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Implementation and Evaluation of a Virtual Simulator System: Teaching Intravenous Skills

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KEYWORDS
Virtual Intravenous simulator;
Teaching innovation;
Simulation;
Clinical competency

Abstract: Use of human simulators has been supported by research as an effective training methodology for healthcare professionals. The study explores the effectiveness of a specific simulator, the Laerdal Virtual Intravenous Simulator by describing its overall impact on IV competency and student satisfaction with nursing students. The sample for this educational intervention was 28 LPN nursing students at a large military medical center in Washington State. Students were randomly assigned to receive either intravenous (IV) simulation or traditional training. In order to provide the same learning opportunity, the groups crossed over after data collection was complete. Data suggests that traditional IV training is the preferred method of learning. Students from the traditional group were more competent administering live IV cannulation.

Although the results of this study are useful, further research is needed to address competency assessment when using simulation technology. Students endorsed using the Virtual Intravenous Simulation system that uses a haptic device interface to train LPN students.

A total of 250,000 cases of IV catheter-related (CR) infections are expected to occur annually. In this case, mortality is estimated as 12%-25% for each infection with a secondary cost to the hospital of at least $25,000 per episode (MMWR, 2002). How can these numbers be reduced? One answer is better training of the nurses that insert IV catheters. How can nursing educators improve training on this high-risk, low-volume skill for nurses in acute care hospitals?

This manuscript is a descriptive study using Laerdal™ Virtual Intravenous simulator. Nursing educators possess limited resources with which to ensure adequate competencies to minimize threats to patient safety and well-being. One answer to limited opportunities to practice safely on real patients is a simulator. While using simulators as an innovative training tool, educators who implement virtual learning tools may ask:

- Does simulation training enhance cognitive gains?
- Does simulation training improve skill competency?
- What is the level of student satisfaction among students who used a virtual IV simulator?

Background

Literature supports use of simulation for training, for formative evaluation and for skill remediation. Simulation allows students to achieve an understanding of their thinking, perceptions, and responses faced or encountered in clinical experience (Oermann & Gaberson, 1998). Advantages of simulation include realism and decision-making with patient - centered scenarios in a lab, teaching in the cognitive, affective areas, and psychomotor domains. The ability to manipulate clinical variables in a controlled,

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safe environment is conducive to significant learning (Billings & Halstead, 1998). More importantly, simulation training is a method to assess the new nurse or student's readiness for nursing practice. Simulation is an effective strategy teaching and evaluating alike. Simulated patient encounters are used to test inter-rater reliability of nursing faculty in evaluating students, to develop skills in problem solving, to promote teamwork, and to enter the patient's room.

Key Points

- The article describes cognitive gains, competency and student satisfaction using the Virtual Intravenous System in concurrence with traditional teaching.
- Student satisfaction is enhanced by using simulation technology as an adjunct in competency validation.
- Validation of cognitive information is important in developing high risk/low volume skills and competencies.

Clinical simulation is a method of teaching psychomotor skills necessary to provide safe care for real patients. According to Jeffries (2005), a simulation model has five major components with connecting variables. The simulation model includes the teacher, student, educational practices, design characteristics, and simulation (intervention), and student's outcomes. Significant training and learning with simulations are dependent on teacher and student interactions, performance expectations, and assigned roles during the simulation experience. A solid conceptual framework supports using simulation in nursing education. Gibbons (2002) and colleagues state that collaboration enhances collegiality, solidarity. The impact is that learning results in cohesive student - faculty bonding. This is very important in modeling and mentoring future nurses.

The VIV Laerdal™ simulator provides a comprehensive training environment for the placement of peripheral IV catheters. This simulator offers training on cognitive and psychomotor skills in IV insertion, based both on single patient case scenarios and a career mode, in which the student can climb the ladder in IV expertise. The VIV Laerdal™ provides intermediate and advanced skill level trainees with the opportunity to practice procedures with realistic complications.

Simulation supplements the clinical sites and the limited number of clients requiring venous cannulation. The VIV simulator provides an opportunity to practice many IV insertions while in a student status. Although it is logical that simulation will benefit the nursing student and eventually the patient; there are few studies to substantiate this belief. Bush and Sinz (2007) described a simulation training project with crisis resource management training for residents. For the Anesthetist's Non-technical Skills (ANTS) System outcomes, teamwork was statistically significant with a median difference of 0.8 ($P = 0.03$). Non-technical skills, such as task management, teamwork, situation awareness, and decision-making were also evaluated. A significant increase on teamwork was observed. The results indicate that the CRM training increased perceived team collaboration, satisfaction with care, and team work skills. Hoffman and Kim (2007) used simulation with the Basic Knowledge Assessment Tool − 6 (BKAT). They demonstrated significant improvement in undergraduate nursing students in critical care when using high fidelity human simulation. By using simulation in nursing education, increased competency and improved patient safety will benefit our profession and healthcare community.

Description of Simulation Study

The virtual IV simulator allows the trainee to perform an IV procedure using a haptic device. A haptic device is one that involves physical contact between the computer and the user, usually through an input/output device, such as a joystick or data gloves, that senses the body's movements. By using haptic devices, the user delivers information to the computer and receives feedback in the form of a felt sensation on some part of the body. This is referred to as a haptic interface. A haptic device allows the trainee to interact with the software program by using a hands-on device (www.laerdal.com Figure 1).

VIV simulation software shows the arm as the IV catheter is being placed into the vein. The trainee is actually placing a device (catheter) into the arm box. Palpation of the vein can be done on this arm box. The IV simulation and patient interaction must be completed in the appropriate sequence and length of time. The trainee's attempts and average cognitive and skill levels are recorded. The VIV simulator provides 40 different arm scenarios ranging from pediatric to geriatric, and including rolling veins, fragile veins, and arms and hands with difficult to penetrate skin. A selection of over 150 cases, including categories: Emergency Medical Technician, Nurse, Military, or Doctor. Within each training category, there are five venues: trauma, medical, surgical, pediatric, and geriatric.

Patient scenarios contain information vital to the trainee's successful performance for the subsequent IV cannulation. A scenario provides the student with bulleted data below the scripted scenario to facilitate appropriate selection of correct equipment specific to that case. All students used the same scenario that required decisions regarding the type of IV access, needle gauge, and site selection. Table 1 provides a description of the scenario used in the study. The expectations are that students at Level I will meet or exceed the following criteria: successful cannulation of a patient of moderate acuity; successful completion of identifying the signs of complications of venous cannulation; and use cognitive and practical knowledge bases for optimal site selection in acutely ill patients. After a review of the scenario, the student inventories 12