Assessing the Impact of Nursing Informatics Competencies on Decision Making Satisfaction: Results of a Preliminary Study

Full paper

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Abstract

Nursing informatics competencies (NIC) refer to the knowledge and skills needed to effectively use technological resources to provide effective care using health care technology (TIGER, 2006). NICs are crucial in providing patient-centered care in healthcare, an industry that uses different technology to support clinical activities, for example, electronic health records (EHR). This study will provide an overview of the benefits of NICs, and propose and validate a theoretical model that can be used to assess the impact of nurses NICs on their satisfaction with their decisions resulting in the use of decision support systems. This preliminary research is important to medical administration and management as well as medical educators because it will demonstrate how this research should advance as it will determine if decision making satisfaction is a viable outcome of nurses and their level of NIC.

Keywords

Information Systems, Informatics, Nursing Informatics Competencies, E-Health, Patient-Centered Care, Decision Satisfaction.

Introduction

The level of care provided by staff in hospitals, long-term care facilities and other healthcare organizations following a patient-centered model of care has the potential to be enhanced by investing in information technology. Some major benefits of technology in health care are determined to be efficiency of care, effectiveness of care, provider satisfaction, patient safety, and patient satisfaction (Buntin et al, 2011). Research on the application of technology in healthcare areas that subscribe to patient-centered care show some positive outcomes (Bates & Bitton, 2010).

Although information technology may benefit health care facilities, little research focuses on the abilities required to effectively use these systems, and the impact on the practitioners themselves. Using information technology to support and transform health care activities is the core of the concept of “e-health”. E-health entails the promotion of efficiency and enhancement of healthcare by using technology to extend the capabilities of healthcare (Eysenbach, 2001). Decision support systems (DSS) are tools that provide information and aide the user in making decisions, especially in the area of healthcare (Henry, 1995; Bose, 2003). DSS have been successfully employed in healthcare, such as PRODIGY, a DSS used and implemented by UK General Practice (Rajalakshmi, 2011) and are currently being implemented in Ontario through the implementation of electronic health records (Ministry of Health and Long-term Care, 2013).
It is important that health information technology (IT) users who use these technologies have a certain level of competency, but there is very little evidence concerning the actual benefits to the individual, the organization, and the impact on the patients when nurses have high levels of nursing informatics competencies. To attempt to address the subjective nature of assessing the impact of nursing informatics competencies (NICs), this research will explore Decision Making Satisfaction (DMS) as a possible outcome of an individual possessing nursing informatics competencies. Nurses lacking these competencies may present barriers when adopting and implementing new technology. Another barrier is the user satisfaction of the individual with the system that is in place in the organization. Systems which are not user-friendly may present barriers when using information systems as users may spend more time trying to learn the system than actually using the system (Deveraj, 2014).

The objective of this research is to determine the impact of NICs on decision-making satisfaction in a nursing environment. Although, this research is preliminary it can contribute to future research in assessing the impact of nursing informatics competencies and their direct impact on the organization, the nurses themselves and the adoption of technology in healthcare. The context of this research is at the individual level in an organizational healthcare setting, more specifically in a single hospital setting. It will examine the skill level of registered nurses and registered practical nurses in a variety of healthcare settings. This paper will present a theoretical model based on literature pertaining to patient-centered care, e-health, nursing informatics and associated competencies, decision making, and user satisfaction.

**Background: Patient-Centered Care and E-Health**

The patient-centered care (PCC) model differs from traditional care models by basing care on the patient’s needs and wants versus basing care on the course of the disease and/or illness (Dawson et al, 2009; Bechtel and Ness, 2010). The PCC model is a collaborative approach to patient care involving the patient, their family, and the care providers (Dawson et al, 2009; Bechtel and Ness, 2010). PCC requires communication, coordination, patient support, and in general whole-person care which is when the health care provider takes the time to understand a patient’s wants, needs, values is a very important attribute of the PCC model (Betchel and Ness, 2010). Shared decision making is a very important attribute of PCC (Barry & Edgman-Levitan, 2012).

Enhancing the PCC model using technology to enrich the collaboration and empower the patient is a concept called patient-centered e-health (Dawson et al, 2009). E-health promises to deliver more efficient, timely, and healthcare and supports a PCC model (TIGER, 2006). E-health promotes efficiency; enhances quality of care; promotes empowerment of the patient, encourages the establishment of new relationships between patient and health care professional; enables the exchange of information, promotes equity, promotes education and more (Eysenbach, 2001). One of the goals of e-health are to deliver value to the patient and achieve operational efficiency (Bose, 2003).

**Nursing Informatics**

Nursing informatics concerns the use of information technology to deliver nursing in healthcare. More broadly, health informatics focuses on many different areas within healthcare. For example, clinical informatics (also known as operational informatics), is the delivery of healthcare services through the application of informatics and information technology (AMIA, 2015). Nursing informatics integrates nursing science, computer science, and information science (AMIA, 2015; Henry, 1995; and Staggers & Thompson, 2002). The goal of nursing informatics is to effectively manage and communicate data, information, and knowledge in nursing practice and is supported through the use of information technology (Staggers & Thompson, 2002).

Nursing informatics supports decisions in all roles and settings (Staggers & Thompson, 2002). Nursing and health informatics are concerned with patient care, processing data, information and knowledge and decision making (Smedley, 2005). A crucial component in enhancing the PCC model of care with information technology is the ability to use informatics tools is integral in being able to provide PCC (Harsanyi et al, 2000; Norton et al, 2006). Indeed, informatics competencies are being incorporated into many nursing programs and becoming required for many roles within healthcare organizations (eg. Curran, 2003; Smedley, 2005).
Nursing Informatics Competencies

The use of technology is becoming more prevalent in healthcare organizations to manage knowledge, especially with the increased knowledge of nurses (Curran, 2003). Nursing informatics competencies (NIC) refer to the informatics skills needed to effectively use these resources to provide effective care using health care technology (TIGER, 2006). Informatics competencies differ from common constructs such as self-efficacy (e.g., Compeau & Higgins, 1995) in the fact that they are typically defined for a specific role by experts in the field, thereby encompassing the entire scope of skills and knowledge required by somebody in that role, as opposed to capturing a more general concept. Although many other informatics competency models have been developed for use in different contexts such as public health (e.g., Sitthisak et al, 2007), a widely accepted competency model for nursing at different levels of nursing includes the following competency classifications: basic computer skills, information management, and information literacy (Chang, 2011; Staggers et al, 2002). Different skills are applicable at different levels including beginning nurse, experienced nurse, informatics specialist, and informatics innovators (Staggers, et al, 2002). Although the specific skills are numerous (e.g. ability to use smart technology, ability to use web browsers, etc.), they can be grouped into these three competencies (Chou and De Martinis, 2013; Sun and Falan, 2013; TIGER, 2006; and Staggers et al, 2002).

First, basic computer skills (BCS) are essential to communication and documentation and include: being able to use word processors; the ability to type; create presentations; web browsing; use multimedia; telecommunications; the ability to use databases and information systems and more (Chou and De Martinis, 2013; Sun and Falan, 2013; TIGER, 2006; and Staggers et al, 2002). Second, information management (IM) is essential to protecting patient security; the ability to use information for decision making; collecting, processing, and presenting data; applying data for decision support and; protecting data and ensuring data integrity (Chou and De Martinis, 2013; Sun and Falan, 2013; TIGER, 2006; and Staggers et al, 2002). Third, information literacy (IL) is essential in ensuring the patient is given accurate, timely and relevant information; the ability to decipher relevant and irrelevant information by using critical thinking skills and; retrieving, evaluating and using information (Chou and De Martinis, 2013; Sun and Falan, 2013; TIGER, 2006; and Staggers et al, 2002).

The body of research surrounding NIC suffers from several setbacks. First, these competencies are usually determined and categorized by experts into the three presented variables, rather than developed through methods that would confirm its psychometric properties. Second, many nursing informatics competency models exist, but the actual impact on the individual, organization, patients, and other stakeholders is explored in the literature in far less depth. In other words, nursing informatics competencies aren’t linked to any outcomes or other ways to measure performance.

NICs can potentially impact the delivery of PCC (TIGER, 2006), however little, if any, research indicates how these competencies can impact PCC and therefore the management of operations within the organization. PCC is the method of care employed by the organization and thus would impact the strategic management of the organization and its employees (Luxford et al, 2011). Organizational impact through the employees individually, or more specifically, DMS will be a proposed measure in the presented models as DMS has been used as an assessment of satisfaction with DSSs (Alawan et al, 2014).

Decision Support Systems and Decision Making

Decision making is the three stage (predecision, decision, and post decision) process of searching for information to choose an appropriate alternative (Zeleny, 1982). The process of decision making in the clinical context starts with assessment, diagnosis/clinical inference, information seeking, and planning (Henry, 1995). However, this linear thought process is not necessarily used by all healthcare providers (Henry, 1995). Information technology is found to support decision making for nurses through technology such as decision support tools (Henry, 1995). Decision support systems (DSS) are adaptable and flexible systems, which support and facilitate decision making by providing solutions to non-structured problems (Rajalakshmi, 2011). DSS tools enable healthcare providers to make informed decisions (Henry, 1995).
Nursing Informatics Competencies and Decision Making Satisfaction

Decision Making Satisfaction

DMS is used as an assessment of satisfaction with DSS (Bharati & Chaudhury, 2004). DSS are tools used to support decisions within an organization such as electronic health records (EHR) or enterprise content management (ECM) systems (Bharati & Chaudhury, 2004). ECM systems are decision support tools, positively influencing decision making analysis, decision quality, and decision making speed (Alawan et al, 2014). ECM use may be beneficial for environments which are demanding in time and require up-to-date information (Alawan et al, 2014). DMS is positively impacted by DSS technology (Bernoider & Schmollerl, 2013).

User Satisfaction

User satisfaction is a person's feelings or attitude in a situation toward a situation, where for instance, the situation is an IT application or system being used (Bailey & Pearson, 1983). The skill level of the user and the information provided by the system strongly influence perceived usefulness and perceived ease of use (Moores, 2012). Additionally, trained and experienced users influence their perception of the system and more trained and experienced users understand the value in the system and the attitude toward the system is explained by the actual usefulness of the system (Moores, 2012).

Research Model

Figure 1 shows the proposed research model. The hypotheses will be explained in detail below.

Figure 1 Research Model

Nursing Informatics Competencies

As previously discussed, competencies of nursing informatics are categorized as basic computer skills, information management and information literacy (Sun and Falan, 2013; TIGER, 2006; Staggers et al, 2002; and Chou and De Martinis, 2013). Basic computer skills are essential to communication and documentation (Sun and Falan, 2013; TIGER, 2006; Staggers et al, 2002; and Chou and De Martinis, 2013). These skills encompass an individual’s ability to use a computer’s basic functionalities. Information management is the ability to use information for decision making by collecting, processing, and presenting data and applying the data for decision support (Sun and Falan, 2013; TIGER, 2006; Staggers et al, 2002; and Chou and De Martinis, 2013). Information literacy is the ability to decipher relevant and irrelevant information by using critical thinking skills and retrieving, evaluating and using information (Sun and Falan, 2013; TIGER, 2006; Staggers et al, 2002; and Chou and De Martinis, 2013). Since nursing informatics involves using DSS to support decision (Staggers & Thompson, 2002), it is proposed that NIC are needed to successfully to use DSS and result in user’s being satisfied with their decisions.

The following hypotheses are proposed:
H1: Basic computer skills will positively impact decision making satisfaction
H2: Information management will positively impact decision making satisfaction
H3: Information literacy will positively impact decision making satisfaction

User Satisfaction

User satisfaction refers to a user’s attitude toward the information system, and determines the intent to use the system (Delone and McLean, 2003; Brown et al, 2002). User satisfaction will be used as a moderator for the research model as the individual’s satisfaction with the system may impact their perception of the decision support received by the system. A nurse with low technology skills may be highly satisfied with the system and therefore perceive their DMS as highly satisfactory. The results must indicate the cause for the DMS.

H1A: The relationship between basic computer skills and decision making satisfaction is moderated (amplified) by the user satisfaction with the decision support system.
H2A: The relationship between information management and decision making satisfaction is moderated (amplified) by the user satisfaction with the decision support system.
H3A: The relationship between information literacy and decision making satisfaction is moderated (amplified) by the user satisfaction with the decision support system.

Data Collection and Analysis

Methodology

This preliminary research employed a quantitative design using anonymous online and paper-based survey (Creswell, 2009). The target population for this research is registered nurses (RNs) and registered practical nurses (RPNs) who are in frontline roles within an Ontario hospital. These nurses did not need to have any familiarity with the concept of nursing informatics. The nurses were sought from various hospital departments in the hospital. Participation was voluntary, anonymous and open to any nurse within the organization. A $200 gift card draw was used to incentivize participants. Research Ethics Board (REB) approval was achieved at Lakehead University and the participating hospital.

The instrument was composed of three sections, using prevalidated instruments. One section contained items measuring participants’ DMS, adapted from Alawan et al (2014). The second section contained items measuring participants’ perceived user satisfaction with their current decision support system, such as an electronic health record system or something similar, adapted from Likourezos et al (2004). The final section contained items for the self-evaluation of level of nursing informatics competencies, adapted from Hunter et al (2013). Additionally, the questionnaire sought basic demographic information such as education level (registered practical nurse, registered nurse, etc.) age, gender, country of birth, department, and employment status. The decision making satisfaction and user satisfaction questions used a five point Likert scale ranging from “strongly disagree” to “strongly agree”. The competency items were ranked on a four-point scale: beginner (1), comfortable (2), proficient (3), and expert (4).

Analysis

141 questionnaires were submitted, however, only 58 questionnaires were complete. IBM SPSS 23 was used to perform the analysis. Analysis of Variance (ANOVA) tests revealed no significant differences in groups delineated by the demographic variables. Table 1 (below) shows the results of the demographic information.
Confirmatory Factor Analysis (CFA) was used to determine item loadings on each of the constructs. Kaiser-Meyer-Olkin measures were all above the recommended level of 0.6, except for BSC, which scored 0.277. All Bartlett’s (Bartlett, 1954) tests of Sphericity were significant. Several items were removed, as the factor loadings were below 0.5: three items from DMS, one from BSC, one from IM, and one from IL. Table 1 (below) shows the correlations and Cronbach’s alpha results. All alpha scores are higher than the recommended 0.7 threshold (Nunnally, 1978).

| Table 1. Demographics of the sample. |

<table>
<thead>
<tr>
<th>Age</th>
<th>Education Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>20-29</td>
<td>36.2% Registered Nurse</td>
</tr>
<tr>
<td>30-39</td>
<td>22.4% Registered Practical Nurse</td>
</tr>
<tr>
<td>40-49</td>
<td>15.5% Other</td>
</tr>
<tr>
<td>50-59</td>
<td>22.4% Clinical Nurse Specialist</td>
</tr>
<tr>
<td>60-69</td>
<td>3.4% Program Director</td>
</tr>
<tr>
<td>Total</td>
<td>100% Total</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Gender</th>
<th>Employment Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>89.7% Casual</td>
</tr>
<tr>
<td>Male</td>
<td>10.3% Full-time</td>
</tr>
<tr>
<td>Total</td>
<td>100% Part-time</td>
</tr>
<tr>
<td></td>
<td>Other</td>
</tr>
<tr>
<td></td>
<td>Temporary part-time</td>
</tr>
<tr>
<td></td>
<td>Total</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Country of Birth</th>
<th>Regular Shift</th>
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</thead>
<tbody>
<tr>
<td>Other</td>
<td>3.4% AM</td>
</tr>
<tr>
<td>Canada</td>
<td>96.6% Overnight</td>
</tr>
<tr>
<td>Total</td>
<td>100% PM</td>
</tr>
<tr>
<td></td>
<td>Various</td>
</tr>
<tr>
<td></td>
<td>Total</td>
</tr>
</tbody>
</table>

| Table 2. Cronbach’s Alpha and correlation of factors. |

<table>
<thead>
<tr>
<th></th>
<th>DMS</th>
<th>USAT</th>
<th>BCS</th>
<th>IL</th>
<th>IM</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>(0.954)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>.501</td>
<td>(0.922)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>.459</td>
<td>.213</td>
<td>(0.976)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>.543</td>
<td>.283</td>
<td>.855</td>
<td>(0.965)</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>.499</td>
<td>.217</td>
<td>.854</td>
<td>.916</td>
<td>(0.910)</td>
</tr>
</tbody>
</table>
In order to assess the multicollinearity of the variables, correlations and Variance Inflation Factors (VIFs) were inspected. Correlations for most variables did not yield anything higher than 0.541, with the exceptions of the three NIC factors, which were between 0.854 and 0.916 (See the Discussion section for more analysis of this result). The highest VIF was 1.295, indicating no issues with multicollinearity, following the guidelines of O’Brien (2007).

Table 2 shows the results of the regression analysis with moderation. H1 through H3 tests all yielded significant results (p < 0.000). Beta (standardized coefficients) values for H1, H2 and H3 were 0.459, 0.543 and 0.499, respectively. Variance explained was 19.6%, 28.2%, and 23.6% for BCS, IL and IM, respectively. To test H1a through H3a, three variables were created from the products of USAT, and each of the three NICs. These variables were then regressed on DMS. All three tests were significant (p< 0.000). R values for H1a, H2a and H3a were 0.618, 0.643, and 0.631 respectively. Variance explained was 38.2%, 41.3%, and 39.8%, respectively.

<table>
<thead>
<tr>
<th>Hypothesis</th>
<th>Significant</th>
<th>Beta</th>
<th>Variance Explained</th>
</tr>
</thead>
<tbody>
<tr>
<td>H1</td>
<td>***</td>
<td>0.459</td>
<td>19.6%</td>
</tr>
<tr>
<td>H2</td>
<td>***</td>
<td>0.543</td>
<td>28.2%</td>
</tr>
<tr>
<td>H3</td>
<td>***</td>
<td>0.499</td>
<td>23.6%</td>
</tr>
<tr>
<td>H1a</td>
<td>***</td>
<td>0.618</td>
<td>38.2%</td>
</tr>
<tr>
<td>H2a</td>
<td>***</td>
<td>0.643</td>
<td>41.3%</td>
</tr>
<tr>
<td>H3a</td>
<td>***</td>
<td>0.631</td>
<td>39.8%</td>
</tr>
</tbody>
</table>

Table 2. Outcome Summary

Discussion

Theoretical Implications

This research establishes NICs as a viable predictor of personal performance in a healthcare context. Although previous research establishes technology self-efficacy as a predictor of performance (Stajkovic & Luthans, 1998), this research establishes a link between popular approaches in healthcare with mainstream information systems and management concepts. A moderating effect of user satisfaction suggests that technology that is designed with the user in mind leads to better outcomes for the healthcare workers despite their skills. Both are needed to realize positive outcomes. More opportunity exists to use healthcare informatics competency models to develop theory, employing relevant variables to measure both individual and organizational performance.

Although this research reports positive and innovative findings, care must be taken in interpreting the three groups of NICs. The three groups of competencies should not be confused as constructs, and their psychometric properties may not exist in all cases. Despite the fact that these classifications are widely used and regarded in some circles, there is a lack of evidence to support their value in health care and the analysis presented supports this notion. A post-hoc Exploratory Factor Analysis was completed for the three NICs, with only one factor emerging from the analysis. A similar approach has been used in several studies (Kin et al, 2014; Naji et al, 2014) where competency items load onto factors that do not necessarily match the classifications that they originally had belonged to, bringing into question the utility of the classifications. Given the widespread use of NICs in nursing, this research chose to examine NICs, yet demonstrating the substitutability of NICs with technology self-efficacy warrants research, none of which is known to have been conducted.

Managerial Implications

This research will impact healthcare organization through strategic management of operations and training and development, specifically health care administration as well as health care educators. Since it was...
determined that NIC support DMS when using technology in healthcare, the strategic management of operations within healthcare organizations could be impacted especially when deciding on technology implementation. Managers should consider the NICs of the nursing staff as well as their satisfaction with the systems they use when it comes to operations within health care facilities. Managers also may want to consider technology training beyond the specific systems implemented at their facility. For instance, enhancing IM competencies could lead to systems that are more user friendly as the nurse could have the ability to help in the development of the system (at the design phase). Additionally, an increase in IM competencies could lead a nurse to develop their own system (for instance in spreadsheet software) for tracking information they feel is relevant, but not monitored. This could lead to many possibilities from developing more effective data management systems to early symptom identification for diseases and illnesses. Finally, the significance of the User Satisfaction as a moderator underlines the importance of the user’s perception of the application as an important component of their overall job.

Limitations and Future Research

This study has several limitations many of which can be addressed by future research. Firstly, the sample size of this study is small with only 58 participants. Future research could replicate this study and expand the number of health care facilities being used. Also, the study was limited to a hospital, limiting generalizability to other sites. Another limitation of this study is the use of quantitative measures in itself, as richer understanding of NICs in practice could be achieved through other popular methods, such as qualitative interviews or job observation.

Other research possibilities include investigating other factors such as documentation time, patient satisfaction and training, which could be valuable from a managerial and organizational perspective. Additional research could focus on using technology for the purpose of training, which could be impacted by a nurse’s informatics competencies. Lin (2013) explored using technology-enhanced learning for the purpose of theory comprehension prior to applying concepts, which impacts patient safety. Nurses could be hindered in learning if their ability to use technology effectively is lacking. A study conducted by Mei et al (2013) observed the implementation of a system monitoring patient falls and used a four-pronged evaluation framework evaluating the fit between the technology and the user. A component of this framework was the technology acceptance model to assess the user's perception of the technology. This research could be expanded to include the user's nursing informatics competencies to explore their impact on technology implementation.

Conclusion

This preliminary research shows support for the proposed theory where nursing informatics competencies impact the decision making satisfaction, which is amplified by user satisfaction. This study shows that this area of research is viable and should be pursued. Although few limitations exist within this study, future research can potentially address these limitations and lead to stronger information systems and technologies within health care facilities that can support and enable a stronger health care system. Overall, NIC can benefit the overall healthcare industry improved knowledge growth and management in an industry which thrives through learning.

REFERENCES


