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A Pilot Study Assessing Simulation Using Two Simulation Methods for Teaching Intravenous Cannulation

Ryan J. Jamison, MSN, RN, Marcella T. Hovancsek, MSN, RN, John M. Clochesy, PhD, RN, FAAN, FCCM

Frances Payne Bolton School of Nursing — Case Western Reserve

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Abstract: Educators often wonder which of competing strategies should be used for knowledge and skill acquisition. This pilot study explored learning outcomes as well as educational practices and design features using a traditional mannequin IV arm and a computer-based haptic task trainer (CathSim). Those using CathSim had a significant increase in post-test scores. Students identified feedback and diverse ways of learning as the most important educational practices. Feedback and provision of cues were design features identified as most important by students.

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It is essential for patient safety that students develop basic clinical nursing skills before caring for live patients. A common skill that nurses perform is the insertion of intravenous (IV) catheters for administering intravenous fluids and medications. Nurses with adequate knowledge and who are supported in the development of the skill of IV cannulation, can combine the technical skill with the caring aspect of nursing (Campbell & Lunn, 1997). However, it has been reported that nurses are performing this procedure without sufficient education (Mitchinson & Goodlad, 1996). In a survey by Wilkinson (1996), widespread dissatisfaction with the poor levels of nurse competency in IV cannulation was reported. Intravenous cannulation not properly performed can lead to complications for patients, such as local infiltration, phlebitis, and pain (Jamieson, McCall, & Blythe, 1992).

Nursing learning resource centers (LRC) provide the opportunity for students to be introduced to psychomotor skills that can be practiced before the students use these same skills in the clinical area. Experiences within the LRC increase students' confidence and help to bridge the theory-practice gap (Hilton, 1996). Traditionally nurses have been taught IV cannulation via a plastic mannequin arm. With the advent of newer technology, nurse educators may incorporate computer models to support learning skills such as IV cannulation in the LRC. One such device is the CathSim Intravenous Training System (CathSim ITS), a haptic task-trainer that incorporates text, audio and video components. However, the effectiveness of using this type of device on student learning requires further evaluation if educators are to consider replacing the traditional method of inserting and IV catheter using a plastic arm. In addition, educational practices and simulation design features that are important to students need to be explored in order to create effective simulations in the future.

The purposes of this study were to compare the use of two different simulation methods (a plastic mannequin arm and CathSim ITS) to learn the skill of IV cannulation and to explore the educational practices and simulation design features that were identified and ranked as helpful to

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their learning by students. The questions guiding the study were:

1. What are the differences in learning outcomes (student knowledge and skill performance) between the traditional method of teaching how to perform IV cannulation (use of a plastic mannequin arm) and the computer-interfaced IV start device (CathSim ITS)?
2. What educational practices are identified as important to students using two different clinical simulations to learn IV cannulation?
3. What simulation design features are identified as important to students using two different clinical simulations to learn IV cannulation?

Literature Review

A computer-interfaced simulator is physiologically based and reacts to interventions in real time, forcing the trainee to critically think and make decisions that are identical to ones that are made in actual patient care (Holcomb, et al., 2002). Clinical simulations using patient simulators have demonstrated outcomes that indicate participants experienced an increased sense of competence and ability to formulate a strategy for specific situations (Garg, Buskman, & Kason, 1997), an enhanced ability to assess variations in practice (McLeod, et al., 1997), an increased awareness of their actions and behaviors (Foley, Nespoli, & Conde, 1997), and an emphasis on critical thinking as opposed to memorization (Bramble, 1994). Most research to date has focused on human patient simulators and not on simulated IV catheter systems. A literature search retrieved only a limited number of studies that evaluate the use of a simulated intravenous catheter system in teaching the skill of intravenous cannulation. No studies were identified that explore the educational practices and simulation design features that are important to students and faculty using simulation.

Chang, Chung, & Wong (2002) compared the effectiveness of nurses' learning of intravenous cannulation through conventional teaching method (i.e., plastic arm) and through the CathSim ITS using a sample of 28 nurses. This study found that there was a high success rate in intravenous cannulation with both the plastic arm and the use of the CathSim ITS and could not establish if one training method was superior over the other.

A larger pretest-posttest experimental study employed by Engum, Jeffries, and Fisher (2003) consisted of 163 subjects (70 baccalaureate nursing students and 93 third-year medical students) randomized into either a traditional group or a simulation group. The study found that the traditional group demonstrated better cognitive gains, student satisfaction, and documentation of the procedure compared to the group learning with CathSim ITS. Both groups were similar in their ability to demonstrate the skill correctly.

The third study by Reznek, Rawn, & Krummel (2002) evaluated construct and content validity as well as learner's perceptions of CathSim ITS. This study demonstrated that CathSim ITS was realistic and highly useful for medical student training among the 41 participants in the study. However, this study did not compare the CathSim ITS to the traditional method of teaching IV cannulation using a mannequin arm.

Intravenous cannulation is important skill to master for students because of the serious complications that may arise from improperly performing this skill in the clinical setting. Limited literature is available on the best way for students to learn proper IV cannulation technique. The available studies show both negative and positive aspects of the use of simulation to learn the skill of intravenous cannulation. Further research is needed to better assess whether training using the traditional method versus simulation using a simulator such as CathSim ITS is most effective for IV cannulation skill acquisition. Additionally, educational practices and simulation design features that are important to students using simulation needs to be explored.

Methods

Research Design

This study was conducted as part of a three-year multi-site, multi-method and multi-phased study to examine the use of simulation in nursing education. This exploratory study used a randomized pretest-posttest experimental design.

Sample

A convenience sample of second-semester baccalaureate nursing students in a required health assessment course in a large midwestern university were invited to participate in the study. Informed consent was obtained from 19 of these students. The pre-test/post-test scores were used only for purposes of the study and were not part of the course grade. Clinical groups were randomly assigned to the traditional group (mannequin arm) ($n = 9$) and the CathSim ITS group ($n = 10$). One student from the CathSim group failed to turn in the post-test and that student's scores were omitted from the results, leaving a total of 9 students in the CathSim ITS group.

Students participating in the study were all females ranging in age from 17 to 24 years old (mean 19.1). Self-reported grade point average of the students ranged from 2.4 to 3.4 (mean 2.9). The sample consisted of 15 Whites, 1 Asian, 1 African-American, and 1 Latino. There were no significant differences between the two groups in regards to age, grade point average, gender, or ethnicity.

Instruments

Student knowledge was measured by comparing the results of an instructor-developed 13-item multiple-choice