Applying Technology Acceptance (TAM) model to determine the acceptance of Nursing Information System (NIS) for Computer Generated Nursing Care Plan among nurses

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Abstract
Background: An advance in the development of information technology and the performance standards in the healthcare systems require an electronic health care record to allow the management of the various sources of clinical data in a patient-centered care approach for the health organization which has been well known in nursing, where patient centered holistic care is central to the majority of nursing models through the nursing process. ***Methods:*** An explorative study has been carried out to determine the level of acceptance of Nursing Information System (NIS) for computer generated nursing care plan among thirty nurses selected by convenience sampling technique in the selected hospital, Bangalore, Karnataka, India, in the pre implementation stage. Self administered Likert's scale questionnaire based on Technology Acceptance Model (TAM) has been employed to collect the data. **Results:** The majority of nurses showed positive intention towards perceived usefulness, perceived ease of use and attitude towards Nursing Information System (NIS) for computer generated nursing care plan and there was significant relation found between perceived usefulness, perceived ease of use and attitude at $p<0.05$ and $p<0.001$ level. ***Conclusion:*** Results evidenced the acceptance of nursing information system and computer generated nursing care plan and also proposed the need to repeat the study after implementing the nursing information system in the actual setting and also to identify the usage of the system. ***Keywords: Nursing Information system, Nursing care plan, Technology Acceptance Model***

Introduction

Healthcare is delivered in dynamic, complex, ever changing environments and to respond proactively for these changes and the growing demands for clinical information, computer systems are being devised to collect, store, retrieve, analyze and communicate health status and health care information[1]. Effectiveness of any health institution depends on its goals and objectives, its strategic location, soundness of its operations, and efficiency of its management systems[2].

The development of information systems has been linked to changing needs in the healthcare industry. A computer-based patient record (CPR) is essential for integrated healthcare networks to be able to accomplish strategic goals of fusing business and clinical operations. The Institute of Medicine (IOM) noted the trend toward integration within the healthcare industry and the importance of having a CPR to support new care delivery methods[3]. Information systems are being deployed in health care systems worldwide, and have the potential to change storage of data, way to access and update specific information about patients[4].

Technology has brought about the automation of nursing information and data, and the advent of the nursing information system can best be integrated into all phases of the delivery of patient care. Nursing professionals have key roles in integrating technology into patient care delivery and involved in the evaluation phases of information systems, also play increasing roles in developing and sustaining the long term strategy for accessing patient information[1]. The Agency for Healthcare Research and Quality (AHRQ) reports hospitals are experiencing a steady increase in patient care costs, along with a nursing resource shortage, as well as expanding healthcare regulation and policy requiring increased organizational information on care quality, safety and outcomes[5]. Recognition of this growing need for nursing data, the computer based patient record facilitates the automation of the nursing care planning process. Summarized by Meadows "The ability to electronically record, integrate and analyze data and information enables nurses to quickly move to the synthesis of nursing knowledge and the development of nursing wisdom, which they can then apply to patient care[6].

Nursing care plans have been used extensively in educational settings as an essential teaching tool and the value of care planning has been reinforced by the Joint Commission on Accreditation for hospitals (JCAH), but it remains difficult to find nursing care plans in the clinical setting whereas in reality, if care plans are written they are often incomplete, outdated, rarely used for determining care and infrequently relied upon as a means of communicating problem management from one shift to another. The nurses view the

care plan as another burdensome piece of time consuming paperwork, preparation or revision of the plan is low in practice settings. Therefore the plan is not available and consequently is not used because it is not a reliable source of information. The perpetuation of this cyclical disuse of the nursing care plan may be ameliorated if care plan construction and modification were quick and simple. A computerized program would facilitate this kind of care planning[7].

The care plan provides a mechanism for provision of consistent and coordinated care[8]. The nursing care plan illustrate the sequential and interrelated phases of nursing process such as assessment, diagnosis, planning, implementation and evaluation, in order to make best possible care decisions and maintain appropriate documentation of meaningful information[9]. In a study where 20 nurses were formally interviewed, various questions were posed regarding the benefits in using a computerized nursing care plan system. In addition to the expected response of streamlined care, nurses added several areas of benefits which included a reference for their memory for patient details, a learning tool for patient care, and a vehicle to easily modify care plan content. These responses highlight the creative potential for nursing care plans as IT solutions are developed[10]. Nursing care plan given its central position in patient care, it would appear obvious that a computerized nursing care plan offers great potential in many areas other than just making care more efficient[11].

The documentation of the nursing care plan is an important but often neglected part of clinical documentation. Therefore there have been some attempts and discussions about how to support the nursing process using computer based documentation systems. Motivation is an essential for learning and important success factors for new computer-based system are user's motivation and acceptance of new ways of working as well as user acceptance is often seen as crucial factor for determining the success or failure of new a project[12]. In order to assess the level of acceptance of nursing information system for computer generated nursing care plan the researcher adopted a modified self-administered questionnaire based on Fred D. Davis Technology acceptance Model (TAM) which to predict the degree to which users unfamiliar with a particular piece of software will actually use that software after being introduced to it. The goal of TAM is to predict information system acceptance and diagnose design problems before users have any significant experience with a system. Davis has developed scales to measure ''perceived usefulness'' (U) and ''perceived ease of use'' (EOU), "attitude" (A), and Behavioral Intention (BI). By gathering user perceptions of a system's usefulness and ease of use, developers can more accurately assess whether that system will ultimately be accepted by users. Based on the description of Technology Acceptance Model the following hypotheses were formulated for the present study in order to assess the level of acceptance of nursing information system for a computer generated nursing care plan.

$H_{1:}$ Perceived ease of use (EOU) will have a significant positive influence on perceived usefulness (U)
$H_{2:}$ perceived usefulness (U) will have a significant positive influence on attitude (A) toward using NIS
$H_{3:}$ Perceived ease of use (EOU) will have a significant positive influence on attitude (A) toward using NIS
H_4: There will be significant association between the level of acceptance with selected demographic variables of the subjects

The tool consisted mixture of Likert's scale items and semantic differential scale items. In the present study the tool consists of two parts sections namely Section A and Section B. Section A deals with the demographic profile of staff nurses and Section B includes the scale consisted of six items with a seven-point Likert's scale with a response ranging from seven to one, representing Extremely Likely(EL), Quite Likely(QL), Slightly Likely(SL), Neither(N), Slightly Unlikely(SL), Quite Unlikely(QU), Extremely Unlikely(EU) in the perceived ease of use and perceived usefulness constructs. The total score ranges from 6 to 42 points; a higher score indicated a higher degree of perceived ease of use and perceived usefulness as perceived by selected subjects. Whereas the attitude construct includes four items differential semantic scale the total score ranges from 4 to 28[13-16]. The calculated Cronbach alpha for the tool was 0.82 and the tool was found to be highly reliable.

Methods

An explorative design has been adopted for the present study to determine the level of acceptance of nurses towards developed nursing information system for computer generated nursing care plan and the thirty nurses are selected by convenience sampling technique who fulfilled inclusive criteria. After obtaining formal permission from the concerned authorities the researcher formulated the case scenarios of cardiac medical conditions from the patient records and applied same to the selected samples. The researcher taught the functioning of the nursing information system by demonstrating the patient care plan tabs from the researchers system. After successful completion of practice session the each subjects were asked to develop a five nursing care plan based on the case scenarios written by the researcher by using the developed nursing information system. At the end of the session the researcher administered the tool in order to assess the participants' level of acceptance towards the developed nursing information system for computer generated nursing care plan. The collected data were coded, organized and analyzed using statistical package SPSS 20 version.

Results and Discussion

Demographic profile of staff nurses

From the findings it was evident that most of the subjects 19(63.3%) belongs to the age group of 21 to 25 years and majority of the subjects 27(90%) whereas majority of the subjects 21(70%) done General nursing and Midwifery and 7(23.3%) subjects undergone certificate course in computer

science and only 1(3.3%) subject completed Diploma in computer science respectively. With respect to overall experience most of the subjects 16(53.3%) had 1-3 years of experience and previous experience in computer application revealed that maximum number of subjects 18(60%) had no sort of experience Exposure to information about nursing information systems showed that majority of the subjects 19(63.3%) heard during their clinical practice and 10(33.3%) subjects known during their curriculum.

Level of Acceptance of nursing information system

Table 1: Assessment of Ease of Use (EOU) among subjects

EOU	Mean	SD	Median	Mean%
EOU_1	6.17	0.83	6.00	88.10
EOU_2	5.30	0.60	5.00	75.71
EOU_3	6.23	0.77	6.00	89.05
EOU_4	5.63	0.72	5.50	80.48
EOU_5	5.60	0.93	6.00	80.00
EOU_6	5.60	0.62	6.00	80.00
EOU	**34.53**	**1.85**	**35.00**	**82.22**

The overall mean score obtained by the subjects was 34.53 (82.22%) with the SD of ±1.85 in the construct of ease of use, it was evidenced that there was a high perceived ease of use about nursing information system. The present study findings were consistent with the study findings of Stocker, Gary (2010) who assessed the technology acceptance of electronic medical records by nurses. The modified Davis survey tool was electronically distributed to nurses in 13 hospitals to assess Davis' TAM model in acute care settings results showed that Perceived ease-of-use and perceived usefulness were the variables used to predict intention of nurses to use electronic medical records in acute health care settings[17]. Study findings Lu CH, Hsiao JL, Chen RF(2012) on factors determining nurse acceptance of hospital information systems were similar with present study findings, the researchers supported that perceived usefulness and ease of use have a significant influence on system acceptance (R=0.75); Perceived usefulness (β1=0.61, P<.001) has a significant influence on system acceptance[18].

Table 2: Assessment of Perceived Usefulness (PU) among subjects

PU	Mean	SD	Median	Mean%
PU_1	6.07	0.64	6.0	86.67
PU_2	5.53	0.57	5.5	79.05
PU_3	5.60	0.50	6.0	80.00
PU_4	5.73	0.52	6.0	81.90
PU_5	5.77	0.50	6.0	82.38
PU_6	5.60	0.50	6.0	80.00
PU	**34.30**	**0.95**	**34.0**	**81.67**

The overall mean score obtained by the subjects was 34.30(81.67%) with the SD of ±0.95 in the construct of perceived usefulness, it was evidenced that there was a high perceived usefulness towards the developed nursing information system and were similar to the study findings of Kowitlawakul Y (2011) who utilized the Telemedicine Technology Acceptance Model based on the original Technology Acceptance Model to predict nurses' intention to use telemedicine technology (eICU), 117 participants from two healthcare systems were participated and the results showed that perceived usefulness is the most influential factor that influences nurses' intention to use the eICU technology[19]. The study findings of Tao D (2008) on understanding intention to use electronic information resources based on a theoretical extension of the technology acceptance model (TAM) by examining the roles of two aspects of e-resource characteristics, namely, information quality and system quality, in predicting public health students' intention to use e-resources for completing research paper assignments revealed that perceived usefulness played a major role in determining students' intention to use e-resources[20].

Table 3: Assessment of Attitude (A) among subjects

A	Mean	SD	Median	Mean%
A_1	6.57	0.504	7.00	93.81
A_2	6.40	0.724	7.00	91.43
A_3	6.60	0.498	7.00	94.29
A_4	6.53	0.507	7.00	93.33
A	**26.10**	**1.21**	**26.50**	**93.21**

The overall attitude mean score was 26.10(93.21%) with the SD of ± 1.21, which evidenced the favorable attitude towards the developed nursing information system. These were consistent with the findings of Chow M et.al (2012) on development of a clinical imaging portal to facilitate independent learning in image interpretation and to explore factors affecting intentions to use the portal based on the technology acceptance model (TAM), among One hundred and twenty-eight nursing students indicated that the portal was perceived as easy to use, useful and satisfying and structural equation modeling (SEM) showed that attitude toward using the portal exhibited the strongest total effect on behavioral intention to use, followed by perceived ease of use and computer self-efficacy[21]. Also similar to the study findings of De Veer AJ and Francke AL (2010) who conducted a questionnaire survey to study the attitudes of nursing staff (685) working in Dutch hospitals, psychiatric organizations, care organizations for mentally retarded people, home care organizations, nursing homes or homes for the elderly towards electronic patient records, results revealed that nursing staff members associate EPR with improved care, especially qualitatively better and safer care and a relatively positive attitude towards EPR was found in three categories of nursing staff in particular, i.e. staff working at least 30hr per week, staff already using EPR and staff working in hospitals, also nursing staff in management positions also tend to have a more positive attitude whereas when the Technology Acceptance Model was tested, attitudes towards EPR were primarily associated with job-related characteristics and perceived usefulness with respect to quality of care[22].

Table 4: Correlation between constructs of TAM

Constructs	r-value	p-value

EOU	**PU**	**0.551**	**0.002**
EOU	**A**	**0.497**	**0.005**
PU	**A**	**0.551**	**0.002**

***p<0.001, *p<0.05

The above table evidenced the significant correlations between the constructs of technology acceptance model, there was a significant influence of EOU on PU, EOU on A and PU on A at p<0.05 and p<0.001level. The study findings were similar with the findings of Nkenke E et al,(2012) who tried to determine the acceptance of Virtual dental implant planning software among forty-three third-year dental students of the University of Erlangen-Nuremberg, Germany by administering a questionnaire based on a combination of the technology acceptance model and the theory of planned behavior (C-TAM-TPB). cronbach's(α), pearson product moment correlation coefficients, and squared multiple correlations (R^2) were calculated. Results revealed that pearson correlations were significant for the pair's perceived usefulness/behavioral intention, perceived usefulness/attitude, and attitude/behavioral intention. Perceived ease of use explained .09% of the variance of perceived usefulness (R^2 = .09), perceived ease of use and perceived usefulness accounted for 31% of the variance of attitude (R^2 = .31) and perceived usefulness, attitude, subjective norm, and perceived behavioral control explain 37% of the variance of behavioral intention (R^2=.37) as well as authors concluded that new technology seems to be accepted by dental students especially because of its usefulness and the students' attitude towards this technology[23].

Regression analysis evidenced that total experience and previous experience in computer applications had significant influence on ease of use at p<0.05 and overall influence of independent variables on perceived ease of use was 56.1% (R=0.749, R-Square=0.561) and respondents with higher experience felt less ease of use compared to respondents with lesser experience and also those who had previous experience in computer applications felt more ease of use about the developed nursing information system and all other parameters had no significant influence on ease of use as well as results showed that professional qualification had significant influence on perceived usefulness at p<0.05 and overall influence of independent variables on perceived usefulness was 49.5% (R=0.704, R-Square=0.495), further the respondents with higher the professional qualification felt higher usefulness compared to GNM and also those who had technical qualification felt less usefulness all other parameters had no significant influence on perceived usefulness. Regression on attitude with demographic variables showed that professional qualification and total experience had significant influence on attitude at p<0.05 and overall influence of independent variables on attitude was 73.4% (R=0.857, R-Square=0.734) and also respondents with higher the professional qualification more favorable attitude compared to GNM and also those who had lesser experience had less favorable attitude whereas higher experience more favorable attitude towards the developed nursing information system and all other parameters had no significant influence on attitude.

Conclusion: In the pre implementation stage nurses expressed a positive level of acceptance towards the nursing information system for computer generated nursing care plan.

Future Implications: The study could be carried out in the real setting after integrating developed nursing information system for computer generated nursing care plan with the existing hospital information system as well as effectiveness of developed nursing information system in terms of functionality and quality of nursing care plan could be assessed.

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