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Development of an assessment instrument to evaluate performance of the skill of decontamination

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SUMMARY

Background and Purpose: Nurses must competently demonstrate psychomotor skills. Few reliable and valid instruments are available for psychomotor evaluation for disaster skills, including the skill of decontamination.
Objectives: The purpose of this study was to develop and refine an instrument to measure the skill of decontamination.
Design: A seven step instrument development design was implemented that included content validity and reliability as well as inter-rater reliability analysis.
Setting and Participants: A convenience sample of approximately 140 participants was drawn from two colleges of nursing at two large academic universities. The sample included senior nursing students in either their community or final practicum nursing course.
Methods: Based on a sample of 140 students who participated in a decontamination training experience using virtual reality simulation, a seven step established process for assessment of reliability and validity was implemented to develop a checklist for the skill of decontamination.
Results: The final instrument statistics: Content Validity Index for the overall instrument score was 0.94, Internal consistency coefficient = 0.607(KR-20) and Inter-rater reliability = 0.9114.
Conclusions: This instrument provides a reliable and valid assessment of nurses' competency in performing the skill of decontamination offering a template for educators to develop similar tools.

In a practice profession such as nursing, the ability to measure performance is critical. However, difficulties in assessing performance-based learning outcomes often affect the ability to evaluate students accurately. The reliability and validity of assessment tools need to be established. While cognitive learning outcomes are often assessed using multiple-choice or short-answer exams, these assessment measures do not often assess higher levels of cognition or other domains of learning (McDonald, 2014). According to Oermann and Gaberson (2014), many significant outcomes that are important to practice cannot be measured by a test, but should be evaluated by other means such as observation of performance. Nurse educators need to look beyond the standard multiple-choice exam and use a variety of assessment measures to evaluate student performance (Benner et al., 2010).

Psychomotor competency assessment offers the opportunity first for evaluation followed by subsequent teaching of higher level cognitive functions such as application, synthesis, and evaluation of nursing knowledge. Psychomotor competency assessment is especially important as it incorporates the acquisition of technical skills as well as cognitive and affective thought processes (Billings and Halstead, 2011). Although the evaluation of performance is an important component of student assessment, there is a lack of instruments to evaluate student performance of decontamination (removal of contaminants by wet or dry methods) in a manner that is both reliable and valid. A web search and literature search of CINAHL and PubMed for key terms of "decontamination" and "checklist", "rubric" or "assessment" yielded no tools measuring the skill of decontamination.

With the recent increase in disasters and infectious disease outbreaks, there is a need to examine psychomotor competencies related to disaster preparation including the use of personal protective equipment (PPE). The purpose of this article is to describe the development and psychometric evaluation of an instrument for evaluating performance of procedures for one disaster-specific skill of decontamination. Included is a description of the qualitative development of content, quantitative analysis of content validity, and a description of the inter-rater and internal consistency reliability to assess student's ability to

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decontaminate a patient. The instrument was developed as part of a pilot study analyzing the use of virtual reality simulation as a method for teaching decontamination to nursing students.

Background and Framework

Psychomotor Skills

Three domains of learning, cognitive, psychomotor, and affective, were first described by Bloom (1956). While each of these domains have been defined as distinct and separate, many competencies required of healthcare workers incorporate more than one domain. In nursing education, faculty must be able to appropriately assess psychomotor performance of skills essential to safe nursing practice (McDonald, 2014). Learning to perform psychomotor tasks is associated with cognitive thought and understanding as well as affective domain aspects such as appreciation for, attitude towards, and values related to a skill (Miller, 2010). Psychomotor learning has been most often described as having the ability to move and manipulate objects (Dave, 1970). Nurses must be able to safely exhibit psychomotor skills that require movements and manipulation of equipment such as inserting a Foley catheter or drawing up medication from a vial. Despite the incorporation of all domains into a psychomotor task, the psychomotor domain is primarily assessed by observation of a student's ability to execute a task through fine or gross motor movements. Checklists, rating scales, or rubrics outlining required steps of a skill are frequently used to evaluate performance in simulated settings (Billings and Halstead, 2011). Yet, many rubrics used to evaluate student performance lack in documented reliability and validity (Adamson et al., 2013).

Dave (1970) described the progressive levels of psychomotor learning as imitation, manipulation, precision, articulation, and naturalization, which denote increasing levels of ability to perform a skill accurately and make appropriate modifications to a skill based on the situation. These concepts (imitation through precision) formed the basis for the total learning experience and for nursing students to learn the disaster-specific skills of decontamination as part of a day-long experience preparing nursing students for leadership in disasters. Online modules contained videos where students viewed the entire decontamination procedure step by step, also reinforced with verbal and written directions using voice over PowerPoint, which explained the skill and provided the opportunity for the imitation phase through demonstration. The virtual environment allowed students to further practice and imitate the skills, giving them feedback and continued practice as part of the manipulation level until they manipulated through the procedure with improved precision. Students were then able to perform the procedure of decontamination on a mannequin without instruction as a means to demonstrate precision. The higher levels of articulation and naturalization were not expected levels of expectation for this activity.

Disaster Competencies

The International Nursing Coalition for Mass Casualty Education (INCMCE, 2003) has identified competencies for nurses responding to mass casualty incidents. The international group included the competencies of assessment and decontamination procedures such as safe use of personal protective equipment (PPE). As part of the National Center for Disaster Medicine and Public Health (NCDMPH) team developing healthcare worker disaster competencies, Schor and Altman (2013) identified “disaster-type knowledge” needed such as “decontamination for chemical and nuclear events” (p. 10). During an emergency, public health nurses may be required to use equipment not a part of everyday practice. Public health nurses may need to be familiar not only with standard personal protective equipment used as part of an agency's infection control program (e.g., gloves, gowns, and respiratory masks), but also with advanced equipment and procedures used in a variety of public health emergencies (e.g., donning and doffing full body suits, setting up and using decontamination equipment) (Walsh et al., 2012).

In 2011, a severe earthquake occurred near the eastern coast of Japan. The resultant tsunami devastated many coastal communities in eastern Japan and the Fukushima Dai-ichi nuclear power plant was impacted releasing radiation contamination. A Radiation Exposure Research Team dispatched to Fukushima, noted the urgency to educate and foster the development of medical care personnel. The need for appropriate knowledge and skills to carry out the measures required to respond to the radiation exposure following this event was imperative. According to Noto et al. (2013), there is an urgent need to train nursing professionals for leadership roles in radiation emergency medicine to provide comprehensive care to radiation survivors.

Decontamination is a critical skill required for responding to radiation-related disaster events. The process involves the removal of gross contamination through the removal of clothing, followed by showering or washing to remove residual particles using gentle scrubbing and includes protection of health care worker and patient from contamination (Centers for Disease Control and Prevention, 2012). Unfortunately, the knowledge of these simple decontamination procedures is not well dispersed as evidenced by surveys in which nurses report that their disaster management knowledge and skills, especially related to isolation and decontamination procedures, are less than optimal (McKibbin et al., 2011). Contamination of the body and clothing of either health care worker or survivor from potentially harmful agents requires, at a minimum, cleansing with soap and water to ameliorate dangers.

In the pilot study, the authors examined the use of virtual reality simulation as a method of delivering decontamination training followed by evaluation of the skill in a simulation laboratory. The training and simulation were part of disaster training for the student nurses. The scenario involved the wet decontamination of a survivor following a radiological event. The radiation scenario was chosen as the level of PPE needed for this type of event is level D (lowest level of PPE) and required only soap and water for decontamination. This scenario was within the capabilities of the students and the PPE and decontamination agents were applicable to other situations. Chemical events and some biologic events require higher levels of PPE. In addition, the proximity of the University to a major Air Force base made the scenario appropriate.

Competency Assessment Instruments

Simulated experiences have been identified as an ideal method to assess psychomotor competencies in a way that avoids risk to actual patients (Jeffries, 2012). In disaster training, the need for simulation is heightened due to the lack of opportunities for practice in actual events. In addition, the simulated environment provides a safe method to assess competencies without exposing students to the potential hazards of a disaster, and in a way that can be repeated as necessary until skill competency is obtained.

A variety of checklists for evaluation of psychomotor competencies demonstrated in simulated environments have been developed (Jeffries, 2012). Instruments also have been developed to use simulated environments as a method to clearly evaluate and document student outcomes (Mikasa et al., 2013). These checklists developed by instructors are often specific to a type of simulation scenario (i.e. psychiatric nursing, obstetric nursing) or general nursing practice reflecting skills such as critical thinking, communication, or assessment. Most checklists are new instruments with limited reliability and validity (Adamson et al., 2013). A critical component of the study was the ability to measure psychomotor performance of learners demonstrating the skill of decontamination in a simulated environment. Any instrument used for assessment must be suitable for both the population and skill