ISSN (Print) : 0974-6846
Indian Journal of Science and Technology, *Vol 9(41), DOI: 10.17485/ijst/2016/v9i41/103913, November 2016* ISSN (Online) : 0974-5645

User Acceptance Model of Electronic Medical Record

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Abstract

Objectives: This research utilizes the Technology Adoption Model (TAM) with Innovation Diffusion Theory (IDT) as a framework to explore users' final choice of Electronic Medical Record (EMR) systems. **Methods/Statistical Analysis:** First, we identify information characteristics (information accuracy and stability) and system characteristics (system security and compatibility). Second, we look into the positive connections among enjoyment, perceived usefulness, ease of use and operation intention of EMR. We test the research model using PLS 2.0. **Findings:** The results show that information accuracy, system security and system compatibility have an important impact on the usefulness perception for EMR while information stability has no influence on its recognized usefulness. **Improvements/Applications:** The results of this study highlight important factors which impact users' acceptance of EMR systems

Keywords: EMR, Extend TAM, Information Characteristics, System Characteristics

1. Introduction

The Electronic Medical Record (EMR) is a system that allows information, such as personal details, medical history and health status, to be computerized, inputted, saved and managed. Medical workers can browse patients' records through an EMR system anytime and anywhere via mobile computers or smart phones, leading to a reduction in patients' expected waiting times. The EMR records not only serve as necessary clinical data for medical education and research, but also as evidence to protect doctors, nurses and patients in the event of legal issues.

EMR systems can have a variety of problems such as data errors or discordance when the data is used or saved by doctors and nurses with ineffectual computer skills[1]. However, the sheer volumes of EMR data improve the treatment quality provided by doctors through information literacy, enabling the effective management of human records and financial accounts. The introduction of hospital information systems such as EMR is necessary to keep pace with changes in the Information Technology (IT) environment.

From regard to a technological aspect, there are different EMR structures like centralized models, federated models and a hybrid of the two[2]. The data based on the centralized models is stored in a single database and the data based on the federated models is distributed with the networks. Each model has its own technological advantages. The EMRs are generally considered secure and easy to manage for the main users. Hence, we will study users' adoption to EMR based on TAM and explain individuals' adoption and choice process of this new information system.

With the introduction of EMR systems, the interests and efforts invested in EMR at hospitals have increased. Thus, we investigate the information and system characteristics for the successful introduction and usage of EMR. This study uses the extended TAM's logics to explain users' adoption of EMR.

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2. Theoretical Background and Hypotheses

2.1 EMR System

With the rapid development of the medical industry, hospitals are ubiquitously introducing medical services, healthcare products and telemedicine systems. Hospitals and governments are interested in EMR, which can manage or digitize all patient records. Based on an electronic database, EMR systems can solve many problems encountered by Paper Medical Records (PMR) such as data errors and omissions, thereby improving the quality of medical records.

200-bed hospitals could look forward to spending over $7.2 million to perform the EMR system. It is assumed that hospitals would be saved $141.9 billion to $369.9 billion annually by the introduction of EMR, resulting from improved effectiveness and decreased information errors, while growing benefits. In fact, EMR-based disease prevention and health promotion alone could produce savings from $80 billion to $160 billion annually[3].

EMRs were widely used in Australia, Europe, Asia and Canada etc. EMRs include the valuable benefits for patients like convenience, portability, efficiency and effectiveness. EMRs also help health-care providers by diminishing clerical mistakes and supplying computerized decision support. Moreover, its technical potentials for furthering medical thrilled the lots of scientists[4].

2.2 TAM

This study explores the integrated model, that is, IDT (Innovation Diffusion Theory) and TAM to understand users' adoption of EMR systems. TAM has been studied the most widely and used to estimate two beliefs: Perceived Usefulness (PU) and Ease of Use (PEU). PU is interpreted as the potential personal expectation utilizing a particular system. It is to grow members' accomplishment within a company environment. PEU refers to the degree to which the potential clients anticipate the use of the focusing system to be endeavor free[5].

A critical object about TAMs tries to give a foundation for tracking impactions of exogenous variables on internal beliefs, attitudes and intentions. Previous studies also identified the antecedents of PU and PEU. For example, [6]identified the website characteristics that would influence perceived usefulness and perceived ease of use of the website. In[7] employed the TAM theory to decide whether the significance of PEU was related to the job properties when measuring the online commerce adoption. Some researchers suggest that adoption models be based on the Davis' TAM and Roger's diffusion of innovation theory. In[8] present an adoption framework of online voting that synthesizes innovation diffusion logic, electronic government utilization and institution-based trust. Therefore, following hypotheses were proposed to investigate the characteristics of EMR systems with TAM and IDT:

H1: Perceived ease of use has a positive effect on the perceived usefulness of EMR.

H2: Perceived enjoyment has a positive effect on the perceived usefulness of EMR.

H3: Perceived ease of use has a positive effect on the usage intention of EMR.

H4: Perceived usefulness has a positive effect on the usage intention of EMR.

H5: Perceived enjoyment has a positive effect on the usage intention of EMR.

2.3 Characteristics of EMR

In spite of the huge benefits of building EMR systems, the health care providers have limitations for adoption and using the EMR systems. Several key reasons of a low adoption at EMR systems are concerned with high cost about implementation, nonsupport from important stakeholders and lack of existing IT infrastructure. Therefore, this paper will propose important factors for health care providers when introducing EMR systems.

IDT theories about innovation diffusion have been widely utilized for significant IT and Information Systems (IS) research. In[9] states an innovation as "as idea, practice or object that is perceived as new by an individual or other unit of adoption. In[10] measure the diverse perceptions, including identity, image, compatibility and relative advantage that a personal may have of introducing a ITs concerned innovation[11] indicate that compatibility, PU and POU have an important influence on usage intention. In[12] connected the basic TA model with the compatibility of IDT to assess and describe customers' behavior in the online store environment. In[13] suggest that consumer interface, recognized security and consumer likings are crucial and powerful factors for the success of EC (Electronic Commerce) websites.

Prior studies detected that only relative advantage and compatibility are constantly concerned with the

Table 1. Measurement items

Construct	Measurement items	Researchers(year)
IA	The information provided by EMR is accurate. The information from EMR is up-to-date enough for my purpose. The information provided from EMR system has no errors.	Kim (2009); Lin (2007)
IS	The information processing speed of EMR system is fast. EMR system speed does not cause any inconvenience for searching information. EMR system responds immediately when I press enter or click the mouse in order to find information.	Kim (2009)
SS	The EMR system can be trusted to safeguard patients' privacy. I would feel totally safe managing information about patients through the EMR website. Overall, the EMR site is a safe place to save patients' information.	Chang and Chen (2009); Vijayasarathy (2004)
SC	Using EMR system is compatible with most aspects of my work. Using EMR system is suitable for my work style. Using EMR system is suitable for my life style.	Moore and Benbasat (1991) Tung et al. (2008)
PEU	I find that EMR system is very easy to use. I find that the human interface of EMR system is clear and easy to understand. It is easy to operate EMR system and do anything that I want it to do. I would be easy to get EMR system to do what I want it to do.	Moore and Benbasat (1991) Tung et al. (2008)
PU	Using EMR system can improve my work efficiency. Using EMR system would enhance my job performance. I find EMR system is useful for my work. Overall, EMR system is helpful in my work.	Moore and Benbasat (1991) Tung et al. (2008)
PE	Using EMR system is fun. Using EMR system makes me feel happy. Using EMR system provides me with enjoyment.	Chen et al. (2014)
UI	I am likely to use the EMR system. I intend to use the EMR system in the future. I plan to use the EMR system.	Petter and Fruhling (2011)

new product development and innovation adoption[14]. In[15] integrated IDT with other theories and explained a compatible relationship between TA and ID theories. In[16] newly cast general factors about the successful cyber government implementation being based on the TAM and IDT. Therefore, usage intention-related aspects of EMR are based on an important combinative model between users' acceptance and the innovative characteristics of EMR systems. We propose the hypotheses 6, 7, 8 and 9.

H6: Information accuracy has a positive effect on the perceived usefulness of EMR.

H7: Information stability has a positive effect on the perceived usefulness of EMR.

H8: System security has a positive effect on the perceived usefulness of EMR.

H9: System compatibility has a positive effect on the perceived usefulness of EMR.

2.4 Research Model

This study adopts an extended TAMs model to explain the characteristics of EMR. The basic assumption is that perceived usefulness, enjoyment and ease of use will have interactive influence on users' behavioral intentions to utilize the EMR (see Figure 1).

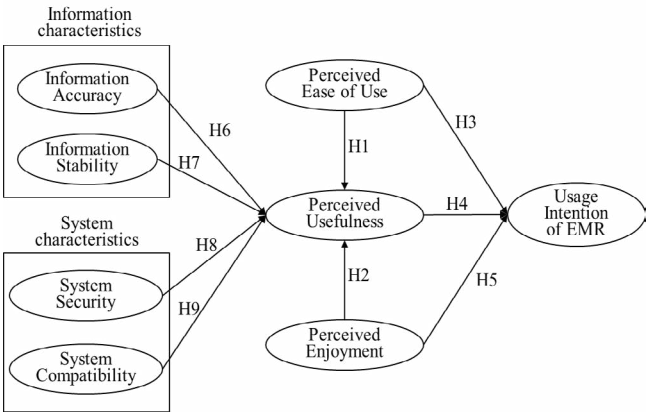

Figure 1. Research model.

3. Research Method

3.1 Measures

The measurement scales in this paper were composed of Likert-type statements with a seven-point scales from 7 (strongly agree) to 1 (strongly disagree). Table 1 provides the all measurements and corresponding references.

3.2 Sampling Method

This study do the survey targeting users of EMR systems, collecting 208 completed questionnaires. Detailed statistics about respondents are shown in Table 2.

Table 2. Descriptive statistics of respondents' characteristics

Measure items		Frequency	Percent
Gender	Male	19	9.1
	Female	189	90.9
	Total	208	100
Age	20-29	93	45.0
	30-39	73	34.9
	40-49	39	18.7
	≥50	3	1.4
	Total	208	100
Position	Doctor	60	28.7
	Nurse	142	68.4
	Etc.	4	1.9
	Total	**208**	**100**

3.3 Measurement Analysis

To assess the fitness for the main empirical model, we did a confirmatory factor analysis using Analysis of Moment Structures (AMOS) 17.0 (see Table 3). We investigated the measurement scales using the two criteria being reported by[17]. First, construct reliabilities would go over 0.8. Second, AVE estimations by each construct are needed to go over the variance because of construct measurement error. The results of the confirmatory factor analysis provide an overview of the model fit. These include chi-square ratio to the d.f. (X^2/df) of 1.442 (382.032/265), GFI of 0.885, adjusted GFI of 0.848, CFI of 0.976, NFI of 0.927 and RMSEA of 0.046. These statics showed a marginal fit rather than the good fit suggested by commonly used criteria[18]. Table 4 presents the correlations among constructs; these correlations reveal that the multicollinearity is not a serious problem in the proposed model.

Table 3. Measurement model results (Confirmatory Factor Analysis)

Factors	Standardized regression weights	t-Value	ICR	AVE	Cronbach's α
IA	0.815	-	0.878	0.571	0.885
	0.893	14.786			
	0.811	14.474			
IS	0.719	-	0.873	0.637	0.864
	0.927	15.144			
	0.851	12.257			
SS	0.885	-	0.854	0.774	0.848
	0.844	14.786			
	0.703	10.976			
SC	0.967	-	0.916	0.663	0.909
	0.740	14.281			
	0.936	14.707			
PEU	0.924	-	0.965	0.823	0.942
	0.947	20.799			
	0.886	17.283			
	0.982	22.038			
PU	0.889	-	0.935	0.806	0.946
	0.866	17.690			
	0.891	18.871			
	0.892	18.985			
PE	0.861	-	0.937	0.676	0.872
	0.916	15.817			
	0.956	12.817			
UI	0.918	-	0.844	0.721	0.884
	0.862	17.476			
	0.602	8.322			

IA: Information Accuracy, IS: Information Stability, SS: System Security, SC: System Compatibility, PEU: Perceived Ease of Use, PU: Perceived Usefulness, PE: Perceived Enjoyment, UI: Usage Intention of EMR

Table 4. Correlation matrix

	IA	IS	SS	SC	PEU	PU	PE	UI
IA	0.756							
IS	0.693	0.798						
SS	0.505	0.484	0.880					
SC	0.592	0.479	0.486	0.814				
PEU	0.574	0.668	0.506	0.621	0.907			
PU	0.584	0.571	0.581	0.638	0.687	0.898		
PE	0.454	0.361	0.440	0.682	0.577	0.615	0.822	
UI	0.448	0.358	0.375	0.549	0.443	0.506	0.503	0.850

4. Hypothesis Testing

SEM (Structural Equation Modeling) methods were applied to verify our research model. The overall statistics fitness show that the hypothesized model presents a good representation of the structures underlying the observed data (X^2 = 450.285, df = 271, X^2/df = 1.662, root mean square residual or RMR = 0.078, GFI = 0.866, AGFI = 0.827, NFI = 0.914, incremental fit index or IFI = 0.964, CFI = 0.963, RMSEA = 0.057).

The hypotheses results are as follows. First, hypotheses 1, 2, 4 and 5 were adopted, but hypothesis 3 was not adopted. Second, hypotheses 6, 8 and 9 were supported, but hypothesis 7 was not supported (see Figure 2).

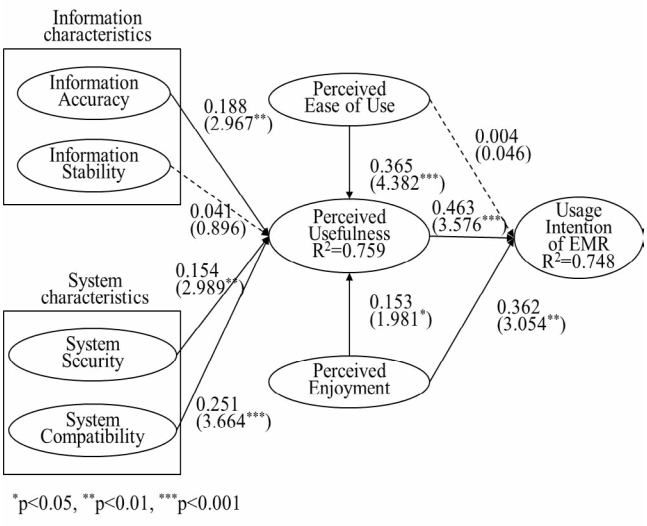

Figure 2. Structural equation modeling results for hypotheses.

5. Conclusion

This study was designed based on the characteristics of EMR and extended TAM, which describes the process of acceptance of new technological products. In order to achieve the study's objectives, we surveyed a hospital's doctors, nurses and employees.

According to the empirical results, perceived ease of use and enjoyment had a high effect on perceived usefulness. In turn, perceived usefulness and enjoyment had a positive effect on the usage intention of EMR. Therefore, hypotheses 1, 2, 4 and 5 were supported. Information accuracy, system security and system compatibility had a meaningful effects on the perceived usefulness of EMR systems, but information stability did not. Thus, H6, 8 and 9 were supported while hypothesis 7 was rejected.

The implications of this study are as follows: There is little previous literature on EMR. While[19] studied the EMR system, his study was basic. This study considered the characteristics of the EMR system introduced at the hospital and estimated its user acceptance. With the growing interest among researchers to investigate users' acceptance of Electronic Health Records (EHR) and healthcare services related to the EMR system, the results are able to offer valuable information towards the study insight being concerned with the new information systems used at hospitals.

6. References

1. Agarwal R, Prasad J. A conceptual and operational definition of personal innovativeness in the domain of Information Technology. Information Systems Research. 1998; 9(3):204–15.
2. Egea JB, Gonzalez MV. Explaining physicians' acceptance of EHCR Systems: An extension of TAM with trust and risk factors. Computers in Human Behavior. 2011; 27(1):319–32.
3. Rogers EM. Diffusion of innovations. 3rd ed. NY: Free Press; 1983.
4. Davis FD, Bagozzi RP, Warshaw PR. User acceptance of Computer Technology: A comparison of two theoretical models. Management Science. 1989; 35(8):982–1003.
5. Hammond KL, Loynes HE, Folarin AA, Smith J, Whitfield TT. Hedgehog signaling is required for correct anteroposterior patterning of the zebra fish optic vesicle. Development. 2003; 130(7):1403–17.
6. Lee KC, Chung N, Kang I. Understanding individual investor's behavior with financial information disclosed on the web sites. Behavior and Information Technology. 2008; 27(3):219–27.
7. Gefen D, Straub DW. The relative importance of perceived ease of use in IS adoption: A study of e-commerce adoption. Journal of Association for Information Systems. 2000; 1(8):1–30.
8. Carter L, Campbell R. The impact of trust and relative advantage on internet voting diffusion. Journal of Theoretical and Applied Electronic Commerce Research. 2011; 6(3):28–42.
9. Lin HF. Measuring online learning systems success: applying the updated DeLone and McLean Model. Cyber Psychology and Behavior. 2007; 10(6):817–20.
10. Moore GC, Benbasat I. Development of an instrument to measure the perception of adopting an Information Tech-

nology innovation. Information Systems Research. 1991; 2(3):192–222.
11. Moon JW, Kim YG. Extending the TAM for a World-Wide-Web context. Information and Management. 2001; 38(2):217–30.
12. Chen LD, Gillenson ML, Sherrell DL. Enticing online consumers: An extended technology acceptance perspective. Information Management. 2002; 39(2):705–19.
13. Chang HH, Chen SW. Consumer perception of interface quality, security, and loyalty in Electronic Commerce. Information and Management. 2009; 46(2):411–7.
14. Vijayasarathy LR. Predicting consumer intentions to online shopping: The case for an augmented technology acceptance model. Information and Management. 2004; 41(2):747–62.
15. Chau PY. Reexamining a model for evaluating information center success using a structural equation modeling approach. Decision Sciences. 1997; 28(3):309–35.
16. Shareef MA, Kumar V, Kumar U, Dwivedi YK. E-Government Adoption Model (GAM): Differing service maturity levels. Government Information Quarterly. 2011; 28(5):17–35.
17. Fornell CR, Lacker DF. Two structural equation models with unobservable variables and measurement error. Journal of Marketing Research. 1981; 18(1):39–50.
18. Venkatraman S, Bala H, Venkatesh V, Bates J. Six strategies for electronic medical. Communications of the ACM. 2008; 51(11):140–4.
19. Chen YC, Shang RA, Li MJ. The effects of perceived relevance of travel blogs' content on the behavioral intention to visit a tourist destination. Computers in Human Behavior. 2014; 30(5):787–99.
20. Hoffmann L. Implementing Electronic Medical Records. Communications of the ACM. 2009; 52(11):18–20.
21. Tung FC, Chang SC, Chou CM. An extension of trust and TAM model with IDT in the adoption of the Electronic Logistics Information System in HIS in the Medical Industry. International Journal Medical Informatics. 2009; 77(4):324–35.