THE EVALUATION OF HIGH-FIDELITY SIMULATION IN NURSING: SELECTED ISSUES IN CONCEPTUALIZATION AND MEASUREMENT

By

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To the faculty of Washington State University:

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THE EVALUATION OF HIGH-FIDELITY SIMULATION IN NURSING SCHOOL:
SELECTED ISSUES IN CONCEPTUALIZATION AND MEASUREMENT

Abstract
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High-fidelity simulation is being used more commonly in nursing education practice laboratories and the increased use is applauded by most faculties. Simulation is a method of evaluating learning objectives that engages the cognitive, affective, and psychomotor domains of learning. Simulation requires big investments on the part of a college or hospital, not just in up front money, but in faculty/staff time and laboratory space. Therefore, central to simulation in nursing is the evaluation of simulation and its addition to the college’s or hospital’s curriculum. To date there has not been a systematic study exploring the relationship between the use of high-fidelity simulation and a student’s clinical judgment skills and to this point there has not been an effective tool to assess clinical judgment in a simulation setting. This paper will consolidate and present the current findings along with identifying strengths and weaknesses of the simulation experience in order to identify any gaps in research so areas for future studies can be identified.

Key words: Simulation, nursing education, clinical judgment, simulation assessment
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Introduction and Background

The nursing crisis in the United States has illuminated several problems in the current education of nurses. There is no shortage of potential students; instead there is a shortage of nursing faculty, of clinical sites and of clinical educators, coupled with employers who expect colleges to do a better job preparing students for work in the “real world” (Henneman & Cunningham, 2005). Hospitals are short staffed and cannot afford lengthy orientation periods for new hires (Winslow, Dunn, & Rowlands, 2005). Already overworked, many nurses do not care to precept new graduates to bring them to the level of an independently functioning health care professional (Winslow et al., 2005). Nursing schools around the world are seeking new and innovative ways to address these problems. One of the newest and most technical innovations is the use of Human Patient Simulators (HPS) which are specialized manikins that simulate patient responses and allow students to practice a variety of skills in a simulation laboratory (Sim-lab) which equates to a “safe clinical setting” (Henneman & Cunningham, 2005).

Nursing schools are increasingly using high-fidelity simulation in nursing education as a way to augment and/or elevate and improve the student’s clinical experience. Simulation provides the opportunity for practical hands-on learning. Hands-on learning enables participants to gain knowledge and skill and to make good clinical decisions – all basic tenets of experiential learning (Underberg, 2003). While simulation has been used in health care education for over 15 years, in the past 3-4 years there has been an increase in popularity and use (Underberg, 2003). This is due in part to the improvement of simulation technology, the reduction in costs, the need for more clinical sites for students, the safety factor of practicing on a manikin, and the ability of
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setting up scenarios the student may not be exposed to in any other clinical setting (Medley & Horne, 2005).

Using simulation first became popular in the late 1960s with simple paper-based simulations that tested the problem-solving skills of nursing students (Garrett & Callear, 2001). In recent years more nursing schools and hospitals are implementing simulation, and more specifically high-fidelity simulation, in order to meet the high market demands for more nurses that are highly trained in technical skills, critical thinking skills and organizational skills (Ravert, 2002).

The use of simulation technology in nursing is designed to create an active learning environment. Simulation is an attempt to replicate some of the essential aspects of a clinical situation so the circumstances can be more readily understood and managed by the student nurse when he/she is exposed to it in the practice setting. Using simulation as a method of teaching promotes the student's ability to apply knowledge he/she has gained from a previous experience (Johnson, Zerwic, & Theis, 1999). It allows for practice in assessment and psychomotor skills and in determining which nursing interventions are appropriate in a clinical setting. Using simulation allows students to “learn in a highly adaptable and safe environment that fosters autonomy, independence, and the development of sound analytical skills” (Peteani, 2004, p. 25).

Nursing educators are responsible for educating nurses to handle diverse clinical situations. To meet these demands, educators must provide the new graduate with more knowledge and skill than in previous years (Bremner & Brannan, 2000). Recent advances in education, such as the use of simulation, are focusing on teaching strategies that ensure students are adequately prepared for work in the health care setting (Klein, Calderwood, & MacGregor, 1989). High-fidelity simulation offers students an opportunity to “put it all together” while
learning as a group in a safe environment with faculty support. After simulation, students are able to analyze their performance and encouraged to learn from mistakes (their own and those of their colleagues).

Statement of the Problem

High-fidelity simulation is being used more commonly in nursing education practice laboratories and the increased use is applauded by most faculties. Simulation is a method of evaluating learning objectives that engages the cognitive, affective, and psychomotor domains of learning. However, there have been no systematic studies exploring the relationship between the use of high fidelity simulation and student’s subsequent clinical judgment skills. Research in the area specific to clinical simulation is limited (Spunt, Foster, & Adams, 2004). Madorin and Iwasiw state, “Research to determine the impact of computer aided instruction has been sparse” (Madorin & Iwasiw, 1999, p. 282). A study to validate simulation’s effectiveness on improving clinical decision making abilities is in process (personal communication, S. Quint, May 21, 2004).

Statement of the Purpose

The purpose of this paper is to explore what is known about simulation in nursing and to identify selected issues in conceptualization and measurement of high-fidelity simulation training. The literature review will include descriptive studies as well as qualitative and quantitative studies about the use of simulation in nursing education and seek evidence related to the effect of simulation on the education process. The review will also explore whether there is an effective tool to measure any effects of simulation. This paper will consolidate and present the current findings and will identify strengths and weaknesses of the simulation experience. This will help to identify any gaps in research so areas for future studies can be identified.
Definition of Terms

Simulation is the act of mimicking a real event, process, or object by taking on its appearance or outward qualities (Seropian, Brown, Gavilanes, & Driggers, 2004). Fidelity is used in the simulation realm to describe the level of technology and accuracy being used. It refers to the level of precision in reproducing the sounds and images needed. High-fidelity simulation attempts to attain realistic enough sights and sound to convince the users they are getting a scene that so closely resembles that which they would encounter in real life as to not be able to tell the difference in the learning experience (Peteani, 2004). A simulator must provide both educationally sound and realistic feedback to a student’s questions, actions, or decisions if it is to be an effective teaching tool. The user should be able to suspend disbelief if the simulator presents with enough realism (Seropian et al., 2004).

Clinical judgment for the purpose of this paper is defined as an inference or understanding regarding a clinical situation and the needs, health issues, or concerns of the patient being cared for (Messecar & Tanner, 2004). This inference is then quickly followed by action on the part of the caregiver. Action may include not acting, modifying the standards of practice, or improvising on the standards of practice thought to be most appropriate by the patient’s response to the action (Haskvitz & Koop, 2004).

Intuition is a key component of the clinical judgment model, and is defined by Benner and Tanner (1987) as “understanding without rationale” (p. 23). Nursing is considered to be both an art and a science. This characterization of the nature of nursing divides the profession into the empirical as well as the aesthetic aspects. Alverzo (2004) further dissected Tanner’s model into “four fundamental patterns of knowing, which are; empirics, aesthetics, personal knowledge and ethics” (Alverzo, 2004, p. 85). Empirics are the traditional science of nursing based on facts that
are organized into laws and theories. Aesthetic knowledge is considered the art of nursing, and includes intuition. Benner and Tanner (1987) identified intuition as a central source of aesthetic knowledge that has a direct impact on practice. In this paper the terms “expert” and “novice” are used to refer to higher and lower levels of skills and experience. As nurses (and nursing students) move through the continuum, it is the intuition component that most contributes to their expanded knowledge base (Benner, 1984).

Self-efficacy, an essential constituent of social cognitive theory, is defined as “beliefs in one’s capabilities to organize and execute the courses of action required to producing given attainments” (Bandura, 1997, p. 3). Self-efficacy theory predicts that if faculty members are capable of improving students’ efficacy beliefs about performing clinical competencies, then students will be more proficient in maintaining their newly learned behaviors in independent clinical practice (Clarke, Owen, & Tholcken, 2004).

Cognitive learning theory defines learning as a process that is active, cumulative, and goal-oriented. The role of a student in a cognitive learning environment is to assume control of the learning situation and become actively involved in it.

The model of clinical judgment (attachment A) developed by Messecar & Tanner (2004) informed an assessment tool by Lasater and Katims (Lasater, 2005) that is used to evaluate the clinical judgment skills of students following simulation sessions at Oregon Heath Sciences University (OHSU). (attachment B)

Literature Review

This paper is designed to provide the reader with the current state of the science with regard to high-fidelity simulation in nursing education. In order to review previous work related to clinical judgment in simulation settings three literature searches conducted in February of
2003, 2004, and 2005 were performed using the search term “simulation.” The first found the majority of papers about simulation referred to its use in flight training for pilots, anesthesiologists at medical school, and nurse anesthetists. Reflective of the increase in simulation usage in nursing, the second literature search conducted in 2004 with the same search criteria found more than 20 articles related to simulation in nursing education. This rapid increase in articles parallels the burgeoning interest in the use of simulation in nursing education. The third literature search specifically looked for additional articles reporting the evaluation of simulation in nursing education. While most of the articles found in all three searches are scholarly descriptions of simulation or the uses of simulation, research findings, both qualitative and quantitative were rare. Although several articles describe how HPS is being used and offer faculty and students' opinions involving the use, no studies documenting a measurable connection between clinical judgment ability and simulation exposure could be found in any of the three searches.

History of Simulation

In the late 1950's nursing students refined physical assessment skills on a life-sized prototype manikin that was modeled after a human being (Peteani, 2004). A later model then came equipped with heart and lung sounds. Students were able to differentiate normal from abnormal sounds. In 1969 Sim-One became the first fully computerized simulation manikin (Peteani, 2004). Earlier versions with separate computerized software have evolved into high-fidelity HPS. The American Heritage Dictionary defines high-fidelity as; n. the electronic reproduction of sound, especially from broadcast or recorded sources, with minimal distortion, adj. characterized by minimal distortion in sound reproduction (American Heritage Dictionary, 2006).
There are several types of simulation available to nursing educators and most have been available for a number of years. High-fidelity simulators mimic much of the human body experience. The two most advanced high-fidelity HPS available to nursing (rather than anesthesia) are Laerdal’s Sim-Man™ and Medical Education Technologies, Inc., Human Patient Simulator (METI HPS™). Manikins such as this allow nursing educators to design realistic healthcare practice scenarios. HPS come equipped with a functioning mouth and airway, a chest that expands and relaxes with each breath, heart, lung and bowel sounds that are programmable, and can display in real-time an electrocardiogram, pulse oximetry, and arterial pressures (Pateani, 2004). Sim-Man™ has software retained within the manikin and is accessed from a laptop or desk-top computer. It can be programmed to imitate pediatric or adult patients of either gender, and a female model can give birth to a Sim-Baby™ (Mortland, 2005). These manikins offer characteristics that are needed in a realistic HPS. They breath, talk, and blink. They can be programmed to respond to interventions. All these features add realism and bring students to believe that what they are seeing and experiencing is “real.” However, manikin-based systems cost between $28,000 and $150,000 (Seropian et al., 2004, 165) and the money needed to train staff and set up mock clinical settings go far above the cost of the manikin. Many schools may forgo purchasing an HPS of the caliber of Sim-Man™ because of the cost constraints (Peteani, 2004).

The software associated with Sim-Man™ attempts to simulate a subject or situation in high-fidelity, and can test many aspects of a student’s learning such as technical skills, knowledge base and clinical decision making. Tools have been developed to test technical skills and critical thinking as it pertains to the clinical judgment process (Feingold, Calaluce, & Kallen, 2004). Software packages use “underlying physiological models and expect students to care for a
patient in a given situation in real time. "The introduction of real time is important because it is a variable that is present in every clinical situation in which health care providers work" (Seropian, et al., 2004, p. 166).

**Increasing Use of High-fidelity Simulation**

Many descriptive papers and studies using qualitative methods have been published to show simulation’s contribution to nursing education. For example, in 2004 Nehring & Lashley published a descriptive study detailing the use of HPS in thirty-four schools of nursing. They sent questionnaires to 66 nursing schools and 150 simulation centers, hospitals, and other higher education institutions that had purchased a METI HPS™ prior to 2002. Responses came from 33 nursing schools in the United States (US) and one in Japan. Of the institutions responding, only three universities indicated they had, or planned to, conduct research about their use of HPS. Three community colleges stated they were initiating research studies and four of the six simulation centers were conducting research but were studying topics such as cost effectiveness of taking examinations using HPS, training efficiency, skill acquisition, and performance assessment (Nehring & Lashley, 2004).

Respondents of Nehring & Lashley’s survey commented “the HPS is useful for developing critical thinking skills, applying theory to practice, providing a better transition to clinical experiences, and providing a safe, simulated experience” (Nehring & Lashley, 2004, p. 247). Yet respondents also noted, that “additional research is needed to affirm the validity of HPS in objective evaluations” (p. 247). Clearly, this points out the lack of research linking clinical judgment and exposure to HPS. An additional issue in the design of Nehring and Lasher’s study pertains to the inclusion criteria that involved only one HPS manufacturer.
Haskvitz, (2004) published a descriptive paper on the use of simulation for students struggling in clinical. In her paper she states, “High-fidelity patient simulators make it possible to recreate the clinical environment both physically and physiologically. There is a wide margin of safety inherent in the process. The simulator will not be harmed if an error is made. Therefore, the simulation center is a safe place for students to practice skills and behaviors until a specified level of proficiency is reached” (Haskvitz & Koop, 2004, p. 183). The Haskvitz (2004) paper describes the testing of technical skills and practice until mastery is obtained. While this is an important issue in terms of safety, again no mention is made of testing clinical judgment or critical thinking skills.

Overview of Simulation in Nursing Education

Of the articles examined in the second literature search, most were published in 2004 (14). All had similar definitions of simulation. For instance, Rauen (2004) says simulation is, “an event or situation made to resemble clinical practice as closely as possible” (Rauen, 2004, p. 46). Another definition states, “simulation as a teaching method promotes the student’s ability to apply knowledge gained from previous and current coursework, practice assessment and psychomotor skills, and consider which nursing interventions are appropriate in a clinical situation (Aronson & Squires, 2004, p. 33). Underberg’s definition states, “Simulation in health care, therefore, can be defined as the use of scenarios to expose providers to a variety of simulated conditions or patients to enable participants to broaden their skills and knowledge base” (Underberg, 2003, p. 31). A group in the United Kingdom using HPS define simulation as “educational tools using a human mannequin and computer to recreate an aspect of medical care for training health-care professionals to perform simple or more complex clinical tasks”
(Blackburn & Sadler, 2003, p. 677). In summary, simulation is a method of teaching that allows or requires learners to apply theory to practice in an integrated manner.

The emphasis in simulation is often on the application and integration of knowledge, skills, and clinical judgment. Unlike a classroom setting using a paper and pencil test, simulation affords the learner an opportunity to function in an environment that is as close as possible to an actual clinical situation and allows for clinical judgment and critical thinking in a safe environment. Testing of nursing students should be designed in such a way as to test the student in as close of possible, the setting and situation of their future workplace setting. HPS used in a clinical setting allows for reality of the simulation, realism in the pace and flow of the setting, and the ability to transfer skills and knowledge from the simulation setting.

Simulation research has not yet identified nor explored the myriad of ways HPS can be used in nursing education. The full scope of HPS remains unknown. Many institutions are buying and using HPS and some are testing the effects of exposure to HPS, but many do not have a clear idea what to test for. While several studies showed how HPS can increase technical skills, (Johnson, et al. 1999) and many students favor the use of HPS, (Feingold, Calaluice, & Kallen, 2004) other students reported they did not believe the simulated session would prepare them adequately to perform in a clinical setting (Feingold et al., 2004). The questions then become: are there ways to facilitate transfer of knowledge and learning from the sim-lab to the clinical area? And, does the simulation experience increase competency and clinical judgment? Anecdotal reports from nursing course faculty do indicate student performance in sim-labs is predictive of “real clinical” performance, but this clearly needs further study and validation (Peteani, 2004).
Additional research problems may arise when attempting to measure clinical judgment skills or critical thinking, as both are extremely complex concepts with varying definitional clarity. Clinical simulations are an excellent example of the use of cognitive learning theory because they force the student to be active, and require the student to use previous knowledge and skills. Sim-lab sessions are directed toward the goal of providing the simulation patient with the best care possible (Johnson et al., 1999). Most studies offering research of simulation utilize questionnaires and a Likert-type scale for student evaluation (Johnson, et al., 1999, Bearnson and Wiker, 2005, Wildman and Reaves, 1997, Mole and McLafferty, 2004, and Henneman and Cunningham, 2005). One problem with many of the studies is that because they are based upon student clinical populations, their sample size is small (often between five and eighteen) which severely limits the generalizability of the findings.

Qualitative studies of simulation in nursing. A qualitative study published in 2004 details results of an exercise survey wherein 89% of students agreed that role playing and simulation of patient situations were essential to the exercise, and 83% agreed participation in the exercise did make them think quickly and prioritize (Mole & McLafferty, 2004, p. 96). That study used a Likert scale and had 123 students participate, giving the findings strength. One of the studies’ aims; to encourage students towards critically examining their clinical practice received the most positive responses. Eighty six percent agreed and 34% strongly agreed that the exercise was beneficial (Mole & McLafferty, 2003). While critical reflection is valuable in development of clinical judgment and students’ responses are likely valid in this regard, the question of whether the simulation intervention in fact did result in improvement in ability to prioritize/think quickly would be strengthened if it were determined by measurable outcomes, rather than student self report.
An earlier qualitative study was conducted by Madorin and Iwasiw (1999) where students reported self-efficacy levels after exposure to computer-assisted instruction (CAI). Their research shows “the mean self-efficacy scores increased significantly immediately following the computer simulation and the computer simulation gave students the opportunity to increase their performance accomplishments by successfully working through a plan of nursing care for a surgical patient; thus, their self-efficacy scores were higher following the CAI” (Madorin & Iwasiw, 1999, p. 284). Self-efficacy is associated with clinical competence (Clarke, Owen, & Tholcken, 2004, and Crosby, 2002).

Rauen’s scholarly paper (2004) states simulation can be used to teach theory, assessment, clinical judgment, decision making, technology, pharmacology and psychomotor skills. HPS can be utilized early in nursing education to augment physical assessment courses, to differentiate between normal and abnormal findings, or to demonstrate positional and physiological findings, and as students move through their nursing courses (Rauen, 2004). Students do spend many hours in the clinical setting, however, they still may never see first hand some of the more critical disease processes or illnesses. HPS can be used to promote effective nursing care in more and more complex situations (Peteani, 2004).

Qualitative research by others has amassed rich descriptions of how simulation helps the student to work through complex clinical problems without jeopardizing the patient (Blackburn & Sadler, 2003). High-fidelity simulation has made this type of learning even more realistic. Simulation enables many students to experience the same complex case, thus balancing the education of a group. A study conducted by Wildman and Reeves used a questionnaire to elicit student response to a simulation session. Comments included, “It raised good ideas which I
Quantitative studies of simulation in nursing. Few studies using quantitative methods have been published that demonstrate how students respond to the simulation experience. One study that did was reported by Alinier, Hunt, & Gordon (2004). They assessed and reassessed consecutive cohorts of nursing students from a university in London. Sixty seven students participated in the study. The tool used was the Objective Structured Clinical Examination (OSCE). Bartfay, Bonbough, Howse, & LeBlanc, (2004) define the OSCE as a performance test that requires the student to demonstrate specific behavior in a simulated work environment and consists of several independent stations. In the Alinier, et al., study, although both the experimental and control groups improved their OSCE scores, the increase was 6.76% for the control group and 13.43% for the experimental group. They report this difference in improvement as highly significant (p<0.05) (Alinier et al., 2003).

Some limitations noted in the paper are the lack of demographic matching of the control and experimental groups until after the first OSCE session, and that the OSCE sessions were changed between the first and second testing sessions. Bartfay, et al., states a student could be exposed to the same OSCE session after a brief absence and not have the results skewed (Bartfay, et al., 2004). Alinier, et al. states the OSCE sessions tested a majority of technical skills (11 of 15 stations) as opposed to testing cognitive skills (4 of 15 stations) and Bartfay, et al. reports that the OSCE “should not be employed as the sole method of evaluation, because it is not designed to measure all the domains of a student’s educational process” (Bartfay, et al., 2004). Alinier, et al. states, “the whole learning exercise could be jeopardized if students were not adequately briefed and prepared for the simulation” (Alinier, et al., 2003, p. 203). While the
exposure to HPS was noted as necessary for the learning exercise, it could also be interpreted
that giving students prior knowledge of the simulation session gave the students an unfair
advantage in their care of the patient and their self-assurance of available equipment.

**Current Uses for Simulation in Nursing Education**

At present, simulation in educational settings is used with patient scenarios that can be
programmed to mimic clinical sessions or to augment course instruction. The HPS units can also
come pre-programmed with mock code drills and life threatening diseases and illnesses. The
METI HPS® can be purchased with an entire curriculum if faculty is not available for scenario
development. An HPS can be used alone or as a part of a health care lab to practice and refine
nursing skills (Medley & Horne, 2005).

Paparella, Mariani, Layton, & Carpenter (2004) report simulation can effectively be used
as an educational strategy. The report establishes the “fun factor” in simulation when simulation
was used as part of a skills fair in a Delaware hospital to increase medication safety awareness.
The simulation was designed with 25 incorrect items for staff to discover. Although they noted
that finding multiple errors for a single patient was unrealistic, it encouraged staff to think
differently about the process of medication administration. Of approximately 50 nurses
attending the simulation session a majority reported enthusiastic feedback to the educators. The
authors stress that a formal evaluation of the simulation exercise was not distributed (Paparella,
et al., 2004).

Of all the forms of simulation used in health care, full-scale simulation is one most
recognized (Seropian, et al., 2004). Full-scale simulation “attempts to recreate all the elements
of a situation that are perceptible to students” (Seropian, et al., 2004, p. 168). The setting is made
to resemble the intended clinical setting as closely as possible. This total immersion of the
student in the experience allows for students to critically think and make clinical judgments in a crisis or non-crisis situation and calls on both cognitive and technical skills.

Students respond to the simulated patient and if the response is inappropriate, they are guided by the lab facilitator to the right decision, or are left to see the consequences of their actions. After each and every session students have an opportunity to debrief. Sessions of full-scale simulation can be unpredictable since students’ actions and reactions can not be scripted.

Institutions must provide additional resources for a full-scale simulation lab. Several lab instructors may be needed for more complex scenarios in order to guide the students taking part in the simulation. Interaction between the students and manikin, and the students and instructors, is a key component of full-scale simulation. It is a dynamic environment that may be broadcast live to peers and video recorded for a debriefing session and for future training.

The debriefing session may use a video recording of the scenario to initiate discussion. Another dimension of this experience is that students can “review and critique their own and other students’ actions and behaviors in an atmosphere conducive to learning; this is a learning experience that students rarely have the opportunity to do in the clinical setting” (Johnson et al., 1999, p.39). Students can also self-assess as well as receive peer assessments, or receive individual assessment with a faculty member or skilled facilitator (Aronson & Squires, 2004).

This dynamic analysis leads the student to synthesis of a plan of action to deal with the information. Debriefing is important for students to identify concepts learned and to relate their learning objectives, discuss application to clinical practice, and evaluate their experience (Spunt, Foster, & Adams, 2004). Students are encouraged to describe their own strengths and areas in which they could improve. Debriefing is used by the instructors to decide if additional
simulation sessions are needed. Subsequent sessions can become narrower in scope and focus intensely (Haskvitz & Koop, 2004) on those areas still needing improvement.

Within the United States, high-fidelity simulation has become quite common. Likewise, several colleges and universities outside the U.S. are now using high-fidelity simulation in nursing education. For example, Cioff (2001) describes in a scholarly paper use of Sim in Australia. In the United Kingdom, Wildman & Reeves (1997) report on a qualitative study with 116 students participating. In Sweden, Rystedt & Lindtrom (2001) conducted interviews with 15 nurses and looked at simulation technologies contribution to learning. In Hong Kong, Wong & Chung (2002) explored the diagnostic reasoning process among nursing using simulation.

Issues and Concerns with Simulation

Problems do exist in providing simulation for students. Simulation labs are very expensive to set up and staff. When the University of Minnesota partnered with Metropolitan State University and Region’s Hospital in 2003 to develop a simulation center for nursing students, the primary goal stated, was to improve patient safety. Health Partners and Metropolitan State built the center for a cost of $350,000 with an additional $120,000 budgeted for 2004 (Patow, 2004). Planned funding will add $800,000 to $1 million over the next three years of the program to purchase additional simulation technology and hire a director, instructional design staff, and technology support staff (Patow, 2004). Clearly state of the art simulation centers are costly.

Further concerns were acknowledged by Underberg (2003), “The major impediment to widespread acceptance of simulation as an effective teaching tool is the lack of reliable and valid methods of evaluation” (Underberg, p. 31). Scherer’s study of nurse practitioner groups, relates skepticism regarding the cost of simulation versus its benefits. The author states that simulation
has "an unsubstantiated value for healthcare education" (Scherer, Bruce, Graves, & Erdley, 2003, p. 339).

This combination of high expense and lack of research-based evidence of improvement in higher level clinical decision making prompts colleges and universities to critically investigate the use of high-fidelity simulation. If the costs of simulation use in nursing education can be outweighed by: (a) an increase in student knowledge, clinical judgment, clinical decision making, and hands-on skills, (b) an increase in the ability to rapidly make accurate decisions about patient care, and (c) an increase in patient safety, then, the increasingly popular use of simulation will continue.

Disadvantages listed by Haskvitz include students citing lack of reality in using the HPS and the Sim-lab environment. Though HPS has been suggested as an alternative to clinical practicum hours, clearly there is wide variation in how realistic the experience is for students. Students are aware that simulation is in progress and may not take it seriously, or conversely, may be aggressively tuned into the situation and become overzealous in their treatment of the patient (Haskvitz & Koop, 2004). Although use of the HPS holds promise, it should not be viewed as a cure-all. HPS are not likely to totally replace traditional clinical based programs in nursing (Scerbo, 2004).

Although HPS are present in many nursing schools and learning centers there is a failure to use the equipment to its fullest. This is a waste of available resources and valuable opportunities for innovative teaching (Sperian et al., 2004). In order to be successful, HPS projects and sim-labs must start small and include all essential phases of planning.
Evaluation of Simulation in Nursing

The literature reviews revealed a scarcity of studies reporting on evaluation of simulation in nursing education. A study was conducted by Goldenberg, Andrusyszyn, & Iwasiw (2005) on the perceived self-efficacy of nursing students after exposure to simulation. Questionnaires were sent to 66 students with a 33% response rate (N=22). Goldenberg et al. used an exploratory, descriptive design and a non-probability convenience sample, obtained from students attending a university in southwestern Ontario, Canada. Part one of the questionnaires sought to determine students’ degree of self-efficacy related to health teaching both prior to and following the workshop. Participants were asked to recall their perceptions of how confident they were about health teaching before and after simulation activities. Following simulation exposure, students’ self-efficacy scores were significantly higher (p=0.001) in post test than scores on the pre test, reflecting greater overall confidence related to health teaching (mean = 3.55) after participating in the workshop than before (mean = 2.96). This supported increasing students’ perceptions of self-efficacy through simulation (Goldenberg, Andrusyszyn, & Iwasiw, 2005). Moreover, there is research support suggesting a modest positive correlation between self-efficacy and clinical competence (Crosby, 2002).

A report published by Winslow, Dunn, and Rowlands (2005) outlines a hospital’s use of simulation to assess competency and learning needs of new and existing RN staff. They cited a need for a mix of clinical knowledge, skills, and information to prepare nurses for the changes in the practice arena. Preparing nurses to make sound clinical judgments, solve complex problems, and think critically is the objective of competency-based education (Winslow, et al., 2005). A questionnaire using a Likert scale was completed by an unknown number of nurses attending an open house for a newly completed lab. The same questionnaire was used later to measure staff’s
response to the skills lab after simulation exposure. The responses revealed the lab to be a positive experience with the learners' objectives being met 96% of the time (no \( N \) listed) (Paparella et al., 2004),

**What Has Been Tried – What Works**

The key to success of a simulation training program is integrating it into traditional education programs (Patow, 2004, p. 77). Training in a Sim-lab is a new and additional step in the learning process. It is a step between classroom instruction and actual clinical instruction with real patients. Equally important is the opportunity for repeated exposure to a scenario and set of symptoms. This becomes vitally important for students with identifiable weaknesses in knowledge or performance. The scenario can be repeated and experienced more than once or until the student masters the technique. It is then the scenario could be modified for additional teaching. This allows the simulation instructor to vary the circumstances to point out that no two patients will be identical.

Simulation has been used in nursing education in multiple contexts. For example, it has been used to teach patient safety in an acute/critical care nursing course, (Henneman & Cunningham, 2005) to train neo-natal nurses, (Yaeger et al., 2004) to teach teamwork in healthcare, (Beaubien & Baker, 2004) to address medical errors, (Garden, Robinson, Weller, & Crone, 2002) to teach critical thinking skills, (Rauen, 2001) to test problem solving skills of senior student nurses, (Roberts, 2000) to help students struggling in clinical, (Haskvitz & Koop, 2004) as an adjunct to clinical teaching, (Johnson, Zerwic, & Theis, 1999) to augment critical incident nurse management, (Nehring, Lashley, & Ellis, 2002), as an enhancement to clinical understanding, (Comer, 2005) and in undergraduate nursing education, (Medley & Horne, 2005, Bearnson & Wiker, 2005).
Is Clinical Judgment What Simulation Really Advances?

Of the nearly 70 articles reviewed, over 55 percent mention clinical problem solving, clinical decision making, and/or critical thinking as a desired outcome of exposure to simulation exposure. The value of teaching decision making and critical thinking comes from the assertion that previously much of teaching was by rote memorization. Now nurse educators are challenged by the fact that they cannot teach all that the students will need to know. Instead, students must be taught to think and where to find information. Simulations depicting actual nursing situations provide students the opportunity to practice a variety of learning experiences that focus on problem-solving and decision making in clinical situations. Students’ responses tell that simulations also increase their confidence in critical thinking and problem-solving (Comer, 2005). Students must respond to a multiplicity of situations without the advantage of pre-preparation. They start to appreciate there is no one fixed way to respond to some situations.

Authors of qualitative studies identify perceptions of nursing students that include: "improved critical thinking and decision-making skills ... increased confidence level and the ability to learn about rare events or unusual complications" (Scherer, 2003, p. 338), "increasing confidence by giving opportunities for critical thinking and decision making" (Aronson, et al., 1997, p.19) "provided opportunities to use critical thinking" and "the simulation experience allows students to validate their knowledge and decision making skills as a ‘nurse’ through an interactive role-playing experience" (Johnson, 1999, p. 40).

Although Garrett and Callear state that their paper “examines the value of using intelligent multimedia simulation for the teaching of nursing clinical decision-making skills” (Garrett & Collear, 2001, p. 382) they did not provide a tool to measure any actual increase in student reported clinical decision making skills.
The difficulty of evaluating students’ learning has been a major road-block to widespread acceptance of simulation in nursing education. Traditional methods of evaluation such as written tests assess knowledge, but do they assess the application of knowledge? Simulation requires nursing students to apply knowledge while a scenario is unfolding and knowledge evolves as the students figure it out. Bremner and Brannon write that “the clinical decision making simulator is an innovative approach to teaching and learning decision-making skills” (Bremner & Brannon, 2000, p. 5) and they go on to discuss the development and use of computer simulation that provides frequent opportunities for clinical decision making for the newly licensed nurse without jeopardizing patient safety. However, upon further examination they do not present a tool to measure the acquisition of decision making skills.

Lasater/Katims Tool in use at OHSU

A model of clinical judgment by Messecar & Tanner (attachment A) informed a rubric tool by Lasater and Katims (attachment B) which was devised in 2004. The “Rubric for Assessing Clinical Judgment in Simulations” (Lasater, 2005) uses the domains of novice to expert as described by Benner (1984). The model describes how the student’s background, relationship with the patient, expectations, and context lead into the student’s initial grasp of a situation. Lasater calls this “Noticing.” Noticing leads to the student’s reasoning pattern where analytic, intuitive and narrative domains reside called “Interpreting.” The nurse then takes action, which Lasater calls “Responding.” This leads to outcomes, on the patient’s part, and then reflection and clinical learning by the student are the conclusion.

The Lasater rubric has face and content validity because of its development with Tanner’s input and the strength of it being based upon Tanner’s model of clinical judgment. Moreover, Lasater’s tool has been tested and used in simulation with baccalaureate nursing
students (BSN) and found to be reliable and valid when used in single simulation sessions. The Lasater tool had not been previously tested in a longitudinal design. It was originally validated with episodic simulation experiences and was used after each Sim session.

Conclusions

Much remains to be learned about the value of simulation in nursing. Whether or not to include simulation in a nursing program requires careful consideration with respect to the financial burden, physical feasibility, and the possible benefits to students. It is essential to critically evaluate how effective the use of realistic simulation in nursing education is. Nursing instructors must also consider whether this technology can address communication, interpersonal interactions, compassionate caring and nursing understanding.

Conceptual Issues

The needed research cannot go forward until the conceptual and measurement issues are addressed. One primary issue of simulation in nursing education pertains to measurement. What do nursing educators want to measure? Low-fidelity simulators have proven effective in addressing the student’s technical skills, (Beaubien & Baker, 2004) and moderate-fidelity simulators have been effective in teaching technical skills and pattern recognition (mock codes on a Resusci-Anne type manikin) (Blackburn & Sadler, 2003). If high-fidelity simulators are to be considered cost effective, a different type of nursing education skills set must be tied to simulation exposure.

Is improving clinical judgment a desired outcome of high-fidelity simulation? If so, how is it measured before and after simulation exposure? To date there is only the Lasater & Katims tool for measuring a nursing student’s ability to apply, analyze, or synthesize knowledge after exposure to simulation sessions and this tool has not seen wide usage. If improved clinical
judgment skill is ultimately the goal of simulation then measuring clinical judgment must occur. If there are tools currently available to measure clinical judgment, do they lend themselves to simulation research? More importantly, if these tools do not appear to be an effective measure of clinical judgment for use in simulation, then additional research is needed to develop tools for this express purpose and then research must be carried out by nursing schools and colleges worldwide so results can be published and shared with others. While Lasater and Katims tool was developed for simulation research, it was not developed for longitudinal assessment.

**Recommendations for Nursing Education**

More institutions are attempting to add high-fidelity simulation to their curricula. Using simulation effectively means more than buying the HPS. It requires money, organization, curricular changes, teaching in simulation, and the devotion of the staff. There are many steps necessary prior to the purchase of the HPS that must be realized if the attempt is to be successful. A carefully laid out plan for simulation will both save money and decrease the likelihood that the school is overwhelmed by the undertaking of the project. It is important to have a vision, guiding principles and framework. Simulation must form part of the learning environment of the future and be used appropriately to ensure effective learning.

Research should focus on discovery of whether simulation improves clinical judgment, and then explore close relationships between simulation and student outcomes. Related questions include; what is the optimum dose of simulation for a student to receive? Could a single episode be effective? How many sessions can replace clinical?

A separate learning environment critical to simulation teaching requires space and dedicated staff. Simulation training must have a dedicated curriculum developed by staff trained in the modality. Additional research is needed to validate tools developed to measure clinical
judgment, and to identify in what situations they can be used. For Example, is the Lasater/Katims tool valid in a longitudinal context, or can only be used for a single episode? Schools and colleges that have done research must be forthcoming with data and analysis. They must be willing to share both the successes and the failures.

Research is required to measure the effectiveness of a simulation experience in nursing education. Glowing descriptive reports from instructors and students citing how much they like this new technology are not enough to convince institutions that the technology is cost effective. Once these projects demonstrate effectiveness and more research takes place, schools may graduate nurses with seamless clinical skills. Students that possess strong foundations of knowledge based on research and confidence in practice as they enter the workplace. The end effect is students able to learn with self-confidence which allows them to develop independence and self sufficiency in practice that then will enhance the profession. The development of a HPS/Sim center is costly. Without clear outcomes in improved clinical judgment, other options may be preferred. In order for the HPS technology to be considered truly cost effective, improved clinical judgment must be the end result.
References


Crosby, K. W. (2002). The relationship between faculty observed performance and student perceived self-efficacy for clinical performance in baccalaureate nursing students. Retrieved 1/31/06, from file://C:DOCUME~1\doutrich.AD\LOCALS~1\Temp\7POJNUD.htm


APPENDIX
A Model of Clinical Judgment

Messecar & Tanner, 2004
# Rubric for Assessing Clinical Judgment in Simulations 1: Noticing and Interpreting Data

<table>
<thead>
<tr>
<th>Clinical Judgment Component</th>
<th>4: Accomplished</th>
<th>3: Competent</th>
<th>2: Needs Improvement</th>
<th>1: Novice</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Effective NOTICING involves:</strong></td>
<td>Systematically and regularly observes and monitors a wide variety of objective and subjective data to uncover any meaningful/useful information</td>
<td>Regularly observes/monitors a variety of data, including both subjective and objective; most meaningful information is noticed except the most subtle and/rarest of indicators</td>
<td>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</td>
<td>Confused by the clinical situation and the amount of data; observation is not organized and important data is missed, and/or assessment errors are made</td>
</tr>
<tr>
<td>Regular Observation</td>
<td>Recognizes subtle patterns and deviations from expected patterns in data and uses these to guide the assessment</td>
<td>Recognizes most obvious patterns and deviations in data and uses these to continually assess</td>
<td>Identifies obvious patterns and deviations from expectations, missing some important information; unsure how to continue the assessment</td>
<td>Focuses on one thing at a time and misses most patterns/deviations from expectations; misses opportunities to refine the assessment</td>
</tr>
<tr>
<td>Recognizing Deviations from Expected Patterns</td>
<td>Aggressively seeks information to plan intervention: carefully collects useful subjective data from observing the client and from interacting with the client and family</td>
<td>Actively seeks subjective information about the client's situation from the client and family to support planning interventions; occasionally does not pursue important leads</td>
<td>Makes limited efforts to seek additional information from the client/family; often seems not to know what information to seek and/or pursues unrelated information</td>
<td>Is ineffective in seeking information; relies mostly on objective data; has difficulty interacting with the client and family and fails to collect important subjective data</td>
</tr>
<tr>
<td>Information Seeking</td>
<td>Focusing on the most relevant and important data useful for explaining the client's condition</td>
<td>Generally focuses well on the most important data, and seeks further relevant information, but also tries to attend to less pertinent data</td>
<td>Makes an effort to prioritize data and focus on the most important, but also attends to less relevant/useful data</td>
<td>Has difficulty focusing and appears not to know which data is most important to the diagnosis; attempts to attend to all available data</td>
</tr>
<tr>
<td><strong>Effective INTERPRETING involves:</strong></td>
<td>Even when facing complex, conflicting or confusing data, is able to (1) note and make sense of patterns in the client's data, (2) compare these with known patterns (from the nursing knowledge base, research, personal experience and intuition), and (3) develop plans for intervention(s) that can be justified in terms of their likelihood of success</td>
<td>In most situations, interprets the client's data patterns and compares with known patterns to develop an intervention plan and accompanying rationale; the exceptions are rare or complicated cases where it is appropriate to seek the guidance of a specialist or more experienced nurse</td>
<td>In simple or common/familiar situations, is able to compare the client's data patterns with those known and to develop/explain intervention plans; has difficulty, however, with even moderately difficult data/situations that are within the expectations for students, inappropriately requires advice or assistance</td>
<td>Even in simple or familiar/common 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 in developing an intervention</td>
</tr>
<tr>
<td>Prioritizing Data</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Making Sense of Data</td>
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</tbody>
</table>

March 15, 2004
## Rubric for Assessing Clinical Judgment in Simulations 2: Responding and Evaluating Treatment

<table>
<thead>
<tr>
<th>Clinical Judgment Component</th>
<th>4: Accomplished</th>
<th>3: Competent</th>
<th>2: Needs Improvement</th>
<th>1: Novice</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Effective RESPONDING involves:</strong></td>
<td></td>
<td></td>
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<tr>
<td>Calm, Confident Manner</td>
<td>• Assumes responsibility:  determines team assignments, assesses the client and reassures them and their families</td>
<td>• Generally displays leadership and confidence, and is able to control/calm most situations; may show stress in particularly difficult or complex situations</td>
<td>• Is tentative in the leader's role; reassures clients/families in routine and relatively simple situations, but becomes stressed and disorganized easily</td>
<td>• Except in simple and routine situations, is stressed and disorganized, lacks control, making clients and families anxious/less able to cooperate</td>
</tr>
<tr>
<td>Clear Communication</td>
<td>• Communicates effectively:  explains interventions; calms/reassures clients and families; directs and involves team members, explaining and giving directions; checks for understanding</td>
<td>• Generally communicates well:  explains carefully to clients, gives clear directions to team; could be more effective in establishing rapport</td>
<td>• Shows some communication ability (e.g., giving directions); communication with clients/families/team members is only partly successful; displays caring but not competence</td>
<td>• Has difficulty communicating; explanations are confusing, directions are unclear or contradictory, and clients/families are made anxious instead of being reassured</td>
</tr>
<tr>
<td>Well-Planned Intervention/Flexibility</td>
<td>• Interventions are tailored for the individual client; monitors client progress closely and is able to adjust treatment as indicated by the client response</td>
<td>• Develops interventions based on relevant patient data; monitors progress regularly but does not expect to have to change treatments</td>
<td>• Develops interventions based on the most obvious data; monitors progress, but is unable to make adjustments based on the patient response</td>
<td>• Focuses on developing a single intervention addressing a likely solution, but it may be vague, confusing, and/or incomplete; some monitoring may occur</td>
</tr>
<tr>
<td>Being Skillful</td>
<td>• Show mastery of necessary nursing skills</td>
<td>• Displays proficiency in the use of most nursing skills; could improve speed or accuracy</td>
<td>• Is hesitant or ineffective in utilizing nursing skills</td>
<td>• Is unable to select and/or perform the nursing skills</td>
</tr>
<tr>
<td><strong>Effective EVALUATING Involves:</strong></td>
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<td></td>
</tr>
<tr>
<td>Reflection/Self-Analysis</td>
<td>• Independently reflects on/analyzes personal clinical performance, noting decision points, elaborating alternatives and accurately evaluating choices against alternatives</td>
<td>• Reflects on/analyzes personal clinical performance with minimal prompting, primarily major events/decisions; key decision points are identified and alternatives are considered</td>
<td>• Even when prompted, briefly verbalizes the most obvious reflections; has difficulty imagining alternative choices; is self-protective in evaluating personal choices</td>
<td>• Even prompted reflections are brief, cursory, and not used to improve performance; justifies personal decisions/choices without evaluating them</td>
</tr>
<tr>
<td>Commitment to Improvement</td>
<td>• Demonstrates commitment to ongoing improvement: reflects on and critically evaluates nursing experiences; accurately identifies strengths/weaknesses and develops specific plans to eliminate weaknesses</td>
<td>• Demonstrates a desire to improve nursing performance: reflects on and evaluates experiences; identifies strengths/weaknesses; could be more systematic in working to improve weaknesses</td>
<td>• Demonstrates knowledge of a need for ongoing improvement and makes efforts to learn from experience/improve performance but usually needs external evaluation and feedback</td>
<td>• Appears uninterested in improving performance or unable to do so; rarely reflects; is uncritical of him/herself, or overly critical (given level of development); is unable to see flaws or need for improvement</td>
</tr>
</tbody>
</table>


March 15, 2004
# Clinical Judgment in Simulations: Observation and Scoring Form

**Student Initials:**  
**Observation Date:**  
**Last four digits of SS#:**

<table>
<thead>
<tr>
<th>Clinical Judgment Scores</th>
<th>Observation Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Noticing:</strong></td>
<td></td>
</tr>
<tr>
<td>• Observation: 4 3 2 1</td>
<td></td>
</tr>
<tr>
<td>• Perception: 4 3 2 1</td>
<td></td>
</tr>
<tr>
<td>• Info Seeking: 4 3 2 1</td>
<td></td>
</tr>
<tr>
<td><strong>Interpreting:</strong></td>
<td></td>
</tr>
<tr>
<td>• Prioritizing: 4 3 2 1</td>
<td></td>
</tr>
<tr>
<td>• Explanations: 4 3 2 1</td>
<td></td>
</tr>
<tr>
<td><strong>Responding:</strong></td>
<td></td>
</tr>
<tr>
<td>• Demeanor: 4 3 2 1</td>
<td></td>
</tr>
<tr>
<td>• Comm: 4 3 2 1</td>
<td></td>
</tr>
<tr>
<td>• Planning: 4 3 2 1</td>
<td></td>
</tr>
<tr>
<td><strong>Evaluating:</strong></td>
<td></td>
</tr>
<tr>
<td>• Reflection/Self-Analysis: 4 3 2 1</td>
<td></td>
</tr>
<tr>
<td>• Commitment to Improvement: 4 3 2 1</td>
<td></td>
</tr>
</tbody>
</table>
| **TOTAL SCORE:**        | **Summary Comments:**

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- **Clinical Judgment Scores:**
  - **Noticing:**
    - Observation: 4 3 2 1
    - Perception: 4 3 2 1
    - Info Seeking: 4 3 2 1
  - **Interpreting:**
    - Prioritizing: 4 3 2 1
    - Explanations: 4 3 2 1
  - **Responding:**
    - Demeanor: 4 3 2 1
    - Comm: 4 3 2 1
    - Planning: 4 3 2 1
  - **Evaluating:**
    - Reflection/Self-Analysis: 4 3 2 1
    - Commitment to Improvement: 4 3 2 1

- **TOTAL SCORE:**

---

- **Summary Comments:**
Instructions for research evaluation tool

This evaluation is based on the novice to expert model. It is a longitudinal device that will indicate student progress through the nursing program.

Circle corresponding number for each category. The number “1” means the student does NOT get the concept of the category. The number “4” means they have great understanding of the category. The number “2” means that they don’t get it BUT they are close. The number “3” means they get it BUT there are few areas not there yet. The data collection does not accommodate 0.5 or half number so if there is a half score given it will be rounded down. Comments are wonderful to have but not necessary of the research project.

The student evaluation with this tool should not be a lengthy process—go with your gut.