

Integrating Health Information Technology Safety into Nursing Informatics Competencies

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Abstract. Nursing informatics competencies are constantly changing in response to advances in the health information technology (HIT) industry and research emerging from the fields of nursing and health informatics. In this paper we build off the work of Staggers and colleagues in defining nursing informatics competencies at five levels: the beginning nurse, the experienced nurse, the nursing informatics specialist, the nursing informatics innovator and the nursing informatics researcher in the area of HIT safety. The work represents a significant contribution to the literature in the area of nursing informatics competency development as it extends nursing informatics competencies to include those focused on the area of technology-induced errors and HIT safety.

Keywords. Technology induced error, health information technology, safety, patient safety, nursing, competencies, nursing informatics

1. Introduction

Nursing informatics competencies are one of the most important types of competencies in a modernized health care system where the use of electronic health records, clinical documentation systems, telehealth systems and patient portals in the hospital, home and community are the norm. With the introduction of these technologies we have had a significant reduction in the number of medical errors. We have also seen the introduction of a new type of medical error (i.e. the technology-induced error) [1,2]. In this paper we outline a framework for introducing the topic of technology-induced errors and patient safety competencies involving health information technologies (HIT) into nursing curricula. Patient Safety was addressed earlier as a relevant topic for nursing during the 2003 Nursing Informatics post-conference, addressing the more general aspects of safe healthcare [3]. The competency work described here builds off Staggers and colleagues' framework in defining nursing informatics competencies for beginning nurses, experienced nurses, informatics specialists, informatics innovators, and nursing informatics researchers [4]. This work represents a significant contribution to the literature in the area of nursing informatics competency development as it

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extends these competencies to include those focused on technology-induced errors and HIT safety and includes those of a nursing informatics researcher.

2. Review of the Literature

2.1 Technology-induced Errors and Health Information Technology Safety

Technology-induced errors have emerged as a significant patient safety issue over the past decade. Technology-induced errors can be defined as errors that emerge from the complex interaction between individuals and technologies during real world work activities. They also include those errors that arise from the technology itself [1,2]. The root causes of these types of errors are many (see Figure 1) [6]. Some of them originate at the government level with changes in policy and legislation that are not mirrored in the technology used by clinicians. A lack of fit between policy, legislation and technology may lead to an error. For example, if there are differences between policies and procedures enacted by a technology and government policy or legislation, a technology-induced error may occur. If the model healthcare organization on which technology developers develop their technology has errors associated with its processes, those errors may be present in the technology, when it is implemented in another organization. This is especially the case when the model terminologies, workflows, policies and procedures found in the technology differ from those in the organization, where the technology will be implemented. Vendor organizations may also introduce new types of errors. Poor programming, requirements gathering, design and software testing may cause technology-induced errors at point of care (see Figure below). Local healthcare organizations may also be a source of technology-induced error. For example, mismatches between technology developed by the vendor and local organizational terminologies, workflow, policy and procedures and devices may lead to technology-induced errors. Also, local organizational customization of the technology to the local setting and poor organizational testing of these new customizations for error inducing properties may lead to a technology-induced error. Lastly, training and support, if insufficient, could lead to clinicians making such errors (see right side of Figure 1) [6].

Technology-induced errors have a number of origins in a health care system [6]. Today, researchers suggest that technology-induced errors range in frequency from 10-30 percent in organizations, regions and countries where there is a very high use of technology by health professionals [7]. In countries where there is use of hybrid paper-electronic patient care technologies these errors are much lower [8]. However, these errors are expected to increase as HIT becomes more widely used and deployed [9]. Over the past several years' researchers have documented the occurrence of these types of errors [1], reported on the types of errors that have arisen [7, 8], investigated the nature of their occurrence [1, 6-9], developed methods that can be used to evaluate the safety of technology [10], investigated/identified the root causes, and the role that technology has in leading to such errors [6]. In addition to this, researchers have identified and developed vendor and organizational strategies that can be used to mitigate technology-induced errors [10].

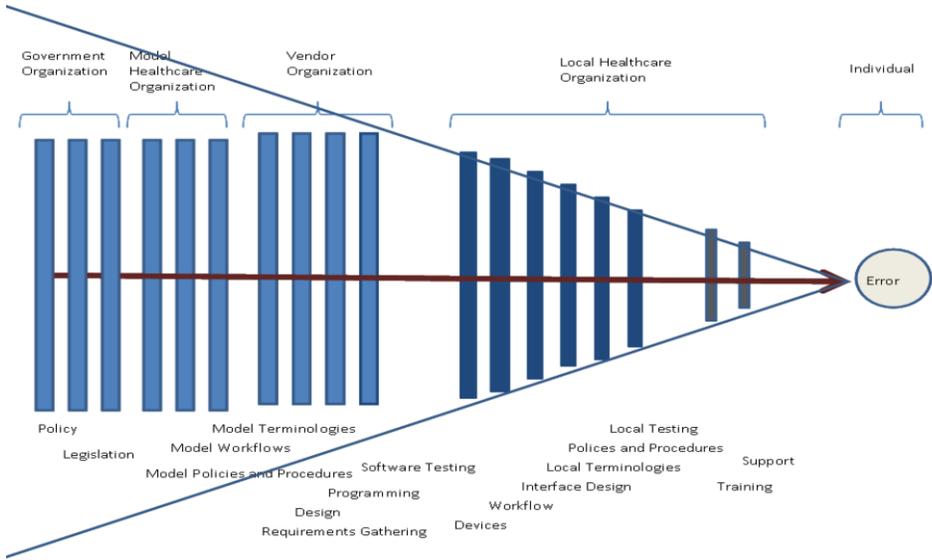


Figure 1. Root Causes of Error [see 6]

2.2 Nursing Informatics Competencies

Nursing informatics competencies remain an important aspect of nursing practice and investigation in nursing research. Over the past several years, researchers have developed nursing informatics competencies, evaluated their acquisition in response to educational interventions aimed at nurses, and described how these competencies can be extended among student and practicing nurses in health care organizations and across regional health authorities [12]. Even as nursing informatics competencies are being developed and incorporated into nursing curricula internationally, there is a need to extend these competencies to include new and emerging areas of health informatics practice, education and research and to reflect these changes in nursing informatics competency documents [13]. For example, technology-induced errors have emerged as a significant patient safety issue with the publication of the Institute of Medicine Report on *HIT and Patient Safety* [14] and the report on *Diagnostic Error in Health Care* [14], which not only outline how technology safety has become a significant public health issue, but how technology influences diagnostic error [15-17]. As well, there is recognition among the nursing informatics practice community that there is a need to extend nurses' knowledge about technology-induced errors to support the development and implementation of safer HIT [16]. Research by Saratan and colleagues [16] identifies that nursing informatics competencies need to be extended to include those that are specific to HIT safety. In a survey study of nursing informatics practitioners in British Columbia, Canada participants reported the need to add HIT safety competencies to already established nursing informatics competencies [16]. However, future nursing informatics competencies surrounding technology-induced errors and HIT safety need to be more fully defined at the undergraduate level and extended to the graduate level to include masters and doctorally prepared nurses in informatics.

In summary, with the advent of new findings arising from the health informatics literature and policy reports on technology safety, there is a need to acknowledge the relevance and importance of extending nursing informatics competencies to reflect these changes so that nurses who are practicing at point of care, expert nurse leaders, nursing informatics specialists and nursing informatics leaders develop these new competencies in the area of HIT safety.

3. Methods

There exist a number of nursing informatics competency frameworks. Stagers et al's [4] work in the area of nursing informatics competencies remains among the most cited of these works. Employing a modified version of Stagger's work as a fundamental framework, the researchers used this framework and extended it to include nursing informatics competencies with a focus on technology-induced errors and HIT safety. Using a modified version of Stagger's framework of nursing informatics practice, that of beginning nurses, experienced nurses, nursing informatics specialists, informatics innovators, and researchers, the authors of this work extended the reviewed literature on technology safety to the development of nursing informatics competencies at five levels to include competencies discussed in the HIT safety literature (See Table 1) [6].

4. Results

In this paper we were able to show that competencies can be developed for nurses that are specific to addressing and managing technology-induced errors and ensuring the safety of HIT. Current research regarding knowledge and skills aimed at reducing technology-induced errors and improving technology safety suggests that nursing informatics competencies at all of Stagger's [4] four levels are present with a focus on technology-induced errors and HIT safety (see Table 1). Nurses working at the point of care have an important role in ensuring that technology-induced errors are reduced by monitoring and reporting on these technology issues (see Table 1, Beginning and Experienced nurses) [7,17,18]. Nurses with graduate preparation can use their knowledge to develop safer software, test software for safety as well as implement these technologies in a safe manner. This work also includes educating point of care nurses about these types of errors and participating in the reporting processes around the technology as it is being implemented. Additionally, this may involve ensuring HIT training and supports are sufficient so that nurses can use the technology without introducing technology-induced errors (see Table 1, Nursing Informatics Specialists). Nurse innovators can contribute to this area of nursing informatics by developing and extending new software development approaches, methods and technologies that make health care safer (see Table 1, Informatics Innovators). Finally, nursing informatics researchers can study the factors or develop new research methods that can be used to enable the development of safe HIT, thereby further developing the nursing informatics research evidence base (see Table 1, Nursing Informatics Researchers).

Table 1. Mapping of Safety Competencies to Nursing Informatics Competencies

Level of Nursing	Nursing Informatics Competencies based on Level of Nursing	Health Information Technology Safety Competencies based on Level of Nursing
Beginning nurses	<ul style="list-style-type: none"> • Fundamental computer technology and information management skills • Use available information and information systems to manage their practice 	<ul style="list-style-type: none"> • Defines a technology-induced error. • Identifies a near miss and observed technology-induced errors at point of care • Verbalizes how near misses and technology-induced errors may cause harm to patients and describes their impact upon patient safety • Reports near misses and technology-induced errors to regulatory bodies and to organizations where they work • Reviews safety alerts and incorporates suggested changes into their practice.
Experienced nurses	<ul style="list-style-type: none"> • Proficiency in their domain of practice • High computer technology and information management skills in their domain of practice • See data elements, trends in the relationships between data elements, see trends and patterns in the data • Collaborate with nursing informatics specialists 	<ul style="list-style-type: none"> • Identifies near misses and observed technology-induced errors in their domain of practice. • Identifies technology-induced errors associated with data elements and their relationships at a unit, organizational or systems level. • Collaborates with nursing informatics specialists to remediate and rectify technology-induced errors with point of care staff • Educates point of care staff about how to prevent and incorporate changes to practice to prevent technology-induced errors
Nursing informatics specialists	<ul style="list-style-type: none"> • Graduate prepared nurses who have additional specialized knowledge about health informatics • Use “use critical thinking, process skills, data management skills, systems development life cycle knowledge and computer skills” 	<ul style="list-style-type: none"> • Analyzes and evaluates technology-oriented incident reports for the presence of technology-induced errors (including how technology might have contributed) to near misses and observed errors. • Investigates technology-induced errors. • Applies error management investigation methods to understand how a technology-induced errors occur including the use of root cause analysis, case study analysis, safety heuristics, usability testing, clinical simulations, and computer based simulations • Develops technology, organizational and nursing practice strategies changes to prevent near misses and actual technology-induced errors. • Reports and works with vendors and health care organizations to address these types of errors • Educates health professionals and health information management professionals about risk mitigation and risk management techniques • Uses these techniques to prevent technology-induced errors
Nursing informatics innovators	<ul style="list-style-type: none"> • Conduct informatics research and generate informatics theory 	<ul style="list-style-type: none"> • Develops new incident reporting methods for technology-induced errors • Analyzes data to identify new types of errors and develops classification systems for technology-induced errors

Level of Nursing	Nursing Informatics Competencies based on Level of Nursing	Health Information Technology Safety Competencies based on Level of Nursing
Nursing informatics researchers		<ul style="list-style-type: none"> • Develops methods for testing software and hardware to ensure the safety • Develops error investigation methods • Develops safety software and hardware • Develops methods that can be used to mitigate technology-induced errors • Develops policy, organizational strategies and vendor strategies that can be used to prevent technology-induced errors • Builds a nursing informatics evidence base for safe HIT. <ul style="list-style-type: none"> • Studies the factors that enable safe HIT development • Develops new research methods that can be used to study the safety of HIT • Extends the evidence-based research in nursing informatics.

5. Conclusions

It is clear that beginning and expert nurses are critical to ensuring technology is safe for use in the process of patient care as their role in identifying and reporting such errors is significant. The involvement of nursing informatics specialists in designing, developing and implementing software is fundamental. Nursing informatics specialists are responsible for employing the current knowledge base about creating, testing and implementing safe technologies. They also use the information provided by beginning and expert nurses to inform their work. Lastly, nursing informatics innovators, in the context, of a new field of study, focus on technology-induced errors and safety to develop new monitoring methods, design and development methodologies, and testing approaches (in addition to educating beginning, expert and informatics specialist nurses). Finally, nursing informatics research can build an evidence base to underpin such HIT safety research. However, simply developing competencies does not provide the skills to support identification and reporting of errors. Therefore, it is important that error reporting systems are developed and beginning level nurses are provided with training in the use of these systems. Again, as per the revised framework, identification and reporting of near misses is an important skill as is recognizing the need to follow up on reported errors or near misses.

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