

# Overcoming challenges to use Electronic Medical Records System (EMRs) in Jordan Hospitals

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## Summary

Electronic Medical Record (EMR) is the electronic middleman which allows users to access and retrieve patients' data, to review patients' medical history, and to facilitate the activation between patients and medical users. Considered as a developing country, Jordan still suffers from modernized management information systems that organize store, retrieve, and facilitate medical data. The objective of this paper is to investigate some of the factors that affect the use of electronic medical record systems in Jordan. Focusing on those affective barriers, it is expected that this paper will provide a deeper insight into the EMR implementation problems in Jordan, and consequently providing well-informed inferences for decision makers to take into considerations for yielding better EMR implementation. This paper discusses the factors which are recognized to be the challenges in the implementations of EMR in hospitals. The paper also describes advantages and history of EMR. This paper will also describe the Method (the sample) to test of the Hypotheses and final results.

## Key words:

*EMR, ITC, Healthcare Information System (HIS).*

## 1. Introduction

Traditionally, hospitals use paper-based profiles of patients to keep track with the patients' illness history, their development and overall general health conditions. Though this traditional technique has long been adopted, it is not without practical problems. One living example of the shortcoming of traditional hospital profiling systems of patients' data was demonstrated by Hurricane Katerina. Hurricane Katrina destroyed the medical records of untold numbers of people, bringing new attention to the need for electronic medical data. Lost medical records expose patients to considerable risk of medical mistakes because physicians would not be able to draw connections between the current health conditions of the patients and their medical history; namely, diagnosis, drugs' effects, and surgery risks assessment [1].

Information and Communication Technology (ICT) is very important nowadays because it has many potential which makes our life easier. The effects of ICT technology on our daily life cannot be refuted. It is impacting on every facet of human activities and the health industry is no

exception. Electronic Medical Record is one type of Healthcare Information System (HIS) like Electronic Health Record (EHR), Computerized Physician Order Entries (CPOE) and Electronic Patients Record (EPR). There are many advantages for using EMR such as; playing a major role to improve patient safety, quality of care, and medical records. EMR implementation benefits healthcare related organizations such as hospitals and clinics in reducing medical errors, facilitating access, supporting clinical decisions and others.

On the other hand there are disadvantages of EMR such as high cost, security, privacy and others. Although there are many advantages of EMR, many studies are conducted to see the challenges or barriers in implementing EMR as people do tend to resist any new technology implementation. EMR is currently available in many countries; nevertheless there are still many obstacles to overcome before it can be implemented successfully. Several technological impacts and social issues have slowed the pace of implementation or prevent the widespread plan to EMR implementation. Users of EMR include administrative staff, medical staff, and patients. The main users are the medical staffs who are physicians and nurses who have used EMR to have electronic access to patient health information. They have found EMR to be very helpful and resourceful. The next section will focus on technology that can be used in EMR. The paper proposes an integrated model based on the technology acceptance model (TAM).

The paper is organized as follows: Section 1 presents the introduction of the paper, while section 2 discusses the electronic medical record in detail. Section 3 describes the history of EMR, section 4 describes advantages of using EMR, section 5 describe the data collocation. Section 6 presents the theory and Hypotheses. Section 7 shows Hypotheses results, while section 8 concludes the paper and presents the future work.

## 2. Electronic Medical Record

EMR is the software that enables medical data to be digitally processed, stored and communicated. It can also

be used to access, process, manage and present medical information of the patients, to doctors, administrative staffs and other users. EMR plays a major role in activating the communication between the users and patients, and between users themselves. It can also be applied for different medical issues, and business areas especially in hospitals.

EMR enable the retrieval of the medical information, storage of data for longer period and availability of data at anytime and anywhere. EMR can be defined as an electronic middleman, which allows the users to retrieve the patient data such as history for patients, diagnosis, treatments, radiology, laboratory and booking for patient in wards [2]. According to Pike [3] and Wald [4], EMR is an electronic record of patient health information such as: medical history, medical encounters, booking, immunizations, diagnosis data, treatment, laboratory data, radiology, as well as administrative issues.

Next section describes the history of electronic medical record and how it has evolved.

### **3. History of Electronic Medical Record (EMR)**

#### **1880s to 1890s**

Dr. John Shaw Billings played a key role in the chain of events that led to the development of computers. Asked to assist the Census Bureau in the 1880 and 1890 census, Dr. Billings suggested to an engineer, Herman Hollerith that punched cards could be used to represent individual citizens, and that machines should be used to tabulate them. Hollerith, whose name later became synonymous with the punched data card, founded the Tabulating Machine Company which later merged into the Computing-Tabulating-Recording Corpora which in 1924 was renamed by Thomas J. Watson, Sr., to International Business Machines Corporation [5].

#### **1950s to 1960 and 1960s Developments**

The year 1958 had witnessed the development of transistor to be later applied in computers; these machines became practical for commercial use outside of special laboratories. In 1960, the adoption of computers for patient data collection and storage was introduced. In 1965, the complete computerized clinical record system was launched, including identification data, physical examination findings, laboratories results, radiology reports, and disease summaries. However, this system contained the medical records of monkeys not humans. [5, 6].

#### **1970s Development**

During this period, a several clinical computerization projects were initiated by medical informatics groups at academic medical centers. Some of the most comprehensive systems were developed in Boston, at Beth Israel Hospital, Brigham and Women's Hospital, and Massachusetts General Hospital. Other notable implementations were found at Yale, Emory Johns Hopkins, and LDS Hospital. Systems housing ambulatory care data were less common, but the COSTAR system at the Harvard Community Health Plan and a system at Kaiser Permanente in northern California were pioneers in this area [5,7].

For most part, these systems were deployed using mainframe or minicomputers in a data center, with video display terminals placed throughout clinical areas of the hospital. Clinical data was captured from diagnostic testing departments such as laboratory, radiology, and pathology. Although physicians found access to diagnostic data which was facilitated by computer systems, direct computer entry of data by physicians quickly proved itself to be problematic. As such physicians continued to write on paper and data entry was later performed by clerical staff working from these input forms.

#### **1980s Developments**

During this period, large comprehensive systems were built and maintained through long-term projects by dedicated informatics teams at academic medical centers. However, these did not become commercially available because the ideas embodied in them required endorsed and development of several clinical departmental systems.

Bedside clinical systems for use by nurses and order-entry applications that were actually used by physicians were two notable breakthroughs during this period. Furthermore, the availability of low-cost personal computers enabled more clinicians to experiment and become familiar with computers, providing growth in the much-needed cadre of computer knowledgeable physicians. However, managed care emerged, bringing new reimbursement schemes such as prepaid capitation and diagnosis related groups, a considerable share of information system capital budgets was devoted during this time to financial and administrative systems - such as DRG groupers and managed care information systems - needed to cope with these changes [5].

#### **1991s Development**

A turning point came in within 1990s, with the publication of a landmark book by the Institute of Medicine, and with the implementation of their recommendation to form the

Computer-Based Patient Record Institute. The Institute provided a much-needed forum for discussion of the challenge, definition of standards, and dissemination of information [5, 8].

### 2000s Development

In the current time, even more importantly, sweeping changes took place in the business of healthcare delivery leading to a wave of horizontal and vertical integration moves, experimentation with new models of health care delivery, and most recently, the emergence of the Internet and the empowerment of the health consumer.

Section 4 will discuss the advantages of EMRs implementation that are already complete in different countries healthcare sectors and how these implementation have improved the quality of clinical performance.

## 4. Advantages of EMR

. According to the Institute of Medicine (IOM) 44,000 to 98,000 deaths occur each year in USA hospitals due to preventable medical errors and over 770,000 individuals are either injured or die each year in hospitals due to adverse drug events. The cost of these errors is about \$38 billion per year [9].

There are many causes of medical errors, and one of these is due to different physicians treating the same patient. Not all or only a few physicians can access to all the patient's medical records. Some of them do not know anything about the history of their patients [9] and these can have damaging consequences if the wrong drugs or treatments are given to these patients.

Another important cause of medical errors is in prescriptions, as writing them on paper is not clear and is too difficult to read it. Thus, electronic prescription would greatly reduce the prescription errors. Medical errors could be reduced by the use of decision support tools that would check for drug interactions as well as dosage levels and allergies. EMR could receive alert reminders for preventative care treatments, testing, and alert about various treatment procedures, guidelines associated with the diagnosis [10].

Moreover, electronic records improve record keeping, recording and documentation of medical examination. EMR usage in hospitals generally reduces cost, improves clarity of documentation, clinical decision support, and enables better communication of information about patient referred for consultation, potential availability of the record anywhere, anytime as well as increased storage capabilities for longer periods of time.

The EMR also enhance the patient provider communication. EMRs can remove the communication

barrier between users and patients. EMR can help public health officials easily detect an outbreak of illness and determine what measures are needed to protect the community [11]. Another advantage of using EMR is the patient privacy and security. Electronic files play a significant role in maintaining patient information and confidentiality, as unauthorized access can reveal history of drug abuse, venereal disease, or life-threatening illness, psychiatric notes reveal inner fantasies, sexual activities, crimes, or the crimes and abuses of family members.

Therefore, if anyone could have easy access to this private information without any security, it can cause a lot of problems for patients, and this can affect their daily lives.

EMR also make it easier for medical researchers to ask questions or query about diseases that were previously been impossible to ask of it, and it may well lead to the discovery of tens or even hundreds of new diseases and allow reclassifications of existing ones [12].

The EMR have some functions associated with patients different than the medical functions such as financial, legal information, research and quality improvement purposes. Due to some reasons, this information must not be shared among many professionals who are not related to the healthcare team.

On the financial side, EMR allows the accounting staff to provide more accurate billing information and allow users to submit their claims electronically. Therefore, receiving payment will be quicker, and the information for any patient will available. Thus, there is no need for the patient to provide the same information over and over again. They may even forget about it. Therefore, there is a general consensus that the widespread use of electronic medical records improves the coordination and quality of healthcare for patients. However, there are still many barriers in implementing EMR in hospital around the world. The next section will discuss of data collocation and sample to identify these factors.

## 5. Data Collocation

The researchers recognized different hospitals of the largest and most famous hospitals in Jordan each of which belongs to a different administrative body for the research. In Jordan, all hospitals can be categorized into the following categories: government hospitals, ministry of defense hospitals, universities' hospitals and private sector hospitals. Some of these hospitals already have full implementation of EMR; others have partial implementation. This variety and diversification of choosing different hospitals add to the stability of the sample. All of the following hospitals are located in different places in Jordan that cover all parts of Jordan; northern, southern, eastern, western and medical center

areas will be targeted in the questionnaire. Also, the purposes of this research, the targeted respondents are chosen from physicians, nurses, pharmacists, lab technicians, medical records staff and administrative staff at different hospitals from different areas in Jordan with different rates.

This variety and diversification would increase the stability of the sample because they can reflect a clear representation of all hospitals in Jordan since the overall attitudes towards using the EMR is more or less the same among them. Specifically, the hospitals' names that are targeted for the study are: (1) The King Abdullah University Hospital (KAUH), (2) Istishari Hospital, (3) Jordan Hospital a Private hospital (4) Specialist Hospital, (5) Khalidy Hospital, (6) King Hussein Cancer Center, and (7) University of Jordan Hospital. The next section will discuss of theory and hypotheses of EMRs in Jordan.

## 6. Theory and Hypotheses

The Technology Acceptance Model (TAM) developed by Davis in 1986 (Davis, 1985), has been constantly utilized for the following purposes: in the assessment of the sufficiency of accepting new technologies and in the identification of challenges of user-system relationship in an organization. TAM is basically an adapted version of prior cognitive-behavioral intention model known as Theory of Reasoned Action or TRA [13], which represented as a framework created in the 1970s to explain the relationships between human beliefs, attitudes and behavior.

TAM identified perceived usefulness (PU) and perceived ease of use (PEOU) as the two basic determinants of technology acceptance. The model suggests causal relationships between both determinants' users' attitudes, intentions and computer adoption behavior (see figure 1).

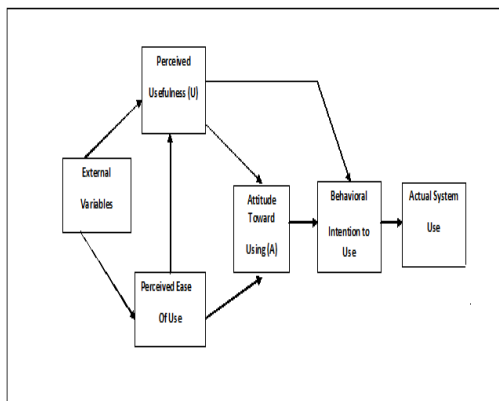


Figure 1: Technology Acceptance Model (TAM)

PU is considered as "the degree to which a person believes that using a particular system would enhance his or her job performance" a definition that calls for secondary reinforcements. PEOU is defined as "the degree to which a person believes that using a particular system would be free from effort". Viewed from the job performance context in the organization, both constructs are suitably applied to means-end behaviors and performance-contingent rewards and the model is evidenced by both theoretical as well as empirical research mainly comprising of samples of students and information technology employees. The model can be utilized to predict and explain usage of concrete systems or prototypes.

Despite Davis's reference to Ginzberg's (1981) discussion regarding the importance of anticipating user acceptance at the initial stages, majority of the empirical support for TAM was collected through the exposition of a group of users to a system and the measurement of the predictive value of the variables in the model [14]. Davis concluded that (a) an individual's computer use can be predicted from his/her intentions; (b) perceived usefulness is a top determinant of intention to use computers; and (c) perceived ease of use is a vital secondary determinant of intention to use computers. Till today, TAM still stands as one of the most influential frameworks when it comes to an exploration of IT acceptance [15].

Though TAM has been identified as a useful model in a relatively wide range of applications, this research has used it to study the adoption behavior of organizational factors and analysis by statistical software such as SPSS. Therefore, the following sections will discuss the role of external variables including organization leadership, cost, training and resistance to new technology in the context of statistical package adoption. Some of A number for hypotheses may be taken from the theoretical framework which is created for the present study. A list of all these hypotheses which aim to explore the factors influencing EMRs in Jordanian healthcare environment .

**H1:** There will be a significant positive relationship between organizational leadership and perceived Ease of use.

**H2:** There will be a significant positive relationship between cost and perceived Ease of use.

**H3:** There will be a significant positive relationship between training programs and perceived ease of use.

**H4:** There will be a significant positive relationship between resistance to new technology and perceived Ease of use.

Next section will desiccation of final results for these hypotheses.

## 7. Results of Hypotheses

The section attempting to investigate the factors influencing the use of electronic medication record (EMRs) Jordanian hospitals. Also, the results of the findings as shows in table 1 collected from the hospitals. The data analysis of the present study has been divided into first is the analysis of the participating respondents through descriptive statistics in order to guarantee data quality. Two, the exploratory factor analysis is carried out and in the third; various dimensions of the items are studied. In the fourth, correlation analysis is carried out and finally in the fifth, the structural model chosen for the purpose of higher order constructs is analyzed. This is followed by the examination of the other factors' influence on using EMRs through multiple regressions.

Table 1: Results of Hypotheses

Hypotheses	B	T-value	Significant-ant	Result
H1	.190	2.251	.025	Supporting
H2	.243	2.631	.009	Supporting
H3	.296	8.757	.000	Supporting
H4	.134	2.441	.015	Supporting

Dependent Variable: Perceived Ease of Use ( $F = 95.171$ ,  $P < .000$ ,  $R = .698$ ,  $R^2 = .488$ , Adjusted  $R^2 = .483$ )

**H1:** The result in Table 1 shows a positive and significant relationship between organization leadership and perceived ease of use ( $t = 2.251$ ,  $p > .05$ ). The result suggests that for each unit increase in the organization leadership, there is an expected increase of .190 in the perceived ease of use in the model. Therefore, hypothesis 1 is supported.

Organizational leadership plays a great role in providing ample time and resources to use EMRs [16-19]. The results of the analysis reveal a positive relationship between management support and perceived ease of use as shown in table 1, a finding which is consistent with Aldosari's results (2003). Results also show that management support is the variable that has the highest effect on perceived ease of use. This positive relationship is also manifested in other studies [20, 21]. However, in the current study, the relationship between the two factors is not hypothesized owing to the lack of support in the previous literature regarding their relationship.

Along the same lines, Morton (2008) carried out a research in the University of Mississippi Health Care (UMHC); an acute care teaching institution in southeastern United States. The study involved a survey questionnaire distributed to 802 respondents comprising of UMHC faculties, residents and fellow physicians. The aim of the study is to find out the attitudes of the respondents towards the EHR application implementation. The results of the study reveal a positive significant relationship between management support and perceived ease of use and the result owes itself to the lack of management support.

Respondents exhibited expectations of management's facilitation of sufficient workstations, provision of training and support and solutions to technical and financial issues in a timely fashion. In addition, the incorporation and consideration of their feedback into the management strategies is among the expectations that respondents have. These expectations showed the relationship of management support, users' involvement and management support of training and finance. Even though most medical organizations are inclined to set up EMRs, they are hesitant to do so mainly due to issues such as lack of support and organization leadership.

**H2:** The result in Table 1 shows a positive and significant relationship between cost and perceived ease of use ( $t = 2.631$ ,  $p > .05$ ). The result suggests that for each unit increase in the cost, there is an expected increase of .243 in the perceived ease of use in the model. Therefore, hypothesis 4 is supported.

EMR implementation includes significant costs for first installation expenses. Therefore, when healthcare institutions decide to implement EMR systems, they have to appropriate a portion of the capital to information systems infrastructure, making it a challenge to build a state of the art system. Not all organizations can afford to do so at the onset of business as this might entail an investment of a significant kind that would represent as a heavy financial burden on the owner of the company. Some firms are hesitant to take the plunge due to the uncertainty of the amount of benefits that will accrue over the years. In the present study, the relationship between cost and ease of use is shown to be significant as displayed in table 1. In other words, health care professionals in Jordan are inclined to believe that cost of a complete HER implementation is higher than the benefits it will later provide. This result is consistent with previous studies [22-24]. It is logical to say, that based on this notion, it is not surprising that healthcare professionals list cost as the most significant barrier to complete EMR implementation. Majority of the respondents who use EMRs in Jordanian hospitals, believe that as a result of the time consuming

factor of EMRs, they have to work longer, and they don't have enough time for patients during the implementation and the initial period. Thus, the three underlying main barriers to EMR implementation are challenges faced with new technology, training and support of organization leadership, and increased time and costs.

**H3:** The result in Table 1 shows a positive and significant relationship between training and perceived ease of use ( $t = 8.757$ ,  $p > .05$ ). The result suggests that for each unit increase in the training, there is an expected increase of .296 in the perceived ease of use in the model. Therefore, hypothesis 3 is supported.

Pioneer EMR researches have embarked on the measurement of physician's perceptions regarding training after EMR implementation. One of these researches was conducted by Aaron et al (2001) who reveal from his study that residents' perceptions of sufficient training relate to perceived usefulness. Similarly, Gadd and Penrod (2001), carried out a survey involving physicians after EMR was implemented for six months and revealed that 23% of the physicians complained about insufficient training. The negative perceptions of these physicians were then related to the overall decrease in EMR satisfaction. In another related study, Lee et al (1996) reveals that physicians who undertook training sessions displayed an increased dissatisfaction of a physician order entry system as compared to those who didn't.

In addition, the result of Alan's (2004) study showed that training issues of physicians and staff are strongly significant specially in regards to computer expertise (novice to advanced) owing to the high costs of training and the absence of management support. In the present study there is a significant relationship between sufficient training and perceived ease of use as exhibited in table 1; a finding which is goes in favor with the results of the above studies and the relationship exhibited by sufficient training and management support. Users place a lot of emphasis on training as it turns out that it has a strong impact on their attitude. It is assumed that that significant relationship might be due to the prior inexperience of the users of EMRs. This is why the training complaints mainly stemmed out from the format of delivery as well as the adequacy of training. However, training is a factor that significantly increases the costs of EMRs implementation because EMR training software will require extra costs for the following: training fees, hiring a trainer to instruct and train, obtaining time and place. In some cases, staffs who are trained requests for overtime which would translate to additional stipends especially in those cases when training is not within working hours. Organizations with a limited budget, therefore, cannot afford to pay for extra training classes.

**H4:** The result in Table 1 shows a positive and significant relationship between new technology and perceived ease of use ( $t = 2.441$ ,  $p > .05$ ). The result suggests that for each unit increase in the new technology, there is an expected increase of .134 in the perceived ease of use in the model. Therefore, hypothesis 4 is supported.

The analysis reveals a significant relationship between new technology and perceived usefulness as displayed in Table 1 which is consistent with the results of prior researches [23-26] and inconsistent with others by [27]. This leads to the acceptance of the null hypothesis and to the researcher's belief that health care professionals tend to consider adopting new technology as a positive thing so long as it leads to increase in quality and efficiency. The results also show that these professionals are inclined to go through changes in their workflow for the EMR system's implementation as long as the above conditions are met.

It can be concluded that healthcare professionals are of the consensus that although some of them are willing to go through the needed changes for EMR implementations, some of their colleagues might not be so amiable to the changes due to the challenges they normally fact in using even industry-leading EMRs owing to its multiple screens and options. As a result, these utilization problems particularly when documenting progress notes, poses as extra work and time on training to some physicians. Consequently, this time and cost become significant barriers to receiving benefits as physicians will be put off from using them which then leads to lower potential for reaching quality improvement.

## 8. Conclusion and Future work

This paper discussed about EMRs and history of implementation, theory of TAM how affected by factors and the barriers that affect the implementation of EMRs and data collocation. Future research in these areas such as the study aimed at studying the situation in EMRs post-implementation, thus, a pre-implementation situation can be explored to find out the whether the displayed behaviors after the implementation has been accurately predicted. In addition to a pre-implementation survey, a supplementary qualitative data collection strategy may be carried out like interviews, observations and discussions with focus group.

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