Abstract: In recent years, high-fidelity simulation has played a growing role in nursing education. Few studies have addressed this use, and research using quantitative design is significantly lacking. This paper examines the current research on simulation in nursing education and recommends areas for future study.

Nursing education is constantly evolving as change takes place in health care delivery and as more is learned about knowledge acquisition and the use of technology. In the 1960s, technology changed the way high-risk flight training was taught, with computer-based simulation training gaining favor. In health care profession education, simulation use is often part of high-tech anesthesia or surgical training. Over the last few years, however, high-fidelity simulation (HFS) training using human patient simulators has been playing a larger role as part of teaching programs in nursing schools and continuing education. This type of simulation utilizes a computer-based mannequin, allowing experiential training of skills, knowledge, and decision-making, which builds confidence in a safe environment, transferable to real patient situations.

What makes HFS so useful is its ability to simulate realistic clinical situations and settings with no risk to the safety of patients (Medley & Horne, 2005; Peteani, 2004). Students can make mistakes without harm and learn by receiving immediate feedback. Scenarios using HFS can be set-up to replicate patient conditions with pulses, heart and lung sounds, vital signs, and echocardiogram waves. The anatomically correct mannequin becomes the patient. This simulator can react physiologically through computer control by the instructor as students interact and intervene. Simulation creates experiential learning, which has been shown to help learners with integration of content that is necessary for safe and effective clinical practice (Medley & Horne, 2005).

In the current state of health care delivery, it is crucial that health care professionals be adequately prepared to deliver fast paced, safe and competent care (Ziv, 2000). Educators must find methods, such as simulation, to improve patient safety by reducing medical errors and protecting patient exposure to less than optimal care (Ziv, 2000; Kohn, et al., 1999).

Based on research, Georgetown University Hospital has incorporated simulation training into nursing orientations for step-down and critical care areas (Rauen, 2004). They have found it to be a valuable educational resource. Beamson and Wiker (2005) used simulation as a substitute for one day of clinical learning due to lack of access to a clinical setting.

Overview of Research Articles

A review of the literature was conducted using the databases Ovid, CINAHL, and Medline, and a thorough
review was performed of individual journals for nursing education and nursing research. Criteria for inclusion in this article included nursing research studies published since 1998 that discussed HFS in education. Despite being open to articles as far back as 1998, the oldest studies found were from 2001. The search resulted in six studies fitting the criteria. These articles are summarized in Table 1.

Several critical areas emerged from the review of literature of simulation in nursing education. These included conceptual definitions, research design, sampling methods, and research findings and implications.

The first critical area was conceptual and operational definitions. Common themes emerged in the articles regarding the conceptual definition of simulation. The definitions included that simulation provided a realistic and risk-free learning environment, which would develop critical thinking, decision-making, knowledge, communication, and clinical skills (Alinier, et al., 2004; Alinier, et al., 2006; Bearnson & Wiker, 2005; Eaves & Flagg, 2001; Feingold, et al., 2004; McCausland, et al., 2004; Rystedt & Lindstrom, 2001). Eaves and Flagg (2001) and Feingold, et al. (2003) studied whether simulated learning transferred to real patient care. Operational definitions in all the studies included surveys and observations of students and nurses in simulated clinical settings. In addition, Eaves and Flagg (2001) observed graduate nurses on patient units after the period of simulated learning.

Childs & Sepples (2006), as part of the National League for Nursing and Laerdal Corporation multi-site study, tested validity and reliability of instruments used to evaluate simulation design and educational practices. This study examined tools that could be used to evaluate simulation design and practices.

The second critical area involved research design. Alinier, et al. (2006) was the only study that used an experimental design. Two designs were pilot studies without control groups or randomization (Eaves & Flagg, 2001; Kelly & Heath, 2003). Eaves & Flagg (2001) examined methods to measure simulated learning. The remaining five studies used qualitative designs.

The third critical area was sampling methods. The studies reviewed used relatively small sample sizes. Alinier, et al. (2006) had a sample of 99 voluntary nursing students who were then randomly divided into control and experimental groups. No eligibility criteria were identified. The authors stated that a power analysis had determined the sample size was adequate. The pilot study by Eaves & Flagg (2001) chose a convenience sample of five graduate nurses at an air force hospital to train on a new simulated medical unit. Kelly & Heath (2003) surveyed 11 nurse practitioner students in the Georgetown University family and acute care programs. No sampling plan was described. There was limited qualitative data from this small sample, including a Likert scale with no rich detail. Bearnson & Wiker (2005) did not describe their sampling plan or sample size adequately. McCausland, et al. (2004) did not fully describe the study group or selection procedure. The sample consisted of 72 baccalaureate-nursing students during their clinical rotation. The level of education and selection procedure was not explained. Despite the relatively large sample size and thorough description of the simulation procedure, comprehensive data was lacking.

In comparison, two qualitative studies thoroughly described the sampling method, which provided rich qualitative data (Feingold, et al., 2003; Rystedt & Lindstrom, 2001). Feingold, et al., used a voluntary, convenience sample of 97 baccalaureate-nursing students enrolled in a course on acute care of the adult with a total response rate of 67%. In comparing respondent and non-respondent groups, minorities were underrepresented. The sample of Rystedt & Lindstrom (2001) came from a local university program for nurses who wanted to work in anesthesia, critical, and emergency care. These 15 nurses were in one of the three programs or from a medium-sized county hospital. They were interested in professional development and computer-based education. They had experience in the specialty field for which they were in school. Group interviews promoted rich qualitative data.

The fourth critical area was study findings and implications. With limited qualitative data, Kelly & Heath (2003) found graduate nurses had positive perceptions of simulation training regardless of the clinical track. They expanded simulation scenarios and encouraged implementation in all clinical tracks because the positive outcomes outweighed the expense and effort.

Students in the Bearnson & Wiker (2005) study reported increased confidence, knowledge, and skills regarding medication administration. Students reported simulation was a valuable addition to their clinical learning but should not be used as a substitution for it.

In the study by Feingold, et al., (2003), students gave high scores in their perception of the value and realism of simulation. Fifty percent of the students’ perceived simulation would transfer to real patients compared to 100% of the faculty. Less than 50% of the students felt increased confidence and competence.

Rystedt & Lindstrom (2001) interviewed nurses of varying levels of experience. The nurses identified that simulation might be most helpful in six critical categories of nursing care, which were judgment, prioritizing care, monitoring, communicating, cooperating, and managing complexity. The study provided extensive qualitative data.

McCausland, et al., (2004) had rich qualitative data of the simulation experience. The study had both positive and negative student evaluations of simulation, with significantly more positive experiences. Students said simulation was helpful, believable, desirable, and even transferable, in contrast to students in the study by Feingold, et al., (2003). The authors discovered unexpected development of teamwork, cumulative benefits of simulation, and the importance of faculty coaching. Preparation lessened over time. The findings suggested it would be difficult to find...
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scenarios that closely matched clinical situations, and future studies might focus on critical thinking, confidence, and competence skills instead.

In the experimental study (Alinier, et al., 2004; Alinier, et al., 2006), highly significant t test scores (p < 0.05) showed the experimental group had improved skills greater than the control group six months later. No difference in confidence and stress was found between the groups. In an effort to control extraneous variables, students who did not go to the experimental group or wanted to be in the control group were eliminated from the study. However, study limitations included an older and more experienced control group, brevity and quality of simulation training, and the level of trainer skill. The authors suggested these limitations might explain differences between the groups. But if control group age and experience were confounding variables, then the control group would have had higher scores at the start. It is likely older and more experienced students may have reported less stress and more confidence, especially if the simulation training had been longer.

A small pilot study by Eaves & Flagg (2001) found graduate nurses required less orientation time, gave superior care, and were more confident compared to graduate nurses who did not receive simulation training. Although positive correlations resulted, they included only five participants, a very small sample from which to draw conclusions. Nurse manager observations suggested skills were transferred to the clinical setting.

**Recommendations**

Recommendations for future research are based on the findings and limitations from the literature review. Much of the focus of the existing research has been on the perceived benefits of simulation. There is agreement in the literature that simulation is beneficial in teaching many important nursing skills. Alinier, et al., (2004, 2006) was the only study that used an experimental design. Future research should use a randomized, controlled design to compare simulation to traditional nursing education. One critical area of study would be the transferability of skills to the clinical setting. These studies will help determine if the benefits of simulation are worth the additional costs and preparation time.

Simulation research in nursing education has focused on learner outcomes and perceptions, but not on patient outcomes. Health care providers, patients, and insurers are interested in care that improves patient outcomes. It would be an important step forward if research could show a relationship between simulation training and improved patient outcomes.

The concepts of simulation and student responses are not reliably measured. Simulation trainer factors have been identified as extraneous variables, and there is no measure of interrater reliability. Future research should use reliable measures of simulation to improve data quality. If most of the studies used different simulation scenarios, do the instruments truly measure the relevant clinical and cognitive skills they claim to? The instrument could be developed from rich qualitative data like Rystedt & Lindstrom (2001) or from a panel of experts like Alinier, et al., (2006). This would provide content validity. Criterion-related validity might determine if faculty observations of nurses correlate highly with the instrument that measures nurse performance.

Studies with representative samples are needed to provide findings which are generalizable to the accessible and target populations. Unlike currently published research, studies must clearly describe sampling plans and use larger randomized samples. The current research is mostly limited to nursing students. Future research should focus more on nurses in acute care settings, especially in response to the Institute of Medicine report of medical errors in hospitals (Kohn, et al., 1999).

The National League for Nursing (NLN) and Laerdal Corporation have completed a collaborative, three-year, multi-site study that examined the use of simulation in nursing education. The sample size, the largest found in the literature, included over 400 nursing students. This study will provide useful information about how to successfully design and implement simulation. Study results can be found on the NLN web site and in a newly published book (National League for Nursing, 2007).

**References**


