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Featured Article

Evaluation of Nursing Student Perspectives of a Simulated Smart Pump

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KEYWORDS

Smart intravenous medication infusion pump;
point-of-care device;
user interface;
usability;
human-computer interaction;
simulation

Abstract

Background: Medical devices are incorporating information technology into complex user interfaces, increasing the need for training and testing. However, the actual devices are costly to purchase and maintain.

Method: Participants in this study programmed a simulated and actual smart medication infusion pump and completed a user satisfaction survey. The number of features accessed successfully and the number of errors made during interface programming with the simulator and pump were compared.

Results: Differences between the pump and simulator show where the simulator needs to be refined to increase fidelity.

Conclusions: Simulating devices provides a low-cost platform for nursing education and for device and interface development.

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Introduction

Medical devices, such as intravenous medication infusion pumps and smart hospital beds, are becoming extensions of the electronic medical record, collecting and dispensing information at the patient bedside (Lovis et al., 2011). ''Smart'' devices integrate computer software and medical device hardware. This evolutionary step is intended to provide clinical support to nurses and reduce preventable and costly error (Paparella, 2009). As the health care system in the United States struggles to increase cost-efficiency and improve patient safety and quality measures, it is doing so while providing care for increasingly

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high-acuity inpatient and complex outpatient populations (Institute of Medicine Committee on Identifying and Preventing Medication Errors, 2007).

Health care information technology, in part incorporated into medical devices, has been described as one of the means by which these goals can be achieved (Institute of Medicine Committee on Identifying and Preventing Medication Errors, 2007). In order for smart devices to realize their full potential to support quality and safe patient care, they must be used by a thoroughly trained and educated workforce, well designed and field tested by those who build them, and evaluated longitudinally to monitor effectiveness (Carayon, Hundt, & Wetterneck, 2010; Luctkar-Flude, Pulling & Larocque, 2010; Trbovich, Pinkney, Cafazzo, & Easty, 2010).

Key Points

- Point-of-care devices are increasingly computerized with complex interfaces.
- Poor usability affects error rates.
- Simulation of smart device interfaces can be a cost effective method for interface evaluation.

Traditionally, vendor research or development, beta testing, and purchase on a trial basis provide a means for user feedback. However, the training of users and development and testing of devices like smart pumps in the clinical setting are problematic because of the risk to patient safety and the disruption that extensive observation to detect problems would cause to care delivery (Elias & Moss, 2011; Ford et al., 2010). Clinical simulation can be an effective means to provide a safe, repeatable, and clinically accurate setting for education and training, including the testing of devices in development, and to test new devices prior to introduction into the clinical setting (Kanstrup, Christiansen, & Nohr, 2011; Leigh, 2011). Clinical simulation can also be used to develop evaluation processes for the device once it is in use. Simulating medical devices can provide a high-fidelity, low-cost platform that can address the needs of educators, health care professionals, organizations, and developers.

Theoretical Framework

Nursing informatics is uniquely positioned to draw on knowledge from the intersection of computer, cognitive, information, and nursing sciences to design a methodology for the development of simulated medical device interfaces (American Nurses Association, 2008). Nursing science brings with it an understanding of the workflow and processes of patient care, analysis of patient data for quality measures, and contributors to patient safety. The realm of computer science contributes knowledge regarding the mechanism of hardware, the tools of software, and the processes of device design. Information science, in this context, contributes to the understanding of the analysis of patient data to support clinical decision making. Finally, cognitive science helps us understand how users perceive and process information.

The intersection of these contributing sciences gives us tools that are needed to address the development of the next generation of medical devices. However in 2003, Effken noted that nursing informatics still lacked a theoretical framework that could guide researchers and that ''When a model was used to guide research, it was generally borrowed from another discipline'' (para. 1). In her publication, the author proposes an organizing metaframework to support nursing informatics research that ties together the contributing sciences, integrates nursing and quality models, and links core concepts (Effken, 2003). This informatics research organizational model brings the system's development lifecycle, including the evaluation phase, together with the system's research organizing model, including the concept of outcomes. With the support of the informatics research organizational model, we can develop tools that allow us to evaluate new technologies, in the form of smart device user interfaces, in the context of nursing practice and include the impact they may have on patient safety and outcomes.

Purpose of the Study

The primary purpose of this pilot study was to evaluate the fidelity of a simulated smart intravenous medication administration pump interface, when compared with an actual smart pump interface, for 4th-year nursing students who had no prior experience with smart pumps. A secondary purpose of the study was to determine if there was a difference in the level of user satisfaction and the thoughts and feelings of nursing student participants after programming medication administrations using the smart pump interface simulator and actual pump.

Methods

Participants

Twenty adult 4th-year nursing students, who had not had experience with smart pump technology, were recruited from a school of nursing at a large academic health sciences center in the southeastern United States to participate in this pilot study, with no preference given to gender or ethnicity. Any non-4th-year nursing students or students who had had experience with smart pump technology were excluded from the study. Recruitment posters were placed in the school of nursing student lounge and in hallways outside classrooms to make nursing students aware of the opportunity. The principal investigator also visited 4th-year student classes to describe the study. Fourth-year nursing students were selected because they already have a clinical understanding of medication administration, but they had not yet interacted with smart pumps. The study was conducted at the school of nursing where the students were recruited.

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