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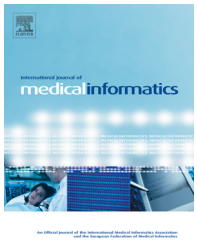

# Use of a human factors approach to uncover informatics needs of nurses in documentation of care

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ABSTRACT

*Purpose:* The success of health information technology implementations is often tied to the impact the technical system will have on the work of the clinicians using them. Considering the role of nurses in healthcare, it is shocking that there is a lack of evaluations of nursing information systems in the literature. Here we report on how a human factors approach can be used to address barriers and facilitators to use of the nursing information system (NIS). Human factors engineering (HFE) approaches provide the theoretical and methodological underpinning to address these socio-technical issues.

*Methods:* This study investigated the use of an NIS, a module of the electronic health record (EHR) previously implemented throughout the hospital system. The study took place in two hospitals (760 beds and 300 beds) within a three-hospital health system. Earlier in the year, the NIS was implemented throughout the health system. We applied a scenario-based evaluation technique in order to understand the barriers and facilitators to nurse use of the NIS as part of improving the healthcare delivery system. The scenarios were designed to have the nurses interact with the major components of the NIS. The research team developed the standardized scenarios to cover the major functions of the system.

*Results:* Twelve nurses completed the study and results show that documentation within the NIS was hindered by several aspects of the interface. This paper discusses the themes associated with the usability of the NIS interface analyzing them using usability heuristics. The team also identified facilitators to use and proposed avenues to support or enhance these facilitators.

*Conclusions:* This study examined the use of an NIS to standardize care and documentation in nursing. It used scenario-based usability testing, applying the "think-aloud" protocol technique to assess the use of the NIS in documenting patient care. This method of usability evaluation exposed an understanding of how nurses use the NIS and their perspective on the system. We hypothesize that this method will offer key insights into how the usability of the NIS not only impacts use but also informs redesign opportunities. In addition, this is one of the few rigorous studies of NIS and provides direction and recommendations for informaticians, developers and nurse decision makers.



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## 1. Introduction

Healthcare information technology (HIT) holds great promise for improved patient outcomes, increased cost-effectiveness, and better patient and staff satisfaction [1,2]. The implementation of new technologies in hospitals often has unanticipated, and frequently undesirable, consequences on workflow [3,4]. Nursing information systems (NIS) are being implemented in an increasing number of facilities with the goal of supporting interdisciplinary communication improving quality of care and increasing patient safety [5]. It should be noted that an NIS contains data collection and integration functionality for nurses and could be used in addition to or alongside an electronic medical record. Often the success of clinical information system implementations are tied to the impact the systems will have on work. These outcomes can be the result of a design based on over-simplified models of human decision making and work practices. The formal descriptions of work practices, such as written procedures, are idealized and may not include important complexities and subtleties that are present in the actual work [6]. In order to understand the impact of such technologies on the work of nurses, it is necessary to study the environment and practice before the technology is implemented. This cannot be done with the traditional randomized control trial methodology. While early studies of clinical information needs focused on physicians, more recent studies have found that nurses' information needs differ from those of physicians, and may include information about protocols and procedures [7], drug therapy, and diagnosis [8]. Nursing responsibilities in healthcare organizations run the gamut from educating patients to medication administration to executing physician orders and ensuring safety. Several researchers have pointed out the danger in trying to compare nurse and physician use [5,8,9].

Human factors engineering (HFE) approaches provide the theoretical and methodological underpinning to address these socio-technical issues [10,11]. HFE is a discipline that seeks to design devices, software, and systems to meet the needs, capabilities, and limitations of users, rather than expecting the users to adapt to the design of the system [10]. The field is multidisciplinary and benefits from the input of experts from diverse domains such as psychology, engineering, computer science, biomechanics, medicine and others. Since the NIS requires a considerable amount of cooperation from a variety of personnel [9], it is imperative that we understand how their processes are changed by the introduction of technology. Often that is most easily understood by investigating the design of the user interfaces. User testing offers a valid and reliable method to investigate the complex factors that impact work [12–14]. Within the literature regarding NIS use and implementation usability and usefulness have been identified as an under investigated yet influential factor affecting practitioners' acceptance [15,16]. Usability is a complex construct defined by both ease of use and learnability. Heuristic evaluation considers different aspects of an interface. The most widely used and validated heuristics were conceptualized by Nielsen et al. [17] and include ten (10) heuristics (see Table 1).

Here we report on how a HFE approach can be used to investigate the impact of usability and usefulness of system interfaces on the use of the NIS. The objectives were to understand if usability heuristics can be used as an analysis tool given that they can be used in the design of successful human–computer interfaces.

## 2. Methods

We applied a scenario-based evaluation technique in order to understand the barriers and facilitators to nurse use of the NIS as part of improving the system. Usability heuristics were then used to analyze the resulting themes that emerged from the evaluation. We hypothesize that this method will offer key insights into how the usability of the NIS not only impacts use but informs redesign opportunities.

### 2.1. Organizational setting

For this study, a case study methodology was used and approval from the researchers' academic institution's Institutional Review Boards was secured. Strong backing from nurse leadership at the health system level as well as in the individual hospitals was obtained. This study investigated the use of an NIS, a module of the electronic health record (EHR) previously implemented throughout the hospital system. Major components of the system include clinical practice guidelines, care plans and the ability to document nursing care. Included in the NIS are approximately 200 evidence-based, interdisciplinary clinical practice guidelines (CPGs) from which nurses select to guide the patient's care during a visit. CPGs are recommendations that are identified to assist in clinical decision making. Earlier in the year of the study, the NIS was implemented throughout the health system. Nurses attended eight hours of training in advance of the implementation. A complete description and evaluation of the NIS implementation is discussed more fully in another publication [18]. The study took place in two hospitals (760 beds and 300 beds) within a three-hospital academic health system.

### 2.2. NIS use

The NIS was used to document patient related issues including the admission profile, physical assessment, educational interventions, vital signs, intake and output measurements, medication administration, assessment findings, interventions completed, and significant event summaries. Upon patient admission, nurses access the NIS to document the clinical visit. Once a clinical practice guideline (CPG) is selected, the patient record is populated with care plans that can be used to collect structured data regarding assessment and education. Nurses would then be prompted to complete documentation based upon the condition and/or problem identified upon admission. Care plans, designed with information from CPGs, are further individualized by nurses for each patient. Content from the care plan populates throughout the assessment and education flow-sheets producing a comprehensive and detailed assessment specific to the chosen plan of care, prompting nurses to recognize important elements of