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A Proposed Framework based Electronic Medical Records (ERM) for Implementation of Technology Acceptance in Healthcare Service

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Abstract

This study extends applicability of the Technology Acceptance Model (TAM) to test user acceptance of EMR in the hospital. This study aims to assess the EMR characteristics which could affect the healthcare profession's belief in accepting the usage of EMR in UiTM Medical Specialist Centre, Malaysia (UiTMMSC), Malaysia. Besides measuring the effectiveness of the system towards the organization's excellence, this study expected to guide the UiTMMSC management in structuring the initiatives to promote the EMR usage among the healthcare professions. The significant of this study is to ensure future research by expanding the similar topic of research with the exploration on specific EMR characteristics or healthcare profession's belief by focusing of particular programs for detail assessment.

Keywords: Electronic Medical Record, Healthcare, Perceived Usefulness, Perceived Ease Of Use, Technology Acceptance Model

Introduction

The healthcare industry is constantly evolving. This evolving affected and changed the tools healthcare professionals utilize in order to provide quality patient care. The conventional paper-based medical records has been replaced with Electronic Medical Records (EMR). An EMR is a record containing all patient medical detail including demographic information, history, physical examination, investigation and treatment, medication and others in digital format. According to Haslina & Sharifah Mastura (2005), as cited by Nurul Izzatty & Nor Hazana (2011), EMR plays an important role in providing patients' medical histories, which include computerized clinical information system that collects, stores, and displays patients' information. With implementation of EMR, the opportunity for patients to receive improved coordinated care from healthcare providers and easier access to their health information. It's a way to make it easier for everyone to be better informed and more involved in the patient's healthcare (Rodriguez, 2011).

EMR is one of the modules under the broader concept of Total Hospital Information System (THIS). In Malaysia, THIS is the project under Ministry of Health (MOH) with the objective of providing a complete electronic system for paperless hospital environment to offer quality health services to the public. MOH defined THIS as quotes by Roshidi Hassan (2012), as a system with an integration of clinical, administrative and financial systems. THIS is made up of various applications such as Person Management, Scheduling, Order Management, Clinical Documentation, Pharmacy Information System, Laboratory Information System, Radiology Information System, and other (Roshidi Hassan, 2012).

Research has suggested that the use of electronic medical record has the potential to help improve safety, quality, and the cost efficiency of healthcare services. However, according to Love, et al. 2012) and Wright, et al. (2013), many healthcare providers still not realized the benefits of the EMR usage since its adoption throughout the healthcare industry has been generally slow. This statement supported Arman & Hartati (2015), that there are several factors that contribute to the low adoption of EMR system which including high cost, concern for the privacy patient's data, social influence, system is too difficult to use and lack of training. According to Liu & Cheng (2015), Paper-based records are still by far the most common method of recording patient information for most hospitals and practices in the U.S. most of the doctors still find their ease of data entry and low cost hard to part with. However, as easy as they are for the physicians to record medical data at the point of care, they require large amount of storage space compare to record in electronic form. Similar situation in Malaysia, retention schedule for physical records be held for a minimum of seven years, same as in the US by law. The costs to store all the media in paper and film format, per unit of information differ dramatically from that of electronic storage media. When paper records are stored in different locations, collecting them to a single location for review by a health care provider is time consuming and complicated, which can be simplified by using an electronic record.

Many studies that have been done to evaluate the user acceptance and examine the factor influence the user acceptance to the EMR system among healthcare professional. However, in this paper we focus on the ERM system known as uniMEDS system that is developed and implemented by UiTM Medical Specialist Centre, Malaysia (UiTMMSC), from the first implementation phase until today, there is no study that has been done to examine user acceptance of the system they developed. This study is important because, the success of EMR implementation is largely dependent upon the cooperation and acceptance of its users. The aim of this study is to examine the factors that influence UiTMMSC healthcare workers' acceptance of EMR system and to identify the characteristic of EMR that leads to acceptance of the use.

Literature Review

Unified Theory of Acceptance and Use of Technology (UTAUT)

Based on previous conducted studies, the EMR plays important roles in delivering quality healthcare services to the patients and EMR implementation is largely dependent upon the acceptance of the physicians and other healthcare professions. According to Holden & Karsh (2010), as cited by Mammen & Weeks (2014), knowing the factors that shaped one's intentions would allow organizations to manipulate those factors in order to promote acceptance and increase IT use. There are numerous framework and model developed to analyze the acceptance of healthcare professions toward EMR system. Arman, A. A., &

Hartati, S. (2015), in their study to analyze factors influencing the acceptance of medical personnel on EMR system using the proposed model, developed conceptual model based on Unified Theory of Acceptance and Use of Technology (UTAUT). According to Venkatesh (2003), UTAUT is behavioral information system models developing by combining 8 models of individual acceptance to information system.

Technology Acceptance Model (TAM)

The term acceptance of technology has been used by researchers from different backgrounds. According to Huang, Chen & Hsieh (2014), TAM developed by (Davis, 1989; Davis, Bagozzi & Warshaw, 1989) that describes acceptance as users' decision about how and when they will use technology. The Technology Acceptance Model according to Vathanophas & Pacharapha (2010), is an adaptation of the generalized TRA (Theory of Reasoned Action) proposed to specify user acceptance and usage behavior for information technology. There is various study that focus on information technology acceptance such as (Arman & Hartati, 2015; Mammen & Weeks, 2014; Liu and Cheng, 2015; Steininger et al., 2014; Vathanophas & Pacharapha, 2010). The Technology Acceptance Model (TAM) as agreed by Holden & Karsh (2010) and Hu et al. (1999), and cited by Steininger et al. (2014), is a suitable approach to predict and explain physicians' reactions to health IT (HIT) particularly in Electronic Health Records (EHR) and Electronic Medical Record (EMR). This statement is supported by Davis (1993), as the user acceptance is often the pivotal factor determine the success or failure of an information system.

Electronic Medical Record (EMR)

Electronic Medical Record can be defines as an electronic system with applications that manipulate or process any information for the purpose of coordinating healthcare and health related services of an individual (Castillo, Martínez-Garcia, & Pulido, 2010). Basically, EMR is the digital version of Patient Medical Records that contain the demographic information, history, treatment, medication, progress note, etc. The information in EMRs does not easily transmit or transfer outside of the healthcare institution. In fact, the patient's record might need to be printed out and delivered by mail to specialists and other members of the care team. According to Alhaqbani (2010), EHR can be defined as a repository of information regarding the health status of a subject of care in computer readable form, stored and transmitted securely, and accessible by multiple authorized users (Ozair et al., 2015). Gartner (2005), refines the EHR definition as an aggregation of patient-centric health data that originates in the patient record system of multiple independent healthcare organizations for the purpose of facilitating care across organizations. Basically the EHR focus on the total health of the patient. EHR are designed to reach out beyond the healthcare organization that originally collects and compiles the information. They are built to share information with other healthcare providers or more than one healthcare organization.

For this study purpose, it is important to clarify the difference between an Electronic Health Record and an Electronic Medical Record because EMR and EHR are often confused. EMR system is a computerized health information system used by healthcare provider to record detailed encounter information such as patient demographics, diagnosis, and treatment, while EHR data is a consolidation of the patient's various medical records, including multiple EMRs created by different healthcare providers. In Malaysia's healthcare setting, the EHR system is being managed by Health Informatics Center *(Pusat Informatik Kesihatan),* Ministry of Health where they gather the patient's information from Government

Hospital, Private hospital, Teaching Hospital and Army hospital in one system called *Sistem Maklumat Rawatan Perubatan (SMRP).*

Development of the framework

The reference model used in this study was UTAUT which is one of the behavioral information system models developed by Venkatesh, V., M. G. Morris, G. B. Davis, and F. D. Davis by combining eight models of individual acceptance to information system, which are Theory of Reasoned Action (TRA), Theory of Planned Behavior (TPB), Technology Acceptance Model (TAM), Motivational Model (MM), a model combining the technology acceptance model and the theory of planned behavior (C-TAM-TPB), model of personal computer utilization (MPCU), innovation diffusion theory (IDT), and social cognitive theory (SCT).

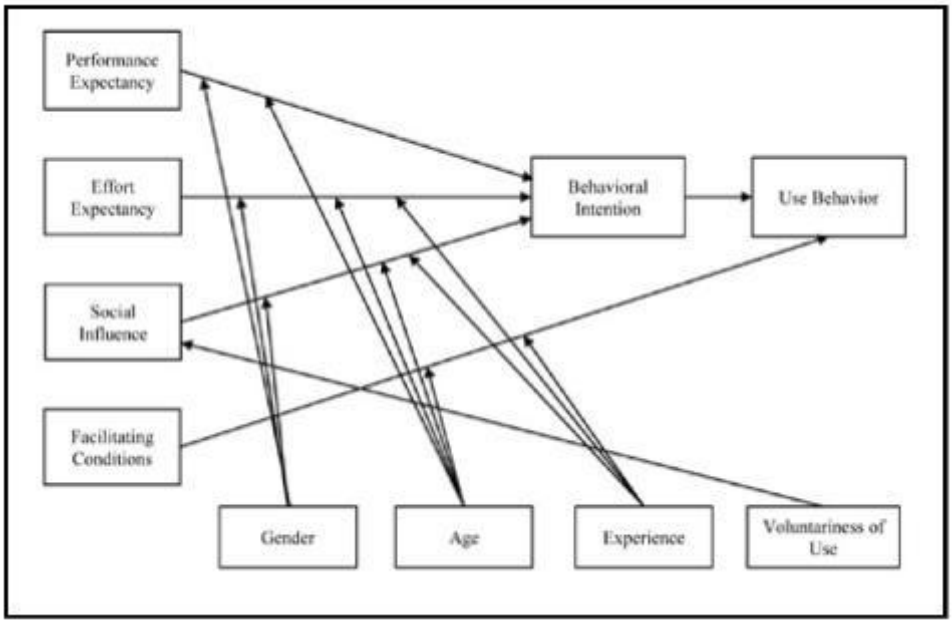

Figure 1. The Unified Theory of Acceptance and Use of Technology (UTAUT)

UTAUT explain how an information system can be accepted and used by users through the users' intention (behavioral intention) and behaviors (use behavior). Behaviors are conducted because a user has intention or desire to use a system. Intention is a desire and may change over time, while behavior is actual form of system usage by the user.

The proposed model for this research as in Figure 2 which is based on the UTAUT model. The factors directly influencing user's acceptance to EMR system are performance expectancy (H1), effort expectancy (H2), social influence (H3) and facilitating conditions (H4). In this proposed model, it was identified that trust (H5), motivation to help others (H6), and privacy risk (H7) were factors which also influenced medical personnel in accepting the EMR system. The addition of the variables was due to several of previous studies.

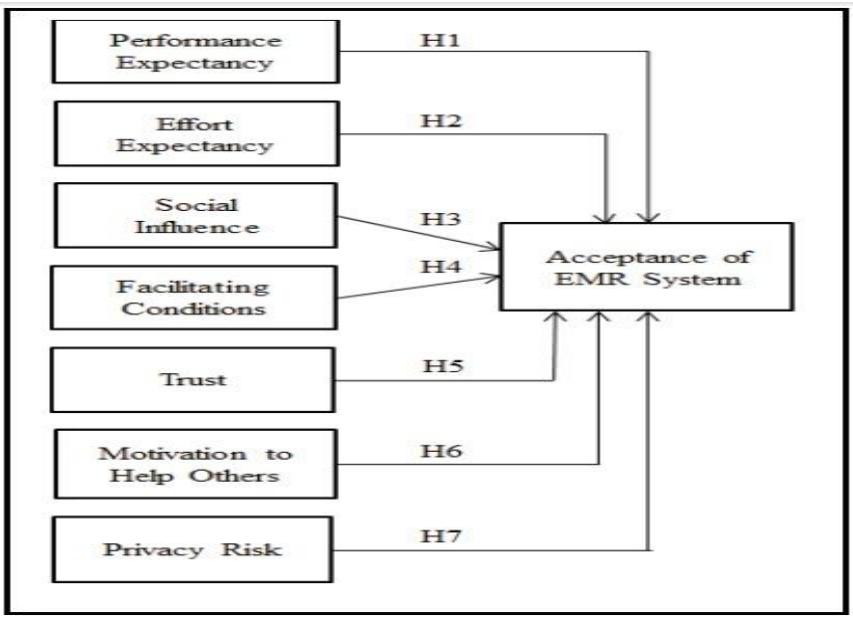

Figure 2. Conceptual model (Arry Akhmad Arman & Sri Hartati, 2015)

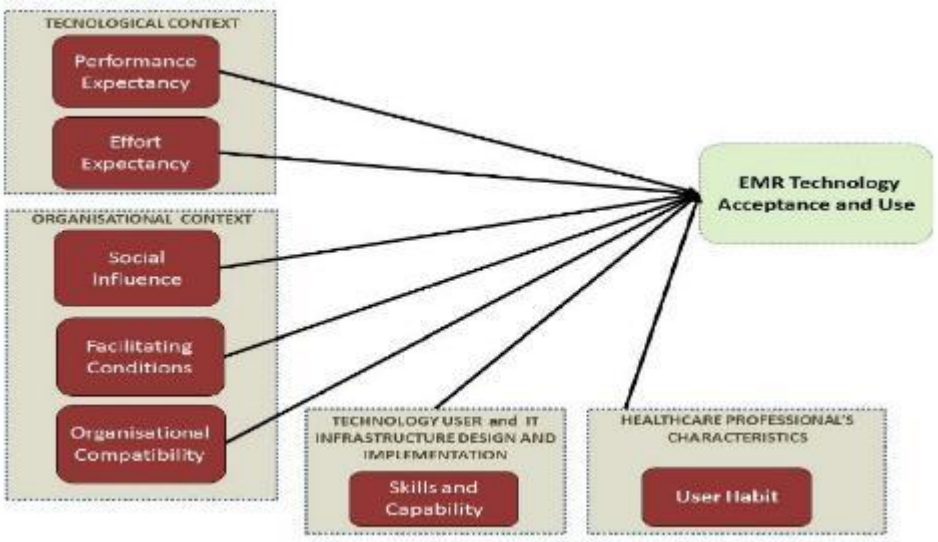

Figure 3. The conceptual model (Mammen & Weeks, 2014)

In this study, the researcher also adopts the Unified Theory of Acceptance and Use of Technology (UTAUT) model developed by Venkatesh, Morris, Davis and Davis to understand the complexity in determining a healthcare professional's acceptance and use of technology. The UTAUT model considers five core constructs, which have an impact on a user's behavioral intention. These core constructs include performance expectancy, effort expectancy, social influence, facilitating conditions and organizational compatibility. Within the UTAUT model factors, such as age, gender, experience and degree of voluntary use, are considered as moderators in that they influence the four core technology acceptance determinants. However, in this study, the researcher is mainly focusing on aspects that directly influence EMR technology acceptance, hence these moderators are not considered. The proposed model for this research are as above where the user habit is included as one of variable that influencing the EMR acceptance and use.

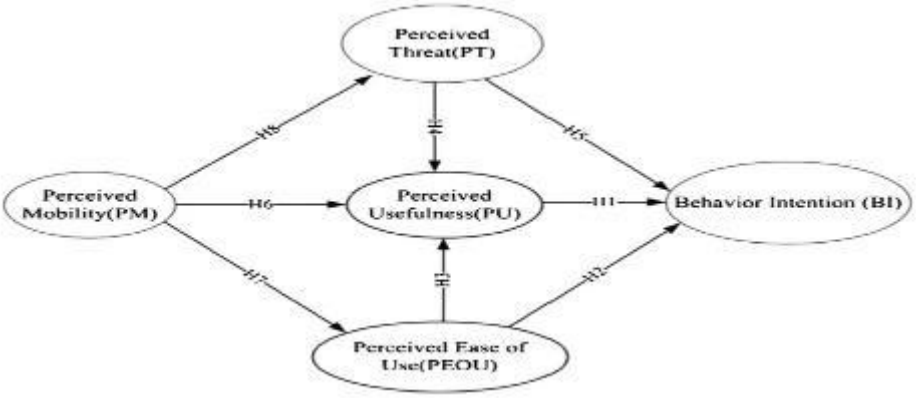

Figure 4. The Technology Acceptance Model (TAM) proposed by Liu and Cheng, (2015)

The Technology Acceptance Model (TAM) is one of the best known theories in the modern information system research and developed by Davis in 1989, and was used to explain the relationship between technology and user behavior. According to Davis (1989), TAM is used to analyze how external factors affect internal beliefs, attitudes and aims. The greatest contribution of the TAM lies in the introduction of two perceived beliefs, (perceived ease of use and perceived usefulness) that influence the users' technology acceptance. These two constructs are the most widely used positive factors.

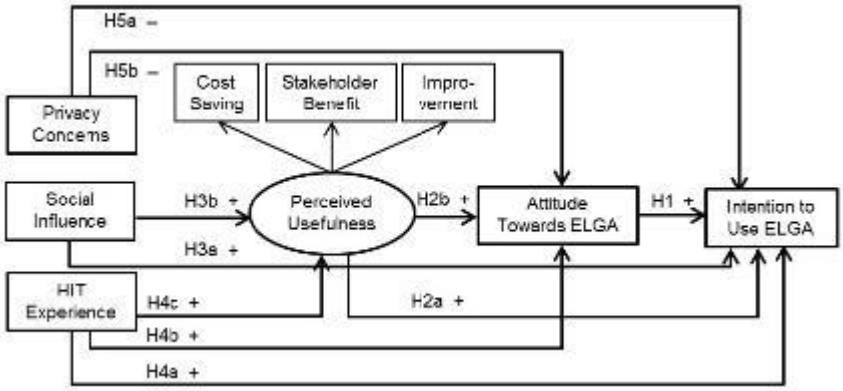

Figure 5. The combination of TAM and UTAUT model proposed by Steininger et al., (2014)

This research also adopted the TAM model as underlying model. Additional aspects that reflect characteristics of the Austrian HIT implementation were identified from other acceptance theories like the Unified Theory of Acceptance and Use of Technology (UTAUT). Derived from the Theory of Reasoned Action (TRA), a general model for the prediction of behavioral intention in any social psychological setting, TAM discovered several constructs that explain and predict (the intention of) IT use there are three key constructs that are expected to determine physicians´ intention to use ELGA: perceived usefulness and perceived ease of use, as well as attitude towards the usage of ELGA.

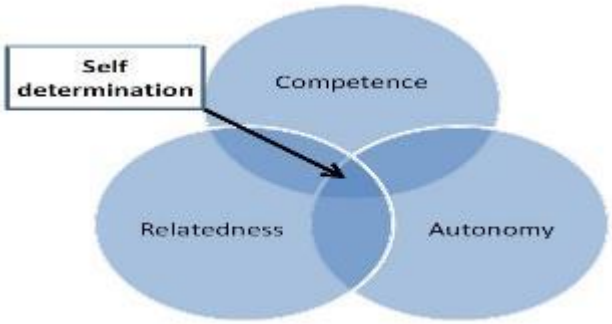

Figure 6. Self-Determination Theory (Deci & Ryan, 2000)

The Self-determination Theory developed by Deci & Ryan (2000), illustrates how the overlapping of the three basic psychological needs which are the competence, autonomy, and relatedness produce self-determination at their nexus.

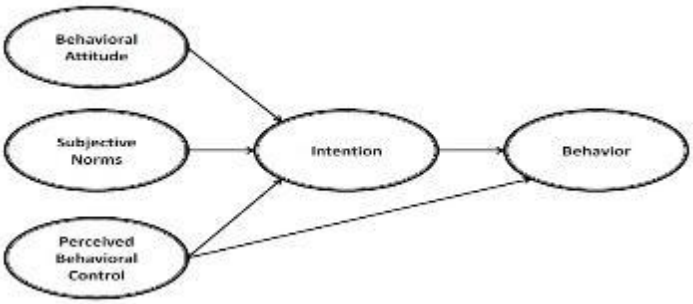

Figure 7. Theory of Planned Behavior (Ajzen, 1991).

Theory of Planned Behaviour (TPB) developed by Ajzen (1991), proposes that an individual's intentions and behaviours are shaped by three major components which are attitudes toward that behaviour, subjective norms, and perceived behavioural control. Ajzen (1991), claimed that intentions are assumed to capture the motivational factors that influence behaviour; they are indications of how hard people are willing to try, of how much of an effort they are planning to exert, in order to perform the behaviour.

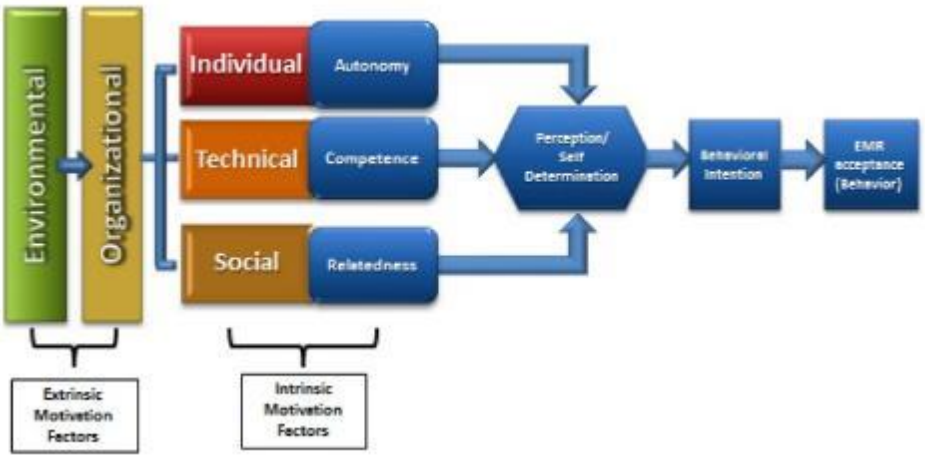

Figure 8. Conceptual Model (Hammad, 2015).

From the two of model discuss above, this dissertation's conceptual model suggested that at the environmental level, the perception of EMR continues to evolve into the organizational level. As illustrated in the conceptual model, three factor categories social, technical, and individual were grouped as intrinsic motivation factors and were aligned with the three components of the self-determination theory (SDT). These factors are referred to as intrinsic motivation factors since they helped facilitate satisfying basic psychological needs leading to self-determination. Since these factors are specific to the organization, they influenced the perception of EMR.

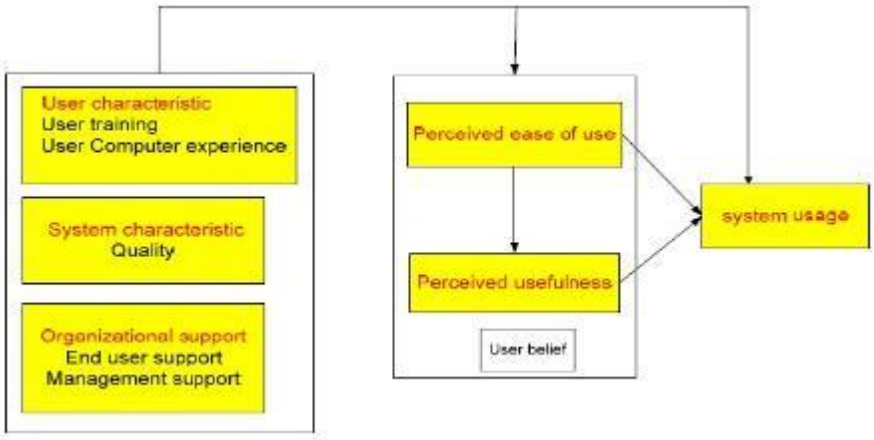

Figure 9. Combination of TAM and TBP (Igbaria, 1986)

The reference model used in this research was from Igbaria (1986) which combined the TAM with Theory of Planned Behavior (TPB) which focused on the perceived behavioral control (PBC) such as skills, opportunities, resources needed to use the system as mainly effect to technology acceptance. The researcher investigated external factors such as user characteristic, organizational support and system characteristics.

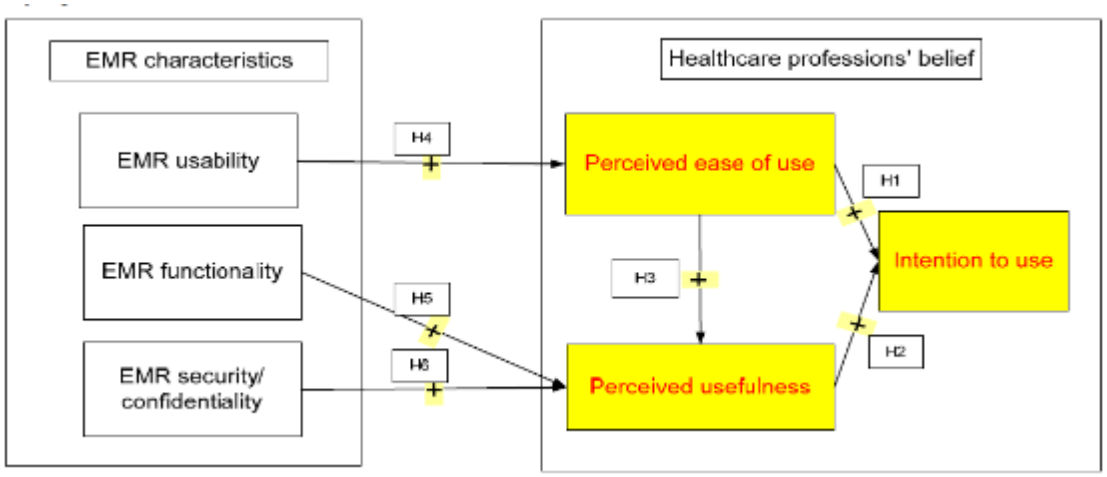

Figure10. Conceptual model (Vathanophas & Pacharapha, 2010)

The researcher adapts core characteristics of EMR described above as EMR system characteristic constructs to include in the TAM which in turns provided more validity of the EMR acceptance in healthcare professions. The characteristic of EMR are the usability,

functionality and security/confidentiality. The constructs of perceived need for security and perceived need for privacy were added to the TAM. The researcher conducted study to determine the intention to use biometric devices by using the TAM with adding the new constructs as mentioned. The results showed that "Perceived need for security" have a significant impact on perceived usefulness, while "Perceived need for privacy" did not have a significant impact on perceived usefulness but have an impact on perceived need for security, therefore have an indirect impact on perceived usefulness (James, et al., 2006).

Table 1
Summary of Five Major Previous Studies Related to Research Topic

Author	Aim of Study	Research Method	Main Findings
Arry Akhmad Arman & Sri Hartati (2015)	The purpose of this study was to analyze factors influencing the acceptance of medical personnel on EMR system using the proposed model. The original model is the unified theory of acceptance and use of technology (UTAUT).	This research adopted quantitative and used Cross-sectional method to collect data, using a structured questionnaire to doctors who have used EMR system in one of Indonesian private hospitals.	It was found that the factors affecting acceptance of EMR systems in the hospital in Indonesia was performance expectancy, social influence, trust, facilitating conditions, motivation to help others, and privacy risk. Effort expectancy was not significantly affected to the medical personnel in acceptance of EMR system.
Anju Mammen & Richard Weeks (2014)	Aims at gaining an understanding of the perceptions of EMR technology implementation and use among healthcare personnel. It focuses on aspects related to the type of technological system deployed, user skills and organizational compatibility.	Adopted qualitative research. Information was gathered by means of a semi- structured interview process with the relevant managers involved during the technology implementation process. Due to the time consuming nature of interview approach, only one clinic and three service providers were selected for conducting the interviews.	The finding is that users require a system that will allow them to do their job efficiently. The research model illustrates two factors, performance expectancy and effort expectancy that influence technology adoption in healthcare. Other technological factors that were identified include system availability, interoperability, speed, multi-disciplinary integration, flexibility, data security and ease to use the system.

Chung-Feng Liu & Tain-Junn Cheng (2015)	Study aims to explore physicians' acceptance of mobile electronic medical records based on the dual-factor model, which is comprised of inhibitors and enablers, to explain an individual's technology usage.	Quantitative method was used where physicians from three branch hospitals of a medical group were invited to participate and complete questionnaires. Total numbers of 158 questionnaires were collected, yielding a response rate of 33.40%.	The study confirmed that the dual-factor model is a comprehensive method for exploring the acceptance of healthcare information technologies, the researchers believe that the results of this study will contribute to the research on the acceptance of healthcare information technologies, particularly with regards to mobile electronic medical records.
Katharina Steininger, Barbara Stiglbauer, Bernd Baumgartner & Bernhard Engleder (2014)	This study examines the effects of social influence, health Information Technology (HIT) experience, and privacy concerns using a modified Technology Acceptance Model (TAM).	Quantitative research where two thousand randomly chosen physicians in private practice in Austria were invited via email to participate in the survey.	The study indicates that the presented model is suitable to explain physicians' intention to use EHR systems. In line with expectations, privacy concerns, social influence, and HIT experience had a significant impact on the perceived usefulness of HIT.
Jasmin Hammad) (2015)	The purpose of this dissertation was to examine the factors that influenced physicians' perceptions of EMR and to identify the factors which led to physicians' acceptance of EMR.	This study used evidence-based research (EBR), which involved critically reviewing and analyzing an extensive amount of scholarly literature consisting of research studies, case studies, quasi-grounded theory development, and analysis of data derived from both primary and secondary sources.	The research indicated that the factors found to influence physicians' perceptions belonged to five major factors and factor categories which are the individual, technical, social, organizational, and environmental. Based on the systematic literature review conducted, the following proposition was confirmed: Factors that facilitate intrinsic motivation are more likely to elicit EMR acceptance than factors that facilitate extrinsic motivation.

			Positive individual characteristics, positive social influences, and positive innovation interaction led to the intention and behaviour of EMR acceptance and utilization.

Proposed Framework

In this study there are various model and approaches that have being used in order to explore on the Acceptance of EMR system in healthcare industries. For this theoretical framework, the researcher adopts the framework from various models and also from the literature review. However, among the approach, the most common model and approach being adopted are including Technology Acceptance Model (TAM) by Davis, UTAUT model adopted by Arman & Hartati (2015), TAM and UTAUT model adopted by Katharina Steininger 2014. The main model for this research is adopted from Vichita Vathanophas & Tullawat Pacharapha (2010). There are one dependent variables, two mediating variable and four independent variables. In this study the relationship between the independent variables, mediating and dependent variable are examined and hypotheses are proposed.

The Figure 11 shows the relationship between independent variable, mediating variable and dependent variable of the study. The Independent Variable (IV) in this study is the characteristic of EMR which is usability, functionality, security and privacy & confidentiality. Two Mediating Variable are perceived ease of use and perceived usefulness and one Dependent Variable (DV) of this study are acceptance of use. In the original model, privacy is excluded because the results showed that “Perceived need for security” have a significant impact on perceived usefulness, while “Perceived need for privacy” did not have a significant impact on perceived usefulness but have an impact on perceived need for security.

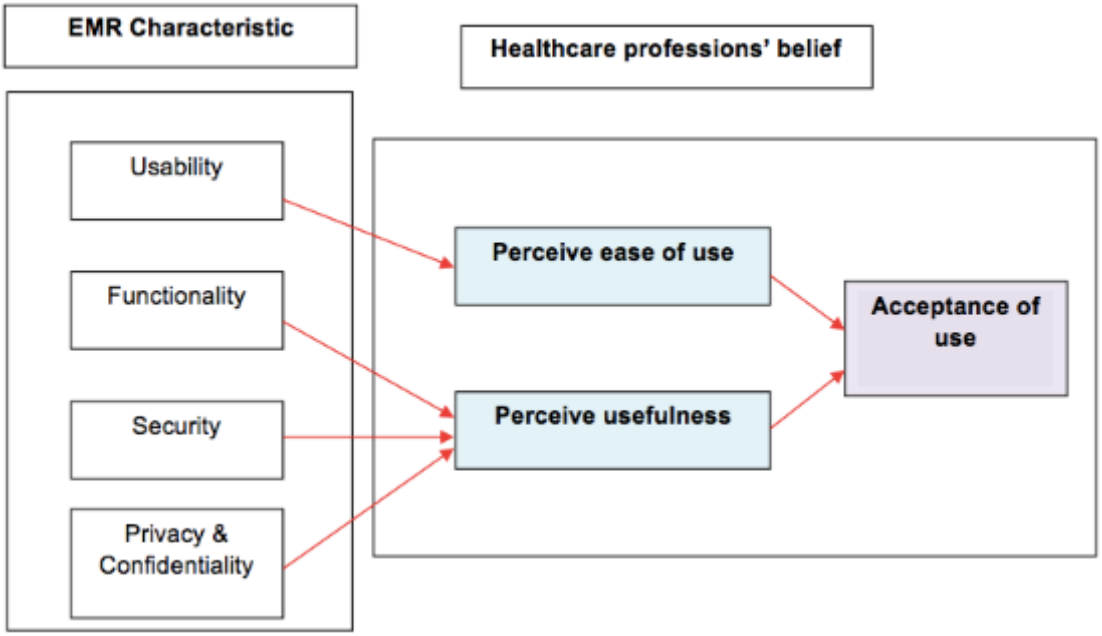

Figure 11. Research Framework.

Discussion

As model proposed by Arman & Hartati, (2015) (refer to figures 2) which include the privacy risk in their model and Steininger, et al. (2014) (refer to figures 5), the model includes the privacy as it had a significant impact on the perceived usefulness of ELGA, which was an unexpected finding. Recent research identified several causes for physicians' fears that data privacy and data protection could not be guaranteed within EHR implementations (W.O. Hackl, Hoerbst & Ammenwerth, 2010). One of the reason why researcher includes privacy as one of the characteristic that define the perceive usefulness is that, based on the previous studies which confirmed that privacy and confidentiality issues is one of the major issue arise with the implementation of electronic Medical Record. For example, in 2013, one of the Teaching Hospital in Malaysia had lost in the law case and sued RM400,000.00 because of privacy & confidentiality and defamation violation. One of the psychiatric patient sued the hospital after his medical information be disclosed to third parties without patient's consent. Unauthorized third parties used the information of patient's appointment at psychiatric clinic, treatment and medication to damage the patient reputation. In the proceeding statement, Judicial Commissioners, Vazeer Alam Mydin Meera stated that, "Legally, the hospital director and the University are responsible for ensuring the privacy and confidentiality of patients' medical information is protected and not disseminated. There should be strict inspection in the system to ensure that unauthorized people do not have the access to the system or the people with access do not misuse the information in the system". Therefore, it is important to analyze the ethical issues in the healthcare environments, especially in regard to the areas of privacy and confidentiality of healthcare records.

Perceive ease of use (PEOU)

The major factors influencing the acceptance of the information system is Perceived Ease of Use (PEOU) which refers to the degree to which a person believes that using a particular system would be free of effort. Given the effort is a finite resource, an application perceived to be easier to use than another is more likely to be accepted by user (Davis, 1989).

Arunkumar (2008), discussed that perceived ease of use can be defined when the users indicate that the systems are easy to learn and navigate. For the purpose of this study, the PEOU is using the usability of EMR to measure the healthcare profession perceived ease of use if the EMR system implemented.

Perceive usefulness (PU)

Perceived Usefulness (PU) as defines by Davis (1989), is the degree to which a person believes that using a particular system would enhance his or her job performance. According to Castillo & Bouwman (2008), PU is the level whereby the confidence of the individuals that a system will able to assist a person to perform their job easier, quicker and produce a good quality. Three EMR characteristic is use to tap the PU construct which are the Functionality, Security and Privacy & Confidentiality. This three characteristic will measure the healthcare profession in UiTMMSC in perceive usefulness of the EMR system implemented.

Usability

Usability is one of important characteristic of good EMR system in promoting both the widespread adoption and meaningful use of EMR which describes how easy it is for users to accurately and efficiently accomplish a task while using a system. According to Zhang & Walji (2011), usability refers to whether a system "is easy to learn, easy to use, and error-tolerant which may be measured by learnability, efficiency, and error tolerance. Learnability is how quickly a new user learns or relearns the user interface to conduct basic tasks. Efficiency is defined as the speed with which a user can complete a task or accomplish a goal. It is typically measured by the length of time required to complete a task. While error tolerance refers to the ability of the system to help users avoid and recover from error.

Functionality

Functionality is the ability to perform a task or function. According to TechTarget, functionality derived from Latin word *functio* which means "to perfom". It is the sum or any aspect of what a product, such as online system or software application can do for the user.

Security

According to Nicholson (1999), security is the protection of computer-based information from unauthorized destruction, modification, or disclosure. Information security includes the processes and mechanisms used to control the disclosure of information. While Van Der Haak et al. (2003), defines data security as the protection of personal information against accidental or unlawful destruction or accidental loss, alteration, unauthorized disclosure or access. Security issues must be addressed differently, and hence new security challenges are raised. According to Wang (2015), the information system design needs the integration of many technologies such as: computers, smart meters, sensing devices, mobile devices, RFID, Wi-Fi network, Low-Power Personal Area Networks, cellular network. Designers should adopt new security design solutions to ensure privacy and data confidentiality. There was a study done in Alberta, Canada in 2000 related to the privacy and security concern of issues surrounding personal information, personal health information and electronic health record where the study showed that 78% of Albertans expressed strong agreement with the importance of protecting individual privacy in the province (Province of Alberta Privacy Commissioner, 2000). When discussing personal health information and privacy and security concerns, a Pan-Canadian Health Information study showed that 25% of respondents had

moderate trust in their government health departments and 51% had a great deal of trust (Pan-Canadian Health Information Privacy and Confidentiality Framework, 2004).

Privacy and confidentiality

McLean (1995), identified four distinct types of privacy. One type of privacy is controlling the access to one's personal boundaries. The second type of privacy is privacy to grow or cultivating interior process for understanding, and enrichment. The third type of privacy is shown as a safety valve for resting and recuperating from the public arena. The fourth privacy is the respect for the individual. The first, third, and fourth types of privacy are important for healing in that they allow the patient to set the boundaries of who has access to them and allows them to heal from their disease. Privacy and confidentiality are concepts that refer to how information is handled. Privacy is the right of individuals to determine when, how, and to what extent information is shared with or transmitted to others. Confidentiality is the concept of trust that is placed on healthcare worker not to share or information about the patient. Both of these concepts come under the broader concept of ethics (Mason, 1999).

Conclusion

In this paper, we comprise the literature reviews about the associate with the proposed framework. The information gathered for this paper are defining together with scholars' sights in order to give the idea about the proposed framework. This paper also helps in developing a better understanding on the proposed framework by discussing and reviewing the previous studies as well as the framework adopted. The reviews of methodological and theoretical are briefly elaborated to present on how the previous studies were conducted and produced their findings on different situations. Followed with the theoretical framework for this study, we brings in the illustration of variables for this study, supported with the explanation of each variable. In conclusion, explanation in this paper intends to give the clear thought on the definitions of related significant structures that would like to be identified for the proposed framework.

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