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Health Information Privacy and Security Framework: Supporting Electronic Medical Records in Healthcare Systems

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Abstract: The need to record information regarding a patient has been considered as an old, but important issue within the medical arena. Recently, much progress has been noted in the process of collection, storage, and retrieval of patients' data, with more healthcare organizations moving towards paperless environment of electronic medical records (EMRs). However, only a handful of studies have looked into privacy and security issues associated with EMRs, as perceived by patients and healthcare providers. Such issues, if left unaddressed, may affect the quality of EMRs, the speed at which they are implemented and accepted by patients and providers, the ability for healthcare institutions to exchange patient information, as well as the quality of patient care and patient safety. As such, this article proposes a comprehensive and multidimensional framework of EMRs success in the healthcare sector. The framework developed in this study can be applied to evaluate and to measure the effectiveness of such EMRs.

Keywords: Privacy, security, electronic medical records, healthcare sector

Paper type: Conceptual paper

1. Introduction

Computerization of health information offers vast opportunities to improve healthcare, to reduce costs, and to ensure access to such care, apart from serving as a valuable aid to medical education. As such, many terms have been used to define electronic patient care records, with overlapping definitions. An electronic health record (EHR) refers to a patient's record that has been compiled in a digital format. In fact, EHRs and electronic medical records (EMRs) have been used widely, and for most users, the terms EHR and EMR are used interchangeably (Thompson et al. 2006). Meanwhile, information technology (IT) in the health area is an even broader term that describes any computerized electronic aid to healthcare delivery. Besides, IT within the healthcare division is often referred to as health information system (HIS) or EMR (Ludwick and Doucette 2009).

The electronic patient record (EPR) offers a broader scope of information, in comparison to medical record. It contains all information related to healthcare regarding the care providers, such as traditional

doctors, dentists, and physiotherapists. Therefore, the EPR focuses on the patient and may contain information from one or more healthcare facilities.

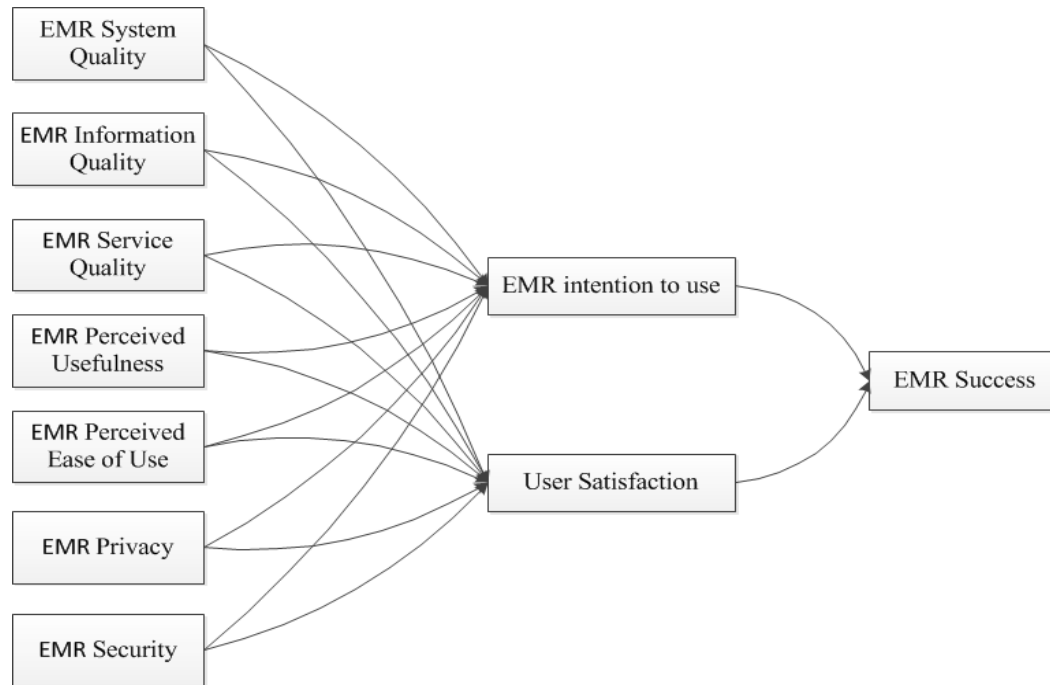
In addition, the need to record information regarding a patient has been considered as an old practice, but an important problem in the medical line. With the development of IT in recent years, much progress has been witnessed in the process of collection, storage, and retrieval of patient data, with more healthcare organizations moving towards the paperless concept of EMRs (Desroches *et al.* 2008). In fact, the latest privacy regulations related to protection of patients' individually identifiable health information, as mandated by the Health Insurance Portability and Accountability Act of 1996 (HIPAA), were released in 2000 (Medicare and Medicaid Services 2011). Nevertheless, only a handful of studies have looked into issues pertaining to privacy and confidentiality associated with EMRs, as perceived by patients and healthcare providers. Such issues, if left unaddressed, may eventually affect the quality of EMRs, the speed at which they are implemented and accepted by patients and providers, the ability for healthcare institutions to exchange patient information, as well as the quality of patient care and patient safety. With that, this study investigated the perceptions of patients regarding privacy and security of EMRs, as well as the effect of these perceptions upon successful implementation of the EMR systems.

Most researches on EMR have focused on issues linked to EMR system usability and applicability in an increasingly diverse environment of primary care delivery (e.g., hospitals, clinics, and outpatient facilities). Nevertheless, studies examining privacy and confidentiality issues associated with EMRs as perceived by patients and healthcare providers are rather scarce. In fact, the study of privacy and security in EMR can assist the present medical practitioners, including those delivering primary care services, as well as administrators who deal with issues of privacy and security in working with patients, so as to have enhanced comprehension on the effect of privacy and security of medical records upon patient care. In addition, more studies are in need regarding privacy and security issues inherent in EMRs, inclusive of ways to assure both privacy and security for all parties involved with EMR and their patients. With that, this study looked into the perceptions of patients regarding privacy and security for EMRs, as well as the impact of these perceptions upon successful implementation of EMR systems.

2. Literature Review

The literature review has revealed that no study has precisely and extensively analysed the success of EMR from the cultural stance. Attention in EMR success is not new; however, evaluation of the minimal past literature points out that this particular issue falls into one of two research gaps. The first research gap is related to generalizability; where some researches have been extremely precise by concentrating on individual case study of success, thus implying the issue of generalizability of the findings (Southon *et al.* 1999; Van't Riet *et al.* 2001); while other studies, on the other hand, are extremely general and offer merely general suggestions, which are expected to suit all conditions (Janols *et al.* 2014; Lorenzi and Riley 2003). In both cases, the studies have failed to identify situation-specific elements that distinguish success from failure for every single EMR (Collins 2000). Next, the second research gap is associated with conceptualisation. Very few EMR studies offer a helpful practical approach, but they lack clear theoretical model as a basis (Lorenzi *et al.* 2004; Sultan *et al.* 2014). On the contrary, few other studies have provided robust theoretical foundations, but minimum practical guidance (Bloomfield 1991; Yusof *et al.* 2008).

Figure 1. The conceptual framework of EMR success



Based on the above research gaps, this study analysed several models that have been verified and proposed in many studies so as to evaluate both the use and success of information system (IS). Besides, in the effort to develop a reliable foundation, this research proposes a conceptual framework by integrating three significant IS success models: (a) technology acceptance model (TAM) (Davis et al. 1989), (b) DeLone and McLean’s information success model (DeLone and McLean 1992, 2003); and (c) privacy and security (U.S. Department of Health and Human Services 2011). Besides, in order to acquire greater comprehension of the overall EMR phenomena in healthcare services, the following sections (see Figure. 1) further elaborate the conceptual framework.

This study suggests that the ‘EMR Success’ as a new factor that is comprised of use and benefits of EMR as the ultimate outcomes of the system. In the proposed framework, the factors that consist of system quality, information quality, service quality, perceived usefulness, and perceived ease of use had been considered as potential determinants of patients’ intention to use and user satisfaction, in which the ‘EMR Success’ factor had been determined by intention of patients to use and their satisfaction.

A. Technology Acceptance Model (TAM)

The TAM was developed by Davis et al. (1989a, b) to predict and explain IT acceptance and usage. This model of IS success relies on theory of reasoned action (TRA) developed by Fishbein and Ajzen (1975). In order to specify the causal relationships between system design features; Perceived Usefulness (PU), Perceived Ease of Use (PEOU), Attitude towards using (A), Behavioural Intentions (BI), and actual system use had been embedded (Davis *et al.*, 1989a, b). PU is defined as “the degree to which one believes that using a particular system would enhance his or her job performance”, while PEOU is denoted as “the degree to which one believes that using a particular system would be free of effort” (Davis 1989 p.320). Besides, the model built by Davis illustrates how the actual system use is determined by BI to apply the technology, which is predicted by attitude towards using the system, whereby attitude refers to “one’s positive or negative feelings (evaluative affect) about performing the target behaviour” (Fishbein and Ajzen

1975 p.216). Additionally, both PU and PEOU also predict attitude towards using the system, in which BI to use the technology is directly affected by PU.

Moreover, the TAM has been considered as a valid model in predicting one's acceptance of IT applications (Adams *et al.* 1992; Davis *et al.* 1989a, b). More recently, TAM was applied to examine the use of web IS (Chen and Tan 2004; Gefen and Straub 2000). Besides, the locus of IS success is the fact that the IS has to be installed, utilized, and accepted (Tung and Rieck 2005). As for the healthcare line, TAM has been applied in studying factors that affected systems and applications acceptance, such as mobile healthcare systems (Wu *et al.* 2007), and healthcare informatics (Ward 2013). In precise, TAM represents complementary steps in a causal chain from key characteristics of healthcare systems design, to beliefs and expectations about outcomes that ultimately determine usage.

B. DeLone and McLean's IS success model

Since the DeLone and McLean's IS success model was published in 1992, nearly 300 articles have used and referred to the model in refereed journals. The main purpose of the model is to synthesize IS success into a more coherent body of knowledge and to provide guidance to future researchers. Hence, a comprehensive taxonomy model that consists of six interrelated dimensions can be applied to evaluate IS success (DeLone and McLean 1992, 2003). These interrelated dimensions of IS success and their associations are System Quality and Information Quality, which affect Use and User Satisfaction, thus influencing Individual Impact, which in turn, affects Organizational Impact. In this case, System Quality refers to a measure of the IS processing itself (DeLone and McLean 1992), while Information Quality is defined as "measures of the IS output" (DeLone and McLean 1992). Meanwhile, Use denotes the utilization of an IT application by individuals, groups or organizations (Kim and Malhotra 2005), whereas User Satisfaction reflects "the net feeling of pleasure or displeasure that results from aggregating all the benefits one hopes to receive from interaction with the IS" (Seddon and Kiew 1996 p. 95). On top of that, Individual Impact refers to the effects of IS systems output upon individual users' behaviours, while Organizational Impact is the effects of the system's output upon an organization.

A decade later, the service quality dimension was added in the revised version of the model as an antecedent of Use and User satisfaction (DeLone and McLean 2003). Next, both Individual and Organizational Impacts were reconstructed as net benefits. Similarly, in the proposed Integrated EMR Success Framework, service quality is added as an antecedent of Use and User satisfaction, where 'Service Quality' refers to "the overall support delivered by the service provider" (DeLone and McLean 2003); 'Individual Impact' reflects the effects of IS system output upon individual users' behaviours; and 'Organizational Impact' is the effects of the system's output on an organization (DeLone and McLean 1992).

C. Health information privacy and security

Privacy is at the heart of the doctor-patient relationship. Patients must share information with their doctors in order to receive correct diagnoses and appropriate treatments. Thus, a patient's medical record has significant personal and private information, which includes medical history, medical diagnoses, X-rays and other digital images, treatment and medication received, as well as the doctor's assessment of the patient's personality traits and mental state (Bachelier 2011). Patient health records are also shared with payer organizations, such as insurance companies, Medicare, and Medicaid, to support payment of services rendered by physicians. Besides, patient health records are also used for more general purposes, such as to improve the efficiency of a healthcare system and the quality of a healthcare delivery service, in support of public policy development and administration at both state and federal levels, as well as in studies for advancement of medicine (Schachter *et al.* 2006).

3. Method

Similar to most other nations worldwide, health system in Jordan has been experiencing substantial demands to enhance its health quality, accessibility, and results, while attempting to minimize costs (Murphy and Neven 2014). As such, the Jordanian government, in January 2009, devised a strategic decision to address the challenges faced related to health services quality and cost by investing in an efficient and cost-effective e-health system. In more recent times, Jordan had decided to implement the EHR system at Prince Hussein and Prince Hamza Hospitals.

With that, this study examined perceptions of patients regarding privacy and security of EMRs, as well as the effect of these perceptions upon successful implementation of EMR systems. As such, the conceptual framework was tested empirically. Moreover, questionnaire was developed so as to test the research hypotheses. Besides, the validity of the questionnaire was determined from a pilot test conducted among patients from Prince Hussein and Prince Hamza Hospitals located in Jordan. Next, the questionnaire was improvised based on the analysis of the pilot study.

After that, the modified questionnaire was employed for the actual survey that involved patients from both Prince Hussein and Prince Hamza Hospitals. The administration of the survey was conducted by the researchers. As for research sample, the respondents were selected randomly to answer the questionnaire.

4. Discussion

The literature depicts some studies that have looked into patients' privacy related to health information in the electronic form (Flynn et al. 2003; Gander and Oswald 2004; Mwachofi et al. 2016; Sibona et al. 2010; Whiddett et al. 2006). For example, Honeyman *et al.* (2005) reported that 77% of their patient respondents were not concerned about the privacy of their EMRs. On the other hand, Davies and Hughes (2014) investigated patients' preferences about whether and how doctors should seek permission to use particular items of anonymous information from their hospital records for clinical audit, teaching, national data collection, and research. The survey was performed by mailing to 166 adult patients in England and the results showed that about 28% to 35% of the respondents were neutral about physicians using their health information (i.e., age, gender, ethnicity, reason for treatment, medical history, personal habits affecting health, type of treatment obtained, and side effects of treatment) for other purposes. However, approximately 5% to 21 % of the patients expected their physicians to ask them for permission before using their information. Next, around 10% of the patients expected their physicians to ask them for permission before using their health information for other purposes, such as combining data with other patients' data to provide better information to future patients, sharing with other physicians how a particular treatment works, teaching other medical professionals, as well as producing research articles about diseases and treatments.

Meanwhile, the respondents in the study carried out by Strayer *et al.* (2010), likewise, seemed unconcerned with privacy issues. They examined physicians' use of tablet computers in the examination room by conducting exit surveys among 96 patients in a family medicine clinic at a large Virginia academic medical centre for over a month period. Most patients expressed positive attitude towards the use of computers, while only 4.3% of the respondents reported that they disliked the physicians using computers. When asked if the use of computer depersonalized the patient's encounter with the physician, 84% of the respondents replied 'No'. In response to questions related to perceptions of decreased privacy of medical information, 61% stated that they believed their data were more secure on the computer tablets than in the conventional data formats. Besides, respondents with high school education were four times more likely to perceive that their data were more secure with the use of technology.

Sibona et al. (2010) also examined the effect of use of computer in the examination room by healthcare providers upon patient satisfaction whether patients who have experienced computers in the exam room

perceived variances in the utility of EMRs. As a result, the patients gave higher overall satisfaction scores when the physicians used computer to enter or retrieve information.

In fact, patients with EMRs perceived benefits, such as increased portability of the record and did not desire more control over their records than those with more traditional paper-based medical records. Angst *et al.* (2006) explored perceptions of patients towards the varied types of personal health record (PHR) systems in order of technology advancement, beginning with paper-based, then personal computer-based, memory devices, portal, and networked PHRs. The results showed that patients' relative perception of privacy and security concerns increased with the level of technology. For example, security and privacy concerns related to networked PHRs were twice when compared to those of memory device-based PHRs. However, more highly educated patients favoured technologically advanced PHR systems.

In contrast to the aforementioned studies, an online poll conducted by Nestor *et al.* (2008) among 2,454 adults between June 9-16, 2008, revealed that 4% of the respondents believed that their medical information or that of a family member had been lost or stolen. When asked which medical records (electronic or paper) they believed may be lost or stolen most often, 47% pointed out computerized records, while 16% claimed paper records, and 23% believed that both computerized and paper records were lost or stolen equally.

Meanwhile, Hassol *et al.* (2004) discovered that a substantial amount of patients had been concerned about the possibility of unauthorized access from both inside and outside of the healthcare system by hackers, thus creating fear among patients that nonmedical individuals (such as insurance companies and lawyers) may gain access to their files or may accidentally see their record. These patients were particularly concerned about unauthorized access to their mental or sexual health information. Next, Prince and Prince (2002) investigated the specific fears of psychiatric patients and found that these patients feared being stigmatized due to their mental illness if an unauthorized person accessed their record. Other studies (e.g. Gordon *et al.* 2010; Whiddett *et al.* 2006) revealed that patients feared that unauthorized access would result in exploitation of their information.

In addition, Whiddett *et al.* (2006) found that patients felt uncomfortable when sharing all their medical information, although the findings were inconclusive relative to exactly the type of information they were comfortable sharing. Nevertheless, the results did indicate that patients were most unwilling to share information about their sexual or mental health. Besides, the respondents in Whiddett's *et al.* (2006) study believed that patients should give their consent before sharing any health information. Meanwhile, Shaw *et al.* (2009) revealed that both physicians and patients believed that medical information should be shared with all healthcare providers, while the patients in Whiddett's *et al.* study believed that only physicians and other healthcare providers that have been specifically identified and authorized should have access to their records and that their information should not be shared with private health insurers or government agencies.

Interestingly, some other researchers have examined the perception of privacy concerns of mental health patients in particular. Flynn *et al.* (2003), for example, surveyed psychiatric outpatients about their concern regarding electronic psychiatric records. Their sample consisted of 80 patients, in which 41 patients refused to have their psychiatric records transferred to electronic records, while 39 agreed to do so. The two groups were similar in age, gender, partner status, and self-reported diagnosis. The survey questions also asked about unauthorized access, security of the electronic record system, stigmatization, impact of the electronic record system on their jobs, and the level of care. Flynn *et al.* further discovered that patients who refused to have electronic record were mostly concerned about unauthorized access, stigmatization, and the impact of the electronic system on their jobs. These patients were also more likely to have a 4-year degree or more. In addition, those who agreed to electronic record expressed greater belief that such records would result in better coordination of care.

Next, Afzal and Salmela (2012) looked into patients' views on carrying their own health information to their healthcare providers. They conducted semi-structured interviews with 10 patients, all of whom were equally distributed in gender and age (60 years and above). Other than that, Forsyth *et al.* found that while the patients were not overly concerned about privacy issues, some believed that they would feel differently if they had a mental illness. According to Plovnick (2010), EMRs may increase the number of people who can access sensitive information about patients and the potential for unauthorized persons to access such information. Plovnick further asserted that for those with mental issues, such as paranoia, the knowledge of the existence of EMRs might aggravate their condition.

Additionally, Papaioannou's *et al.* (2010) review of the literature found that healthcare providers are more concerned about patient privacy of personal information than the patients themselves. Furthermore, a survey of more than 400 doctors conducted by the Association of American Physicians and Surgeons revealed that the doctors were reluctant to use EMRs because they feared that the data would invite external interference, such as from the government, to control practice of medicine. Moreover, 81% of the respondents indicated that their Practice excluded the use of EMRs. Some physicians viewed EMR software as a violation of the rights of their patients and of the Hippocratic Oath. They see no way to completely protect these records and are, therefore, reluctant to suspend traditional methods of record keeping. These doctors believe that it is fairly easy to steal documents out of their computers and even their nurses can print such information (Kübler-Ross 2009). Thus, while EMR proponents assumed that EMRs would be popular among healthcare providers as EMRs may ease the lives of doctors and health professionals, EMRs have yet to be accepted in the United States, as quickly as anticipated (Desroches *et al.* 2008). Doctors are indeed very concerned about their rights and those of their patients', thus unwilling to do anything to compromise those rights (Kübler-Ross 2009).

The research also shows that privacy is a significant issue for both patients and doctors, which may hinder large-scale implementation of electronic record keeping systems. Hence, perceptions of patients must be the subject of further research. Patients who are concerned about the privacy of their EMRs may not completely disclose significant health-related information to their healthcare providers, thus compromising safe and effective care. This is particularly essential for patients with mental health issues who fear stigmatization. Ultimately, the studies related to EMR lack knowledge on factors, which could influence these success initiatives, in the presence of privacy and security aspects of patients' information. Consequently, determining the success factors of EMR may offer a foundation for hospitals, besides inducing decision makers in the healthcare sector to adopt or to change such Health IS projects.

5. Conclusion

At present times, studies pertaining to EMR, from the patients' perspective, are limited, while measurement of EMR in the health sector lacks scientific framework, especially from the patients' perspective. This research, hence, sheds light on the factors that may influence the success of EMR so as to obtain adequate understanding and knowledge of factors that could have an impact upon security and privacy of EMR.

This study contributes to the developing body of research regarding EMR success. Future research may consider a cross-sectional survey research approach. Moreover, it will be interesting to explore the effects of patients' perceptions on privacy and security aspects of using EMR in healthcare systems.

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