

# Construction of Extended Technology Acceptance Model of Electronic Medical Records in Jordan: The Influence of Doctors' Self-Efficacy and Perceived Behavioral Control

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## ABSTRACT

*The implementation of Electronic Medical Record (EMR) in Jordan public hospitals has started since 2009. The motivation of doing this study is to observe doctors' acceptance of EMR in Jordanian public hospitals. This study aims at constructing doctors' acceptance model of EMR using Technology Acceptance Model (TAM) based on individual capabilities. The model will apply TAM as the basic theory and extending Self-Efficacy (SE) and Perceived Behavioral Control (PBC) as two factors of individual characteristics. Initial findings show that the main factors of the model should compose of Perceived Usefulness, Perceived Ease of Use, Behavioral Intention to Use, Self-Efficacy, and Perceived Behavioral Control. The result of the pilot test shows that all factors are reliable with Cronbach Alpha 0.838. The recommendation to the top management of healthcare organization, in order to increase doctors' acceptance of EMR, that the new deployment of EMR should focus on delivering awareness and continuous training on using EMR among doctors at the early stage of EMR implementation.*

### Keywords

*Technology Acceptance Model, Perceived Usefulness, and Perceived Ease of Use, Behavioral Intention to Use, Self-Efficacy, Perceived Behavioral Control, and Individual Characteristics.*

## 1.0 INTRODUCTION

EMR is defined as "a patient record system which is the set of components that form the mechanism by which patient records are created, used, stored, and retrieved. A patient record system is usually located within a health care provider setting. It includes people, data, rules and procedures, processing and storage devices, and communication and support facilities" (Institute of Medicine (IOM), 1997). EMR offers a lot of benefits such as improving patient safety and quality (Edwards, 2006), reducing medical error (Croll, 2010), and

reducing costs of data collection (Thompson, Classen, & Haug, 2007). Despite the obvious benefit of using Information Systems (IS) in an organization, the resistance of IS users is a common problem (Daim, Tarman, & Basoglu, 2008), and healthcare industry is considered as one of the industries that suffer from this problem (Daim et al., 2008).

However, EMR adoption has received little attention in the IS literature, thus, there is a need to study this phenomenon (Hennington & Janz, 2007). EMR can enhance the healthcare services' delivery (DesRoches et al., 2008), but it has been slow in becoming part of the participation of healthcare professionals, which has led healthcare organizations not to adopt EMR systems (DesRoches et al., 2008). Therefore, there is a need to study on doctors' acceptance and the factors that influence the use of EMR. User acceptance and the use of technology have been issues of research for over a decade (Venkatesh, 2000). Dillon and Morris (1996) defined user acceptance as "the obvious willingness within a group to use IT for the tasks it is designed to support". Moreover, it was found that studies on user acceptance of healthcare systems regarding healthcare managers and professionals' perceptions have affected the healthcare system implementation's success (Kijisanayotin et al., 2009).

There have been several theoretical models introduced to study user acceptance of IS implementation. Among of them are Theory of Reasoned Action (TRA) (Davis et al., 1989), Theory of Planned Behavior (TPB) (Ajzen, 1991), Technology Acceptance Model (TAM) (Davis et al., 1989) and Social Cognitive Theory (SCT) (Bandura, 1986).

TAM was proposed by Davis in 1989. It was adopted from the TRA to predict and explain user acceptance and rejection of computer-based technology (Davis et al., 1989). It was attempted to provide a basis to study the effect of external variables on user behavior by identifying some basic variables as determinants of

computer acceptance. This model is graphically depicted in Figure 1.

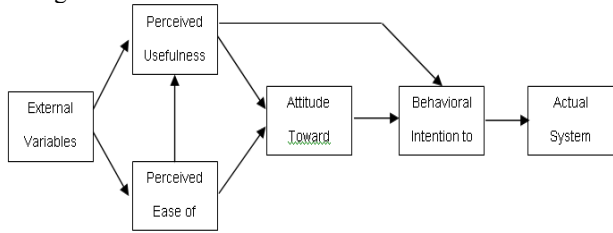


Figure 1: Technology Acceptance Model (Adopted from Davis et al. (1989))

TAM suggests the perceived usefulness (PU) and perceived ease of use (PEOU) as particular beliefs, act as determinants of computer acceptance behaviors (Davis et al., 1989). According to TAM, external variables influence PU and PEOU (Davis et al., 1989). In fact, PU is also influenced by PEOU, and both determine the person's attitude toward using the system (ATT) (Davis et al., 1989). This ATT with PU determine the behavioral intention to use the system (BITU) which in turn determines the actual system used (Davis et al., 1989).

Literatures also identify that Self-Efficacy (SE) and Perceived Behavioral Control (PBC) can influence PU and PEOU. Therefore, it can be concluded that the factors are relevant to determine doctors' BITU of EMR in their daily work. The ITU is defined as "the strength of one's intention to perform a specified behavior" (Davis, et al., 1989).

In detail, PU refers to the degree to which a person believes that using a particular system would enhance his or her job. The PU constituted of six variables: (1) Accomplish task more quickly; (2) Improve Job Performance; (3) Increase Productivity; (4) Enhance job effectiveness; (5) Easy to do job; and (6) Useful in job. Meanwhile, PEOU is the extent to which a user believes that using a system will be relatively free of effort. It consists of five variables: (1) Easy to Learn; (2) Easy to do; (3) Clear and Understandable; (4) Flexible to interact; and (5) Easy to become skillful.

The SE factor is originated from Social Cognitive Theory (Bandura, 1982). Bandura (1995) defines self-efficacy as "people's belief about their capabilities to produce performance that influence events affecting their lives". Compeau & Higgins (1995) adopted the self-efficacy factor into their study of technology adoption and defined this factor as "an individual's perception of

his or her ability to use a computer in the accomplishment of a job task". They also believed that "Without skill, performance is not possible; without self-efficacy, performance may not be attempted" (Compeau & Higgins, 1995).

On the other hand, PBC is referred to as "a person's estimate of how easy or difficult it will be for him or her to carry out the behavior" (Ajzen & Madden, 1986).

Both refer to people's beliefs they are capable of performing a given behavior (Tavousi, Hidarnia, Montazeri, Hajizadeh, Tarimain, & Ghofranipour, 2009).

Therefore, doctors' ITU of EMR can be measured based on Individual Capabilities (IC): SE (Bandura, 1982), PBC (Ajzen & Madden, 1986), PU (Davis et al., 1989), and PEOU (Davis et al., 1989).

Hence, this paper aims at constructing doctors' acceptance model based on IC that refers to SE and PBC. The theoretical foundation for this study is based on TAM.

## 2.0 LITERATURE REVIEW

The robustness of TAM has been tested in the healthcare application domain. Many studies can be found in the literature, that have used an enhanced version of TAM, depending on the technology being studied (Aggelidis & Chatzoglou, 2009; Bhattacharjee & Hikmet, 2007; Bhattacharjee & Hikmet, 2008; Chau & Hu, 2002; Djamasbi, 2009; Johnston & Warkentin, 2008b; Liu & Ma, 2005, 2006; Park & Chen, 2007; Rawstorne et al., 2000; Tung et al., 2008; Walter & Lopez, 2008; Whetstone & Goldsmith, 2009).

Table 1 lists previous studies of TAM in healthcare, which tested the main factors of TAM; PU, PEOU, BITU and SE. These studies have tested the social and behavioral perspectives, in addition to the PBC from the individual capabilities perspective.

Besides that, Table 2 lists the studies of TAM in healthcare, which tested the main factors of TAM; PU, PEOU and BITU. These studies have tested the Social and Behavioral perspectives, in addition to the PBC from the Individual Capabilities Perspective.

Table 1: Summary of TAM in healthcare - PU, PEOU, BITU, and SE

Author	Technology	Factors	Country	Respondent	Finding	
					Independent Factor	Dependent Factor
(Y. Park & Chen, 2007)	Smart phone	- Perceived usefulness - Perceived ease of use - Behavioral Intention to use - Self-efficacy	USA	Medical doctors, nurses and healthcare providers who work in a local hospital network	Perceived ease of use	Perceived usefulness
					Self-efficacy	Perceived ease of use
					Perceived usefulness	Behavioral intention
					Self-efficacy	Behavioral intention
(Aggelidis & Chatzoglou, 2009)	Information technology in hospitals		Greece	HIS users: Medical, nursing, and administrative personnel	Perceived ease of use	Behavioral Intention
					Perceived usefulness	Behavioral intention
					Self-efficacy	Behavioral intention
					Self-efficacy	Perceived ease of use
(Johnston & Warkentin, 2008a)	Information System	- Behavioral Intention to use - Self-efficacy	USA	healthcare professionals	Perceived ease of use	Behavioral intention
					Self Efficacy	Behavioral Intent
(Wu, et al., 2007)	Mobile in healthcare industry systems including mobile Picture Archiving and Communication Systems and mobile order systems		Taiwan	Physicians, nurses and medical technicians that work in hospital	Perceived ease of use	Perceived usefulness
					Self-efficacy	Perceived ease of use
					Self-efficacy	Perceived Usefulness
					Perceived usefulness	Behavioral intention
					Perceived ease of use	Behavioral Intention

Table Error! No text of specified style in document.: Summary of TAM in healthcare - PU, PEOU, BITU and PBC

Author	Technology	Factors	Respondent	Finding	
				Independent Factor	Dependent Factor
(Chau & Hu, 2002)	Telemedicine technology	- Perceived Usefulness - Behavioral Intention to Use - Perceived Behavioral Control	Doctors	Perceived Usefulness	Behavioral intention
				Perceived Behavioral Control	Behavioral Intention
(Yi et al., 2006)	PDA	- Perceived	Doctors	Perceived Usefulness	Behavioral intention

		Usefulness - Perceived Ease of Use - Behavioral Intention to Use - Perceived Behavioral Control		Perceived Behavioral Control	Behavioral Intention
				Perceived Behavioral Control	Perceived ease of use
(Rawstorne et al., 2000)	Computerized nursing care plans in Patient Care Information System	- Perceived Usefulness - Perceived Ease of Use - Behavioral Intention to Use	Nurses	Perceived Ease of Use	Behavioral Intention to Use
				Perceived Ease of Use	Perceived Usefulness
				Perceived Usefulness	Behavioral Intention to Use
				Perceived behavioral control	Behavioral Intention to Use

study to provide reasonable amount of variance and generalization.

Based on Table 1 and Table 2, the studies show that both factors i.e. SE and PBC has never been tested together with TAM in EMR domain especially in Jordan.

From the literature review, it can be concluded that doctors' acceptance model can be constructed based on Social, Behavioral, and Individual Capabilities Perspectives. The literatures also show that the SE and PBC that may affect PU, PEOU and BITU the application especially the EMR system. Therefore, SE and PBC are two factors that can be integrated into the extended TAM as determinants of PU, PEOU, and BITU of EMR systems. It has been shown that the integration of different models can provide more understanding and explaining of individual technology acceptance model.

Hence, user acceptance factors can be classified into Individual Capabilities, Social, and Behavioral Perspectives. The Individual Capabilities Perspective consists of SE and PBC. The Social Perspective consists of PU and PEOU. Finally, the Behavioral Perspective consists of BITU. These three user acceptance perspectives are used to construct the research model.

Researchers in many countries have conducted acceptance studies in various healthcare domains. However, in biomedical informatics domain, specifically in Jordan, very few studies have been conducted to determine doctors' acceptance of EMR. To date, no specific model has integrated the three user acceptance perspectives to explain the doctors' acceptance of EMR in Jordan. Such instructed model is necessary inline with the recent widespread of EMR implementation.

### 3.0 METHODOLOGY

This study will apply the cross-sectional survey in an attempt to gain greater understanding of the factors that contribute to the BITU of EMR in Jordanian Public and Private hospitals. These hospitals are selected as the site

Target respondents are doctors who have at least a month experience of using the EMR in outpatient clinics. Based on their experience, they are defined as stakeholder of EMR. The data will be analyzed using Analysis Of Variance (ANOVA) and Multiple Regression Analysis.

Based on the factors as identified in literatures; SE and PBC for Individual Capabilities, PU and PEOU for Social Perspective, and BITU for Behavioral Perspective; the research model has been constructed. The model is depicted in Figure 2.

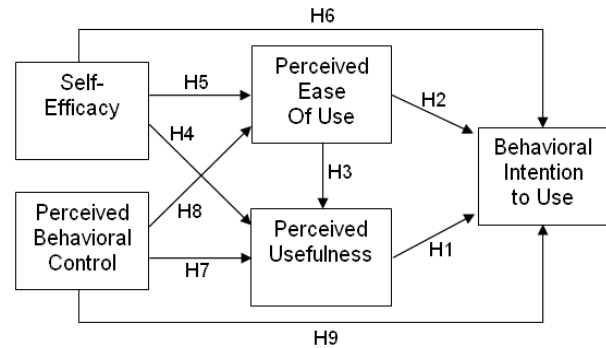


Figure 2: Research Model

Based on the research model, the following hypotheses have been constructed to test the relationship between observed factors:

- H1: PU has direct effects on BITU
- H2: PEOU has directs effect on BITU
- H3: PEOU has direct effects on PU
- H4: SE has direct effects on PU
- H5: SE has direct effects on PEOU
- H6: SE has direct effects on BITU
- H7: PBC has direct effects on PU

H8: PBC has direct effects on PEOU  
H9: PBC has direct effects on BITU

After constructing the research model and formulating relevant hypotheses, a questionnaire has been design based on the observed factors in the research model. A pilot study was carried out which involved 35 doctors from private clinics to test the reliability of the questionnaires.

#### 4.0 PILOT TEST

The questionnaires were distributed to 35 doctors from private clinics. Response rate from the respondents was 100 percent. Reliability test was performed to examine the reliability of the instruments and make sure that the items are error-free. Therefore, the consistency of the measurement across the items in the instrument could be confirmed (Sekaran, 2003). Table 3 shows the results of the test in which the Cronbach's Alpha values for all factors are greater than 0.80. Therefore, all the factors are good and can be included in the questionnaire.

Table 3: Reliability readings for pilot test

Factor	Cronbach's Alpha	No. of Items
Perceived Usefulness	0.845	6
Perceived Ease of Use	0.889	6
Self-Efficacy	0.772	10
Perceived Behavioral Control	0.722	3
Behavioral Intention to Use	0.809	3

Cronbach's Alpha (1.0 Best; >0.80 Good;  $\geq 0.60$  &  $\leq 0.80$  Acceptable) - (Sekaran, 2003)

The pretest questionnaires will also be tested for validity using the anti-image correlation matrix technique. Computation of the correlation matrix will be used to determine the appropriateness of the factor analytic model in order to justify the factor validity of the items (Sekaran, 2003).

#### 5.0 DISCUSSION

Researchers in many countries have conducted acceptance studies in various healthcare domains. However, in biomedical informatics domain, specifically in Jordan, very few studies have been conducted to determine doctors' acceptance of EMR. Currently, there is no specific extended TAM integrating Individual Capabilities: SE and PBC with PU, PEOU and ITU. Therefore, this study takes the initiatives in constructing as extended TAM by including SE and PBC factors to explain about doctors' acceptance of EMR in Jordan. Such integrated model is necessary inline with the recent widespread of EMR implementation.

Doctors' acceptance model has been conducted based on factors that have been identified in literatures. To test the relationship among the factors in the research model, a hypothesis testing study is used. EMR users in public and private hospitals in Jordan are selected as target respondents. The personal administered questionnaire survey method will be used in this study to test the constructed doctors' acceptance model. Then the data collected will be analyzed by ANOVA and Multiple Regression using the statistical analysis tool SPSS version 18.0. The results from the hypotheses' testing will justify whether the tested factors can be included in the doctors' acceptance model.

#### 6.0 CONCLUSION

As a conclusion, this study has successfully constructed an extended TAM that based on Individual Capabilities: SE and PBC. This model can be used to predict doctors' acceptance level of EMR in Jordan. The outcomes of the study are useful to the top management of healthcare organization in preparing a strategic plan for EMR implementation. Specifically focus on doctors' awareness, readiness, and training plan of EMR.

This study contributes to the knowledge of biomedical informatics domain related to doctors' acceptance model of EMR systems in Jordan. This study will also contribute to the theoretical knowledge of TAM. Specifically, the extended TAM is composed of Individual Capabilities, Social and Behavioral Perspectives. Therefore, the findings will enhance the theoretical knowledge, especially to TAM that is applied in the biomedical informatics and particularly in the EMR domain. This study enhances the original TAM, which originally consisted of perceived usefulness and perceived ease of use from the social perspective and behavioral intention to use from the behavioral perspective, by introducing the self-efficacy and the perceived behavioral control from the individual capabilities perspective.

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