

Factors influencing nurses' acceptance of hospital information systems in Iran: application of the Unified Theory of Acceptance and Use of Technology

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Abstract

User acceptance is a precondition for successful implementation of hospital information systems (HISs). Increasing investment in information technology by healthcare organisations internationally has made user acceptance an important issue in technology implementation and management. Despite the increased focus on hospital information systems, there continues to be user resistance. The present study aimed to investigate the factors affecting hospital information systems nurse-user acceptance of HISs, based on the Unified Theory of Acceptance and Use of Technology (UTAUT), in the Shiraz University of Medical Sciences teaching hospitals. A descriptive-analytical research design was employed to study nurses' adoption and use of HISs. Data collection was undertaken using a cross-sectional survey of nurses (n=303). The research model was examined using the LISREL path confirmatory modeling. The results demonstrated that the nurses' behavioural intention (BI) to use hospital information systems was predicted by Performance Expectancy (PE) ($\beta = 2.34, p < 0.01$), Effort Expectancy (EE) ($\beta = 2.21, p < 0.01$), Social Influence (SI) ($\beta = 2.63, p < 0.01$) and Facilitating Conditions (FC) ($\beta = 2.84, p < 0.01$). The effects of these antecedents of BI explained 72.8% of the variance in nurses' intention to use hospital information systems ($R^2 = 0.728$). Application of the research model suggested that nurses' acceptance of HISs was influenced by performance expectancy, effort expectancy, social influence and facilitating conditions, with performance expectancy having the strongest effect on user intention.

Keywords (MeSH): *Health Information Management; Hospital Information Systems; Technology; Electronic Medical Records; Nurses; Iran*

Supplementary term: *Unified Theory of Acceptance*

Introduction

Increasing investment in information technology (IT) by healthcare organisations around the world has led to the identification of user acceptance as an important issue in the implementation, as well as in the management, of technology (Hu et al. 1999). Thus far, more than 40% of the changes in IT in different fields, including in the areas of healthcare systems, have led to failure or abandonment (Aarts & Gorman 2007). One of the reasons for such failures is an insufficient understanding of the socio-technical dimensions, particularly of how individuals and organisations accept information technology (Giuse & Kuhn 2003; Aarts and Gorman 2007). In fact, individuals' acceptance, and users' utilisation of the technology together constitute the most important factors leading to successful IT implementation (Selder 2005). A developing trend can be observed in hospital information systems (HISs) as the number of hospitals interested in creating these systems and developing and main-

taining electronic patient records is increasing. Such systems, however, are not always fully used by the relevant staff members (Hamidfar, Limayem & Zegordi 2008).

The development, use, and acceptance of IT are quite difficult functions (Maass & Eriksson 2006), and the ever-increasing use of IT has generated various studies investigating factors that affect its implementation and acceptance. In fact, an understanding of why people use technology and the investigation of the factors that are effective in new technology acceptance help to ensure that it is successfully utilised. Moreover, in light of their central role in healthcare, nurses should be major users of technology; indeed, their acceptance and utilisation of computerised systems are considered to be key indicators of successful system implementation (Hilz 2000).

There are various models and theories of technology acceptance, some of which have been applied in the healthcare field (Holden & Karsh 2010). The

Unified Theory of Acceptance and Use of Technology (UTAUT) model, presented by Venkatesh in 2003, combines eight theories of technology acceptance¹ (Venkatesh et al. 2003; Kijasanayotin, Pannarunothai & Speedie 2009). Subsequent validation of UTAUT in a longitudinal study found it accounted for 70% of the variance in usage intention (Venkatesh et al. 2003). This model incorporates all the factors in the previous models and is capable of presenting acceptable results in real samples and systems (Venkatesh et al. 2003). The main components of this theory include performance expectancy, effort expectancy, social influence, and facilitating conditions (Holden & Karsh 2010). The UTAUT successfully integrates all constructs in previous models and can explain variance in IT behavioural intention and use behaviour. This theory could explain 69% of the users' intention to use technology whereas the previous models could explain up to 40% of intention (Kijasanayotin, Pannarunothai & Speedie 2009).

Aims of the current research

The aim of the present study was to explore factors affecting nurse-user acceptance of hospital information systems (HIS) in the Shiraz University of Medical Sciences teaching hospitals, based on the Unified Theory of Acceptance and Use of Technology (UTAUT).

The specific research hypotheses were:

- *Hypothesis 1:* Performance expectancy has a significant effect on the nurses' behavioural intentions to adopt hospital information systems.
- *Hypothesis 2:* Effort expectancy has a significant effect on the nurses' behavioural intentions to adopt hospital information systems.
- *Hypothesis 3:* Social influence has a significant effect on the nurses' behavioural intentions to adopt hospital information systems.
- *Hypothesis 4:* Facilitation of conditions has a significant effect on the nurses' behavioural intentions to adopt hospital information systems.

Method

Research design

A cross-sectional survey was conducted in the selected hospitals during the six-month period, 1 March–31 August 2012. A descriptive-analytical research design was employed to study nurses' adoption and use of HISs. The research model adopted for the study is shown in Figure 1.

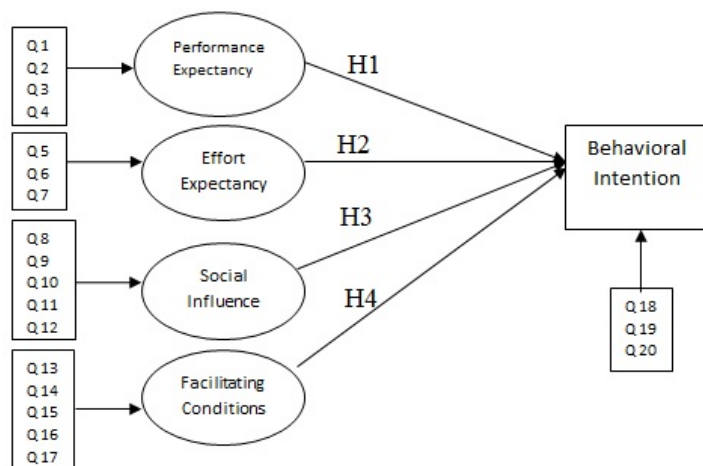


Figure 1: The proposed research model (Hamidfar, Limayem & Zegordi 2008: 242)

Sample

The target population comprised the nurses working in hospitals affiliated with Shiraz University of Medical Sciences, Shiraz, Iran. These hospitals were the Nemazi, Shahid Chamran, Hafiz, Ali-e-Asghar, and Shahid Faghihi teaching hospitals, and the study data were collected therein. These hospitals were selected due to the availability of hospital information systems in a Windows Operating System, which provided the nurses with the opportunity to use the information systems in their daily work. We obtained a list of all employed nurses from the Personnel Department, enabling the random sampling of 20% of each hospital's nurses: this generated a sample size of 350 nurses.

Materials and procedure

A questionnaire survey method was used; the purposely-designed, validated, self-administered questionnaire consisted of two sections, the first of which included provision for respondents' demographic information; the second section allowed for responses relating to the nurses' perceptions of the hospital information systems. Consistent with a previous study (Limayem & Khalifa 2000), a five-point Likert scale was used for construct measurements, with 1 being 'strongly disagree' and 5 representing 'strongly agree'. All questions were closed, and designed to accommodate responses according to the five-point Likert scale.

The researchers personally distributed the questionnaires to the sample of nurses who worked at the five hospitals, and who were using the hospital information systems. Three hundred and three of the 350 distributed anonymous questionnaires were returned: all

¹ 'Technology Acceptance Model' (TAM), 'Theory of Reasoned Action' (TRA), 'Theory of Planned Behavior' (TPB), 'Innovation Diffusion Theory' (IDT), 'Combined TAM and TPB' (C-TAM-TPB), 'Model of PC Utilization' (MPCU), 'Motivation Model' (MM), and 'Social Cognitive Theory' (SCT)

were complete and considered to be valid, constituting an 87% response rate.

In order to identify the factors influencing the nurse subjects' intention to adopt hospital information systems, the current study used the UTAUT model; specifically, 'facilitating conditions', as a direct antecedent of the users' behavioural intention. The current study was undertaken within a restricted timeframe and conducted on a voluntary basis; therefore, investigating the effects of experience and voluntariness was not feasible, and the moderating effects of age and gender were not tested in this research. Examples of the foci of some of the questions included: (i) 'Performance expectancy': respondents were asked to assess the usefulness to their work of the hospital information system, and the relationship between use of the system and their productivity; (ii) 'Effort expectancy': respondents were asked to assess the ease of learning, training in, and working with the hospital information system; (iii) 'Social influence': respondents were asked to assess the effects of the system on the satisfaction of other healthcare providers.

Data analysis

First, SPSS (v. -15.0) was used to obtain descriptive statistics for reporting the variables. Cronbach's alpha was used to examine the reliability of each factor. The reliability of the collected data was assessed by examining Cronbach's alpha coefficient. Second, the Structural Equation Modelling technique was employed: LISREL software (v. 8.5), in order to estimate the path coefficients and test the model hypotheses.

Results

Characteristics of the respondents

The results showed that 93.4% of the respondents were female, 6.6% were male, and 89% of all respondents were aged between 36-40 years.

Results for each construct

Table 1 shows each construct's related Cronbach's alpha and the square root of AVE (Average Variance Extracted). An alpha value of 0.60 or above is considered to be the criterion for demonstrating the internal consistency of the scales (Nunnally 1994). According to Table 1, internal consistencies of the constructs were considered acceptable since Cronbach's alpha related to each of them exceeded 0.83, demonstrating satisfactory reliability.

Table 1: Cronbach's Alpha and square root of AVE (Average Variance Extracted) for each Construct

CONSTRUCT	CRONBACH'S ALPHA	SQUARE ROOT OF AVE	
		AVE	AVE
Performance Expectancy	0.86	0.85	0.72
Effort Expectancy	0.85	0.89	0.79
Social Influence	0.96	0.82	0.67
Facilitating Conditions	0.84	0.86	0.74
Behavioural Intention	0.96	0.97	0.94

As shown in Table 2, all the standardised loadings of the items on their corresponding factor were larger than 0.7 (except for that of SI which was 0.65), showing good convergent validity (Gefen 2000).

Table 2: Factor loading

CONSTRUCT	INDICATOR	LOADING
Performance Expectancy	Q1	0.79
	Q2	0.86
	Q3	0.74
	Q4	0.81
Effort Expectancy	Q5	0.86
	Q6	0.85
	Q7	0.77
Social Influence	Q8	0.83
	Q9	0.79
	Q10	0.87
	Q11	0.65
	Q12	0.73
Facilitating Conditions	Q13	0.85
	Q14	0.74
	Q15	0.77
Behavioural Intention	Q16	0.80
	Q17	0.85
	Q18	0.77
	Q19	0.88
	Q20	0.90

Table 3: The actual and recommended values of fit indices

FIT INDEX	χ^2/df	GFI	AGFI	CFI	NFI	RMSEA
Recommend value	< 3	> 0.90	> 0.80	> 0.90	> 0.90	< 0.08
Actual value	2.34	0.931	0.861	0.963	0.954	0.057

Note: χ^2/df is the ratio between Chi-square and degrees of freedom; GFI is Goodness of Fit Index; AGFI is Adjusted Goodness of Fit Index; CFI is Comparative Fit Index; NFI is Normed Fit Index; RMSEA is Root Mean Square Error of Approximation.

The results of the application of Structural Equation Modelling technique, LISREL software (v. 8.5), to estimate the path coefficients and test the model hypotheses, are presented in Table 3.

Table 4 presents the results of testing the hypotheses related to the research model. Each of the hypotheses was strongly supported with a significance level of 99%.

Table 4: The results of testing the hypotheses

HYPOTHESES	EFFECTS	PATH		
		T-VALUE	COEFFICIENT	REMARKS
H1	PE → BI	2.34	2.85	Supported
H2	EE → BI	2.21	2.36	Supported
H3	SI → BI	2.63	2.45	Supported
H4	FC → BI	2.84	2.69	Supported

Discussion

The results demonstrated that the nurses’ behavioural intention to use hospital information systems was predicted by performance expectancy ($\beta = 2.34, p < 0.01$), effort expectancy ($\beta = 2.21, p < 0.01$), social influence ($\beta = 2.63, p < 0.01$), and facilitating conditions ($\beta = 2.84, p < 0.01$). The effects of the above-mentioned antecedents of the behavioural intention totally explained 72.8% of the variance in the behavioural intention to use hospital information systems ($R^2 = 0.728$).

As depicted in Table 4, all of the research hypotheses were confirmed. The results confirmed the appropriateness of the main constructs represented in UTAUT. The results also provided strong support for the additional construct, representing the effect of Facilitating Conditions (FC) on the behavioural intention toward hospital information systems acceptance, which was consistent with the findings of Wu et al. (2007). Performance expectancy, effort expectancy, facilitating conditions, and social influence therefore strongly affected the nurses’ use intention in relation to the technology.

The nurses’ behavioural intention is a function of the perception that nurses are useful (performance expectancy), that the system encourages ease of

use (effort expectancy), that it is important to use the nurses in the system as viewed by others (social influence), and that there is an organisational and technical infrastructure to support the use of the system (facilitating conditions).

The predictive power of these four factors was substantial and accounted for the behavioural intention to use hospital information systems. This study demonstrated the direct effects of performance expectancy, effort expectancy, social influence, and facilitating conditions which are the core constructs of the UTAUT model. The findings of the present study showed that of the four influencing factors, performance expectancy was by far the strongest predicting factor playing a major role in the nurses’ intention to use information systems. Our results are consistent with a number of prior studies which showed performance expectancy to be more effective in comparison to effort expectancy and social influence (Hamidfar, Limayem & Zegordi 2008; Wu et al. 2007; Holtz & Krein 2011; Ifinedo 2012; AlAwadhi 2008; Zhou 2008; Wang & Shih 2009; Chang et al. 2007).

The data analysis supported the appropriateness of UTAUT model to explain the intention and actual usage of the hospital information systems. Consequently, a more useful hospital information system to help the nurses improve the productivity and quality of their work would be desirable. A hospital information system should also be easy to learn and to use. This is consistent with the results of previous research conducted by Kijisanayotin, Pannarunothai & Speedie (2009) and Chang et al. (2007).

The impact of social influence on behaviour intention was less significant than that of subjects’ expectancy of performance and effort expectancy on the system. When the nurses perceive that the management emphasises and expects them to use computer systems, they will be encouraged to use them and will deal better with associated pressures.

Previous studies found the facilitating conditions, such as required resources (i.e. hardware and software), knowledge of IT and technical support will remove the barriers to using new systems (Taylor & Todd 1995). In this study, facilitating conditions had

only a slightly significant impact on the nurses' utilization of hospital information systems. Most of the barriers to using hospital information system were removed by the provision of full supports such as training sessions and better hardware and software.

Strengths and limitations of the study

The strengths of this study were the sample size and the high response rate (87%) that reflected the views of nurses about hospital information systems. The limitations of the research revolved around the fact that hospital information systems are a relatively new phenomenon in Iran and subsequently, a limited number of hospitals have established hospital information systems. The target population thus constituted the nursing staff from a limited number of hospitals. Time constraints for completion of the study ruled out the conduct of a longitudinal study.

Conclusion

Nurses comprise a major component of the respective hospitals' workforces. In the event that they did not accept new information systems in their daily work, hospitals would potentially be faced with financial and non-financial risks, for example to patient care and safety. It might be assumed that the nurses' acceptance of the hospital information systems and their associated technology will be advantageous to their hospitals, specifically, improvements in the quality of nursing services provided, and in the efficiency and effectiveness of nursing staff performance. The current research provided a useful tool for hospital managers in need of assessing the probability of success of new technology and helped the nurses to understand the benefits of acceptance in order to focus on the aspects of performance expectancy, effort expectancy, facilitating conditions, and social influence. Moreover, considering the importance of the patients' information and its centrality to high quality clinical nursing decisions, the nurse take-up of an efficient system could prevent risks to the hospitals and their stakeholders, especially the patients.

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