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Use of a simulation intervention to examine differences in nursing students' hand hygiene knowledge, beliefs, and behaviors

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ABSTRACT

Background: Although hand hygiene remains an essential aspect of quality care, adherence to best patient safety practices continues to pose major challenges.
Objectives: The objectives of this study are to examine hand hygiene knowledge, beliefs, practices, perceived importance and behaviors using Social Cognitive Theory and simulation-based intervention.
Design: Participants were taken from a convenience sample of 131 undergraduate nursing students enrolled in a nursing fundamentals course at an urban university in the midwestern United States, and then randomly assigned to their respective groups. Using an experimental pretest-posttest design, control and intervention groups received the same lecture pertaining to hand hygiene and 3 data collection points where van de Mortel's Hand Hygiene Questionnaire (HHQ) was administered. In addition, the intervention group viewed a 6.5 min video related to healthcare acquired infection and participated in 4 simulated situations requiring hand hygiene, based on World Health Organization guidelines. For all students, the hand hygiene technique was assessed through the use of Glo Germ, followed by handwashing and photography under ultraviolet light (posttest only). Image illumination was analyzed using image processing software. Microbiological sampling plates (pretest-posttest) were assessed quantitatively by colony counting.
Results: Study findings did not support differences in the intervention group for the 5 hypothesized relationships. Social desirability responding and negative item confusion were found to occur with the HHQ in the student population. There was a significant difference in the UV hand photographs, with students in the afternoon having lower values than students in the morning.
Conclusions: Given the study results, there were no definitive educational recommendations to teach hand hygiene to nursing students. Future research should continue to further examine multi-focal modalities to enhance adherence to hand hygiene practices, as well as control for extraneous mediating or moderating variables found in educational settings.

1. Introduction

In 1847, Semmelweis was the first to link hand hygiene with infections acquired during hospital care (Semmelweis, 1861). Hand hygiene is championed as key to decreasing the number of healthcare-associated infections (HAIs). However, the number of HAIs reached 722,000 with 75,000 resulting deaths in the United States (U.S.) in 2011 (Magill et al., 2014). Healthcare-associated infections are responsible for approximately $10 billion in direct costs to the U.S. healthcare system (Zimlichman et al., 2013). Despite hand hygiene being linked to significant morbidity, mortality, and cost, it is established in the literature that compliance is difficult to achieve and maintain in healthcare settings. Hand hygiene is a critical patient-safety behavior.

High levels of hand hygiene compliance can decrease HAIs (World Health Organization, [WHO], 2009). Hand hygiene compliance among healthcare workers in hospitals varies widely. Compliance rates in hospitals average 40% (Erasmus et al., 2010), and one hospital reported a rate of 6.5% in a surgical intensive care unit after video cameras were placed in the unit (Rosenberg, 2011). Research efforts by behavioral scientists have been stymied by the lack of successful behavioral interventions in this educated population.

Healthcare workers are expected to know how to prevent healthcare acquired infections (Farley et al., 2012), and hand hygiene is a major focus of reducing such infections (WHO, 2009). Studies have found varying reasons for noncompliance: intensity of work activity and perception of value placed by administrators (Pessoa-Silva et al., 2007), lesser self- efficacy (De Wandel et al., 2010), and beliefs regarding hand hygiene and transmission of HAIs (Erasmus et al., 2009). A review of educational interventions found that most studies taught hand hygiene technique, but the outcome measures were proper technique

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and compliance (Cherry et al., 2012). Therefore, the problem is that hand hygiene intervention studies have not increased or sustained adherence to hand hygiene guidelines. In addition, investigations of educational interventions and linking knowledge and hand hygiene performance outcomes remain unclear.

The incorporation of new knowledge into a knowledge base, while the norm in hand hygiene education, has not been shown to be effective in changing long-term behaviors (Erasmus et al., 2010). Simulation is an active learning method which influences learner behavior in accord with Social Cognitive Theory (SCT). The purpose of this study was to use simulation to instruct undergraduate nursing students to increase their knowledge, self-efficacy, positive beliefs, and the curricular importance of hand hygiene.

2. Background

Research with nursing students has shown that beliefs about hand hygiene efficacy and actions by healthcare workers in the hospital influence compliance with hand hygiene guidelines (Erasmus et al., 2009). Students are prone to overestimating compliance with hand hygiene guidelines, as well as their knowledge and abilities (Cole, 2009). This situation is due to the theory-practice gap in nursing; the skills that students learn in school require more knowledge to be used in a work setting (Duchscher, 2009). Students who develop reflective skills and understand the theory behind nursing actions can have an increased appreciation for the connection between theory and practice (Hatlevik, 2012) to better transfer behaviors into practice. Simulation is an educational strategy for nursing that allows students to develop confidence and apply classroom theory, as well as build psychomotor proficiency (Hope et al., 2011).

Educational interventions are effective for increasing hand hygiene compliance in short-term studies (Mathai et al., 2010). Most studies do not report sustainability past one year. A review of educational strategies for hand hygiene found that role-modeling is an integral component of a program. Role-modeling is part of simulation and SCT states that role-modeling is part of observational learning. SCT provides a framework to intervene on the development of personal standards (Bandura, 1991). Nursing students who receive education and an intervention that increases confidence and proficiency are likely to have more self-efficacy, which has a considerable role in promoting action (Bandura, 1991). Role modeling and repetition are components of simulation. SCT was used because it is congruent with the principles of simulation training, and the concept of self-efficacy has been the subject of simulation research.

The belief that people have in their ability to complete tasks and attain goals is self-efficacy (Bandura, 1991). Self-efficacy beliefs greatly influence a person's regulation of his behavior. When people consider themselves to have high self-efficacy, they will set higher goals than if they do not perceive themselves to be capable (Bandura, 1991). Therefore, it is important to educate nursing students in a manner that will increase their self-efficacy. Simulation will allow nursing students to practice performing hand hygiene with a patient manikin and gain proficiency, which may increase their self-efficacy beliefs and goal achievement.

Nursing students who practice patient safety behaviors will be in a better position to do what is expected in the clinical setting (Gantt and Webb-Corbett, 2010). Individual experience is a factor that has been shown to change behavior (Nicol et al., 2009). Simulation allows for nursing students to experience their training while they practice a task.

3. Methods

This study utilizing the Hand Hygiene Questionnaire (van de Mortel, 2009) will be an experimental pretest-posttest design with a control and intervention group. The pretest-posttest was longitudinal, with 3 time points for data collection of van de Mortel's Hand Hygiene Questionnaire. There was a posttest only assessment of hand hygiene technique using an ultraviolet fluorescent compound (Glo Germ) and pretest-posttest of hand microbiological contamination for a wide variety of organisms (Lucet et al., 2002).

Pilot testing of the posttest assessment of the fluorescent compound procedure was performed to ensure that the digital pictures under ultraviolet light are clear and distinct. The pretest-posttest microbiological sampling procedure was pilot tested to confirm that the procedure allowed for colony growth.

3.1. Sample

Participants were obtained from a convenience sample of 131 undergraduate nursing students enrolled in a nursing fundamentals course at an urban university in the midwestern United States, and then randomly assigned to their respective groups. A power analysis calculated using time averaged differences as a model (Diggle et al., 2002) showed that at a power of 0.70, significance of 0.5, the total sample size needed is 86 (43 per group) to detect an effect size as low as 0.35. Sample size allowed for a total attrition of 33% (non-participants and participants who withdrew). The university's Institutional Review Board approved the study protocol, and required all students take part in study activities as part of the class. The researcher obtained informed consent via an approved consent document. If students chose not to participate in the study, there was no impact on their class grades. Confidentiality was maintained through the assignment of a study identification number.

3.2. Data Collection

The Hand Hygiene Questionnaire (HHQ) was developed by van de Mortel (2009) using healthcare students. The 4 subcomponents have been tested in nursing students (van de Mortel, 2009) and are a Hand Hygiene beliefs scale (HBS, $\alpha = 0.8$), practice inventory (HHPI, $\alpha = 0.74$), knowledge component (HHK), and importance scale (HIS, $\alpha = 0.77$). The Marlowe-Crowne Social Desirability scale is used with the questionnaire to identify whether questionnaire answers were influenced by this type of response. Beliefs within the HBS include self-efficacy and positive beliefs (beliefs about barriers and rewards). SCT was used as the theoretical underpinning (van de Mortel, 2009) for the HBS. The HHQ has been used with nursing and medical students in Australia, Sweden, Greece, and Italy ($n = 1721$).

All students received a 45 min lecture inclusive of hand hygiene with the same content for both experimental and control groups, followed by the HHQ pretest. The lecture was part of the class, not a study component. The lecture topics were medical asepsis/infection control; standard precautions; and transmission-based precautions.

The intervention took place after the experimental group received the standard 45 min lecture on hand hygiene and infection control. The video *Partnering to Heal* was chosen as it was complementary to the HHQ. It was developed as a video-simulation training program to increase awareness of healthcare-associated infections through the depiction of poor patient outcomes related to breaches of patient safety. The content of the video included knowledge, importance, and practices, and the use of different perspectives showed beliefs held by the characters.

The HHQ was given to students before and after the intervention, then again one week later (Table 1). The intervention consisted of a 6.5 min video *Partnering to heal: Teaming up against healthcare-associated infections* (US. Dept. of HHS) and 15 min simulation of the WHO's 5 moments of hand hygiene. The researcher read the simulation instructions while demonstrating the simulations. For example, the first scenario directed the student to place the call light in the patient manikin's hand, and required the student to simulate the use of hand sanitizer before and after patient contact. The entire lab section engaged