HFS prior to beginning the research process. This familiarity should negate any variation that might have occurred in the data related to a learning curve regarding the use of HFS.

Unit of Analysis

The unit of analysis for the study was the HFS event. This included: pre-planning, briefing, simulation practice, debriefing and journal reflection. It was believed that the suggested sequence of HFS noted here would be intricately linked to the development of SA in nursing students during simulation. Improvements for design took place within one or all parts of the HFS scenario after aggregating and analyzing data.

It was understood that the random assignment of students into groups might produce group dynamics that negatively or positively influenced the study results. Therefore, the HFS was conducted four times in each phase prior to data analysis to minimize this phenomenon. Students assumed the role of key informant during the data analysis of this project. Video/audio taping was utilized to provide prompts for the students to remember their thoughts and perceptions during the simulation as part of the debriefing stage. These tapes were also utilized by the researcher to provide clarification about behavioral observations made during each stage of the standardized framework. Additionally, a review of student journaling about their perceptions, actions, and plans for improvement was conducted to provide information to strengthen the design of the HFS standardized framework.

Human Subjects Protection

It was recognized that students fall into the category of a vulnerable population and it was important that their rights were protected throughout the study. This was accomplished in the following ways. Students participated in the study as an independent activity and received informed consent that this participation would not positively or negatively impact or influence their standing in the nursing program. Students were informed regarding the nature, scope and intent of the proposed research study. Written consent reiterated that the purpose of the study was to develop new simulation procedures with the goal of creating a better learning experience not to evaluate the competency of the participants (Appendix B). Participants were given a gift card as a token of appreciation at the end of the study. This gift card was offered whether the participant completed the study or not. A waiver to videotape/audiotape during simulation was currently in use as part of the curriculum at University X and each participant had previously signed this agreement. Confidentiality procedures, i.e. consent forms, audio/visual recordings and field notes are being kept in the researcher's locked file cabinet for the duration of the research study and for a period of three years thereafter. A coding system has been used to preserve anonymity of the research participants.

Description of High Fidelity Simulation Design

The company Medical Education Technology Incorporated (METI) developed the high fidelity simulator utilized for the study. In addition to the HFS simulator, METI has designed a series of programmed simulated clinical experiences (SCE) to be utilized with their simulators. The simulated clinical experiences, utilizing evidence based practice guidelines, have identified minimal behavioral outcomes expected of nursing student's during the HFS experience. These SCEs have been organized through METI's Program for Nursing Curriculum Integration (PNCI) to correspond to the level of clinical nursing practice during a specific semester of nursing school curriculum ("Medical," n.d.). The high fidelity scenario utilized (with permission from METI) comes from the basic Medical Surgical portion of the PNCI that correlates to the clinical competency level of the volunteer nursing students in this study.

The minimal expected behaviors outlined within METI's SCE, combined with a goal directed task analysis (GDTA) developed by the researcher, were utilized to produce an observational tool for the simulation practice phase of the HFS. The researcher then incorporated each core behavior into an observational rubric that utilized a framework of SA (Appendix C). The observational rubric had an expected performance score on cue (perception) and pattern recognition (comprehension) behaviors that was used to quantify outcomes of participants for the purpose of generating the changes for Phase II of the study.

The Chronic Heart Failure (CHF) Exacerbation PNCI SCE was chosen as the HFS scenario utilized in this research project. This scenario provided a foundational learning opportunity related to a dynamically changing patient condition. It was also identified as a high volume type of patient for the students of the trimester program based on the patient population of the hospital that they practice within. Additionally, there was a potentially lethal patient outcome if care was not managed appropriately which created a time pressure and high stakes outcome environment for decision-making. The details of the scenario and pre-planning questions are included for review (Appendix D).

The selected simulation relied upon the nurse's ability to perform a multi-faceted assessment and to recognize patterns rather than just individual cues to guide nursing care interventions. The pre-planning phase for this scenario required participants to focus on the pathophysiologic presentation of the client with congestive heart failure. If critical patterns of the pathophysiology of CHF were not recognized, the patient's decompensation would require emergency intervention. Additionally, the simulation required application of learned psychosocial and interpersonal communication skills.

Data Collection

Four methods of collection of data were used during the project (Table 2):

1. Self-reported survey data generated by the participants to understand preferences and to create census information regarding the tested group,
2. Direct observation of the HFS learning experience (designed as a four phase process).
3. Lasater Clinical Judgment Tool (2007) to identify individual performance for personal feedback to participants.
4. Review of knowledge/learning demonstrated through pre planning care plans and post simulation journals.

All data analysis was retrospective in nature. Data were collected at each stage of the HFS event.

Table 2.

HFS Data Collection and Analysis Plan

Framework	Instructional Design/ Technique	Data Collection	Data Analysis
Question and Answer; Nursing Care Plan (NCP) development	Nursing Process	Review of CIS for key assessments, plans, and interventions	Identification of correct pathophysiology, nursing diagnosis and plan of care
Pre Simulation Conference (Briefing)	Mind mapping using goal directed task analysis	Videotape/ Audiotape, direct observation field notes	Identification of key areas of assessment/reassessment, safety, communication, and planning care
Simulation Scenario	Goal Directed task Analysis	Videotape/ Audiotape, Direct observation field notes	Implementation of mind map created in pre simulation conference
Debriefing	Crew resource Management	Videotape/ Audiotape, Direct Observation field notes	Reflection on what went well, what could be improved, what was learned. Focus on teamwork, task management, communication and application to “real” world setting
Reflective Journaling (to be completed in the debriefing stage)	Reflection-on-action	Review of journal for thematic material regarding learning experience	Identification of personal opportunities to improve with development of a specific plan to accomplish it

Direct Observation

The researcher assumed the role as an overt participant/observer during simulation. This was done in all phases of the HFS process as outlined above. Detailed field notes describing the richness of the HFS process were taken during each phase of the simulation process. Video and/or audiotaping were conducted simultaneously during each phase and utilized for further analysis as a method of clarification after the actual events. The process of aggregating and coding data was started by utilizing a framework consistent for observing in a participatory, immersive, social constructed environment of practice – minimally looking at the environment, artifacts and tools, identity formation/role identification, and social environment. During the simulation practice phase a behavioral observation tool was utilized to provide the researcher with a rubric for identifying important behaviors of SA during the simulation (Appendix C). This observational tool was created using a GDTA methodology in keeping with the theoretical premise of SA. The tool identified fundamental expectations of performance during the HFS that would indicate if the behaviors of perception and comprehension related to cue recognition and pattern formation were present. Additional comments were noted in written format to describe events, environmental factors, social interactions that occurred outside of the expected behaviors listed in the rubric. This notation was done to capture rich detail while in the moment of the simulation. Expected behavioral outcomes that indicated a presence of SA1 Perception, SA2 Comprehension, and SA3 Projection were utilized to determine whether there was a transfer of learning into practice.

The data gathered from the analysis of Phase I was used to alter the design of the HFS to improve the learning process. This alteration took place before Phase II simulations were conducted. All aspects of data collection and analysis were repeated in the same manner as outlined above after the Phase II simulations were completed. Detailed notes were kept by the researcher to document the alterations that were made to the design of the research in order to preserve the historical evolution of the process for research reporting. All data captured from each session of HFS (total of seven sessions) was reviewed and categorized on the same day as the simulation practice took place in order to document the richness of the experience. Each simulation session was reviewed a second time upon completion of Phase I and Phase II in order to capture any data that might have been missed or misunderstood during the first analysis. This second round of review was completed in one continuous sitting so as to keep the researcher in the moment. This two-pronged approach was an attempt to clarify understandings and an attempt to maintain trustworthiness and credibility of the data. It was important to keep the understanding of the experience as true to the experience of the participants as possible in order to reflect the original experience (Creswell, 2003; Speziale & Carpenter, 2003). Additional informal interviews with students were planned to take place as a clarifying tool, but were not deemed necessary due to the richness of the audio/videotaping that took place.

Lasater Clinical Judgment in Practice Rubric

The Lasater Clinical Judgment in Practice Rubric (Lasater, 2007) was used as a benefit to the participants for taking part in the research study (Appendix E). The desired outcome was to give each participant meaningful and specific feedback regarding his/her performance during the simulation. It was also used as a screening tool to indicate when post simulation directed journaling would take place in an effort to gather deeper understanding from participants who did not perform at a 2.0 level in noticing and interpreting. The researcher conducting the simulation administered this evaluation.

The Laster Clinical Judgment Rubric (2007) evaluated four areas of clinical judgment development: noticing, interpreting, responding, and evaluating. The literature review identified that effective responding and effective evaluation are two areas that have been explored regarding learning with HFS. For the purpose of this study, the dimensions of noticing, interpreting, and reflection were the most consistent with the development of SA and were identified as the focus. It proved valuable to understand how simulation developed the learner's ability to observe, seek information, and recognize deviations from expected patterns. The use of a standardized tool was helpful in establishing a framework for conversations about learning during simulation.

Journaling During Debriefing

A coding rubric was used to provide the framework for evaluation of the journaling that participants did during the debriefing phase of simulation (Appendix F). The coding tool was created using specific themes from the literature that have been documented to improve or decrease SA. Transcribed statements were matched with themes reflecting either improvements or reductions in the SA behaviors of the participants. This data was utilized to create changes in the educational techniques used in the research design to improve behavioral demonstration of SA in Phase II of the research.

Procedures

Recruitment of Participants

Participants for the study were recruited using email communication on at least three separate occasions over a three-week period (Appendix G). Phase one consisted of 12 students who were randomly assigned to four groups to participate in the HFS. Phase two consisted of 9 students who were randomly assigned to three groups. The original design had intended for each phase to have 12 students. However, this was altered based on lack exhaustion of interest of the volunteer pool. Despite the unplanned alteration, each phase of the study was still able to run multiple simulations in order to compensate for the potential impact that individual group dynamics might have on the results.

Demographics

A survey (Appendix A) was distributed to participants to gain understanding of the demographics of participants in each of the phases. The results of survey demonstrated similarity in the categories of age, language, and grade point average between the groups in Phase I and Phase II. Ethnicity and gender were different between the two groups, however this was not seen as a factor that influenced the results of the study.

Phase I Participants

As expected, females outnumbered males 83% to 17%. The age demographic ranged from 21 years to 46 years, with a mean age of 24. Ethnicity was varied with 50% classified as White, 33% Asian, and 8.5% respectively as Hispanic and African American. English was the primary language of 92% of the participants. Grade point average ranged from 3.2 to 3.9, with a mean of 3.5.

Phase II Participants

Phase II participants showed a slightly different picture in the categories of gender and ethnicity. Gender was almost equally distributed in this group with 55% female and 45% male participants. Ethnicity was reported as 55% Asian, 22.5% White, and 22.5% Hispanic. Age ranged from 21 years to 33 years, with the mean at 24 years. 100% of the participants in Phase II spoke English as their primary language. Grade point average ranged from 3.0 to 3.8 with the mean at 3.4.

High Fidelity Simulation Plan

The HFS simulation framework (Table 3) was defined as a four-step procedure incorporating a pre-planning, briefing, simulation practice, and debriefing/reflective journaling. The HFS simulation event followed a format that dedicated one hour of time spent in each step of the plan.

Table 3.

High Fidelity Simulation Plan

Task	Type of Activity	Time
Pre-planning development of Nursing care plan and concept map of pathophysiology (Appendix H)	Individual	1 hour
Pre Simulation Conference/Briefing	Group	1 hour
Simulation Practice Scenario	Group	1 hour
Debriefing	Group	1 hour

Step 1: Pre-planning. The entire process of running a scenario for HFS was grounded within the problem based context of the patient scenario. As mentioned

previously this would be the Exacerbation of CHF SCE provided through METI's PNCI product (Appendix D). Prior to coming to simulation, as an individual activity, participants were asked to review the basic tenants of the designated scenario. It was expected that this written review would minimally consist of a pathophysiology concept map, identified priority nursing diagnosis, and a corresponding goal and plan for resolution of the problem identified in the nursing diagnosis. This format follows the Nursing Process that is a foundational concept in nursing practice. Expert practitioners in the field of nursing have routinized these mental models of care within their LTM. The purpose of pre-planning for the participant was to provide him or her with an opportunity to formulate a plan of care for the patient. This planning forced the HFS participant to explore development of a mental model of care to project the actual and potential interventions that might occur when caring for this particular type of patient. Additionally, included in the SCE format, learners were provided with exploratory questions to augment their knowledge base for performance of this particular scenario (Appendix D).

Using the terminology of the SA model, the participants were expected to identify the goals of care and choose a normative mental model of the expected course of that care. The development of the concept map and nursing care plan identified the participant's individual thought processes about the care of this type of patient. The models chosen by the participant represented a cohesive understanding of his/her tentative theories for action. The cues and patterns identified in the pre-planning phase marked the preliminary decision-making guide for the participant during the simulation practice step.

One student from each phase failed to complete the requested pre-planning activity. All completed documents were reviewed and compared to an answer key and model CIS (Appendix H). It was expected that the participants would write a narrative description of the pathophysiology of Congestive Heart Failure describing both right and left sided failure that integrated an analysis of expected signs and symptoms, diagnostic alterations, and appropriate interventions, including medications. One hundred percent of the participants who completed the preplanning assignment were able to demonstrate an adequate level of individual knowledge in the pathophysiology and question answering portions of the preplanning activity prior to coming to the simulation day.

A list of priority nursing diagnoses was developed that related to the scenario. It was hoped that participants would choose to plan care using one of the priority nursing problems identified as: Fluid Volume Overload, Impaired gas exchange, Decreased Cardiac Output, Anxiety, and/or Impaired Healthcare maintenance management. Other less priority alternatives could include: Ineffective Breathing Pattern, Altered Tissue Perfusion: Cardiovascular, Altered Urinary elimination, Risk for Caregiver role strain, and/or Ineffective Individual Therapeutic regime management. Priority goals and interventions were compared against the key (Appendix I). Eighty-three percent chose nursing diagnosis from the priority listing while the remaining 27% chose from the secondary list. The frequency of use was as follows: Fluid Volume Overload - 33%, Decreased Cardiac output - 50%, Ineffective Breathing and Altered tissue perfusion with 8.5% respectively. Of note, in Phase I of the study, there were no psychosocial care plans identified from any individual.

It is important to note that this pre-planning practice is required of a student prior to caring for a patient on a "real" clinical day. It is a non-negotiable process that occurs in order to supplement the student's knowledge base and provide a beginner's guide for safe patient care. Students who do not adequately prepare to safeguard patient care (in simulation or in clinical apprenticeship) are sent home. This expectation corresponds to the concept of realism that is necessary to suspend disbelief during simulation practice.

Step 2: Briefing. The briefing stage was utilized to create a team developed, goal oriented mental map regarding the care of the simulated patient. Briefing sessions of one hour in length took place prior to each of the four simulation practice settings. During the pre-simulation meeting, the participant's individual understandings were shared in a group setting as an attempt to create deeper meaning. Social context and dynamic group interaction are parts of the HFS that require some negotiation. Pre-briefing provides the team with the opportunity to formulate specific, consensus driven goals. This technique has been modeled in aviation and the military for the past two decades (Prince & Salas, 1998). Because SA is driven by goal selection and influenced by prioritization and time management it made sense that the team formulates mutual goals to guide their performance together. Pre-briefing has been specifically helpful in improving SA within contexts of new situations (Endsley & Robertson, 2000). Minimally, the environment, roles, goals, and social interactions necessary for a successful nurse-patient interaction were reviewed and refined during this phase. This process was mapped on a whiteboard using concept mapping principles to obtain a visual display of the care of the patient prior to engaging in the actual simulation practice. Pre-briefing has been found helpful to mediate deterioration of SA during practice when there are high cognitive demands, situations of ambiguity, and time pressure (Orasanu & Fischer, 1997).

The researcher facilitated the development of the maps by creating a visualization of the ideas, concepts, interventions and goals identified by the participant. The researcher's expertise provided rich descriptions of theory and experience to illustrate the links between perception and comprehension that a novice would lack. The facilitator was guided by the GDTA (Appendix J). The GDTA identified decision-making steps and pertinent cues and patterns for the HFS of CHF. Behavioral task analysis is not a new concept. It has been utilized in research for decades as an acceptable methodology to understand the concrete aspects of task performance. Crandall and Getchell-Reiter (1993) took the concept to a different level by focusing the analysis around the dynamic information needed to make a decision, renaming it GDTA. This concept mapping activity was videotaped and reviewed twice during data analysis to identify all ideas discussed by the group.

The action of defending and explaining individual choices with respect to their own model helped the learner move beyond memorized facts and concepts toward an evolving understanding of care that was inclusive and collaborative. CRM suggests that adults learn and remember more when actively participating versus receiving a lecture (McDonnell et al., 1997). CRM techniques have also been demonstrated to improve SA of the team by improving the ability to communicate directly with team members (Prince & Salas, 1998). This collaborative understanding provided the basis for competent action as the group proceeded into the HFS.

Each map was unique to the distributed knowledge of the individual cohort of three participants. During the briefing participants were asked to identify the following topics: (a) priority systems for assessment, (b) primary patient problem and goal for resolution, (c) nursing interventions, and (d) evaluation points. The results of the concept mapping activity revealed some interesting results. Universally participants mapped information regarding the cardiovascular, respiratory, urinary, neurological, peripheral vascular and medication assessment (Table 4).

Table 4.

Phase I Concept Mapping Cues

	Cardiovascular	Respiratory	Urinary	Neuro	Peripheral Vascular	Medications	Anxiety (25%)
Assessment	Heart rate (100%)	Respiratory Rate (100%)	Urinary Output (100%)	Level of Consciousness (100%)	Capillary refill (0%)	Lasix (100%)	Patient verbalization (25%)
	Heart sounds (100%)	Lung Sounds (100%)			Edema (100%)	Digoxin (100%)	Heart rate (25%)
	Heart Rhythm (100%)	Respiratory rhythm/effort (100%)			Peripheral pulses (100%)	ACEI (100%)	Respiratory rate (25%)
	Blood Pressure (100%)	Pulse Oximetry (100%)				Beta Blockers (100%)	Blood Pressure (25%)
	Jugular Vein Distention (100%)	Use of Oxygen (100%)					
	Edema (100%)	Circumoral cyanosis (0%)					
	Weight gain (0%)	Fatigue (0%)					
Diagnostics	Chest X ray, Echocardiogram, BNP (100%)	Chest Xray, ABG's (100%)	BUN, Cr levels (100%)				
Interventions	Administer Lasix (100%)	Manage oxygenation (100%)	Manage output (100%)	Monitor for changes in LOC (100%)	Sequential Compression Device (100%)	Monitor potassium levels (100%)	Talk with patient, therapeutic touch (25%)
Evaluation	Decrease in abnormalities: heart sounds, JVD, edema, BP Monitor to prevent rhythm changes, fluid restriction (100%)	> 92% pulse oxygenation (100%)	> 30 ml output every hour (100%)	LOC checks (100%)	Deep Vein Thrombosis assessment (100%)	Urine output, heart rhythm stabilization, (100%)	Decrease in physical s/s of anxiety (25%)

Equally universally, the maps were void of the discrete assessment cues of: weight gain, circumoral cyanosis, fatigue, and capillary refill. Psychosocial goal management was only mapped in one of the four groups.

Step 3: Scenario Demonstration. The actual scenario provided each group the opportunity to apply their collaborative plan and knowledge in a dynamically changing scenario. The patient simulator's responses were based on the learner's interventions and the interventions were dependent upon the patient's response within the environment. It is this reciprocal relationship and the evolving expertise of the group that created an opportunity to evaluate the evolution of SA during this phase of training. Four separate HFS simulations of the CHF patient were conducted during Phase I. The time for completion of the simulation ranged from 31 minutes 50 seconds, to 43 minutes and 37 seconds, with the mean being 35 minutes and 45 seconds. The non-interruption technique was utilized for this phase of the research design to maintain the fidelity of the simulation. The researcher role during the simulation step was to note areas during the scenario that would be utilized for review and discussion within the debriefing phase. The researcher did not have a role in the conduction of the simulation, but participated as a data collector during the event.

In the Phase I design, participants were allowed to choose their own role designation for the simulation. Universally, this was assigned according to tasks - one participant did all the interventions, one participant did the physical assessment, and one participant did the data collection on the whiteboard in the room. There was not a lot of thought put into other aspects of role delineation such as conflict management, leadership, and communication. This led to an observed tunneling of activity based on their assigned tasks and contributed to time delays in action. This was observed on the videotapes as people waiting for individuals to complete their tasks prior to embarking on the next level of intervention with the patient and/or physician, ignoring the patient verbalizations of anxiety, and uncertainty of how to proceed once the task was completed. There was not a lot of consensus checking among the group, nor did they utilize each other to deal with their uncertainties.

The CHF data collection tool (Appendix C) was used to document behaviors that were demonstrated during the simulation practice phase of the experiment. This tool identified seven areas of performance that would demonstrate acceptable performance of the HFS related to management of the patient. These areas were: congestive heart failure management, hypoxia management, decreased kidney function management, decreased peripheral vascular function management, anxiety management, medication administration, and recognition of resolution. Each of the seven management patterns was further designated into behaviors of Perception, Comprehension, and Projection to reflect the demonstration of SA behaviors in these areas. The researcher gathered data during the simulation practice of each group. The video/audiotape of the HFS simulation was reviewed a second time (after the completion of all four HFS simulations) and the tool was used again to assure a comprehensive description of what transpired during the simulation state. At the end of data re-review the results were aggregated to determine if the expected behaviors of perception (SA1) and comprehension (SA2) took place during the HFS.

All four groups performed according to expectation in the areas of hypoxia management, medication administration, and recognition of resolution meeting the expected thresholds for performance. Participants demonstrated confidence and speed of action when intervening to improve respiratory ability. Phone conversations with physicians utilized excellent description of situation, background, assessment, and response (SBAR) - accurately painting the picture of the patient to obtain the necessary treatment. In review of the concept maps created in pre briefing, these areas were discussed and outlined in much detail regarding goals and interventions. Two physical assessment indicators (perception) for respiratory management; circumoral cyanosis and fatigue were missing from 100% of simulation performance as well as from the pre-briefing concept map.

All four groups had difficulty with the congestive heart failure management. There were problems identified in both the perception and comprehension categories. In the perception category, all groups missed completing a urinary assessment (perception) and informing the physician of lack of urine output (comprehension). The urinary assessment began for 75% of the groups after the administration of Lasix as a treatment for the CHF. Universally all groups also had difficulty with assessment of jugular vein distention (JVD), capillary refill, weight gain, and heart sounds. When comparing the "action" during the simulation to the "plan" developed in the pre-briefing phase it was noted that all groups had failed to identify capillary refill and weight assessment in their concept maps. JVD, and abnormal heart sounds, however, had been identified as key assessment cues.

The HPS manikin used for this research had some limitations in fidelity that might have affected the participant's ability to detect two of these indicators. JVD cannot be detected visually and the heart sounds are complicated by the mechanical sounds of the simulator's operation making them hard to distinguish. Hearing abnormalities in heart sounds is also considered to be a skill that requires expertise and considerable practice that might not have been developed enough within this level of participant.

Anxiety management was another key pattern where 100% of the groups encountered difficulty. The recognition of anxiety as a manageable symptom failed to be noted in 50% of the groups. Seventy-five percent of the groups could readily tell that the physical parameters of heart rate, blood pressure, and respiratory rate continued to be elevated, but failed to connect it to the verbalizations of anxiety from the patient. Participants were more concerned with the tasks surrounding oxygen management and rarely interacted with the patient or stopped to listen to the patient's complaints. When comparing this to the concept map developed in pre-briefing it was noted that the psychosocial aspects of patient care had not been mapped out in the same manner that the physical aspects had in 75% of the maps. The one group that mapped anxiety as having an impact on the management of CHF (in terms of physiologic signs and symptoms) was the group that actually managed the anxiety during the simulation.

Three out of four groups had difficulty with urinary assessment. The assessment of the urinary system for these three groups did not even begin until after the medication, Lasix had been administered. Additionally, the slightly high BUN and Cr levels were not assessed for normality nor discussed with the physician during phone calls. It was noted in the debriefing discussions that the participants had not recognized the abnormal lab values because they had not memorized the normal ranges for lab values. In the hospital setting the normal range values were always present on the report.

After the second review of video/audio tapes it was noted by the researcher that performance time of key indicators should be reviewed. HFS creates a time-pressured state that relates to real practice. It made sense that time sensitive interventions would be monitored to see if improvement could be measured based on improved SA. The researcher chose the following interventions to note timeliness: completion of physical assessment, insertion of foley catheter, first phone call to physician, and administration of Lasix. Research indicates that improved SA translates to faster recognition of trends, which allows for a faster reaction to events (Endsley & Robertson, 2000). The chosen timed interventions generate additional important information to guide the care of the CHF patient during the HFS. The videotapes were reviewed a third time (during Phase I only) to identify the time frames for each of these interventions. There were no expected time frames for completion of these interventions identified.

After completion of the HFS each participant was individually rated regarding his/her performance by the researcher conducting the simulation using the modified Lasater Clinical Judgment Rubric (2007; Appendix E). This was utilized to provide the participant with feedback regarding his/her performance for his/her personal growth as an added benefit for participating in the research. Research has shown that students desire to receive individual and specific feedback regarding their own performance during simulation (Lasater, 2007; Nielsen et al., 2007). This information was also utilized to provide the researcher with a means to segment the study performers to collect additional data to utilize for improvement of the design of the curriculum. It was intended that participants who received an individual rating of lower than 2 on the Lasater scale in the categories of noticing, interpreting, and/or reflecting would be asked to do a directed journaling activity immediately after the debriefing phase of the simulation. There were no participants who met these criteria within either phase of the research.

Step 4: Debriefing and reflective journaling. Simulation debriefing took place immediately following the simulation practice phase. This was done in the same room that had been used for the pre-briefing. The concept map that had been created prior to simulation performance was present during the debriefing activity. A CRM style was utilized to conduct the debriefing. Participants were encouraged to have direct conversation with each other about performance while the researcher remained in the background acting as a facilitator when the conversations lagged. The researcher's role consisted of setting the expectations and rules of conduct for the event. During the debriefing the researcher again played the role of facilitator – drawing out quiet participants, integrating instructional points as needed, reinforcing positive aspects and ensuring that all critical topics are covered (McDonnell et al., 1997). Because the study worked with novice practitioners an intermediate level facilitation style which required some prompting of discussion or substantial supplementation of analysis was utilized (Appendix I). The supplemental analysis occurred only after the participants completed their own analysis.

The videotape and audiotape performance of the simulation was reviewed during the debriefing. It was at this time the group utilized reflection-on-action to understand what learning had occurred and identified opportunities for improvement in the future. The goal was for the participants to analyze and evaluate their group and individual performance. Studies have shown that students value this part of the simulation experience as a group activity (Lasater, 2007).

The researcher utilized a modified Situational Awareness Global Assessment Technique (SAGAT) methodology to elicit reflective feedback regarding the SA of the individual and group during the simulation. The technique, as designed by Mica Endsley (1997), is utilized to freeze performance during a simulation at a randomly selected time and engage the participants to discuss their current perceptions of the situation, thus providing rich data regarding the level of SA collected immediately at the interval.   For this study the technique was modified and utilized during the debriefing stage. The researcher chose two highlights of each team's simulation performance to view during debriefing. The components of the viewings varied based on the dynamics of the group. At least one of these reviews included an aspect of the simulation performance where action/care appeared to be difficult for the group. Immediately after viewing a videotape segment the participants were requested to write a journal note to describe what their individual thoughts were at the time of the highlighted performance. Participants were additionally prompted to identify the positive performance of the group and individuals as well as the opportunities and plan for improvement during this segment of the debriefing.

Reflection is considered one of the guiding principles of nursing learning and is an important part of the HFS process.   This stage of the simulation is not universally done. This study believed that this was where a large part of the individual learning of the student takes place. This activity was utilized to help the participant develop the skill of reflection-on-action, providing him/her and with a mechanism to plan for improvements in the future to develop SA level 3 (projection). Journals were explored for learning themes that demonstrated enhancements or difficulties with SA. The debriefing discussion resumed directly after the individual journaling activity so that the group could discuss their insights together.

Immediately following the debriefing, the researcher reviewed the journal segments using a coding rubric. This rubric (Appendix H) identified aspects documented in the literature that interfered or enhanced the performance of SA. Additional analysis was conducted by grouping/regrouping themes to validate previous assumptions and identify recurrent patterns. Category reduction is an essential component that helps identify what the core variables are (Creswell, 2003; Speziale & Carpenter, 2003). The original categories of perception, attention, pattern matching, synthesis, and short-term memory were collapsed into the following categories attention tunneling, knowledge deficit, action planning, and timeliness of action. These final categories embraced the core themes collected from the debriefing journals. This information was utilized to identify themes to improve the design of Phase II.

Data Based Design Revision

Design based research functions as an iterative process using the data collection and analysis to inform the next phase of the research. Examining the data and determining meaning was done after Phase I, producing an evolutionary transformation of the techniques that would be used during Phase II of the research. After aggregating the data to discern meaning, the researcher then went back to the literature to seek an understanding of additional techniques that might be able to be used to improve the acquisition of SA as it related to the specifics of this project's data. It was determined that two stages of HFS (briefing and simulation practice) would be changed in an attempt to improve SA.

Briefing

The data from Phase I identified two areas necessitating change in the briefing process. A pattern identified in the data showed participants had difficulty in HFS performance with recognition of discrete cues when they were not mapped within the pre-briefing map. The four groups had varied levels of expertise in caring for CHF patients therefore, it could be surmised that these subtle cues were missed based on gaps in their knowledge base. This was supported by the data that identified cues that were left off of the group developed concept map were subsequently left out of the HFS performance. The cues that were missing from concept mapping during phase I were: circumoral cyanosis, capillary refill, fatigue, and weight gain. Additionally, psychosocial goal of relieving anxiety were absent from 75% of the concept maps created during Phase I.

The literature identifies expertise as having a direct relationship to SA with relation to knowledge base, reference and context (Shebilske, Goetti, & Garland, 2000). During Phase II, the facilitator augmented the mind map development to make sure that all elements of the GDTA would be included in the concept map. Psychosocial problems were identified and mapped in the same manner as physical problems during the second phase. The researcher would wait until the group had exhausted their creation before adding information to their map that was missing according to the GDTA.

S*imulati*on

Videotaped performance of the groups highlighted that the participants demonstrated lapses in the continuous scanning behavior representative of SA. These lapses in SA had the potential to negatively impact the HFS performance in terms of timely action when caring for the patient. The journaling data identified that role assignment and poor communication contributed to these lapses. Two distinct changes were made to the simulation phase of the protocol based on to attempt to lessen or eliminate these lapses in SA.

Role Definition

In the Phase I design, participants were allowed to choose their own role designation for the simulation. Universally, this was assigned according to tasks - one participant did all the interventions, one participant did the physical assessment, and one participant did the data collection on the whiteboard in the room. There was not a lot of thought put into other aspects of role delineation such as conflict management, leadership, and communication. This led to an observed tunneling of activity based on their assigned tasks and contributed to time delays in action. This was observed on the videotapes as people waiting for individuals to complete their tasks prior to embarking on the next level of intervention with the patient and/or physician, ignoring the patient verbalizations of anxiety, and uncertainty of how to proceed once task was completed. There was not a lot of consensus checking among the group, nor did they utilize each other to deal with their uncertainties.

Role designation, particularly with group settings, has been identified as an important precursor for SA. Moray (1994) distinguished the difference between a team and a group to understand error production and to develop strategies to improve. Teams exist through the formulation of a common task with specified roles while a group is an informal collection of people. Phase two created roles that consisted of more than just a task assignment. These roles specifically addressed the importance of conflict management, leadership, and communication. The roles were identified as: primary nurse, associate nurse, and data analyst. The primary nurse had the responsibility for decision-making for the care of the patient. This responsibility included delegation and supervision of duties and management of conflict resolution. The associate nurse had the responsibility to coordinate distributed tasks and provide therapeutic communication (as a primary function) with the patient during the simulation. The data analyst was responsible for aggregating data for the group to provide a clear overview of what was occurring within the simulation. This individual remained on the periphery of the simulation in order to remain focused on the larger picture. Duties of this role included contact with the physician. The participants were allowed to choose their own roles as defined by the phase two definitions.

Verbalization Protocol

The second change in this portion of the protocol was to institute a "talk out loud" methodology. Participants were encouraged to think aloud to facilitate the ability of the group to understand what was going on during the simulation. While it was still preferable to run the simulation without interruption, it was noted in the first Phase that participants had difficulty moving forward when faced with a lack of individual knowledge or clear understanding of the group's direction. Verbal and non-verbal communication with others is a vital component of SA (Endsley, 1997). The literature supports a verbal protocol technique as improving SA by providing feedback loops to validate personal SA and match it with the team's SA (Endsley & Robertson, 2000). The Phase II design also included a mechanism to stop the simulation temporarily if participants were noted to be at a point of standstill. This pause would be employed to allow each member to state their thinking out loud, and then the simulation would be re-started. Again, the pause technique created a mandated checking of SA (without the interference of "teaching" during the HFS event) in order to move forward with the care of the patient.

Improvement of Fidelity

Simulation fidelity must represent believable and recognizable occurrences so that participants can be expected to react as they would in the real environment (Wickens, 2000). Additional changes were made to improve the fidelity of the simulation based on feedback received in the debriefing segment. Lab results used in the simulation were redesigned to include normal ranges. This was in response to the overwhelming lack of identification of decreased urinary output during HFS performance. The physical symptom of jugular vein distention was simulated by placing a small note on either side of the neck that stated JVD, to compensate for the poor fidelity of jugular vein distention on the simulator. Additional scripting was provided to the HFS operator to improve verbalization of anxiety.

Summary

HFS as a learning environment has the potential to positively impact the education of our future doctors and nurses. The potential benefits of reducing the time spent in apprenticeship type learning situations that take place over years of time could be a positive factor in helping hospitals manages the crisis of the nursing shortage. Understanding how to leverage the tool of the HFS using specific techniques to develop SA in novice health care professionals makes this a valuable learning tool. Focusing on the skill of SA will help us create thinking individuals who will be better prepared to deal with the complex and changing workplace of today's hospital. Improving the speed and accuracy of decision-making to prevent or minimize patient safety incidents can provide important ROI information for those trying to implement this expensive tool as a strategy in their organizations.

Chapter 4: Findings

This study intended to gather a rich understanding of how the design of HFS contributed to the development of Level 1 and Level II SA in baccalaureate nursing students. Jeffries (2005) introduced a simulation design framework to describe the necessary variables of teaching using HFS. The model identified five major components and additional relevant variables that should be considered when designing HFS. This study took the key concepts of Jeffries simulation model: a) fidelity, b) objectives, c) expertise, and d) reflective learning and applied specific teaching modalities to improve nursing student decision-making during the simulation experience. Using Endsley's (1997) framework of Situation Awareness, the design of the study outlined the delineation of perception and comprehension behaviors, often masked by expert practice, as key outcomes for simulation performance. This chapter presents the findings of the study and analysis of the data according to each of the research questions. The quotations presented in this chapter are personal communications from participants in the study elicited from January 18, 2010 to February 14, 2010.

The three research questions that guided the study were:

1. How does the design structure of high fidelity simulation instruction contribute to the development of Level I (cue recognition) and Level II (pattern recognition) situation awareness?

2. What design components of high fidelity simulation impact the acquisition of cue recognition and pattern recognition?

3. What instructional techniques may be implemented or included by faculty to emphasize development of cue and pattern recognition for situation awareness?

Demographics

The results of the pre simulation survey demonstrated similarity in the categories of age, language, and grade point average between the groups in Phase I and Phase II. Ethnicity and gender were different between the two groups, however this was not seen as a factor that influenced the results of the study. All 21 students had completed the second semester of nursing school with a grade of "C" or better. All students were volunteers for the study.

Phase I Participants

As expected, females outnumbered males 83% to 17%. The age demographic ranged from 21 years to 46 years, with a mean age of 24. Ethnicity was varied with 50% classified as White, 33% Asian, and 8.5% respectively as Hispanic and African American. English was the primary language of 92% of the participants. Grade point average ranged from 3.2 to 3.9, with a mean of 3.5.

Phase II Participants

Phase II participants showed a slightly different picture in the categories of gender and ethnicity. Gender was almost equally distributed in this group with 55% female and 45% male participants. Ethnicity was reported as 55% Asian, 22.5% White, and 22.5% Hispanic. Age ranged from 21 years to 33 years, with the mean at 24 years. 100% of the participants in Phase II spoke English as their primary language. Grade point average ranged from 3.0 to 3.8 with the mean at 3.4.

Research Question 1: How Does the design of High Fidelity Simulation Impact Learning Outcomes of Situation Awareness?

Pedagogical Model: Building Capacity for Situation Awareness

Design based research created an opportunity to study HFS from an inclusive perspective to understand how the structural design contributed to the learning outcome. A four-part HFS design (Pre-planning, briefing, simulation practice, and debriefing/reflection) was created for the research study. The design intended to scaffold the learning process; beginning with individual understanding, transforming into group practice, and culminating with reflective learning. Key features addressed within the design were: domain knowledge, cue recognition and pattern development, contextual deliberate practice, and building team capacity. Using an iterative format of design based research, data was gathered and analyzed to augment these important features by refining the teaching techniques to meet said outcomes.

Having a theoretical framework to guide instruction was an important feature of this research project. Understanding the goal of HFS in relation to an overarching objective of improving decision-making skills - specifically SA, created the ability to utilize evidence based instructional techniques to achieve them. Planning HFS experiences using evidence based teaching techniques is supported by the literature (Jeffries, 2005; Jeffries & Rizzolo, 2006). The ultimate goal of learning using HFS is the preparation of nurses who can positively impact patient care outcomes in an environment that necessitates customized interventions based on clinical judgment. Teaching techniques that are situated within context to develop recognition of cues and patterns assists in achievement of that goal.

HFS provides an excellent venue for teaching in context. It is well documented that knowledge and learning are dependent upon the context of the practice environment (Barab & Duffy, 2000; Benner, 1984; Lave, 1993). Nursing learning, in particular, is shaped through experiential patient care interactions that require the ability to individualize care and manage competing priorities (Benner, 2000; Kim, 1999). Naturalistic decision-making theory purports that training for this type of decision-making should focus more on understanding the situation in order to make better decisions.

Robertson and Endsley (1995) through their work with pilots, determined that simulation based training can enhance the SA skills that are necessary for effective decision-making. Additional literature supported that guided practice and feedback built into simulation practice can accelerate proficiency by exposing participants to real world situations while reinforcing strategic associations (Cannon-Bowers & Bell, 1997). Decision-making to develop the SA skills of perception, comprehension and projection can be trained for using a deliberate practice model. The question becomes how to design that experience to maximize the development of SA behaviors.

The design of this study used a staged approach to learning in an attempt to create multiple opportunities to maximize cue detection and pattern recognition in order to perform in the contextual case based learning environment. Just as knowledge cannot be separated from context, it was believed that the presence of these particular stages were intimately linked to the HFS performance. Each stage provided a scaffolding of learning opportunities to develop and practice the skills of SA. Feedback from the participant surveys indicated that the quality of the simulation practice was dependent upon individual and group preparation prior to the actual experience. Participant 017 stated, "I feel simulation is a *major* reference for real life decision-making."

Pre-planning: Supporting Domain Knowledge Acquisition

The target population being observed was one that had not mastered the domain knowledge of nursing. Theory tells us that SA is dependent upon a foundational knowledge base (Endsley et al., 2003). In order to maximize the participant's ability to make situation specific decisions within the HFS, preparation was required to augment their limited experience and knowledge base. The structural design of the simulation event created two phases prior to actual simulation practice to improve foundational knowledge to maximize their capacity for SA.

A pre-planning stage requiring participants to gain foundational knowledge of the disease process of congestive heart failure was implemented. This consisted of answering some knowledge driven questions pertaining to specifics of the simulated clinical experience and developing a plan of care for the patient. Participants identified that exploration of the disease process, problem definition, and actions planning prior to coming to the simulation experience were important steps to develop an individual mental model for action.

Data extracted from the self-reported survey from both phases of the research indicated that participants believed pre-planning activities were a "necessary evil" to provide for a positive simulation experience. "Pre-planning helps us to understand what kind of problems our patients might have" (Participant 018). Participant 015 stated, "pre-planning allows for the briefing session to be productive." There was a universal feeling that the success of the simulation would be negatively impacted if this step was not done.

Determination of a priority nursing diagnosis was a key pre-planning activity because of its influence over goal selection. SA theory indicated that the dynamics of context within decision-making are addressed through the identification of goals. Goal delineation created a definition of the situation, which allowed the participant to take action by filtering the activity surrounding him/her through the lens of the goal. Goals determined what environmental elements to pay attention to (from a top down perspective) as well as serving as a lens to catch important data (bottom up perspective) that might have evolved in the simulation (Endsley et al., 2003).

Choosing a priority nursing diagnosis was identified as an indicator of an individual's knowledge regarding the necessary care for a patient with CHF. Data analysis revealed that there were no significant differences between Phase I and Phase II with regard to building foundational knowledge through pre-planning (Table 5). Participants from both phases chose from the priority list of nursing diagnoses with decreased cardiac output being the most frequently chosen followed by fluid volume overload as secondary in frequency. Creating a plan of care stemming from these two most frequently chosen diagnoses indicated that the foundational knowledge assembled in preparation for HFS was on target to correctly care for the patient during simulation practice.

Table 5.

Foundational Nursing Diagnosis Comparison

Priority Nursing Diagnosis	Phase I	Phase II
Fluid Volume Overload	33%	23%
Decreased Cardiac Output	50%	56%
Anxiety	0%	0%
Impaired Health care Maintenance	0%	11%
Impaired Gas Exchange	0%	11%
Secondary list	27%	0%

Planning for psychosocial care of the patient was not strongly represented in either phase of the research. Only one participant, from the total of 21, chose a psychosocial nursing diagnosis during the pre-planning phase. This trend continued into the briefing stage, where only 25% of the concept maps created in Phase I identified Anxiety as a significant assessment factor for the simulation performance. Of particular interest was how this lack of psychosocial pre-planning had a negative impact on the participants' ability to manage the patient's anxiety during simulation practice in both phases of the experiment.

In Phase I participants recognized and managed the patient's anxiety 60.71% of the time. Phase II of the study implemented a change to augment the knowledge base of participants regarding anxiety and psychosocial problem recognition. Management of anxiety was added as a goal for the briefing concept mapping activity. Deconstructing the cues and interventions corresponding to anxiety management, as had been done with the physical problems, should result in improved HFS performance in this area. The results of Phase II behavioral analysis demonstrated that this intervention had a positive effect on HFS performance in terms of recognition of the problem (perception) moving from 60.71% to 80.95%. However, despite the improvement in results during Phase II, participants continued to experience difficulty in talking with the patient and relating the continuation of cardiovascular symptoms (i.e. increased heart rate, increased blood pressure after Lasix administration) to the psychosocial problem (comprehension), which contributed to the lack of 100% performance in Phase 2 in this area. This demonstrated a lack of pattern recognition or SA Level II. It is common for psychosocial stressors to augment and/or skew the symptoms that patients present with during assessment. Failure to recognize this interdependency could lead to misinterpretation of cues when assessing, as it did in both phases of this research. Faulty SA is often experienced by novice practitioners because of their reliance on rule base behaviors and the inability to manage the complexity and dynamics of the environment (Chi et al., 1981). Knowing procedure is not enough for decision-making, it requires a continual scanning of the environment and prioritization of the data in order to facilitate good decisions (Roth, 1997). HFS allows us to create a teaching environment where the skill of continuous assessment is deliberately practiced within a variable setting.

In retrospect, the results seem to indicate that additional pre-planning regarding managing psychosocial goals could be beneficial for improved HFS performance. This planning should specifically focus on identification of how stress and anxiety affect the physical parameters of assessment, as well as, development of therapeutic communication techniques to utilize to decrease anxiety.

Briefing: Managing Complexity, Setting Goals, and Maximizing Expertise

SA is negatively influenced by uncertainty, complexity, and team dynamics (Endsley et al., 2003). SA is also influenced by an individuals' expertise level. HFS produces a naturalistic environment where all of these negative influences could be present. The briefing stage of HFS was designed to create a mechanism to address ways to reduce uncertainty and complexity by creating an opportunity for the team to develop shared goals prior to entering into the HFS practice phase. Participants rated briefing as essential for good HFS practice. Most participants rated it higher than debriefing on the self-reported survey. Comments reflected sentiments such as Participant 015's statement, "helps clarify decision-making by organizing pre-planning ideas...would crash and burn without this part."

Simplifying Complexity

Complexity is a known variable that comes into play within a HFS that when unmanaged works directly against SA by reducing the ability to perceive and understand cues from the environment. A briefing activity was also seen as a way to reduce the complexity of the HFS by providing a mechanism to review and discuss the event prior to entering into practice. Briefings are a well-known and used tool within aviation and military training prior to engagement in simulated practice.

Complexity was addressed within the group process of briefing by allowing for discussion among the participants regarding different pathways to take, system dynamics, and predictability of change (Endsley et al., 2003). This gave the team the ability to address the uncertainty within their individual mental models created in the pre-planning activity. This shared mental model provided a common framework for organization and a shared identity to guide strategic planning for goal accomplishment within the HFS (Salas, Cannon-Bowers, & Johnston, 2001).

Goal Delineation

The importance of goal determination and its impact on SA has been extensively discussed throughout this research. The briefing stage, which was completed after the pre-planning stage, was seen as an extension of the knowledge building activity by creating a group experience to refine the foundational knowledge base. The group briefing activity established mutual goal formation that was used by the team during the simulation practice stage.

Importance of Distributed Knowledge Discovered

The design of using small groups to conduct HFS was influenced by the setting at University X. It has been discovered through experiential practice of using HFS at University X that groups larger than four resulted in dissatisfaction from the participants and an inability to engage all learners actively in the HFS activity. The design size of three per HFS cohort was chosen based on this experience. Literature supported the concept of smaller sized groups, however the "right" size has not been determined objectively.

As an outcome of this research, it was discovered that the design of working in small teams had additional benefits that were not overtly recognized during the creation of the initial design. The small group size allowed for an intimate environment for participants to share their individual plans of action with each other as indicated by

Participant 017, "Briefing helps with priority cues. It allows us to gain a different point of view from our peers." Participants identified that the group construction of the concept map helped them with the simulation practicum by leveraging the group's knowledge. The ability to visualize their plan of action on a whiteboard was also mentioned as a positive experience.

Prince and Salas (1998) studied preflight preparation of pilots and determined that there was considerable variation in the process based on the pilots' expertise level. The varied expertise resulted in a difference in focus during the briefing activity. Their research also discovered that bringing a group of pilots together in a briefing session resulted in the pilots developing a better mental picture of the environment specifically as it related to the ability to discuss priorities and identifying contingency planning actions. Group briefing was found to benefit novice pilots more so than those with multiple years of experience.

In this limited study, the design of small group setting had an unintended positive impact on the learning experience, as reported by participants, by creating an opportunity to leverage knowledge. This small group setting allowed for participants to scaffold their individual learning with the group's varied learning experiences resulting in an improved SA of the group during HFS performance. It is not clear whether it was the variable of the small group alone, or the instructional technique of concept mapping that created this improvement. Further research would be necessary to determine the impact of each of these variables.

Guiding Practice with Expertise

In Phase I, participants during briefing were allowed to create their own concept maps without the facilitator adding additional/missing content. It was expected that the pre-planning activity from the night before would allow participants to incorporate all elements of the GDTA in the concept map. Phase I results of the concept mapping activity demonstrated participant's confidence and ease in identifying the physical assessment components for a CHF patient. Participants were able to create maps that included most of the elements identified by the GDTAtool. The following discrete assessment elements were missing from all of the Phase I concept maps: weight gain, circumoral cyanosis, fatigue, capillary refill, and anxiety management. Subsequent performance during HFS practice indicated that assessment cues left out of the briefing concept map were also omitted in the simulation practice resulting in lower performance in CHF and anxiety management (Figure 3).

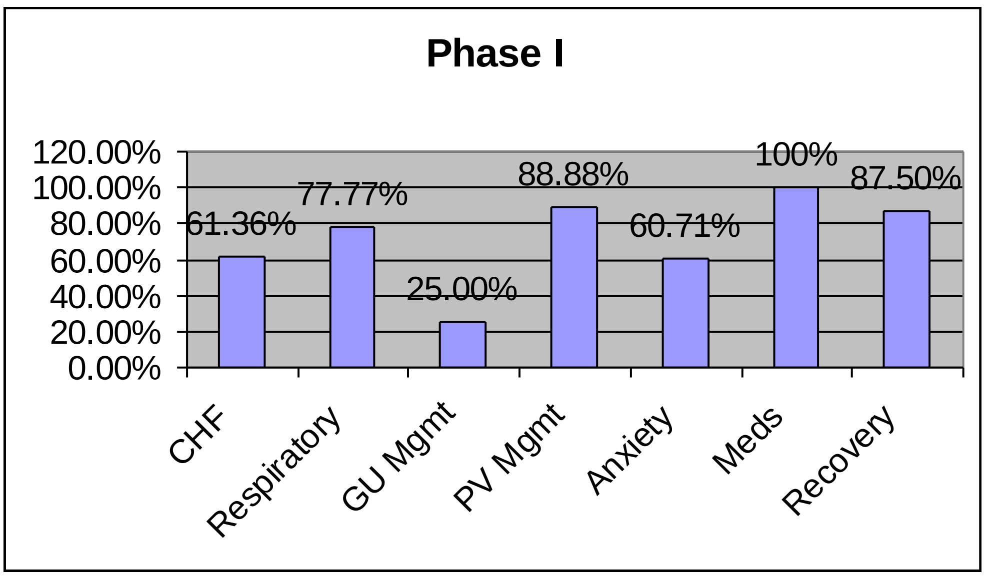

Figure 3. Phase 1 simulation performance for situation awareness

In retrospect it seems fairly obvious that the facilitator's expertise and ideal management plan (GDTA) for care of the CHF patient should somehow be overlaid on the process of concept map development in order to produce the best results for HFS participants. It became clear that the directed facilitation of the expert practitioner was an important factor in normative model development - especially with participants that were still learning in a professional domain. The Jeffries simulation model (2006) identifies the teacher role in facilitation as "essential to the success of using alternative learning experiences" (p. 3). Benner et al. (2010) describe the teaching role as coach allowing for students to "see and understand the nature of the context off patient's current clinical condition, the immediate history, the most urgent current concerns, and why they are urgent or salient" (p. 118). The facilitator role, as indicated by this research, served to provide the expert mentorship necessary for seeing the interconnection of cues and patterns within the clinical scenario. This was a necessary feature when working with newcomers to a domain of practice.

Phase II of the study continued briefing using concept mapping. The difference in Phase II was that the facilitator made sure the map was complete, after the team had completed their assembly, by adding missing elements or categories that were identified in the goal directed task analysis. Concept maps created in phase II matched the GDTA100%, yet the individual display of the data varied between groups based on their construction methodology. Performance in Phase II HFS practice did show improvement over Phase I in all areas of the expected care management goals. Marked improvement was noted in the areas of CHF and anxiety management (Figure 4). Concept mapping, however, did not guarantee that cues identified in briefing would be seen during performance as was the case with jugular vein distention, abnormal heart sounds, weight gain, edema, and abnormal lab values.

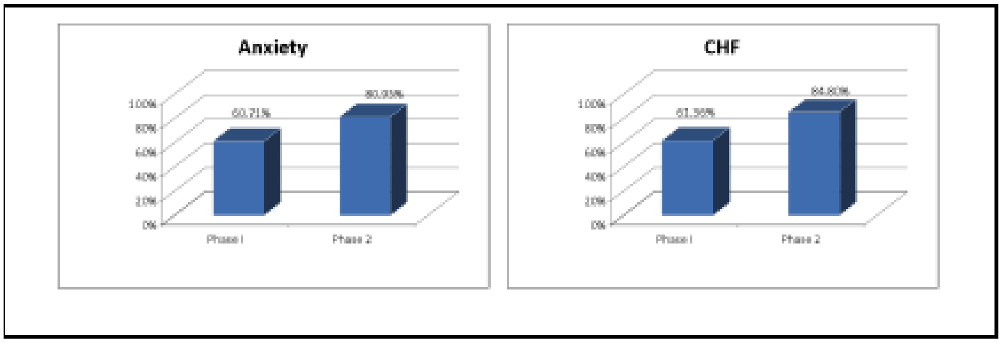

Figure 4. Phase II comparison of situation awareness and Phase I for anxiety and CHF management

Although omissions happened less frequently in Phase II than in Phase one, they still happened and it is unclear as to why. Fidelity could have been a factor in several of the specific cues that were missed. Another hypothesis could be related to information overload that commonly occurs when a novice practitioner is placed under time-pressured practice because of short-term memory overload (Endsley, 1997). A further investigation of this matter would have been beneficial. In the design of future experiments, the researcher would suggest adding an intervention to conduct further questioning after results were analyzed in order to understand what might have contributed to this type of phenomenon.

This study found that creation of a blueprint of action (GDTA) to guide the inclusiveness of concept mapping activities during briefing was able to positively influence a participant's performance during HFS. An additional finding was that the preparation of the instructor for the HFS had a strong influence in the development of pattern recognition, identification and prioritization of cues, and linking patterns together.

Simulation Practice: Demonstrating Behaviors of Situation Awareness

The design of the simulation practice stage emphasized the characteristics of time stress, shifting/competing goals, dynamic environment, and multiple players. All of these factors are present in "real world" care of patients. Although numerous knowledge building activities were built into the design, it was the actual performance under reality-based conditions that denoted whether didactic knowledge was transformed into practice.

Decision-making in the "real world" is an activity that takes place over time and depends on the continuous updating of information. It has the characteristics of continuous task control requiring feedback loops to check whether or not the intervention created resolution to the identified problem (Rasmussen, 1993). SA is the ability to continuously gather that data and target it as useful information to meet a specific goal. What was observed in this research was that managing the feedback loops and scanning activities of SA as a team required additional tools.

The creation of teams was part of the initial structural design for using HFS in order to accommodate training for multiple participants based on the needs of University X. The discovery made during the research process was that the dynamics of the team had an effect on the HFS performance. In all likelihood the design of simulation for University X would continue to utilize a team model as Phase I had been designed. Therefore, looking at teaching strategies to facilitate team awareness needed to be added during the second phase of the research.

Phase I debriefing identified that participants had assigned roles for the HFS performance based on tasks that needed to be completed with little thought about team function. During the simulation practice in Phase I it was observed that there were several instances where "waiting" behavior occurred. One obvious cause for this behavior was related to knowledge deficits that an individual participant might have encountered while caring for the patient. The debriefing journaling activity confirmed that this was partially the case. Another cause identified during the debriefing activity by participant's indicated that the pauses were a result of "waiting" for the other person to "finish" what they were doing.

While it is true that in the health care arena, patient care is often delivered as part of a team effort, building team SA was not identified, nor intentionally planned for in the initial design of this research. Phase II of the design needed to incorporate specific techniques to maximize group SA in order to address these findings. The specific techniques employed will be discussed further under Research question 3.

Debriefing/Reflection to Improve Situation Awareness

Reflection-on-*a*ction. Decision-making in naturalistic settings is embedded in context and affected by the dynamics of the situation rather than by a single judgment isolated from contextual constraints (Orasanu & Connolly, 1993). Debriefing created an opportunity for reflection-on-action and closed the learning loop for participants of HFS by giving them a chance to review their actions and think without the pressure of performance at the same time. It was especially important for these nursing learners to practice the skill of reflection-on-action. Mastery of the skill of reflection-on-action is foundational for the reflection-in-action activities that come with expertise development over time. HFS creates an opportunity to deliberately train for these skills.

The self-survey noted that debriefing was seen as a valuable time for participants to actually see their performance (via videotaping) and receive evaluative feedback regarding it. Participants identified that debriefing was an opportunity "to look back on our performance and figure out what went good and what to improve on" (Participant 007). This would be consistent with the findings in the literature. Of note, participants liked the combined activity of journaling during debriefing that was used in this study "…it made it real to me" (Participant 021).

Deliberate Practice

Learners have difficulty understanding how to decompose complex tasks into basic elements and can miss the subtlety of a situation because of reliance on rules-based knowledge (Benner, 1984; Dreyfus, 1997). Debriefing using videotaped performance to highlight discussion provides for a rich opportunity to highlight decision-making in terms of cues, patterns, and inferences that are part of SA. The ability to reflect-on-action provided the participants with an opportunity to enhance their SA at all three levels (perception, comprehension, and projection). Debriefing as an activity allows new learners to study their actions devoid of time pressure as well as practicing the skill of projecting future actions if given another chance. Self-awareness, critical analysis of action, knowledge, and/or feelings, and development of a new perspective of action are noted to be key steps in the process of reflection (Atkins & Murphy, 1993; Boud, 1985; Ruth-Sahd, 2003; Schon, 1991). The facilitator role was important during this deliberate practice in terms of being able to identify relevant "teaching moments" that occurred during the HFS practice to initiate discussion. The videotaped performance provided a contextual framework for the discussions that took place during the debriefing. All participants within this study were familiar with using videotaped feedback during debriefing and value the technological ability to provide this rich feedback.

Summary

The research results within this sample indicate that while scaffolding learning improves the likelihood of demonstrating behaviors of SA during simulation practice, it does not guarantee 100% accuracy of those behaviors. This indicated that there are additional variables that influence the performance of SA. Some of these influences will be discussed in the answer to research question two; specifically relating to HFS design components that impact the acquisition of cue and pattern recognition.

Research Question 2: What Design Components of High Fidelity Simulation Impact the Acquisition of Cue Recognition and Pattern Recognition?

The research results from Phase I clearly indicated that there were multiple variables that influenced the acquisition and demonstration of SA during the HFS. This was not an unexpected finding and could be related to the sophistication of HFS as a teaching modality. The realistic replication of clinical situations including the management of prioritization and consequence indicated that there were other aspects outside of the design structure that need to be addressed when teaching with simulation. In this research study, the components that stood out were fidelity, time pressure, and role delineation.

Fidelity

The ability to suspend disbelief and allow the learner to engage in the professional role using the tools of the profession to creatively problem solve differentiates a simulation learning experience from that of role play (Lowenstein, 2007). The lab setting utilized for the research was designed to simulate a real patient room with all the equipment needs that would be found within the hospital (Figure 5).

Figure 5. SIM Lab

The high fidelity training manikin used in this research presented a physiologically based interactive "patient" reflecting exacerbated CHF as the case based scenario. While the case based scenario was pre-programmed, it is important to note that it had the capability of being altered dependent upon the actions or lack of action on the part of the participants. This interactivity is what makes the tool of HFS dynamic. All participants in the study began with the same HFS scenario, yet the experience of each group during the HFS performance phase was unique based on the characteristics of the team and their decision-making.

Phase I performance in the HFS uncovered some deficits in fidelity that negatively impacted the ability for participants to perceive and comprehend data gathered within the simulation. The management of the CHF, urinary and peripheral vascular goals of care was negatively impacted because of the inability to detect cues (Figure 6).

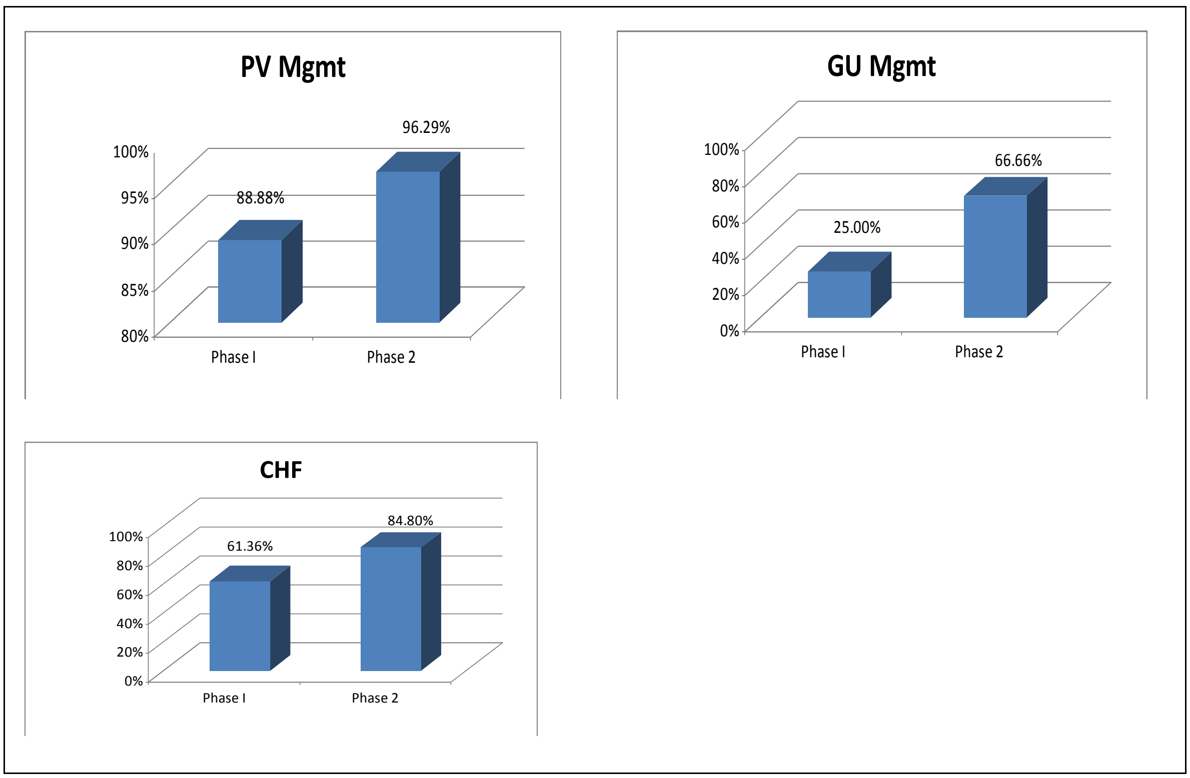

Figure 6. Phase II and I comparisons for CHF, urinary and peripheral vascular management goals

Participants were able to discuss during debriefing that there were several "lapses" in fidelity that made it difficult for them to recognize cues during the HFS practice. Lack of cue recognition resulted in absence of decision-making related to management of the problem. Jugular vein distention, peripheral edema in the ankles, and heart sounds are all limited by the design of the manikin. In urinary management it was noted that the normative ranges of the lab values were missing from the reports making it difficult to detect borderline high values for action.

Minor changes in fidelity were added to Phase II as was possible. A label was added to the neck veins stating jugular vein distention, participants were warned that ace wraps meant edema, and normal ranges were added to lab reports to improve fidelity. The results of Phase II indicated that performance of SA behaviors related to these items were improved. However, it was unclear whether this improvement was as a result of the changes made regarding fidelity or the additions made in concept mapping during the briefing phase. Additional fidelity issues such as absence of a scale were discovered at the end of phase two that could have impacted performance of noticing cues regarding weight indicating that continuous improvement of simulation fidelity is something that should be looked at with every iteration of simulation performance.

Time Pressure

Understanding how time impacts the event or when an action must take place is a critical part of SA related to comprehension (Endsley, 1997). In dynamic environments the rate at which information changes and how an individual perceives those changes is part of SA (Endsley, 1997). It was determined that the HFS performance stage would be run without interruption in an effort to observe for SA behaviors in a "real world" context. This technique allowed the simulation to continue without guidance from the facilitator when the participants became "stuck."

Timeliness in performance of key interventions during the HFS improved between Phase I and Phase II in all categories except medication administration (Table 6). There was one team in phase two that took double the amount of time to complete the HFS than any team in the research project. The presence of this outlier skewed the data to appear closer in timing than was actually observed if examining individual events (Appendix J). It appeared that these improvements in timeliness were directly related to the improvements made in communication and role delineation. The specific techniques that were utilized will be discussed related to research question number three.

Table 6.

Timeliness Comparison

	Time for completion	Assessment completed	MD Notified	Foley Inserted	Lasix Administered
Phase I Average Times	35 min 45 sec	12 min 15 sec	12 min 25 sec	23 min	18.5 min
Phase II Average Times	33 min 37 sec	8 min 6 sec	12 min	22 min	19 min 6 sec

Role Delineation

The task assignment methodology used by the groups of Phase I contributed to attention tunneling and interfered with group performance during the simulation.

Participants of the study identified this deficiency during debriefing in addition to the researcher's observations of the same. These results were also corroborated by the verbatim comments that were made in Phase I debriefing journals.

In order to focus on higher order cognitive tasks such as leadership, conflict management, communication and delegation an additional design component of role definition was instituted in Phase II. The participants of Phase II were allowed to choose their assignment (as in Phase I), but the role had definitions regarding what higher order performance expectations would be required. The role assignment of primary nurse assisted the groups in decision-making during the HFS by providing leadership that allowed the participants to come to action faster. Creation of a "big picture" person (data analyst) who could step in and re-orient the group to the goals of treatment also served to assist groups in making faster transitions by drawing the attention back to reviewing the data collection, searching for patterns, then creating the plan of action.

The new conceptualization of roles contributed to a positive impact on the overall timeliness of action as well as the SA behaviors of the groups in Phase II. Videotape review observed less waiting for people to complete tasks. The groups in Phase II had a greater awareness of the patient needs as demonstrated by the team's ability to acknowledge the patient verbalizations as an important goal. This was noted in increased eye contact and increased use of therapeutic touch while conducting tasks. There was also improved communication demonstrated by delegation and supervision activities that took place during the simulation, which allowed the groups to proceed through the simulation practice stage in less time than their predecessors.

The improved performance cannot be attributed to this isolated variable since there were multiple changes made to the simulation in Phase II, but it did demonstrate that assignment of roles can help HFS participants focus on higher order skills in order to minimize task oriented attention tunneling that can occur when one is under time pressure. The results suggest that new learners tend to think of their jobs in terms of specific tasks and this focus can negatively impact their ability to perform in the multivariate environment of simulation. Assignment of roles with specific higher order responsibilities may help minimize this behavior and should be considered as a design feature when working with new learners.

A surprise finding resulting from the assignment of roles was the identification of identity formation as an outcome of simulation. One subject noted in his/her debriefing journal that he/she

> liked how we assigned different "roles." That helped me to realize that being a nurse is really being a multi-tasking person. That helped me to see different aspects and parts of nursing roles that a nurse should be able to perform when taking care of a patient. (Participant 018)

Benner, et al. (2010) describes this outcome as formation; when a student nurse begins to move from being a layperson into the professional practice identity. She goes on to define formation as "being constituted by the meanings, content, intents, and practice of nursing rather than merely learning or being socialized into a nursing role in an external way" (p. 86). Further research in the area of HFS and identity formation might yield some valuable information in this area.

Research Question 3: What Instructional Techniques May Be Implemented or Included By Faculty to Emphasize Development of Cue and Pattern Recognition for Situation Awareness?

The importance of HFS structure has been discussed extensively throughout this research project and provided the foundation for research question number three. Identifying specific, evidence-based teaching-learning practices and matching them to the appropriate stage of the simulation design was part of what this design based research project explored. An iterative process and data driven analysis with targeted changes assisted in improving understanding of how specific instructional techniques enhanced or hindered the SA and decision-making of the participants. GDTA, concept mapping, SA global assessment technique, verbalization protocols, and CRM were specific evidence-based pedagogical interventions used to improve SA during this research on HFS. These techniques were utilized in specific areas of the HFS structure in order to maximize the probability of attaining the outcome of improved Level I and Level II SA.

Briefing Techniques

Goal directed task analysis. Applying GDTA to identify the basic goals, decisions needed to accomplish those goals and the SA cues required to make those decisions was a foundational step in understanding how SA influenced decision-making within this case based scenario. Development of the GDTA tool (Appendix K), in an attempt to deconstruct the decision-making of an expert's practice, provided the researcher with a rich understanding of how specific cues related to and impacted the ability to make decisions. The tool itself was the foundation for facilitation, outcome measurement, and performance improvement for the HFS event.

The task of creating this tool highlighted the importance of having a dynamic focus during the HFS in order to enhance decision-making ability. While knowledge is important and psychomotor skills improve efficiency it is SA that allows the decision-maker to maintain the flexibility and fluidity necessary to meet the environmental and individual patient needs. The GDTA tool was used two different ways in this research. First, it served as a guide to identify specific goal directed tasks and their corresponding cues for the concept mapping activity. Secondly, it served as a documentation rubric for quantifying the behaviors demonstrated within the high fidelity practice stage. Minimally, it provided the facilitator with a facilitation points necessary to enhance the development of perception and comprehension of HFS participants. The GDTA became an important tool creating a framework for the facilitator to use additional techniques such as discovery learning and Socratic questioning to uncover the normative aspects of care that should minimally be covered to prepare for the HFS practice stage.

Concept mapping: Moving from information to pattern recognition. A technique of concept mapping was used in both briefing phases of this research to create a visual of the primary problems and goals, priority systems of assessment, interventions for problem resolution, and evaluation feedback loops. Participants used information from their pre-planning activities to guide the construction of this map. Studies show that concept-mapping activities have the ability to create longer retention of knowledge and improved ability to apply knowledge in novel settings (Canas, Ford, Novak, & Hayes, 2001; Mintzes, Wandersee, & Novak, 1998; Novak & Gowin, 1984). The hope was to perform concept mapping in the briefing phase to assist the participants to perform care giving duties within the HFS without the reliance on checklists and tasks. The rationale was that in order to imitate "real world" readiness participants need to internalize a mental model of care.

Participants in the study were familiar with concept mapping techniques having used them in previous semesters to understand pathophysiology. The goal of the mapping activity was to assist the participants to focus on pattern development by breaking down the focus areas of CHF management, respiratory management, urinary management, peripheral vascular management, medication management, anxiety management and recovery management into discrete elements that identified expected patterns and behaviors. By focusing on what the normative picture would "look like" the participants could then apply anticipatory thinking to project actions and interventions during the simulation. The design objective for using the concept map was to create the development of comprehension by repurposing all the available data from pre-planning, simulation question and answer by organizing the random data pieces. As mentioned previously facilitator expertise was also deemed important in this process. This constructive activity training helped reorganize knowledge to improve working mental models for the HFS practice phase. Feedback from the research participants indicated that this technique was extremely helpful in guiding their assimilation of knowledge to participate in the simulation practice stage.

Simulation Techniques

Improving team situation awareness. The data from Phase I indicated the need to develop some team oriented techniques in order to facilitate improvement in team SA. The literature supports that the dynamic social interaction of the team has a direct influence over the SA (Moray, 1994). Strategies employed by teams to improve information seeking and checking activities helps the development of team SA by allowing the team to notice trends and react to events faster (Prince & Salas, 1998). Endsley and Robertson (2000) identified that the technique of employing verbal protocols allows for a mechanism to validate personal SA with members of a team resulting in an overall improvement in attention sharing and task management.

It was determined that the Phase II of the research would use the intervention of verbalization protocols. This intervention was implemented to address the identified "waiting" behaviors that were observed in Phase I of the HFS performance. Verbatim statements gathered from the Phase I debriefing made it clear that there was a theme of lack of communication that had a negative impact on HFS performance. Statements such as "we all knew something was wrong, but communicating it to each other was difficult" (Participant 006), "should have worked better together," "Group structure focused on tasks that hindered cohesive knowledge of the group" (Participant 002) and "Should have voiced completion of task for all to hear" (Participant 004) indicated that communication (or lack of it) had negatively impacted the participants' SA during the simulation performance stage.

Prince and Salas (1998) conducted research upon flight crews and determined that there were four major actions important for team SA: (a) identification of problems, (b) demonstrating knowledge of the actions of others, (c) keeping up with flight details, and (d) verbalizing actions and intentions.

The groups in Phase II of the research utilized a verbalization protocol that encouraged a "talk out loud" technique to promote shared knowledge among the group and awareness of the actions of others. It was believed that this protocol was partially responsible for the faster performance in completion of priority interventions (Table 6). The "talk out loud" technique created an atmosphere where the group could complete individual tasks at the same time because it made the thinking of the group transparent The debriefing and journals of Phase II participants did not reflect the same frequency of communication difficulty amongst the team as was found in Phase I. The self reported survey indicated that participants found the "talk out loud" technique during simulation practice to be a benefit. "It made us think and figure things out…..better than having the instructor tell us what to do" (Participant 021). There was an overall improvement of SA in the form of perception and comprehending discrete cues between Phase I and Phase II (Figure 7).

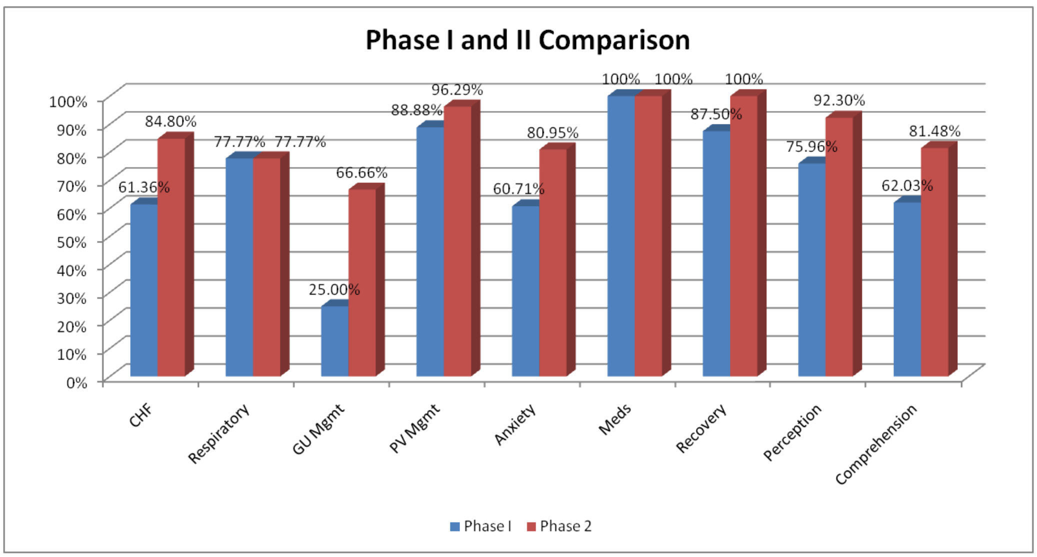

Figure 7. Phase I and II comparison of perception and comprehension cues

As previously noted, it is believed that the deliberate practice of concept mapping to match the GDTA improved the likelihood that participants would be able to perform using good SA. Instituting a "talk out loud" technique in Phase II allowed for the teams to coordinate their activities faster (Table 6) by making thoughts and actions transparent to the group as a whole. During the HFS performance, participants were seen prompting each other verbally by identifying the completion of tasks or their intent to begin a task, which improved their cohesiveness as a team. Statements such as “Lasix in – do we have any urine output yet?” “I am going to get the labs while you finish the physical assessment,” and “I’m not sure how to use this type of mask, can I get some help” all demonstrated the ability of the team to leverage their personal SA to maximize the overall function of the team during simulation performance.

Verbal protocols also improved the participant's ability to move ahead in a simulation when experiencing difficulty. In phase two, one team developed an impasse during the simulation where the technique of stopping and verbally reporting what each member was thinking had to be utilized. Interestingly, the verbalization identified that members of the group were focused on separate goals. The moment occurred after Lasix had been administered, yet all of the vital signs were still reporting high (because of the anxiety level of the patient). During this stoppage one participant reported he was thinking about why the vital signs had not normalized, the second participant reported he was thinking that the patient was going to have a significant event and go into shock, and the third participant was focused on monitoring and evaluating the effects of the Lasix administration from a data collection viewpoint. Once these thoughts were verbalized, the team restarted the simulation and proceeded with a team evaluation that the data that they were seeing was related to the anxiety of the patient and implemented steps to reduce it.

Debriefing: Reflective Practice Techniques

Situation awareness global assessment technique (modified). The ability to demonstrate SA in decision-making is about trying to understand the complexity of the situation not the simplicity of it (Klein, 2000). Understanding what was used for assessment (or not) was an important part of understanding if the design of the HFS improved SA or hampered it. The Situation Awareness Global Assessment Technique (SAGAT), developed by Mica Endsley (2000a), is a validated tool for measurement of SA. This technique is generally utilized during the simulation practice phase to "freeze" time and gather data regarding the participants' SA allowing for validation against the current reality of the moment. The design of the debriefing included a modified SAGAT technique to attempt to gather data regarding the participant's SA using the videotape of their HFS performance. It was understood that the delay in gathering the data had the potential to deteriorate the awareness. A decision was made that maintaining the fidelity of time pressure during the HFS was more important than the need to stop and gather SA information at intervals. The videotaped performance provided the participants with a "refresher" of the activity, cues, and interventions that were happening at the time to spark their memory regarding the SA that was in use at that moment to guide the journaling activity. Phase I and Phase II played two videotaped segments (one highlighting good practice and one highlighting some difficulty) during the debriefing stage to provide a platform for deconstruction by the group. The activity of journaling was added to this segment to attempt to capture the individual's personal SA at the time of the event. Participants were asked to journal immediately following the videotape segment viewing to identify what attention cues were important, which were distracting, which were missed and why that might have occurred. While the participants were familiar with videotape augmented debriefing, the journal focusing on SA was a different focus for them.

The results of the journaling activity provided rich detail regarding the SA that was taking place at those junctures in time. The prominent themes coded from the journal data indicated that knowledge deficits, timely action, attention tunneling and action planning were consistently mentioned as detractors from SA. These themes are consistent with Endsley's (2000b) identification of processes that impact SA. Journals of phase II were less centered on communication difficulties than the first Phase. Items were more individually focused in their commentary – "I forgot my focused assessments from the briefing" (Participant 013), "I was waiting for a catastrophe to happen which caused me to freeze in anticipation" (Participant 020), and "…not sure which mask to use. Don't have experience and became nervous" (Participant 014).

The data gathered from the SA global assessment technique (SAGAT) inspired journaling had some predictable and surprising results when comparing Phase I and Phase II (Figure 8). Improved communication, which was noted to be the significant deterrent to SA in Phase I trials, also decreased the knowledge deficits that caused delays in action. The groups of Phase II were observed to employ more helping behaviors during the HFS performance as evidenced by employing checking activities with each other. The increase in attention tunneling, however, was a surprising result. This seems to indicate that the cause of attention tunneling was related to something more than group dynamics and role delineation. The literature on SA supports that attention tunneling is a result of limited working memory and prioritization of attention. These data support the idea that the participants in the study were still in the learning phase which had the ability to limit their awareness. It was unclear as to why this was worse in the second iteration than the first and could have been related to the individual characteristics of the participants. More studies would be necessary to tease out the meaning in this area.

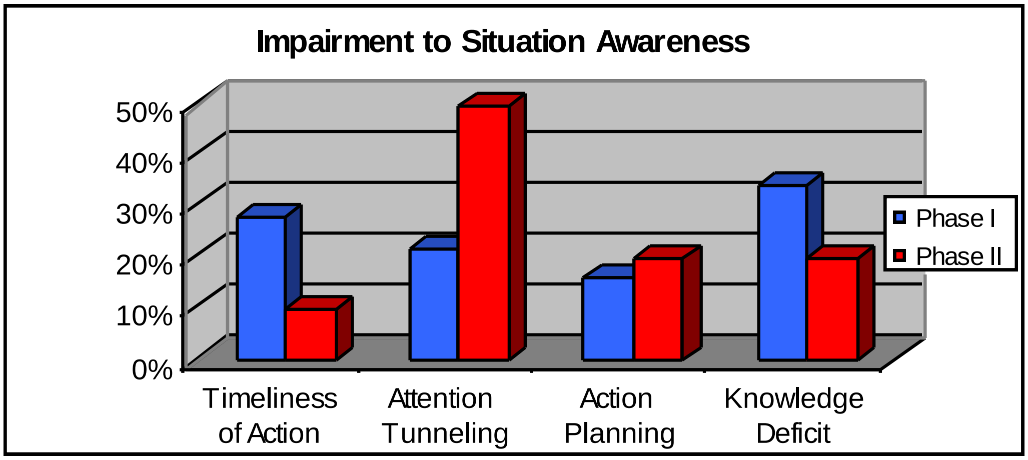

Figure 8. Comparison of impairment to situation awareness

Crew resource management technique. The literature on using debriefing with simulation is probably the richest of all HFS topics. There are multiple techniques available to do debriefing with additional frameworks being validated as HFS use increases. This research decided to utilize a well-established and well utilized technique for debriefing that has been used for years in the fields of aviation, anesthesia training, and the military.

CRM is a technique that is specialized for team training and serves to strengthen communication skills as well as being a debriefing pedagogy. It is a technique that focuses on teamwork, workload management and communication as key factors in teambuilding. This technique embraced an active participation model that used the deliberate practice of reflection-on-action to improve team awareness and effectiveness through self-debriefing. The facilitator role was that of reinforcement and utilization of expertise to enhance understanding of points that were missed by the crew. Team members were encouraged to do most of the talking and address each other in the process of the discussion. This technique was chosen because it was believed that this type of assertive communication would be necessary in the real world environment of healthcare. Deliberate practice of these skills within the current apprentice model of learning is minimal. HFS debriefing was seen as a safe environment to develop these assertive, team oriented communication skills. An intermediate level of facilitation was utilized with this group because of their learning level (Appendix I).

Observations of debriefing activities demonstrated that the participants were oddly focused on the negative aspects of their individual and group performance and had to be facilitated through the positive aspects with great detail. After the journaling activity each participant was able to state what had happened individually, but again had to be facilitated through a discussion of "what could have been" or "what would they do differently." This behavior was consistent with their status of learner and consistent with the literature of SA-projection of future events is improved with expertise and experience. The technique of CRM provided the learner with the ability to practice this projection skill to attain some expertise in this area with guided leadership. As noted in research question number one, debriefing activities cannot be uncoupled from the HFS performance without losing significant learning opportunity.

Summary

The purpose of this research was to explore whether or not HFS could be utilized to improve decision-making in baccalaureate nursing students. SA was the framework for decision-making that was explored because it focused on a continuous assessment foundation that fit within the domain of nursing practice. Decision-making informed by continuous assessment of cues and patterns allows for flexibility to deal with shifting and/or conflicting priorities, individual patient needs, and complex environments.

The use of HFS for clinical healthcare training has been a topic of debate. Intuitively, the tool appears to be a fit and is widely utilized despite the lack of empirical evidence that demonstrates its effectiveness or improvement over traditional methodologies. This research was designed to examine what strategies might be employed in conjunction with using HFS that might improve the decision-making skills of the participants. A four-step model was proposed using specific techniques to augment the development of perception and comprehension skills. Within the limited sample of this research, the results indicate that by developing guiding objectives and understanding outcomes of specific instructional techniques HFS could be a very useful tool in training decision-making. The design based research process was helpful in teasing out the salient techniques that improved high fidelity performance while gaining a rich understanding of the multiple influences in the process.

Chapter 5: Discussion

Novice practitioners have documented deficiencies in their ability to make effective or efficient use of available information, estimating risk and uncertainty, and selection of a course of action (Del Bueno, 2001, 2005; Shanteau, Grier, Johnson, & Berner, 1991). Gone are the days of long orientations under the guidance of a mentor where rule based practice could assist the new graduate until a sufficient amount of expertise could be developed. The ever-changing dynamics of the practice setting mandate that health care practitioners develop a new skill set of flexibility in order to adapt (IOM, 2004). The IOM Quality Chasm report (2001) identified the need to create a health care system that is individualized for the patient and anticipates needs, shares knowledge freely and transparently, makes decisions that are evidence based, and promotes collaboration among clinicians. The ability to develop this new skill set requires that training institutions consider alternative methods for preparing practitioners for professional practice. The IOM report *Keeping Patients Safe: Transforming the Work Environment of Nurses* (2004) identifies that nurses play a central role in patient safety as the largest component of the healthcare workforce with the most direct and constant interface with patients. The ongoing surveillance of care is perhaps the most important role that the nurse plays in maintaining patient safety. Preparing our nurses to excel in this assessment ability is where SA training focuses.

HFS where case based learning under “real life” pressures of time, consequence, and prioritization appears to be a perfect fit for the mandate of changing our educational approach to training. The HFS allows for the deliberate practice of decision-making in a safe setting by improving a practitioner's ability to perceive and comprehend data within the environment to guide interventions for patient care. It is well documented that expertise is developed over time by having multiple exposure to diverse cases. HFS provides an opportunity to standardize that exposure and deliberately practice on low volume, problem prone patient cases to improve decision-making in areas that would normally take years to attain. Yet the tool of HFS is expensive and in the resource restricted environment of healthcare it is important to be able to speak directly about the concrete return on investment that it affords in training health care personnel. The literature is strangely silent on this aspect that limits the ability of some hospitals and educational settings to be able to take advantage of the opportunities HFS can offer to training.

What started out to be a study of what high fidelity could offer in terms of training for decision-making capability ended up being more about how learning occurs during the use of HFS. Teaching using HFS is much more than just taking the manikin out of the box and running students through the pre-programmed scenario and calling it a clinical day. There is richness to the learning process using HFS that needs to be better understood in order to maximize the ability of the learner to perform effectively in the "real" care setting. This study identified the importance of four factors that influence the effectiveness of HFS: (a) design, (b) theoretical framework, (c) instructor expertise, and (d) development of adaptation expertise.

Importance of Design Based Research

This study has illustrated the complexity involved with research using HFS. While it is important to the industry to be able to document measurable outcomes in order to establish return on investment for the expensive outlay of money, this research has indicated that it is just as important to understand how to utilize the tool to maximize the type of outcome desired. Design based research provides a framework where the beauty of the evolutional process of using HFS could be explored. It is believed as a result of this research that the discovery lies in the nuances of using this tool. More research is needed to gain a richer understanding of how learning can be designed for HFS. It is believed that we have only scratched the surface of the endless possibility to date.

It was proposed that there was a structure of pre and post learning that should take place in order to produce the maximum benefit to the participants of HFS. The importance of this design was discovered to have an overlapping richness that was difficult to dissect into a concrete cause and effect model. The design of pre-planning, briefing, HFS practice, and debriefing provided an opportunity to scaffold learning-building from individual understanding, to group application, ending with the ability to reflectively think about improvements for future actions.

Additionally, this research was able to identify key techniques that had impact on improved SA for this small study. Concept mapping, role delineation, and verbalization protocols were are seen to have a positive effect on the participants in this study. It would be worthwhile to see if the results could be replicated using a larger population.

Theoretical Foundation

Understanding learning from a theoretical framework provided the ability to manipulate elements and teaching strategies during the HFS to maximize the expected outcome. The framework of SA was a good fit for training nursing decision-making because it emphasized the cognitive skills necessary to be successful in today's healthcare environment and were a match for the skills needed for the nursing profession.

Situational learning is an operational framework that has been utilized in training nurses over the past 30 years. Using HFS to augment this apprenticeship training model has the ability to drastically improve novice practice if utilized to attain specific outcomes. Identification of those outcomes has yet to be determined by the current literature review. The results of this project identify that it might be possible to take the SA framework that has been extensively taught in aviation and military training and transfer it to the acquisition of decision-making in the healthcare arena. More research needs to be done in this area to confirm this finding.

Instructor Preparation

Perhaps the most important discovery of this study was the about the role of the instructor using HFS. The literature documents that instructor comfort is the largest impediment to using HFS, but it focuses more on the technological aspects of using the tool than the pedagogical. The detailed planning that was necessary to produce noticeable outcomes within this small sample was quite extensive. Understanding objectives from more than just a student perspective, but from the expert practitioner's was a daunting task. Of note, was the fact that this was not a one-time event either, but one that required (and still does) multiple revisits to the literature for guidance and the users for understanding of the phenomenon. This speaks directly to the need for ongoing formalized training for HFS facilitators in order to capture the exciting changes that are taking place within this field of training. One could consider HFS teaching a specialty that must be trained and mentored in order to gain equality of outcomes in our nursing students.

Adaptation Expertise

Too often in healthcare and education we see the end goal of training as a static set of core competencies. The tool of HFS suggests that there should be a re-evaluation of that thought process to look at the ability to maintain a flexible and adaptive approach to learning as the end objective of teaching. Minimally, educators in healthcare settings should begin to add adaptation as a desired core competency. This would require that as educators we adopt the same practice of adaptation within our teaching practice to support and role model these important behaviors. In this study, learning with HFS provided the participants with an ability to see how multiple interventions based on sound theoretical knowledge could result in the same outcome. It is this expertise that is so necessary for today's practice environment.

Summary

The benefits of training with HFS have yet to be enumerated within the health care setting. There are certainly well documented examples of how simulated practice improves decision-making within the aviation and military professions. The results of this design based research study suggest that there is an opportunity to transfer the evidence based learning that has occurred in those domains as a foundation for research opportunities for the future as HFS continues to be used in healthcare training. The need for professional development surrounding using HFS as an instructional tool was also strongly supported by this research. Most importantly, though, this study supports that contextual learning, under naturalistic conditions can improve the participants ability to "think on their feet" and make decisions which is needed in the healthcare practitioner of today.

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APPENDIX A

Demographic Survey

Number: ________________________________ Date: _______________

1. Gender: _____ Male _____ Female

2. Age: ____________________________

3. Race:

_____ American Indian or Alaska Native. A person having origins in any of the original peoples of North and South America (including Central America), and who maintains tribal affiliation or community attachment

_____ Asian. A person having origins in any of the original peoples of the Far East, Southeast Asia, or the Indian subcontinent including for example, Cambodia, China, India, Japan, Korea, Malaysia, Pakistan, the Philippine Islands, Thailand, and Vietnam.

_____ Black or African American. A person having origins in any of the black racial groups of Africa. Terms such as "Haitian" or "Negro" can be used in addition to "Black or African American"

_____ Native Hawaiian or Other Pacific Islander. A person having origins in any of the original peoples of Hawaii, Guam, Samoa, or other Pacific Islands

_____ White. A person having origins in any of the original people of Europe, the Middle East, or North Africa.

_____ Hispanic or Latino. A person of Cuban, Mexican, Puerto Rican, South or Central American, or other Spanish culture or origin, regardless of race. The term, "Spanish origin" can be used in addition to "Hispanic or Latino".

_____ Other (please list) ____

_____ Decline to state.

4. GPA: ____________________________

5. Primary Language Spoken:

_____ English

_______ *Other: (Please list)* ____

APPENDIX B

Informed Consent

Memorial Health Services Research Council

Institutional Review Board

Long Beach Memorial Medical Center

Department of Clinical Workforce Development

Informed Consent to Participate in a Research Study

Title: Designing High Fidelity Simulation to maximize student registered nursing decision-making ability

Principal Investigator:	Cathleen M. Deckers RN, MSN Doctoral Student, as part of dissertation process	Phone #:	562 989-6542
Contact Person:	Cathleen M. Deckers RN, MSN	Phone #:	562 989-6542

MHS Project Number: 637-09

Purpose of the Study

The nurse's responsibility for patient care in today's healthcare environment has become increasingly complex. These responsibilities require the ability to think quickly, adapt to changes, all the while focusing on patient safety as one of the ultimate outcomes of care. Our standard model of teaching nursing practice for the last four decades has not varied much from the traditional lecture to teach didactic knowledge and clinical to apply psychomotor skill acquisition using an apprenticeship model (Tanner, 2006). Research has demonstrated that new graduate nurses are not prepared to practice in the fast paced environment that currently exists (Del Bueno, 2001, 2005). High fidelity simulation provides healthcare educators with a learning tool that mimics the health care practice environment without risk to patients. Instructors have the ability to create a dynamic learning environment where decision-making under time pressure and high stakes replicates nursing care at the bedside. This type of experiential learning helps the nursing student refine their clinical decision-making ability. The purpose of this study will be to explore different curricular techniques to improve your decision-making ability by enhancing situation awareness (specifically, noticing, interpreting and reflecting behaviors). Study is being conducted as part of the dissertation process for student, Cathleen Deckers to complete EdD of Educational Technology and Leadership, Pepperdine University.

Describe Procedure

The study will be conducted in two (2) phases. At your convenience you will participate in one five (5) hour simulation. This participation will include a pre-planning phase that will be done at home just prior to the simulation that requires you to create a plan of care for the patient as well as answer some questions that will provide background for the simulation that will take place. Students will be randomly paired in groups of one to three (1 - 3) for the simulation day performance. The simulation day will be conducted in three stages: pre-briefing, simulation practice and debriefing. Each stage will last approximately one hour in length. The pre-briefing (Stage I) will begin with the signing of a written consent form to participate in this study. A demographic survey that includes information regarding age, gender, ethnicity, and English Language speaking skills will also be given prior to starting the simulation event. The pre-briefing stage will require students to participate in a concept mapping exercise. The simulation practice (Stage II) will be conducted with no stoppage of time as students care for the patient in the simulation. The debriefing (Stage III) will be conducted over an hour and will utilize the techniques of CRM and SAGAT. Each stage will be video and audiotaped. Audio/video taping is a mandatory requirement of this study. Participants will not have the ability to edit or erase the taping, but will have the opportunity to review it during the debriefing stage of the study. The Principle Investigator (PI) will participate in the study as an observer documenting behaviors throughout the simulation. After completion of four (4) cohorts of simulations the PI will code the behaviors of the participants in the simulation (during all three phases) for specific themes related to situation awareness – specifically noticing, interpreting, and reflecting. Consistent and emergent themes will be noted and consolidated. Curricular changes for Phase II of the simulations will be determined based on the data analysis from the Phase I simulations. Phase II will be conducted in the same manner as Phase I noting that the teaching techniques utilized may be changed to enhance decision-making capability. It is hoped that this study could provide a curriculum that could then be tested using an experimental model against traditional HFS curricular formats to see if decision-making is improved.

Physical Requirements

You will be asked to participate in a five hour session of simulation. This will require the physical ability to practice bedside nursing (which incorporates standing, lifting, bending) as well as approximately 2 hours of sitting during the pre-briefing and debriefing stages.

Duration of the Study

Participation in the study will require a maximum of 5 hours of time from each subject. This will be conducted in a one-time visit. The study is expected to be conducted for a 2-3 month period with final write up to be completed by March 2010. Research data will be retained for a three (3) year period after the conclusion of the study.

Risks/Side Effects

There are minimal anticipated potential or perceived psychological risks or side effects associated with this study. The subjects may experience a minimal level of physical and mental stress during the performance of the study. Even though the nature of the study is development of a teaching methodology, to safeguard the participants in the study, the PI will not have any current or future grading responsibilities for these individuals.

Physical Requirements

Participants will be asked to participate in a five-hour session of high fidelity simulation.

This will require:

1) The physical ability to practice bedside nursing (which incorporates standing, lifting, bending) as well as approximately 2 hours of sitting during the pre-briefing and

debriefing stages. Students will be removed from the study if they display signs of not being able to practice in the physical environment.

Anxiety

2) Because simulation is an immersive educational experience, the potential for high levels of anxiety during the practice phase of the study could exist. Students who exhibit this will be removed from the study to minimize individual distress

Grading

3) The students will be volunteering to participate in the study during non-school hours. Despite this protection there may be a perceived threat related to current and future grading of the subjects in the study. To safeguard from this, the PI will not have any current or future grading responsibilities for the subjects in the study.

Potential Benefits

There may not be any direct benefits to you for your participation in the study other than the opportunity to practice your clinical decision-making skills and to contribute to a research study. However, there is potential value to society as a whole by validating the worth, value, and effectiveness of High Fidelity Simulation as a tool for developing and improving expertise and decision-making in nursing clinical practice.

Alternatives

There are no alternative arrangements outside of not participating in the study. You have been given the opportunity to ask questions which have been answered to your satisfaction. You understand that the principle investigator will answer any questions that you may have in the future.

Costs and Payments

There will be no cost to you related to participation in this study. You understand that you will receive no financial gain for your participation in this study. A token gift card of $10.00 value will be provided to you as a thank you for your participation in this study.

Physical Injury Statements

There should be no risk for physical injury or sickness as a result of participation in this study. Any medical treatment that is required as a result of a physical injury related to this study is not the financial responsibility of Long Beach Memorial Medical Center.

Compensation

You will be compensated with a $10 Starbucks Gift Card for your time if you are accepted for the study and finish the simulation. If for any reason you cannot finish the study this compensation will continue to be awarded. The Gift Cards will be awarded at the conclusion of your simulation practice.

Voluntary Participation/ Right to Withdrawal

You understand that your participation in this study is voluntary. You may decide not to participate or you may withdraw from the study at any time, without penalty. Your participation or non-participation will not affect your status in the CSULB Nursing program.

Audio and Video Taping

You understand that video and audio taping will be conducted as a requirement for participation in this study. You understand that you will have no ability to edit or erase these tapes. You understand that they will be maintained according to the same confidentiality as the other documents produced during this study.

Confidentiality

You understand that any information about you obtained from this research will be kept confidential and your name will never be identified in any report or publication unless you sign a release. You consent to the publication of study results so long as the information is anonymous and/or disguised so that identification cannot be made. You also understand that authorized representatives of the MHS Institutional Review Board (MHS Research Council), California University, Long Beach Institutional Review Board, and the Pepperdine University Dissertation Committee may examine your records, and there will be no breach of confidentiality.

All data collected will be coded with Participant ID numbers to assure confidentiality. Only the researcher will know the participants and their associated Participant ID number. A master copy of the ID numbers and associated data will be kept in a locked drawer and destroyed after 3 years. All video/audio tapes will be kept in the same space for the same duration of time. Only the researcher will have access to this data. Should the participant elect to withdraw from the study, the data from that participant will be destroyed immediately**.**

IRB-FDA Clause

This proposal has been reviewed and approved by the Memorial Health Services Institutional Review Board (MHS Research Council), which serves as the IRB for (**Long Beach Memorial Medical Center**, which is composed of physicians and lay persons. If you have any questions about your rights as a research subject, or regarding a treatment related injury, or desire further information concerning the availability of compensation or medical treatment, you may contact the Office of Research Administration, Memorial Health Services, at (562) 490-3737. Additionally you may contact the CSULB office of University Research @ (562) 985-5314 if you have questions about your rights as a research participant.

Cathleen M. Deckers has discussed this study with you. If you have any questions you can reach her at [redacted].

I certify that I have read the preceding or it has been read to me, that I understand its contents, and that any question I have pertaining to the preceding have been, or will be answered by the researcher and that my permission is freely given. I have been given a copy of this consent form along with a copy of the "*Rights of Human Subjects in Medical Research*," and I consent to participate in this study.

____

Participant's Name

____________________________________ __________ ________

Participant's Signature Date Time

<u>Certificate of Investigator</u>:

I certify that I am the Principal Investigator or Co-Investigator responsible for this study, for ensuring that the subject is fully informed in accordance with applicable regulations, and for advising the MHS Research Council (IRB) of any adverse reactions or unexpected events that may develop from this study.

__________________________ __________ _________

Principal Investigator or Date Time

Co-Investigator

NOT VALID WITHOUT IRB STAMP OF APPROVAL

RIGHTS OF HUMAN SUBJECTS IN

MEDICAL RESEARCH

Any person who is requested to consent to participate as a subject involving a medical experiment or who is requested to consent on behalf of another has the right to:

1. Be informed of the nature and purpose of the experiment.

2. Be given an explanation of the procedures to be followed in the medical experiment, and any drug or device to be utilized.

3. Be given a description of any attendant discomforts and risks reasonably to be expected from the experiment.

4. Be given an explanation of any benefits to the subjects reasonably to be expected from the experiment.

5. Be given a disclosure of any appropriate alternative procedures, drugs or devices that might be advantages to the subject, and their relative risks and benefits.

6. Be informed of the avenues of medical treatment, if any, available to the subject after the experiment if complications should arise.

7. Be given an opportunity to ask any questions concerning the experiment of the procedure involved.

8. Be instructed that consent to participate in the medical experiment may be withdrawn at any time and the subject may discontinue participation in the medical experiment without prejudice.

9. Be given a copy of any signed and dated written consent form used in relation to the experiment.

10. Be given the opportunity to decide to consent or not to consent to a medical experiment without the intervention of any element of force, fraud, deceit, duress, coercion or undue influences on the subject’s decision.

PARTICIPANT SIGNATURE: ________________________

DATE: ___________

APPENDIX C

Observation Tool

Pattern Recognition: Congestive Heart Failure Comments:		
Noticing Cues Situation Awareness Level 1 *Expect 4/6 LCJR - FO*	Interpretation Actions Situation Awareness Level II *Expect 2/4 , LCJR – RD, IS, PD, MSD*	Anticipation Planning Situation Awareness Level III *Expect 0/4, LCJR – PD, MSD*
○ Assesses neuro status: orientation, psycho-social status ○ Assesses respiratory rate, lung sounds, rhythm & Pulse oxygenation status ○ Assesses pulse quality, & rhythm ○ Tachycardia ○ Increased Blood Pressure ○ Assesses urine output (30	○ Identify Vital Sign Findings (BP, RR, HR, lung sounds) as Abnormal ○ Seek additional data for analysis specifically intake/output balance, weight gain/loss, Jugular Vein distention, Heart Sounds, & diagnostic data: daily lab results cardiomegaly from chest X-ray ○ Identify decreased output, increased weight gain, jugular vein distention, & S3 heart sounds as abnormal ○ Notify MD of change in patient condition (report information includes:	○ Abnormal echocardiogram results (30% ejection fraction) ○ Implements Fluid restriction ○ Implements Activity Restriction ○ Implement Daily Weights

ml/hour) ○ Assesses peripheral vascular status (pedal pulses, edema)	○ Abnormal Cardiac assessment information (S3, tachycardia, Increased BP, JVD) ○ Abnormal Respiratory assessment information (Increased RR, Rales, Dsypnea) ○ Presence of edema ○ Weight gain ○ Abnormal lab results minimally: ○ Abnormal CXR results ○ Seek MD order for lasix and digoxin	

Pattern Recognition: Hypoxia Comments:		
Noticing Cues Situation Awareness Level 1 *Expect 2/4 LCJR – FO, RD*	Interpretation Actions Situation Awareness Level II *Expect 3/5, LCJR – RD, PD, IS, MSD*	Anticipation Planning Situation Awareness Level III
○ Circumoral cyanosis ○ Low Oxygen Saturation Percentage ○ Fatigue	○ Identify abnormal respiratory assessment (increased rate, shallow rhythm, low pulse ox results, rales) ○ Places patient in High Semi Fowlers position	

○ Assessment of respiratory status (rate, rhythm, quality)	○ Applies oxygen & reassesses O2 status ○ Titrates oxygen to maintain pulse oxygenation at > 94% ○ Notify MD of change in patient condition report information includes: ○ Oxygen saturation percentage, ○ Respiratory assessment information (rales, rate, difficulty) ○ Current level of O2 administered and current methodology ○ Seeks MD order for ABG's	
Pattern Recognition: Decreased Kidney Function Comments:		
Noticing Cues Situation Awareness Level 1 *Expect ½, LCJR - FO*	Interpretation Actions Situation Awareness Level II *Expect 3/3, RD, PD, IS, MSD*	Anticipation Planning Situation Awareness Level III
○ Assesses for urine output ○ Assesses current kidney function	○ Identifies abnormal kidney function (creatinine and BUN levels) ○ Continues to monitor urine	

from lab work	output hourly (expects >30ml/hour) ○ Notify MD of abnormal lab values: creatinine and BUN	

Pattern Recognition: Decreased Peripheral Vascular Function Comments:		
Noticing Cues Situation Awareness Level 1 *Expect 4/4, LCJR - FO*	Interpretation Actions Situation Awareness Level II *Expect 3/5, LCJR -RD, IS, PD, MSD*	Anticipation Planning Situation Awareness Level III *Expect 0/2, LCJR – IS, MSD*
○ Assesses peripheral vascular system ○ Presence and quality of pedal pulses ○ Presence or absence of edema ○ Rate of capillary return	○ Identifies abnormal peripheral vascular assessment findings: ○ Absent pedal pulses ○ Presence of 2+ pitting edema ○ Peripheral skin temperature cool, dry and cyanotic ○ Slow capillary return ○ Applies Sequential Compression Stockings to legs	○ Monitors for s/s of DVT (localized calf pain, Homan's sign, localized warmth) ○ Monitors for s/s of Pulmonary embolism (acute respiratory distress, increased pulse, low BP)

Pattern Recognition: Anxiety Comments:		
Noticing Cues Situation Awareness Level 1 *Expect 4/4, LCJR - FO*	Interpretation Actions Situation Awareness Level II *Expect 2/3, LCJR – RD, IS, PD, MSD*	Anticipation Planning Situation Awareness Level III
○ Assesses for psychosocial status of client ○ Asks how did patient sleep?	○ Listens attentively to client discussions and determines patient to be suffering from anxiety ○ Identifies physical signs and	

○ Asks how does client currently feel? ○ Asks questions related to behaviors that are being noticed	symptoms of client anxiety (tachycardia, restlessness, dsypnea, verbal statements) ○ Implements nursing measures to decrease anxiety (therapeutic touch, giving information, active listening, relaxation techniques)	
Pattern Recognition: Administers Lasix IV safety Comments:		
Noticing Cues Situation Awareness Level 1 *Expect 2/2, LCJR - FO*	Interpretation Actions Situation Awareness Level II *Expect ½, LCJR – RD, IS, PD, MSD*	Anticipation Planning Situation Awareness Level III, LCJR – MSD, IS
○ Assesses IV access ○ Identifies 5 rights of medication administration	○ Administers medication over ____ time ○ Observes for urine output within ____ minutes	○ Monitors K levels after lasix admin ○ Monitors HR & rhythm after lasix admin.
Pattern Recognition: Resolution of CHF Comments:		
Noticing Cues Situation Awareness Level 1 *Expect 2/3, LCJR - FO*	Interpretation Actions Situation Awareness Level II *Expect 3/5, LCJR – PD, IS, MSD*	Anticipation Planning Situation Awareness Level III
○ Reassesses respiratory system	○ Identifies normalization of assessment parameters	

hourly ○ Reassesses cardiac system hourly ○ Reassesses urine output hourly	○ Respiratory ○ Cardiac ○ Kidney ○ Anxiety ○ Notifies MD of client improvement	

APPENDIX D

Chronic Heart Failure Exacerbation Simulated Clinical Experience

Questions to Prepare for the Simulated Clinical Experience	**References**
1. When assessing a patient with symptoms of heart failure, how does the nurse differentiate between right and left sided failure? 2. What are the compensatory mechanisms the overloaded heart resorts to when attempting to maintain normal cardiac output? 3. What drug therapies are commonly used for a person who has an exacerbation of chronic heart failure? How do these medications work? 4. What other therapeutic interventions would be anticipated for a person who has an exacerbation of chronic heart failure? 5. What are the nursing responsibilities related to the administration of digoxin? What are the signs and symptoms of digitalis toxicity? 6. Outline and prioritize a long term care plan for someone with an exacerbation of chronic heart failure. Include specific teaching points to be reviewed in the care plan.	Abdelhafiz, A. H. (2002). Heart failure in older people: Causes, diagnosis and treatment. *British Geriatrics Society, 31,* 29-36. Almeda F. Q., and Hollenberg, S. M. (2003). Update on therapy for acute and chronic heart failure. *Postgraduate Medicine, 113,* 36-46. Gibbs, C. R., Davies, M. K., and Lip, G. Y. H. (2000). ABC of heart failure management: Digoxin and other inotropes, b-blockers, and antiarrhythmic and antithrombotic treatment. *British Medical Journal, 8,* 230-233. McKelvie, R. S., Benedict, C. R., and Yusuf, S. (1999). Evidence based cardiology: Prevention of congestive heart failure and management of asypmptomatic left ventricular dysfunction. *British Medical Journal, 318,* 1400-1402. Nohira, A., Lewis, E., and Stevenson, L. W. (2002). Medical management of advanced heart failure. *JAMA, 287*(5), 628-640. Peacock, W. F., Bosker, G., Albert, N., and Emerman, C. L. (2001). Congestive heart failure in the elderly: Current strategies for optimizing outcomes and the mandate for DVT prophylaxis. *Clinical Cardiology Consensus Reports,* 1-18. Peacock, W. F., Freda, B. J., Emerman, C .L., and Volturo G. A. (2002). The clinical challenge of heart failure: Comprehensive, evidence-based management of the hospitalized patient with acute myocardial decompensation – diagnosis, risk stratification, and outcome-effective treatment. *Emergency Medicine Consensus Reports,* 1-13. Torosoff, M., and Philbin, E. F. (2003). Improving outcomes in diastolic heart failure. *Postgraduate Medicine, 113,* 51-61. The Royal Melbourne Hospital. (2004). Evidence based guidelines: Management of acute pulmonary oedema. Retrieved February 9, 2005 from http://www.mh.org.au/ClinicalEpidemiology/New_files/PDF/APO%20Guidelines.pdf

Simulated Clinical Experience Overview	Learning Objectives

Location: Telemetry Unit

History/Information:
Mr. Corona is a 67 year old male with ischemic cardiomyopathy and a history of chronic heart failure. He is a veteran who also cares for his 70 year old wife at home who has early Alzheimer's. His neighbor, who is also a veteran, brought him to the ED. He was complaining of shortness of breath, especially at night and when walking, fatigue, and swelling in his ankles and feet. Physical examination revealed mild respiratory distress and 2+ dependent pitting edema. Serum creatinine level was 1.0mg/dl. Upon questioning Mr. Corona about the events leading up to this morning, he stated that he did not take his "water pill" for the last 5 days because his wife's ankles were swollen so he gave the pill to her. He also admitted to being out of "one of them heart pills" but cannot remember which one. He states he is on several heart medications. He has not brought any of his medication to the ED with him. 12-lead ECG revealed sinus tachycardia without ectopy. His chest radiography showed cardiomegaly with perihilar infiltrates. ABGs were drawn and the results are pending. A saline lock was inserted into his right forearm and he was admitted to the telemetry unit. He is allergic to penicillins, cephalosporins and midazolam.

Healthcare Provider's Orders:
Admit to telemetry floor
Telemetry monitoring (notify healthcare provider if rate <60 or >120 or development of arrthymias)
Administer O_2 2-5 LPM per nasal cannula to maintain pulse oximeter > 95% (notify healthcare provider if <95%)
Pulse oximeter every 4 hours
Incentive spirometry every 4 hours
Vital signs every 4 hours
Apply sequential compression devices
Intake and output every shift
Low Sodium diet
Fluid restriction of 1000mL per day
Daily weights; Bathroom privileges
Lab: Electrolytes, blood glucose, BUN, creatinine, magnesium level, CBC, cardiac enzymes

Digoxin 0.25mg PO every day	Furosemide 40mg PO twice a day
Captopril 6.25mg PO every 6 hours	Potassium 20meq PO every day
Metoprolol 12.5mg PO every day	Docusate sodium 60mg PO every day

Saline flush every shift
Nitroglycerine 0.4mg tablet SL every 5 minutes x 3 PRN chest pain
Morphine Sulfate 2mg IVP for unrelieved chest pain (notify healthcare provider)

1. Describe the pathophysiologic changes that result in right-sided heart failure and left-sided heart failure (KNOWLEDGE).
2. Use history information and assessment data to plan and provide care for the patient with acute exacerbation of chronic heart failure (SYNTHESIS).
3. Anticipate diagnostic orders and therapies, including medications, for the patient with acute exacerbation of chronic heart failure (COMPREHENSION).
4. Evaluate effectiveness of treatment plan and revise as necessary (ANALYSIS).

APPENDIX E

Modified Lasater Clinical Judgment Rubric

Simulation Experience for Individual Evaluation

Dimension	Exemplary (4)	Accomplished (3)	Developing (2)	Beginning (1)
Effective noticing involves:				
Focused observation (FO)	Focuses observation appropriately; regularly observes and monitors a wide variety of objective and subjective data to uncover any useful information	Regularly observes and monitors a variety of data, including both subjective and objective; most useful information is noticed; may miss the most subtle signs	Attempts to monitor a variety of subjective and objective data but is overwhelmed by the array of data; focuses on the most obvious data, missing some important information	Confused by the clinical situation and the amount and kind of data; observation is not organized and important data are missed, and/or assessment errors are made
Recognizing deviations from expected patterns (RD)	Recognizes subtle patterns and deviations from expected patterns in data and uses these to guide the assessment	Recognizes most obvious patterns and deviations in data and uses these to continually assess	Identifies obvious patterns and deviations, missing some important information; unsure how to continue the assessment	Focuses on one thing at a time and misses most patterns and deviations from expectations; misses opportunities to refine the assessment

Dimension	Exemplary (4)	Accomplished (3)	Developing (2)	Beginning (1)
Effective interpreting involves				
Information seeking (IS)	Assertively seeks information to plan intervention: carefully collects useful subjective data from observing and interacting with the patient and family	Actively seeks subjective information about the patient's situation from the patient and family to support planning interventions; occasionally does not pursue important leads	Makes limited efforts to seek additional information from the patient and family; often seems not to know what information to seek and/or pursues unrelated information	Is ineffective in seeking information; relies mostly on objective data; has difficulty interacting with the patient and family and fails to collect important subjective data
Prioritizing data (PD)	Focuses on the most relevant and important data for explaining the patient's condition	Generally focuses on the most important data and seeks further relevant information but also may try to attend to less pertinent data	Makes an effort to prioritize data and focus on the most important, but also attends to less relevant or useful data	Has difficulty focusing and appears not to know which data are most important to the diagnosis; attempts to attend to all available data

Dimension	Exemplary (4)	Accomplished (3)	Developing (2)	Beginning (1)
Effective responding involves:				
Making sense of data (MSD)	Even when facing complex, conflicting, or confusing data, is able to: (a) note and make sense of patterns in the patient's data, (b) compare these with known patterns (from the nursing knowledge base, research, personal experience, and intuition), and (c) develop plans for interventions that can be justified in terms of their likelihood of success	In most situations, interprets the patient's data patterns and compares with known patterns to develop an intervention plan and accompanying rational; the exceptions are rare or in complicated cases where it is appropriate to seek the guidance of a specialist or a more experienced nurse	In simple, common, or familiar situations, is able to compare the patient's data patterns with those known and to develop or explain intervention plans; has difficulty however, with even moderately difficult data or situation that are within the expectations of students; inappropriately requires advice or assistance	Even in simple, common, or familiar situations, has difficulty interpreting or making sense of data; has trouble distinguishing among competing explanations and appropriate interventions, requiring assistance both in diagnosing the problem and developing an intervention
Calm, confident manner	Assumes responsibility; delegates team assignments; assesses patients and reassures them and their families	Generally displays leadership and confidence and is able to control or calm most situations; may show stress in particularly difficult or	Is tentative in the leader role; reassures patients and families in routine and relatively simple solutions, but becomes stressed and	Except in simple and routine situations, is stressed and disorganized, lacks control, makes patients and

		complex situations	disorganized easily	families anxious or less able to cooperate

Dimension	Exemplary (4)	Accomplished (3)	Developing (2)	Beginning (1)
Effective responding involves:				
Clear communication	Communicates effectively; explains interventions; calms and reassures patients and families; directs and involves team members, explaining and giving directions; checks for understanding	Generally communicates well; explains carefully to patients; gives clear directions to team; could be more effective in establishing rapport	Shows some communication ability (e.g. giving directions); communication with patients, families, and team members is only partly successful; displays caring but not competence	Has difficulty communicating; explanations are confusing; directions are unclear or contradictory; patients and families are made confused or anxious and are not reassured
Well-planned intervention/ flexibility	Interventions are tailored for the individual patient; monitors patient progress closely and is able to adjust treatment as indicated by patient response	Develops interventions on the basis of relevant patient data; monitors progress regularly but does not expect to have to change treatments	Develops interventions on the basis of the most obvious data; monitors progress but is unable to make adjustments as indicated by the patient's response	Focuses on developing a single intervention, addressing a likely solution, but it may be vague, confusing, and/or incomplete; some

				monitoring may occur
Being skillful	Shows mastery of necessary nursing skills	Displays proficiency in the use of most nursing skills; could improve speed or accuracy	Is hesitant or ineffective in using nursing skills	Is unable to select and/or perform nursing skills

Dimension	Exemplary (4)	Accomplished (3)	Developing (2)	Beginning (1)
Effective reflecting involves:				
Evaluation/Self Analysis	Independently evaluates and analyzes personal clinical performance, noting decision points, elaborating alternatives, and accurately evaluating choices against alternatives	Evaluates and analyzes personal clinical performance with minimal prompting, primarily about major events or decisions; key decision points are identifies, and alternatives are considered	Even when prompted, briefly verbalizes the most obvious evaluations; has difficulty imagining alternative choices; is self-protective in evaluating personal choices	Even prompted evaluations are brief, cursory, and not used to improve performance; justifies personal decisions and choices without evaluating them
Commitment to improvement	Demonstrates commitment to ongoing improvement; reflects on and critically evaluates nursing experiences;	Demonstrates a desire to improve nursing performance; reflects on and evaluates experiences; identifies	Demonstrates awareness of the need for ongoing improvement and makes some effort to learn from experience and	Appears uninterested in improving performance or is unable to do so; rarely reflects; is uncritical of himself/herself

	accurately identifies strengths and weaknesses and develops specific plans to eliminate weaknesses	strengths and weaknesses; could be more systematic in evaluating weaknesses	improve performance but tends to state the obvious and needs external evaluation	or overly critical (given level of development); is unable to see flaws or need for improvement

Source: Kathie Lasater, EdD, RN. Developed from Tanner's (2006) Clinical Judgment Model.

APPENDIX F

Coding Rubric for Journaling

Perception	Attention	Pattern Matching with LTM	Synthesis, Analysis, & Metacognitive Processes	Memory (STM)	Interpersonal Factors
Regularly observes and monitors data	Ability to discriminate relevant from irrelevant cues	Ability to decompose data into discrete elements	Interprets data into meaningful information - ability to synthesize patterns	Identifies goals	Group structure/ people
Recognizes normal and obvious patterns suggesting deviation	Continually reassesses - seeks information for clarity	Ability to compose data into patterns	Ability to manipulate disparate data into meaningful information	Identifies plan of action	Group structure/tasks
Attention tunneling - stops scanning /assessment	Recognition of cues but no action		Lacks knowledge or experience: Equipment Psychomotor Didactic	Seeks advice/ assistance as needed	Group structure/role clarity
	Attention sharing - across environment not individual task		Engages in rule based decision-making (not matching situation/ context)	Engages in active reflection during action	Confidence level of individuals
			Timeliness of Action	Fails to chunk information (information overload)	Conflict resolution
			Priority given to target goals	WAFOS - limits to active working memory	Communication
			Data uncertainty - is equipment functioning correctly		
			Reflection on outcomes relative to decisions made		

APPENDIX G

Recruitment Letter

Dear CSULB Student,

In partial fulfillment of my doctoral studies at Pepperdine University, I will begin conducting research for my dissertation study in Spring 2010. My study is titled: Designing High Fidelity Simulation to Maximize Student Registered Nursing Decision-Making Ability. The purpose of this study will be to explore instructional techniques to utilize during a HFS simulation to enhance situation awareness and decision-making ability of the participants.

You should be aware that you are free to decide not to participate or to withdraw at any time without affecting your relationship with the Long Beach Memorial Medical Center or California State University, Long Beach. The study will not and cannot be used for any kind of performance evaluation, disciplinary measure, or basis for subsequent employment opportunities.

Your participation in this study will involve one three hour long taped simulation. This simulation will be transcribed by myself and coded with Participant ID numbers to assure complete confidentiality. No names will appear on the final report; the use of pseudonyms will protect your identity. Only I will know your identity, your associated numeric Participant ID number, and your pseudonyms. A master copy of this information and all data collected will be kept in a locked drawer and will be destroyed after three years.

Each study participant will receive a $10 gift certificate to Starbucks.

I welcome the opportunity to discuss this study further with you and to answer any questions you may have regarding the study. Please call or e-mail me to set up a time to discuss this further or to set up your interview times (I am hoping to conduct all simulations in Spring of 2010).

I look forward to hearing from you soon!

Cathy Deckers, RN, MSN
Work phone: [redacted]
Cell phone: [redacted]
E-mail: [redacted] or [redacted]

APPENDIX H

Pre-planning Key Nursing Diagnosis and Patho

DATA ELEMENT	PRESENT	ABSENT
Pathophysiology Review • R sided failure s/s • L sided failure s/s • Diagnostics: labs, echo, ekg • Treatments: Lasix, fluid restriction, weight management		
Nursing Diagosis		
Priority: • Fluid Volume Overload • Decreased Cardiac output • Impaired gas exchange • Anxiety • Impaired healthcare maintenance		

management		
Secondary: • Ineffective Breathing • Altered tissue perfusion • Altered urinary elimination: cardiovascular • Risk for caregiver role strain • Ineffective individual therapeutic regime management		
Questions Answered		
Medication Tables		
Labwork		
Diagnostics		

APPENDIX I

Crew Resource Management Guidelines for Facilitating Debriefing

FACILITATION BASICS

- Keep discussion crew centered
- Encourage crew participation from all members
- Balance role as instructor and facilitator
- Reinforce good performance following crew analysis

INTRODUCTION

- Clarify role as instructor
- Identify expectations for crew participation
- Identify length of session

AGENDA and FORMAT

- Use the C-A-L Format
- Help crew develop an agenda
- Ensure all critical issues are covered

FACILITATION TECHNIQUES

- Use questions to promote crew participation
- Follow up on crew topics and redirect crew questions and comments back to them
- Ask questions that begin with what, how, and why to encourage deeper discussion

- Encourage crewmember to discover their own answers
- Direct questions to quiet crewmembers
- Use active listening along with silence/pauses to encourage participation and elicit thoughtful crew responses.

USE OF VIDEO

- Index important events during the simulation
- Introduce the video segment and seek crew analysis of the event.
- Pause video for comments and to discuss important aspects of crew performance

REINFORCE CRM THROUGH CREW INTERACTION

- Encourage members to address each other directly
- Ask crewmembers to discuss how they were affected by each other's actions
- Encourage crew to discuss what they were each thinking

ELICITING IN DEPTH ANALYSIS AND EVALUATION

- Don't give your analysis or evaluation before the crew completes theirs
- Get crew to discuss what went well
- Get crew to discuss what could be improved and how
- Encourage crew to discuss how they might have handled things if they did not go well
- Ask crew to analyze why they made the decisions they made

- Encourage crew to discuss the factors that enabled or impeded their success
- Have crew discuss how they can apply what they learned in “real” application

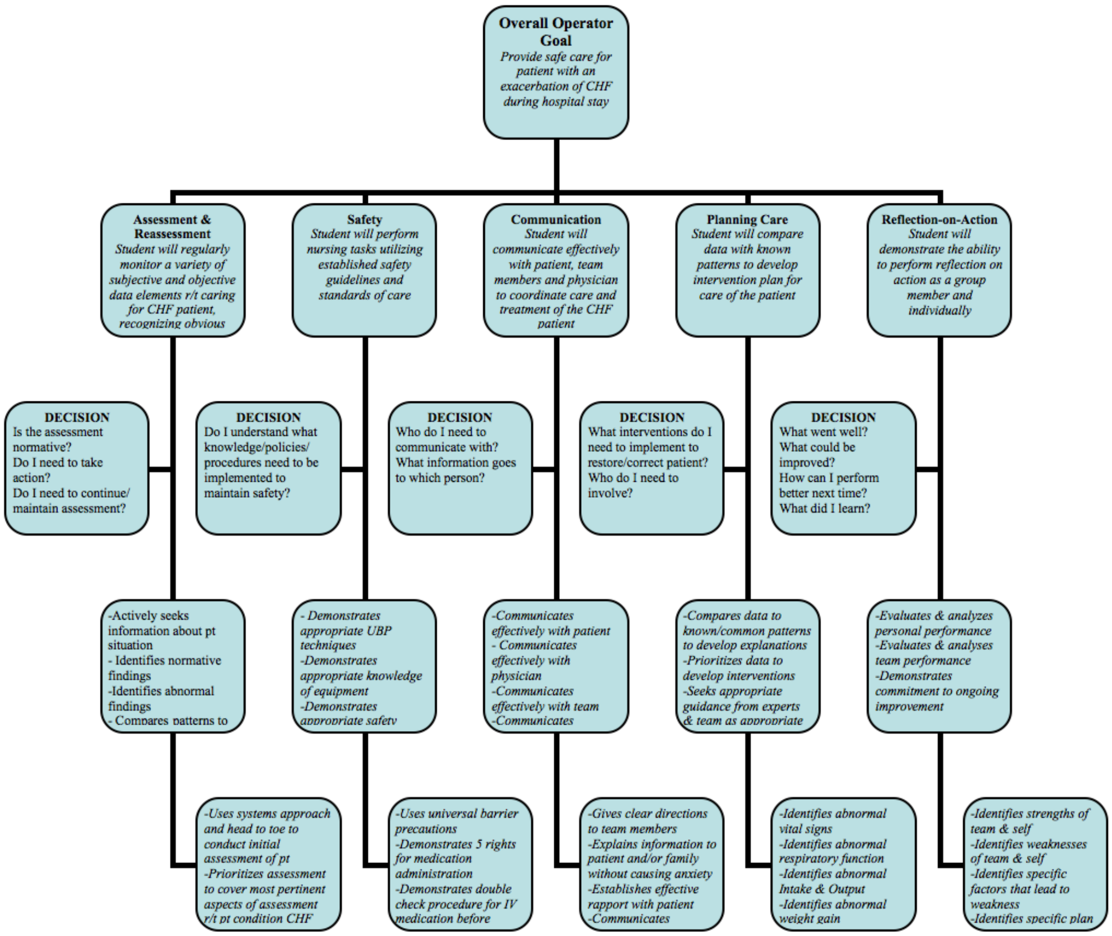
APPENDIX J

Timeliness Data for Individual groups

Phase/Group	Assessment Completed	MD notified First time	Foley Inserted	Lasix Administered	Time of completion
Phase I					
Group 1	14 min	14 min	20 min	17 min	34 min 6 sec
Group 2	6 min	6 min	22 min	21 min	32 min 35 sec
Group 3	12 min	13 min	20 min	19 min	31 min 50 sec
Group 4	15 min	20 min	30 min	17 min	43 min 37 sec
Phase II					
Group 1	10 min	15 min	30 min	25 min	50 min 41 sec
Group 2	8 min	10 min	21 min	18 min	32 min 33 sec
Group 3	8 min	11 min	15 min	15 min	27 min 16 sec

APPENDIX K

Goal-Directed Task Analysis



APPENDIX L

Post HFS Evaluation Survey

1. What aspects and/or phases of the simulation were helpful in assisting you to identifying priority cues for decision-making?

2. What, if any, features of the simulation phases (pre-planning, briefing, simulation practice, debriefing, reflective journaling) helped/hindered identification of patterns to guide decision-making?

3. Please take the following phases of the simulation and rank them in the order of priority (with one being most important and 5 being least important) as to helpfulness in identifying cues and patterns for decision-making in the care of the patient with CHF.

    _____ Pre-planning Phase

    _____ Briefing

    _____ Simulation Practice

    _____ Debriefing

    _____ Reflective Journaling

APPENDIX M

Patient Information/Plan of Care

Nursing 250L

Student:	Date of Care: Unit: 02/12/09 SIM LAB LBMMC	
Patient Initials:	Admission Date: Yesterday (02/11/09)	
Age & Gender: 46 yo Female	Allergies:	Primary Nurse: Marina Coelho UAP:
Code Status:	Social Support:	Surgical Procedure (POD): Total abdominal hysterectomy with bilateral salpingo-oophorectomy

Chief Complaint on Admission:

Focused Assessment:

Admitting Diagnosis and Current Diagnosis:

Admitting: Pt. is being admitted for a total abdominal hysterectomy with bilateral salpingo-oophorectomy due to her chronic pain and excessive hemoraging

Current: The patient is postoperative for a total abdominal hysterectomy with bilateral salpingo-oophorectomy has had sever anemia and two outpatient blood transfusions.

Significant Medical History and Co-Morbidities:

Chronic Pain

Excessive Menstrual Flow

Anemia

Worse Case Senario

Pt. goes further into anaphylactic shock followed by cardiac arrest and death

V.S. (baseline) (02/11/09) TEMP: 37 C BP: 110/70 HR: 78 RR:16 PAIN: (02/12/09) TEMP: 37.4 C BP: 102/60 HR: 88 RR: 18 PAIN: pt. is complaining of discomfort	SaO2 (baseline)	O2 Administration Rationale
Tubes/Drains (Intake & Output) Urinary catheter to bedside drainage; Discontinue morning of postoperative day one Oxygen to maintain SpO_2 greater than 92% Rationale Common complications post-op is urinary retention after abdominal surgery and anesthetics. I&O should be monitored closely for any issues with the excretory system Supplemental oxygen is give in case of decreased saturation r/t pain and immobility. Pt. is also on strong pain meds that can decrease RR, maintaining saturation is ideal for healing and avoiding post-op complications	Diet/Nutrition NPO, until passing flatus then begin clear liquid diet and advance as tolerated Rationale Pt. has recently had extensive abdominal surgery, to prevent paralytic ileus, a diet of NPO has been given until pt. demonstrates a readiness for a more complex diet. NPO also given prior to surgery	Intravenous Therapy IV of D5LR with KCl 20mEq per liter at 125mL/hour Site(s) Status It is important to keep the patient's electrolyte balanced which is a common complication post-op. Pt is also NPO so not receiving any source of K, CL, and surgars other than the one being given IV to maintain BP, HR, and cellular energy supply

Diagnostic Evaluation (20 pts)

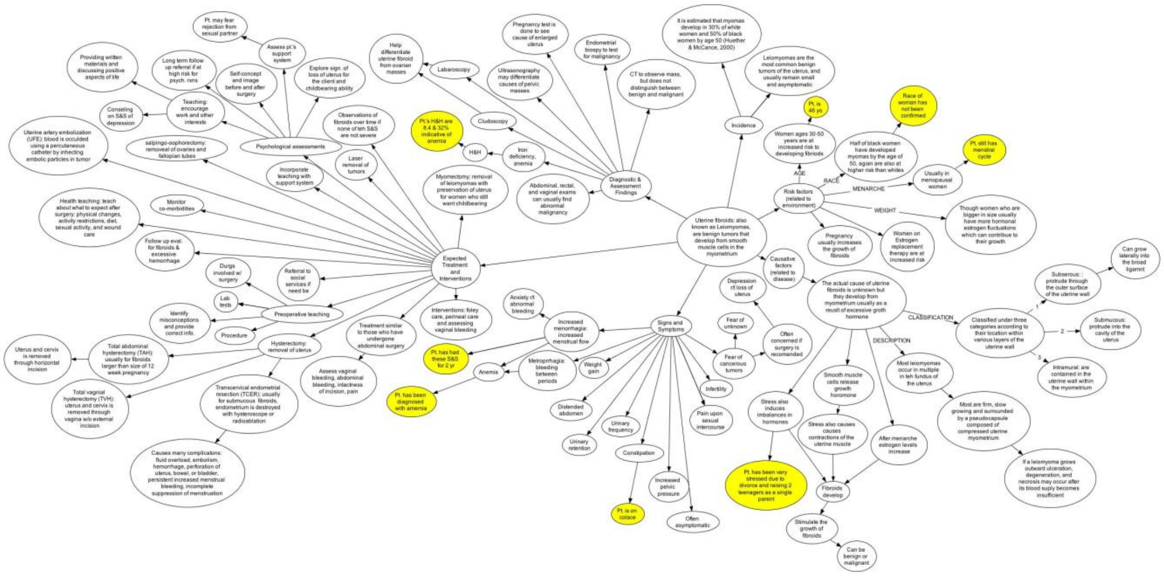
NURSING ORDERS	RATIONALE
1. NPO until passing flatus then begin clear liquid diet and advance as tolerated	Pt recently has had major surgery, GI system needs to be assessed for functioning prior to normal diet implementation
2. Vital signs q 4 hrs	Protocol for every pt. especially if the are post-op 1 day
3. Out of bed to chair evening of surgery and then ambulates 3 times per	Helps with circulation and prevention of atelectasis, as well as stimulates pt. mentally as opposed to being bed bound

day	
4. Intake and Output q shift	Pt fluid volume needs to be monitored closely for hypovolemia r/t to shock
5. AM labs: H&H, electrolytes and BUN, creatinine, and glucose	Pt. has a history of anemia, electrolyte will inform health care workers about volume and cardiac status
6. Oxygen to maintain SpO_2	Pt. is on respiratory depression meds, also help with perfusion of alveoli to prevent atelectasis
7. Sequesntial compression devices on while in be	Help prevent DVT especially for pt. who have recently undergone surgery or who have mobility restraints
8. Incentive spirometer	Help reduce risk of atelectasis and pneumonia

LABORATORY TEST	REFERENCE VALUE	Results (↑) (↓) Admit (02/11/09)	w/ date Recent	EXPLAIN VALUES NOT WITHIN NORMAL RANGE
CBC WBC Neutrophils Lymphocytes Monocytes Eosinophils Basophils RBC Hgb Hct MCV MCH MCHC RDW PLT *Basic Metabolic Panel* Glucose Calcium Sodium Potassium CO2 Chloride BUN Creatanine *Coagulation* PT PTT INR *Other*	M: male F: female 4500-11,000/µl 2500-7000 µl 1700-3500 µl 200-600 100-300 40-100 M: 4.7-6.1 millioin/mm^3 F: 4.2-5.4 million/mm^3 M: 14-18 g/100 mL F: 12-16 g/100 mL M: 42-52% F: 37-47% 80-98 µm^3 27-31 pg 32%-36% 11.5-14.5 coulter S 150,000-400,000 µl 70-105 mg/dl 9-11 mg/dl 136-145 mEq/l 3.5-5.3 mEq/l 22-30 mEq/l 95-105 mEq/l 5-20 mg/dl 0.6-1.2 mg/dl 10-15 sec (1-1.2 INR) <35 sec. 0.8-1.1 Warfarin 2.0-3.0 Mech Valve 2.5-3.5	8.4 32%		-WBCs Should present as normal unless there are underlying infections, but may be decreases as a result of anemia -RBCs should be decreased r/t blood loss from excessive menstruation and anemia -Hgb Related to the patient chronic anemia from excessive menstrual bleeding. -Hct Also related to the patients chronic anemia due to her menstrual cycle and postponing surgical intervention for the past two years -PLT should also be decreased r/t excessive bleeding -GLC May be increased considering the pt is on D5LR -Ca levels can be decreased due to diet NPO -Na may be decreased as a result of continuous IV of D5 and diet of NPO -K should be elevated since the pt. is on a continuous IV containing K -Cl should be elevated since the pt. is on a continuous IV containing Cl -BUN levels may be decreased due to lack of protein intake -Cr levels may be decreased due to lack of protein intake -PT, PTT, and INR should all be normal unless show slight declines as a common result of antibiotics. Unusually high or low scores can be suggestive of underlying disease or complications

Other Diagnostics or Significant Information (X-rays, MRI, Other Studies):

Concept Map/ Pathophysiology



Nursing Process Application

<table>
<tr><td colspan="2">DOMAIN: PHYSICAL</td></tr>
<tr><td colspan="2">NURSING DIAGNOSIS
Acute pain r/t surgical incision AEB patient stating feeling of discomfort since 0430 (Ackley & Ladwig, 2006).</td></tr>
<tr><td colspan="2">DESIRED PATIENT OUTCOME (Measurable & Patient Centered)
Client will use pain rating scale to identify current pain intensity and determine comfort/function goal throughout the shift (Ackley & Ladwig, 2006).</td></tr>
<tr><td>NURSING INTERVENTIONS
1. Determine whether the client is experiencing pain at the time of the initial interview. If so, intervene at that time to provide pain relief. Assess and document intensity, character, onset, duration, and aggravating and relieving factors of pain during the initial evaluation of the client (Ackley & Ladwig, 2006)

2. As the client to describe past experiences with pain and the effectiveness of methods used to manage pain, including experiences with side effects, typical coping resources, and the way the client expresses pain (Ackley & Ladwig, 2006).

3. Establish a comfort-functioning goal with the client (Ackley & Ladwig, 2006).

4. Describe the adverse effects of unrelieved pain (Ackley & Ladwig, 2006).</td><td>RATIONALE
1. Doing this at the initial assessment will first help the client understand that she is being listened to as well as having her understand that you will solve her pain issues. Recoding the data on her pain will aid in analyzing and gaining a better understanding of it as well, hopefully preventing it before it becomes untollerable.

2. This will allow for an individualized persective on treating the patient's pain. Each person responds differently to pain and pain management, understand what works best for the client will help manage her pain with more efficiency.

3. The patient is a woman who has experienced chronic pain for the past two years. She may have a higher pain tolerance than most. Educating her on having a higher pain level greater than 3 is not beneficial to her treatment and establishing a mutual agreement will allow for better healing

4. Expalin to the patient that unrelieved pain will inhibit her from moving which can increase her changes of atelectasis and poor circulation. Both of these issues put the patient at risk for pneumonia and poor circulation which increases her changes at delayed healing.</td></tr>
<tr><td colspan="2">EVALUATION OF DESIRED PATIENT OUTCOMES (MET, PARTIALLY MET, NOT MET)

TO BE COMPLETED DURING CLINICAL</td></tr>
<tr><td colspan="2">DOMAIN: PSYCHOSOCIAL</td></tr>
<tr><td colspan="2">NURSING DIAGNOSIS
Ineffective coping r/t ineffective use of problem-solving process AEB posting postponing surgical intervention for two years AMA (Ackley & Ladwig, 2006).</td></tr>
<tr><td colspan="2">DESIRED PATIENT OUTCOME (Measurable & Patient Centered)
Client will use effective coping strategies (at least 1) prior to the end of the shift (Ackley & Ladwig, 2006).</td></tr>
<tr><td>NURSING INTERVENTIONS
1. Observe for contributing factors of ineffective coping such as poor self-concept, grief, lack of problem-solving skills, lack of support, recent change in life situation, or gender differences in coping strategies (Ackley & Ladwig, 2006).

2. Collaborate with the client to identify strengths such as the ability to relate the facts and recognize the sources of stressors (Ackley & Ladwig, 2006).

3. Be supportive of coping behaviors, allow the client time to relax (Ackley & Ladwig, 2006).

4. Provide mental and physical activities within the clients</td><td>RATIONALE
1. Discourage bad coping mechanisms and try to help the client replace them with more productive ones. Make her aware of why her coping mechanisms may be inappropriate with out sounding condescending or insensitive.

2. Speak to the client about her positive attributes. Try not to focus solely on her issues. Identify her preferences as well as listen to her and try to understand where she is coming from.

3. Give the client the support she needs without treating her too much like a child. Reassure her when she feels uncomfortable and allow some time to focus on things she</td></tr>
</table>

ability (Ackley & Ladwig, 2006).	would like to do. 4. Encourage the client to bring books, watch TV, and listen to the radio. Being a single patent of two teenagers, the client probably does not get much time to herself or to do things she likes. By finding out her personal preferences and helping her get relaxing resources may help in developing better coping mechanisms.
EVALUATION OF DESIRED PATIENT OUTCOMES (MET, PARTIALLY MET, NOT MET)	

Patient Teaching

<table>
<tr><td colspan="2">DOMAIN: EDUCATION</td></tr>
<tr><td colspan="2">PRIMARY TEACHING NEED
The client need to be taught important of the incentive spirometer and how to use it in order to prevent complications like atelectasis and pneumonia associated with her reduced mobility from surgery and pain.

ASSESSMENT DATA (what led you to determine this need)
The night shift nurse claimed that the patient had been asleep most of the night after her surgery yesterday morning, which probably mean that she did not get the opportunity to teach this extraordinarily important task to the patient. If the night nurse did teach this, the patient could have still been groggy from the anesthesia r/t the surgery. Since the patient also states to be in discomfort she will probably not be moving much and guarding her abdomen due to the pain. Also, from her recent divorce and the stress of having to raise two teenagers as a single parent, the pt. probably is not motivated or thinking about how she can help her self</td></tr>
<tr><td colspan="2">DESIRED PATIENT OUTSOME OF TEACHING SESSION (Measurable & Patient Centered)
The patient will be able to demonstrate how to successfully use the incentive spirometer and state how often the physician recommends her to use it prior to the end of the shift.</td></tr>
<tr><td colspan="2">METHOD OF INSTRUCTION (Demonstration, Discussion, Written Handouts)
The nurse will demonstrate how to accurately use the incentive spirometer at least twice. In addition, the patient will demonstrate how to accurately use the incentive spirometer to the nurse at least once as well as state how many times the physician ordered her to do this. The nurse will also give the patient a hand out with written directions on how to use the spirometer.</td></tr>
<tr><td>NURSING INSTRUCTION
1. The nurse will develop a trusting Relationship with the client as well as listening to the patients concerns prior to any education.

2. The nurse will use clear and simple language when speaking to the patient. The tone cannot be condescending yet must still be adult appropriate.

3. The nurse will observe the patient without interrupting her, give her positive feedback as well as instructing how to fix any mistakes

4. The nurse will provide the patient with written instructions.</td><td>RATIONALE:
1. This patient is probably feeling depressed and unmotivated. To move right in to teaching her a task she does not think she needs or feels hopeless will do no good. There must first be a trusting relationship between health care professional and patient. Otherwise the patient my feel that all the nurse care for is the task rather than the client.

2. The patient is in a very sensitive position, any harsh words or un-encouraging comments may put her further into a depressive state.

3. This further elaborates on the 1st instruction. Most of all the patient needs to be heard. From her history, one could assume that she probably does not feel appreciated or considered. Listening to her and giving positive feed back will further increase nurse client relationship

4. Written instructions will help the client remember exactly what is expected of her. If she forgets exactly what the procedure is later during treatment she always has something to refer to.</td></tr>
<tr><td colspan="2">EVALUATION OF DESIRED PATIENT OUTCOMES (Met, Partially met, Not met)</td></tr>
</table>

Medication

Be sure to include all IV fluids, hourly rate of administration and drops per minute.

Class	Name Generic/ Trade	Dose	Rt	Freq	Action/ Rationale (for this patient)	Precautions/ Side Effects/ Nursing Interventions
ANALGESICNARCOTIC OPIATE =AGO-NIST	TRADE: Morphine GENERIC: morphine sulfate	PCA: 2 mg q 2-10 min w/ 4 hr lockout of 40 mg	IV PCA	q 2-10 min w/ 4 hr lockout of 40 mg	Action (including onset): Agonist activity by binding with the same receptors as endogenous opioid peptides. Absorption: Variably from GI tract. Peak: 60 min PO; 20–60 min PR; 50–90 min SC; 30–60 min IM; 20 min IV. Duration: Up to 7 h. Rationale: PRN for pain	Precautions: Initially patient is at risk for respiratory depression later for constipation Side Effects: Skeletal muscle flaccidity,. decreased cough reflex, orthostatic hypotension, <u>cardiac arrest.</u> *Constipation*, *nausea*, vomiting, oliguria, Respiratory: <u>Severe respiratory</u> (Wilson, et al., 2008). Nursing Interventions: No not mix with other sedatives or other CNS depressants. Action potentiate by St. John's wort and some herbals, Respirations of 12/min or below and miosis are signs of toxicity. Withhold drug and report to physician, Monitor I&O.
ANALGESICNARCOTIC OPIATE =AGO-NIST	TRADE: Mor-phine GENERIC: morphine sulfate	IVP 2-4 mg q 2 hrs	IVP	Q 2 hr	Action: Agonist activity by binding with the same receptors as endogenous opioid peptides Absorption: Variably from GI tract. Peak: 60 min PO; 20–60 min PR; 50–90 min SC; 30–60 min IM; 20 min IV. Duration: Up to 7 h. Rationale: PRN for pain	Precautions: Initially patient is at risk for respiratory depression later for constipation Side Effects: Skeletal muscle flaccidity,. decreased cough reflex, orthostatic hypotension, <u>cardiac arrest.</u> *Constipation*, *nausea*, vomiting, oliguria, Respiratory: <u>Severe respiratory</u> (Wilson, et al., 2008). Nursing Interventions: No not mix with other sedatives or other CNS depressants. Action potentiate by St. John's wort and some herbals, monitor I&O. Respirations of 12/min or below and miosis are signs of toxicity. Withhold drug and report to physician (Wilson, et al., 2008).

ANTIEME-TIC; ANTIVERTIGO AGENT; PHENOTHIAZINE;	TRADE: HISTANTIL , PHENERGAN GENERIC: Promethazine	25 mg	IVP	Q 6 hr PRN	Action: In common with other antihistamines, exerts anti-serotonin, anticholinergic, and local anesthetic action. Antiemetic action thought to be due to depression of CTZ in medulla. Absorption: Readily from GI tract. Onset: 20 min PO/PR/IM; 5 min IV. Duration: 2–8 h. Rationale: PRN for nausea	Precautions: Interacts with other CNS depressants and alcohol Side Effects: Body as a Whole: Deep sleep, coma, convulsions, cardiorespiratory symptoms, extrapyramidal reactions, nightmares (in children), CNS stimulation, abnormal movements. Respiratory: Irregular respirations, respiratory depression, apnea. CNS: Sedation *drowsiness,* confusion, dizziness, disturbed coordination, restlessness, tremors. CV: Transient mild hypotension or hypertension. GI: Anorexia, nausea, vomiting, constipation. Hematologic: Leukopenia, agranulocytosis. Special Senses: *Blurred vision, dry mouth,* nose, or throat. Skin: Photosensitivity. Urogenital: Urinary retention (Wilson, et al., 2008). Nursing Interventions: Supervise ambulation, sometimes masks symptoms of complication from other medications
SALINE CATHARTIC; ANT-ACID	TRADE: MOM GENERIC: magnesium hydroxinde	30 mL	PO	Daily PRN	Action: Causes osmotic retention of fluid, which distends colon, resulting in mechanical stimulation of peristaltic activity. Rationale: PRN-constipation	Precautions: Monitor vitals closely and watch for fluid loss, I&O Side Effects: GI: Nausea, vomiting, abdominal cramps, *diarrhea.* Urogenital: Alkalinization of urine. Body as a Whole: Weakness, mental depression, dehydration, coma. Metabolic: Electrolyte imbalance with prolonged use. CV: Hypotension, bradycardia, complete heart block and other ECG abnormalities. Respiratory: Respiratory depression (Wilson, et al., 2008). Nursing Interventions: Most effective when taken on an empty stomach.
STOOL SOFT-ENER	TRADE: Colace, DSS GENERIC: docusate sodium	100 mg	PO	Daily	Action: Anionic surface-active agent with emulsifying and wetting properties. Rationale: Constipation	Precautions: Increases system absorption of mineral oil Side Effects: Abdominal cramping, *diarrhea,* and nausea (Wilson, et al., 2008). Nursing Interventions: Withhold drug if diarrhea develops

	TRADE: Feosol, Fer-In-Sol, Fer-Iron, Fero-Gradumet, Ferospace, Ferralyn, Ferra-TD, Fesofor, Hematinic, Mol-Iron, Novoferrosulfa , Slow-Fe GENERIC: ferrous sulphate	325 mg	PO	b.i.d w/ meals	Action: *Ferrous sulfate:* Standard iron preparation that corrects erythropoietic abnormalities induced by iron deficiency but does not stimulate erythropoiesis. *Ferrous gluconate:* Claimed to cause less gastric irritation and be better tolerated than ferrous sulfate. Rationale: Treatment of anemia	Precautions: Carful when using with hemolytic anemias and with pt.'s receiving repeated transfusions Side Effects: GI: *Nausea, heartburn,* anorexia, *constipation,* diarrhea, epigastric pain, abdominal distress, *black stools.* Special Senses: Yellow-brown discoloration of eyes and teeth (liquid forms). Large Chronic Doses in Infants Rickets (due to interference with phosphorus absorption). Massive Overdosage Lethargy, drowsiness, nausea, vomiting, abdominal pain, diarrhea, local corrosion of stomach and small intestines, pallor or cyanosis, metabolic acidosis, shock, cardiovascular collapse, convulsions, liver necrosis, coma, renal failure, death (Wilson, et al., 2008). Nursing Interventions: always take with meals, when oral intake resumes
ANAL-GESIC, NONSTEROIDAL ANTIINFLAMMATORY DRUG (NSAID); ANTIPYR-ETIC	TRADE: Toradol, Acular, Acular LS GENERIC: ketorolac	30 mg	IVP	Q 6 hr for 3 days	Action: Anionic surface-active agent with emulsifying and wetting properties. Rationale: *Short-term* management of pain; , reduction of post-operative pain after refractive surgery.	Precautions: History of peptic ulcers; impaired renal or hepatic function; older adults; debilitated patients; diabetes mellitus; SLE; CHF; Side Effects: CNS: Drowsiness, dizziness, headache. GI: Nausea, dyspepsia, GI pain, hemorrhage. Other: Edema, sweating (Wilson, et al., 2008). Nursing Interventions: Correct hypovolemia prior to administration of ketorolac. Lab tests: Periodic serum electrolytes and liver functions; urinalysis (for hematuria and proteinuria) with long-term use. Monitor patients with a history of cardiac decompensation, renal impairment, heart failure, or liver dysfunction as well as those taking diuretics. Discontinuation of drug will return urine output to pretreatment level. Monitor for S&S of GI distress or bleeding including nausea, GI pain, diarrhea, melena, or hematemesis. GI ulceration with perforation can occur anytime during treatment. Drug decreases platelet aggregation and thus may prolong bleeding time. Monitor for fluid retention and edema in patients with a history of CHF (Wilson, et al., 2008).