International Journal of Engineering & Technology, 7 (4.35) (2018) 609-616

International Journal of Engineering & Technology

Website: www.sciencepubco.com/index.php/IJET

Research paper



Adoption of Cloud-based E-Health Record through the Technology, Organization and Environment Perspective

Hidayah Sulaiman[1]*, Asma Magaireh[2], Rohaini Ramli[3]

[1,3]Information Systems Department, College of Computer Science & IT,
Universiti Tenaga Nasional, Malaysia
[2]Ministry of Education. Jordan
**Corresponding author E-mail: hidayah@uniten.edu.my*

Abstract

With the ever increasing cost of investing in technological innovations and the amount of patient data to be processed on daily basis, healthcare organizations are in dire need for solutions that could provide easy access and better management of real time data with lower cost. The emerging trend of organizations optimizing cost in investing less on physical hardware has brought about the use of cloud computing technology in various industries including healthcare. The use of cloud computing technology has brought better efficiency in providing real time data access, bigger storage capacity and reduction of cost in terms of maintenance. Although numerous benefits have been publicized for organizations to adopt the technology, nevertheless the rate of adoption is still at is infancy. Hence, this study explores factors that may affect the adoption of cloud-based technology particularly within the healthcare context. A quantitative study was conducted through the distribution of survey in Jordanian healthcare facilities. The survey was conducted to gauge the understanding of cloud-based EHR concepts identified through literature and validate the factors that could potentially provide an impact towards the cloud-based EHR adoption. The theoretical underpinnings of Technology-Organization-Environment (TOE) were investigated in studying the impact towards the adoption of cloud-based EHR. Results indicate that Technology-Organization-Environment factors such as privacy, reliability, security, top management support, organizational readiness, competition and regulatory environment are critical factors towards the adoption of cloud technology within a healthcare setting.

Keywords: *Adoption, Technology, Organization, Environment, healthcare, Electronic Health Record (EHR)*

1. Introduction

In meeting demands of the current technological expectations in healthcare services, it is imperative for healthcare providers to enhance their existing Information Technology (IT) systems including the infrastructure to support the daily operations. Technologies involving patient's record, radiology and billing system are some of the most critical applications in a healthcare setting. Hence, due to the criticality, these systems are evidently costly to maintain. Patients these days demand real-time analysis and expect integration among local healthcare facilities with regard to their medical records [1]. Unfortunately, due to economic and financial reasons, the smaller healthcare facilities are unable to fully implement the IT systems, and use the manual approach of handling patients' records using a paper-based filing system [1] [41].

The numerous ways that these healthcare facilities maintain the medical records has caused difficulty for both patients and larger healthcare facilities such as the Genera Hospitals or Specialists Clinics to access patient's data [20]. Pardamean and Rumanda [35] suggested that, in order to eliminate these difficulties, the use of computing technologies involving high computing power, reliable software, and applications that provide data sharing is required. A common system that has been used in various healthcare organizations to manage patients' medical data is also known as the E-Health Records (EHR). This system provides an integration of all aspects of hospital operations from registration to pharmacy management and can be installed in many participating healthcare settings. Although, the technology provides a solution for providing a more centered approach for medical records across different healthcare facilities, nevertheless, the EHR will generate a large variety of data obtained from different clinical services and can be distributed by geographic locations by different users [5]. Due to the different input of data from different sources, this will result to difficulty in sharing and exchanging date between healthcare organizations. Therefore, it is imperative that the EHR be standardized across healthcare organizations in an integrated system environment.

Recently, there has been a rapid growth of interest in cloud computing technologies in providing solutions for healthcare organizations. It is marketed by various cloud computing vendors that cloud technologies will provide lower cost and improve access on data for business operations. Cloud computing technologies has also been argued as one of the advanced technological solutions that can be implemented in the healthcare setting to provide better services. Some of these services may include exchange of information between medical records systems with the government, specialist hospitals, patients, clinicians, pharmacists, and insurance companies [19]. However, the adoption of cloud computing is a complex process involving various success factors. It requires thorough feasibility study and evaluation before the innovation can be introduced to the organization [19]. This study is looking into the critical factors that are imperative in adopting the integrated cloud-based for e-health record system specifically looking into hospitals in developing countries. These factors are critical for the

Copyright © 2018 Authors. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.

healthcare IT operations administrators to understand and serve as a guideline to the decision-makers of the healthcare services namely in developing countries where IT adoption in healthcare studies are relatively scarce. This study will look into the adoption of cloud computing in Jordanian healthcare facilities. Jordan is a developing nation, embarking into a complete e-health system for the nation's health and well-being [49]. Governmental efforts such as introducing the healthcare the first national e-Health initiative known as Hakeem was introduced almost 10 years ago, and was overseen by the Jordanian non-benefit agency (Electronic Health Solutions) [49]. Hakeem is an EHR system expected to provide a comprehensive healthcare services to patients, through digitization that will utilize electronic medical information and services anywhere throughout the healthcare facilities in Jordan. Furthermore, this project aims to assist the management of recurring illnesses, and advanced nature of healthcare service through giving the ability of alerting patient and associated medical care center with specified exams, tests, or medication when such information is desired. Hakeem project is considered as a way forward in the Jordanian e- health services, however this project is still confronting barriers that allows seamless integration between participating hospitals [49]. In understanding the barriers and expectations of adopting a new technology, this would lead to better support for Jordanian healthcare stakeholders in embracing the initiatives towards the enhancement of the healthcare services by adopting cloud computing technology.

2. Literature Review

Cloud computing is considered as a comparatively new phenomenon in the field of technology. It is based on web or software based technology through which shared resources such as information, infrastructure and software are furnished to computers and other devices by means of a network or internet.

Among the well-known cloud computing implementations are virtual computing, utility computing, cluster computing, distributed computing, Software as a Service (SaaS), Infrastructure as a service (IaaS) and Platform as a service (PaaS), which have been integrated to bring about a technology that acquire limited space and infrastructures [20]. Numerous healthcare vendors have adopted various manifestation on e-health systems, however majority of them store medical records in unified databases as electronic records. Commonly, a patient may have several healthcare providers inclusive of essential care physicians, specialists, therapists, and other medical experts [35]. Moreover, a patient may utilize different healthcare insurance agencies for distinctive sorts of insurances, such as medical, dental, optical and other related medical problems.

Commonly, every healthcare provider maintains its own database for e-health record. Sharing data among health care organizations over managerial levels is meant imparting data between their systems [41]. This information sharing is operationalize through the electronic health records (HER) systems. The interoperation and cooperation among distinctive healthcare provider systems has been moderate to a great degree [46]. Cost and inconvenience have been referred to as the greatest hindrances to the implementation of health IT, particularly Electronic Health Records (EHR) systems [35]. Cloud computing enables an alluring IT implementation in reducing the expense of EHR as far as both organization and IT support for medical practices is concerned [46].

It is broadly perceived that cloud computing and open measures are paramount foundations to streamline healthcare whether it is for keeping up health records, observing patients, overseeing infections and coordinating effort with companions and examination of information [5]. Numerous healthcare organizations anticipate that managing healthcare applications supported by clouds will roll out progressive improvement in the way we carry out healthcare processes today. Empowering the right to gain entrance to health care "Everywhere" will not just help us enhance healthcare processes but allow our data to be available from anytime, anywhere and lead to reducing expenses [44].

Several studies and models have been proposed and tested in many current adoption research [31].Given that this study is focusing on healthcare organizations, the attention will be given to the innovation adoption from the perspectives of the organizational level [3]. This study will refer to the Technology, organization, and Environment (TOE) framework for the reason that TOE framework has been proven to offer sound theoretical ground and is well used in other empirical studies [31] Hence, it is expected that through this theoretical lenses, the adoption process would be better understood namely in the cloud computing adoption context within healthcare organizations.

2.1. Adoption through Technology-Organization-Environment Perspective

The TOE framework offers studies on factors that affect the adoption of innovation [12]. The focus has been on the perspectives of technological, organizational and environmental. The technological perspective is referring to the application of technology in organization. The organizational perspective refers to organizational matters such as management support, human resources, structure and size. The environmental perspective is looking at the problems that surround the organization such as competitors, government policy and direction as well as the nature of the industry.

Current studies that have implemented TOE suggested that TOE is indeed suitable to be applied to the adoption of IT open innovations. This includes the integrated cloud based EHR system [41]. From the perspective of this research, the cloud-based EHR is referred to as an open system and this is evident though the integration of several EHR systems in public and private health care organizations. Therefore, it is apparent that organizational, technological and environmental factors are important in ensuring the success of cloud computing adoption, which justifies the use of TOE framework in this study to establish factors affecting adoption of integrated cloud based EHR system in healthcare organization.

2.2. Technology Dimension

The technology dimension refers to the adoption of specific information technology in the organization. In view of the cloud computing technology, issues relating to data security, privacy, and reliability are the major concerns for adoption, particularly in the healthcare industry [20], [23]. As a result, establishing a secure environment for EHR data integration and sharing is indeed critical [26]. In view of TOE, this study will further explore the impact of data security, privacy, and reliability as critical factors under the technology dimension.

Previous studies have indicated that the security factor is the most important issues in the adoption of innovations in any organization [42], particularly in the adoption of cloud computing environment [26], [42]. Given the nature of cloud computing as an open environment, data security has been identified as the major concern for adoption, especially in the healthcare industry [19]. In the healthcare setting, cloud computing offers great potential for quick access to medical information and other related healthcare information. Healthcare IT infrastructure is very complex and for this reason organizations are taking additional measures to protect the transfer of patient data [23]. Therefore, this study posits that security of data plays critical role to the adoption of cloud computing in healthcare organization. This is being hypothesized as follows:

H1. Security is positively related with cloud computing adoption in EHR system.

It has been identified that privacy is one of the cloud computing concerns that could lead to utilization issue in organizations [2]. In the use of e-Health systems, privacy has been highlighted to be among the main worries [19], [2]. Obvious concerns are on the

safety of patients' records against unsolicited use by parties who have access to this data [11]. A common practice in using the system will obviously require access to patients' records. Hence, to be able to control interconnectivity between different parties can be a major issue [2], [25]. This explains the concerns that the patients, healthcare organization and other associated parties may have on the privacy and safety of their information hence the demands to see sound solution in protecting the privacy prior moving onto the cloud is imperative [41].Therefore, this study hypothesizes that:

H2. Privacy is positively related to cloud computing adoption in EHR system.

Reliability refers to the software which can provide continuous service without errors in order to keep the organizations' business operating efficiently [9]. Rahimli [37] suggests that software reliability is very important in ensuring the success of cloud computing adoption. This is due to having high reliability will be attractive to users and organizations that depend on quick responses and reliable information from cloud-based applications. Utilization of cloud computing for a critical application such as the E-Health systems requires assurances of good reliability for the provided services. In this regard, AbuKhousa et al. [2] suggested that e-Health cloud services and data should be free of error due to critical decision making that involves the lives of the patients. The research has also asserted that data in e-Health cloud should maintain its accuracy and validity regardless of possible software, hardware and network failures. The study of Rahimli [37] also indicated that reliability has a significant impact on organization's decision to cloud computing adoption. Although the importance of reliability in E-Health industry [2] and cloud computing adoption [4], [37], is clear, studies that empirically examine the influence of reliability in E -Health cloud adoption are still lacking. Therefore, this study contributes to examine this factor by the following hypothesis:

H3. Reliability is positively related to cloud computing adoption in EHR system.

2.3. Organizational Dimension

Organizational factors affect healthcare organization's intention to adopt new information systems technology [23]. In this study, the organizational dimension represents top management support, and organizational readiness.

Many previous studies found that the top management support is an imperative factor for organizations looking to create a supportive environment and providing the suitable resources required for the adoption of cloud computing [3], [25], [26]. Top management support refers to whether or not the executives understand the nature and functions of cloud computing technology and therefore fully support the innovation [23]. Studies have indicates that as the complexity of technologies increases, the top management support is essential in ensuring successful integration of resources, reengineering of processes, and maintaining potential organizational change through an expressed vision and commitment as well as sending positive signals of confidence to all employees of the organization [25]. Lumsden and Anabel [26] added that the top management plays an important role in overcoming any barriers and resistance to changes. The study of Lian, Yen & Wang [23] found that top manager's support is a critical factor affecting the cloud computing adoption in hospitals. Additionally, the adoption of cloud computing technology is usually a large project and a huge undertaking for hospitals. Lian, Yen & Wang [23] have added if a given hospital has a good top manager's involvement, then the adopting of cloud computing technology will be met in a positive manner. Therefore, this study posits the following hypothesis:

H4. Top management support is positively related to cloud computing adoption in EHR system.

The organizational readiness of refers to the readiness of the organization as a whole in terms of infrastructure, human resources and financial sustainability to adopt the new technology [25]. Infrastructure refers to the overall communication backbone, network technologies and systems implemented in the organization, which is able to provide a platform to the cloud computing applications. The human resources refer to employees who are with the knowledge and skills to implement cloud-computing-related IT applications [25], [43]. The proposed cloud computing services will only become part of an organizations value chain activities if they have the necessary infrastructure, strong financial capabilities and employee competency [25]. Hence, organizations that have the readiness are better primed for adoption of cloud computing. Lian, Yen & Wang [23] also highlights that any healthcare organization that has readiness such as adequate human resource support, good financial standing and adequate IT infrastructure, the adoption of cloud computing technology will then be more successful. Therefore, this study hypothesizes that:

H5. Organizational readiness is positively related to cloud computing adoption in EHR system

2.4. Environmental Dimension

The environmental dimension represents the current operating environment of the healthcare industry. This will no doubt provide an impact to healthcare organizations as they adopt new information systems [23].

Within the environmental context, the regulatory environment has been recognized as a critical factor influencing innovations adoption in organizations [45]. Regulatory environment refers to government policy that affects innovation acceptance in society [46]. Cushman et al. [10] claims that a broad social acceptance to health record system in hospitals requires appropriate regulatory environment. Accordingly, governments can encourage IT innovation's assimilation through supportive regulations and policies in areas involving supportive legislation on key issues such as digital signatures,regulating the internet to make it a trustworthy business platform through privacy and consumer protection laws and dealing with fraud and misuse. Other than that, providing incentives for using e-transactions in government by offering technical support, training, and funding for the use of e-transactions may also be applied [46]. Studies have highlighted that the regulatory environment plays a critical role in the adoption of IT innovations in healthcare organizations. Chang et al. [7] have found that regulatory environment is a significant factor to adopt e-signature in hospitals. Similarly, Cushman et al. [10] concluded that the regulatory environment affects the adoption of personal health record systems. In cloud computing domain, Lian, Yen & Wang [23] have identified that government policy to be an environmental factor which could affect cloud computing adoption in healthcare organizations. However, Lian, Yen & Wang [23] have ignored legislative considerations in addressing regulatory environment. Legislative is considered as one of the main components of the regulatory environment, especially, in e-healthcare context [10], [46]. AbuKhousa et al. [2], argues that there are still no clear or well established legislations and laws for the electronic capturing of patient data through the e-practices of healthcare. [13]. Dua'a, Othman & Yahya [13], also highlights that the regulations for protection of patient data are still unclear in many countries namely developing countries that are still implementing various types of heathcare technologies. Such shortage suggests a lack of standards for medical informatics, policies, interoperability, and transmission methods for E-Health cloud technology [2]. In such a case, the stakeholders in the E-Health cloud do not have a solid base to start offering and implementing the technology [19]. As a result, more problems and distrust may occur in healthcare cloud-based due to this shortcomings [36]. As such this study hypothesizes that:

H6. Regulatory environment is positively related to cloud computing adoption in EHR system.

Competitiveness in this study refers to the extent in which an organization is being put under pressure by its competitors' performance. Competitive pressure is seen as motivation and adoption driver [22], [26]. Various industries possess the characteristics of

being in need of a rapid change in response to becoming largely aware of their competitors' adoption of technology and inclining towards following the technological trend [26]. Via the adoption of cloud computing, organization will benefit from operational excellence, more accurate presentation of data and sound understanding of market visibility [25]. Pressures resulting from the competitors adoption of technology has lead to outsourcing of IT infrastructure among organizations in a hope to not only improve the standard of service but also sourcing for a more competitive pricing, as an attempt to elevate their market share [26]

The healthcare sector has dramatically changed in their business operations. The competition between hospitals has become more intense, hence, led to the increase in competition. This has forced the hospitals to adopt new innovations quickly to provide better services and gain strategic advantage [23]. The current e-healthcare studies confirmed that the competition has significantly impacted hospitals' decision in adopting new innovations [23], [24]. Consequently, this study hypothesizes that:

H7. Competitiveness is positively related to cloud computing adoption in EHR system.

3. Methodology

This study adopts a quantitative methodology through a statistical analysis on a survey conducted to various healthcare settings. In order to empirically prove the hypothesis, a survey was distributed to 106 IT personnel of Jordanian hospitals. Jordan was selected as a case representing a developing country that has strong economic and financial sustainability investing towards a healthcare reform using technological innovations. The Jordanian hospitals' sector consists of four types of hospitals which are: public hospitals, private hospitals, Ministry of Defense hospitals or military Hospitals, and university hospitals. The senior IT officers working in Jordanian hospitals have helped to compile the mailing list for the targeted samples. Samples comprise of officers involved in working for the development of IT framework and they have been involved in the awareness programs related to cloud computing technology. An online survey was conducted using Google Docs, where the link to the survey was emailed the targeted samples through the mailing list compiled. However, 22 questionnaires were distributed off-line, due to the technical issues of the respondent's e-mails. Statistical Package for Social Science (SPSS) application was used for data analysis of the questionnaire, variables examination used to gauge the effectiveness of the variable data on this research and the frequencies to quantify the respondents' view over each item from the questionnaire. Correlation analysis between variables is done to understand to what extent the variables are related to each other [47]. Pearson correlation is used in this study since it is the most common statistical measure to indicate the linear relationship between two variables [47]. The Pearson correlation value ranges between +1 to -1. If the correlation value is closer to +1, this indicates that there is a perfect positive linear relationship between variables [. There were 97 responses collected and 2 of the responses were dismissed for errors. Hence, the number of valid responses are 95 which provides 89% of response rate for this study.

4. Results

The correlation between variables is defined as a measure to what extent the variables are related to each other [34]. Pearson correlation is the most common statistics measure to shows the linear relationship between two variables [34]. Given that the data provided a normal distributed value, hence Pearson correlation was used. The Pearson correlation value ranges between +1 to -1. If the correlation value is closer to +1, it will indicate that there is a perfect positive linear relationship between variables [29].

Table 1: Pearson Correlation

		AD	SC	PR	RL	MS	OR	RE	CO
AD	Pearson Correlation	1							
	Sig. (2-tailed)								
	N	95							
SC	Pearson Correlation	.735**	1						
	Sig. (2-tailed)	.000							
	N	95	95						
PR	Pearson Correlation	.864**	.800**	1					
	Sig. (2-tailed)	.000	.000						
	N	95	95	95					
RL	Pearson Correlation	.801**	.773**	.853**	1				
	Sig. (2-tailed)	.000	.000	.000					
	N	95	95	95	95				
MS	Pearson Correlation	.867**	.807**	.930**	.954**	1			
	Sig. (2-tailed)	.000	.000	.000	.000				
	N	95	95	95	95	95			
OR	Pearson Correlation	.843**	.798**	.873**	.825**	.878**	1		
	Sig. (2-tailed)	.000	.000	.000	.000	.000			
	N	95	95	95	95	95	95		
RE	Pearson Correlation	.501**	.414**	.528**	.508**	.502**	.483**	1	
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000		
	N	95	95	95	95	95	95	95	
CO	Pearson Correlation	.817**	.735**	.852**	.718**	.800**	.814**	.445**	1
	Sig. (2-tailed)	.000	.000	.000	.000	.000	.000	.000	
	N	95	95	95	95	95	95	95	95

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 1 indicates the correlation between factors that affect the adoption of cloud-based EHR and the total score of cloud-based EHR adoption in Jordanian hospitals. The highest correlation is between Top Management Support (MS), and cloud-based EHR adoption (AD) in Jordanian hospitals. The high positive correlation of 0.867 indicates that when the Top Management Support (MS) score increases the EHR adoption in Jordanian hospitals also increases. Therefore, it can be said that top management support is positively related to cloud computing adoption in EHR system and the hypothesis (H4) is accepted. Privacy (PR) is the second highest correlation with the adoption of cloud-based EHR in Jordanian hospitals with the positive correlation of 0.864, which demonstrates that the adoption of cloud-based EHR increases when the privacy (PR) increases. Therefore, privacy is positively related to cloud computing adoption in EHR system and that leads to the acceptance of the hypothesis (H2).There is also a high positive

correlation between competitiveness (CO) and the adoption of cloud-based EHR in Jordanian hospitals with the correlation of 0.817, which means that when competitiveness score increases the EHR adoption in Jordanian hospitals will also increase. Thus, it can be deduced that competitiveness is positively related to cloud computing adoption in EHR system and (H7) is therefore accepted. Organizational readiness (OR) has a good positive correlation with the adoption of cloud-based EHR in Jordanian hospitals with a correlation of 0.843, thus, it is clear that the adoption of cloud-based EHR in Jordanian hospitals increases when organizational readiness increases. Therefore, organizational readiness is positively related to cloud computing adoption in EHR system and (H5) is accepted. Reliability (RL) is another variable that correlates positively with the adoption of cloud-based EHR in Jordanian hospitals with correlation of 0.801, which shows that the adoption of cloud-based EHR increases when the reliability increases, hence, reliability can be considered to be positively related to cloud computing adoption in EHR system, and that leads to the acceptance of the hypothesis (H3).Similarly, security (SC) is significantly positive and correlated with adoption of cloud-based EHR in Jordanian hospitals with correlation of 0.735, as it increases the adoption of cloud-based HER will also increase. Thus, it can be said that the security is positively related with cloud computing adoption in EHR system, and that leads to conclude that (H1) can be accepted. The correlation between regulatory environment (RE) and cloud-based EHR adoption is 0.501. Although it seems a bit weak than the rest of the other factors, nevertheless there is still some positive relation towards EHR adoption. Therefore, it can be said that the regulatory environment is positively related to cloud computing adoption in EHR system. Hence, hypothesis (H6) is accepted.

Table 2: Hypotheses test results

H	Code	Statement	Pearson Correlation	Rank	Accepted \ Rejected
H1	SC	The security is positively related with cloud computing adoption in EHR system.	0.735	6	Accepted
H2	PR	Privacy is positively related to cloud computing adoption in EHR system.	0.864	2	Accepted
H3	RL	Reliability is positively related to cloud computing adoption in EHR system	0.801	5	Accepted
H4	MS	Top management support is positively related to cloud computing adoption in EHR system.	0.867	1	Accepted
H5	OR	Organizational readiness is positively related to cloud computing adoption in EHR system.	0.843	3	Accepted
H6	RE	Regulatory environment is positively related to cloud computing adoption in EHR system.	0.501	7	Accepted
H7	CO	Competitive is positively related to cloud computing adoption in EHR system.	0.817	4	Accepted

5. Discussion

The theoretical foundation of the proposed framework is based on Technology, Organization, and Environment (TOE) Model [12]. Figure 2 describes the general components of the proposed framework on the factors that affect the adoption of cloud-based EHR system in Jordanian hospitals. This section explains the components of the Cloud-Based EHR Adoption (CEHRA) model. The CEHRA model consists of three main parts; Technological dimension which include privacy, reliability, and security factors. The Organizational dimension which consists top management support, and organizational readiness and finally the Environmental dimension which contains competition and regulatory environment factors.

The technological dimension refers to the technology applications whether internal or external to the Jordanian hospitals. Results of questionnaire analysis indicated that the technological factors do affect the adoption of cloud-based EHR in Jordanian hospitals. Ranked by the level of importance are Privacy, Reliability and Security, respectively. Privacy has been established to be the main technological factor that would affect the adoption of Jordanian cloud-based EHR system. This is prompted by the facts that both patients' personal information and privacy have been acknowledged to be a sensitive matter [50]. It also involves storing and processing sensitive data about patient's health status. Therefore, there are many concerns from Jordanian hospitals about the patient's information being stored in EHR for fear that the confidentiality may be tampered while being stored on cloud. Therefore, the concerns about the protection of patients' information could affect the Jordanian hospitals' decision to adopt cloud-based EHR.

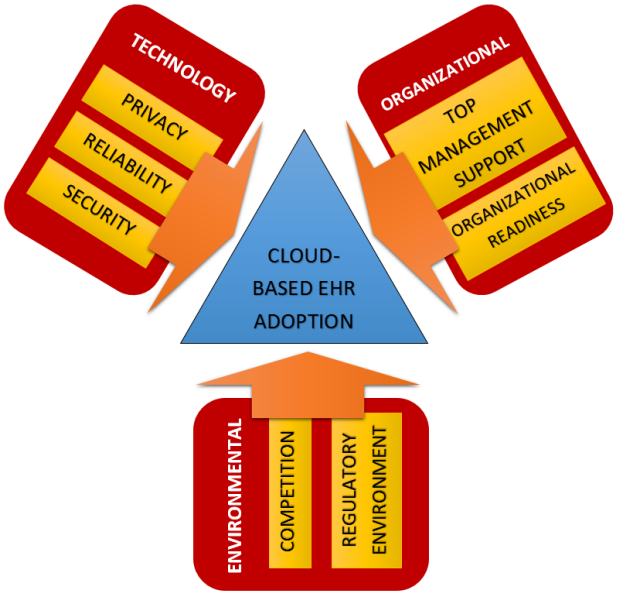


Fig 2: Cloud-Based EHR Adoption (CEHRA) Model

Should the Jordanian hospitals adopt cloud-based EHR, it is imperative that measures must be taken to ensure that the data being handled and utilized is consistent and free of errors [51]. This is due to, the nature of data in healthcare sector being critical for decision making that may directly affect patients' life and wellbeing [51]. Findings of this study also supports the study of Zhang et. Al [52], which indicates reliability of healthcare data is an important factor affecting adoption of cloud-based EHR adoption. The Jordanian hospitals' ability to trust that the cloud providers will deliver the requested service constantly, and with accurate information, will affect the hospitals' decision to adopt cloud-based EHR. In this scenario, the reliability of cloud-based EHR system could be a strong incentive to the adoption. Hospitals are currently having to endure many challenges in managing patients' records such as handling volumes of medical records, patient's

data and managing claims for health insurance. As a result, the reliability of data obtained from cloud will be beneficial in the adoption of cloud-based EHR especially from the perspectives of easy and accurate access to patients' information.

In Jordanian hospital, there have been concerns with regard to security of data associated with cloud-based EHR. Being an open environment that has allowed sharing of data among hospitals, it is very important that measures are taken to ensure suitable and adequate access control, secure transferring of data mechanism and reliable authentication mechanism are in place. Findings of this study also indicate that Jordanian hospitals have concerns about security issues such as the transmission, storage, and the usage of data in cloud-based EHR system. Therefore, they believed that the ability to be sure that cloud-based EHR is secure and the confidentiality of information stored are intact will affect the adoption of cloud-based HER.

Organizational dimension looks at different issues within the Jordanian hospitals. In this study, the findings have demonstrated that the top management support, and organizational readiness are critical organizational elements that affect the Jordanian hospitals' initiatives to adopt cloud-based EHR system. Top management support has also been established to be one of the important factors that will influence the adoption of cloud-based EHR system in Jordanian hospitals. The contribution of top management support in adoption of cloud-based EHR is manifested in the financial resource allocation, the provision of administrative approvals to facilitate changes on organizations and process improvements. In addition, the encouragement given to the employees to embrace cloud-based EHR is equally important. Should the senior management are not willing and do not show the willingness to technological advancements, hence the adoption will risk failure. It is well known that, the top management's vision, and supports are instrumental and hold very crucial position in ensuring success prior to the adoption process as well as after the technology has been adopted [41]. Awareness of top management in the benefits of cloud-based EHR could create a positive environment for its adoption. In actual fact, cloud computing is still in its infancy in Jordan, and is still a vague subject for many healthcare organizations. Hence, the extent of awareness among the decision makers in the Jordanian hospitals about how advantageous cloud computing is can increase their conviction in adopting this technology in their work activities.

Organizational readiness revolves around the organizational elements of infrastructure, human resources, and sufficient financial standing to ensure that cloud-based EHR system is properly adopted. Findings of this study also indicated that lack of experiences among employees, and limited financial resources in most Jordanian hospitals have lead to major issues affecting the adoption of cloud-based EHR. However, the interviews results in previous study [41] have indicated that cloud providers in Jordan stated that sufficient work knowledge is the basis for adopting any IT innovation. Hence, immediate action plan is to conduct advertising campaigns, pre-implementation and post-implementation training, and brochures to educate healthcare users on the use of new technology.

The results of this study also found that organizational readiness also motivate Jordanian hospitals in understanding that the main advantages of cloud computing in healthcare organizations is to reduce IT costs [2].Currently, Jordanian healthcare sector is facing numerous challenges pertaining to technological infrastructure namely in rural areas and small clinics where organizational readiness are limited both from the perspectives of infrastructures, financial standing and experts. Moreover, the phenomenon of technological divide in comparison to other healthcare organizations can also be a challenge. Most IT applications in other healthcare organizations in Jordan are of semi-autonomous and not standardized. There are different EHR applications, different programing languages, different applications and screens for different purposes. Hence, an integrated cloud computing approach will be the best option to overcome these challenges.

Environmental dimension refers to issues surrounding the Jordanian hospitals. The identified environmental factors that could affect the adoption of cloud-based EHR system in Jordanian hospitals are competition and regulatory environment. Competition is another important factor to be considered in adopting IT innovations [50]. In the early 2000s, there have been major development in medical services in the Jordanian healthcare sector [49]. Due to the massive implementation of a new healthcare services strategy, there have been fierce competition among hospitals to provide better services [49]. The competition revolves around the use of latest IT applications in various healthcare facilities. Thus, it is not surprising that Jordanian hospitals do look forward in adopting cloud-based HER. This decision is undertaken in order to maximize their market share, reduce cost, achieve effectiveness in service delivery, and face the competition pressures. The results of previous healthcare technology related studies [5], [13], have indicated that hospitals do accept that the adoption of cloud-based EHR can be a major strategy for improving the competitive advantage, and will affect the level of its operations in the future. Therefore, Jordanian hospitals are also seriously looking into adopting integrated cloud-based innovations in its daily operations.

Regulatory environment refers to government policy that affects innovation acceptance in society [46]. The results found that the regulatory environment is a critical factor that affects the adoption of cloud-based EHR in Jordanian hospitals. It has been established that these initiatives have improved the opportunities for investment in Jordanian IT market, changed the society's perspectives in creating technological culture and automation in the healthcare processes by using e-services. Hence, the Jordanian government's policy in establishing a holistic IT implementation will sanction a promising environment for the healthcare institutions. Thus, reducing the barriers and costs in terms of maintenance. However, the findings of this study also indicates that the absence of legislatives ground that governs cloud computing process in Jordan will increase the concerns of Jordanian hospitals on the adoption of cloud-based EHR. Reputation will be tarnished, and be subjected to legal matters in the event that the confidentiality of the patients' information is compromised. Lack of legal policy is one of the main challenges in facing adoption of cloud computing in healthcare sectors [2] especially when cloud computing is considered as a new phenomenon. Therefore, the lack of well-established regulations could hinder the positive outlook of cloud-based EHR system among the Jordanian hospitals.

6. Conclusions

This study introduces healthcare adoption factors imperative for the adoption of new technology through the Cloud-Based EHR Adoption (CEHRA) model. The proposed model provide critical factors that will allow decision makers to consider upon implementing cloud-based EHR in healthcare settings similar to the environment of the Jordanian healthcare settings.

Findings have confirmed that the factors are positively related to the cloud-based EHR adoption namely through top management support and privacy of data. There have been evidence of concerns coming from the decision makers in the Jordanian hospitals about privacy and security issues in relation to the adoption of cloud-based EHR systems which could be the stumbling block in the cloud-based EHR adoption initiative. From the perspective of regulatory environment, the findings of this study have recognized that there is a lack of legislatives ground to govern cloud computing process in Jordan which will subsequently increase the concerns of Jordanian hospitals about the adoption of cloud-based EHR. The lack of well-established regulations could increase the concerns of Jordanian hospitals from adopting cloud-based EHR system. Therefore, in the perspective of a developing country, a top-down approach for the adoption of new technologies and innovations is still considered as the main driving factor. Nevertheless, this study has also proven that as a stepping stone towards the

adoption of new technologies in a healthcare setting such as the cloud computing technology, practitioners can still refer to the basic technology, organization and environmental factors to ensure that the success of adoption is embraced by healthcare users in a more acceptable and holistic manner.

Acknowledgement

The researchers would like to thank the Jordanian hospitals personnel and all anonymous researchers who were involved in this study.

References

[1] Abdollahzadehgan, A., Gohary, M. M. & Amini, M. 2013. The Organizational Critical Success Factors For Adopting Cloud Computing In Smes. Journal Of Information Systems Research And Innovation (Jisri), 4, 67-74.

[2] Abukhousa, E., Mohamed, N. & Al-Jaroodi, J. 2012. E-Health Cloud: Opportunities And Challenges. Future Internet, 4, 621-645.

[3] Alshamaila, Y., Papagiannidis, S. & Li, F. 2013. Cloud Computing Adoption By Smes In The North East Of England: A Multi-Perspective Framework. Journal Of Enterprise Information Management, 26, 250-275.

[4] Behrend, T. S., Wiebe, E. N., London, J. E. & Johnson, E. C. 2011. Cloud Computing Adoption And Usage In Community Colleges. Behaviour & Information Technology, 30, 231-240.

[5] Bisbal, J. & Berry, D. 2009. An Analysis Framework For Electronic Health Record Systems. Methods Of Information In Medicine, 48.

[6] Cao, Q., Baker, J., Wetherbe, J. & Gu, V. 2012. Organizational Adoption Of Innovation: Identifying Factors That Influence Rfid Adoption In The Healthcare Industry. Ecis 94.

[7] Chang, I., Hwang, H.-G., Hung, M.-C., Lin, M.-H. & Yen, D. C. 2007. Factors Affecting The Adoption Of Electronic Signature: Executives' Perspective Of Hospital Information Department. Decision Support Systems, 44, 350-359.

[8] Chong, A. Y.-L. & Chan, F. T. 2012. Structural Equation Modeling For Multi-Stage Analysis On Radio Frequency Identification (Rfid) Diffusion In The Health Care Industry. Expert Systems With Applications, 39, 8645-8654.

[9] Chu, R., Lai, I. K. & Lai, D. C. Trust Factors Influencing The Adoption Of Cloud-Based Interorganizational Systems: A Conceptual Model. Engineering, Management Science And Innovation (Icemsi), 2013 International Conference On, 2013. Ieee, 1-3.

[10] Cushman, R., Froomkin, A. M., Cava, A., Abril, P. & Goodman, K. W. 2010. Ethical, Legal And Social Issues For Personal Health Records And Applications. Journal Of Biomedical Informatics, 43, S51-S55.

[11] Doukas, C., Pliakas, T. & Maglogiannis, I. Mobile Healthcare Information Management Utilizing Cloud Computing And Android Os. Engineering In Medicine And Biology Society (Embc), 2010 Annual International Conference Of The Ieee, 2010. Ieee, 1037-1040.

[12] DePietro, Rocco, Wiarda, Edith & Fleischer, Mitchell (1990). "The context for change: Organization, technology and environment", in Tornatzky, L. G. and Fleischer, M. (Eds.) *The processes of technological innovation*, Lexington Books: Lexington, MA., pp. 151-175.

[13] Dua'a, N., Othman, M. & Yahya, H. 2013. Implementation Of An Ehr System (Hakeem) In Jordan: Challenges And Recommendations For Governance. Him-Interchange.

[14] Gavrilov, G. & Trajkovik, V. 2012. Security And Privacy Issues And Requirements For Healthcare Cloud Computing. Ict Innovations 2012, Web Proceedings Issn 1857-7288, 143.

[15] Grandon, E. E. & Pearson, J. M. 2004. Electronic Commerce Adoption: An Empirical Study Of Small And Medium Us Businesses. Information & Management, 42, 197-216.

[16] Harrison, D. A., Mykytyn Jr, P. P. & Riemenschneider, C. K. 1997. Executive Decisions About Adoption Of Information Technology In Small Business: Theory And Empirical Tests. Information Systems Research, 8, 171-195.

[17] Hsiao, S.-J., Li, Y.-C., Chen, Y.-L. & Ko, H.-C. 2009. Critical Factors For The Adoption Of Mobile Nursing Information Systems In Taiwan: The Nursing Department Administrators' Perspective. Journal Of Medical Systems, 33, 369-377.

[18] Karahanna, E., Straub, D. W. & Chervany, N. L. 1999. Information Technology Adoption Across Time: A Cross-Sectional Comparison Of Pre-Adoption And Post-Adoption Beliefs. Mis Quarterly, 183-213.

[19] Kazley, A. S. & Ozcan, Y. A. 2007. Organizational And Environmental Determinants Of Hospital Emr Adoption: A National Study. Journal Of Medical Systems, 31, 375-384.

[20] Kuo, A. M.-H. 2011. Opportunities And Challenges Of Cloud Computing To Improve Health Care Services. Journal Of Medical Internet Research, 13.

[21] Kuo, M.-H., Guo, Y. & Sahama, T. Cloud Computing For Healthcare Research Information Sharing. Proceedings Of The 2012 Ieee 4th International Conference On Cloud Computing Technology And Science (Cloudcom), 2012. Ieee Computer Society, 889-894.

[22] Laforet, S. 2011. A Framework Of Organisational Innovation And Outcomes In Smes. International Journal Of Entrepreneurial Behaviour & Research, 17, 380-408.

[23] Lian, J.-W., Yen, D. C. & Wang, Y.-T. 2014. An Exploratory Study To Understand The Critical Factors Affecting The Decision To Adopt Cloud Computing In Taiwan Hospital. International Journal Of Information Management, 34, 28-36.

[24] Liu, W. & Park, E. 2013. E-Healthcare Cloud Computing Application Solutions.

[25] Low, C., Chen, Y. & Wu, M. 2011. Understanding The Determinants Of Cloud Computing Adoption. Industrial Management & Data Systems, 111, 1006-1023.

[26] Lumsden, J. R. I. & Anabel, G. 2013. Understanding The Determinants Of Cloud Computing Adoption Within The Uk. European, Mediterranean & Middle Eastern Conference On Information Systems. Windsor, United Kingdom.

[27] Lupse, O. S., Vida, M. M. & Stoicu-Tivadar, L. Cloud Computing And Interoperability In Healthcare Information Systems. Intelli 2012, The First International Conference On Intelligent Systems And Applications, 2012. 81-85.

[28] Mahler, A. & Rogers, E. M. 1999. The Diffusion Of Interactive Communication Innovations And The Critical Mass: The Adoption Of Telecommunications Services By German Banks. Telecommunications Policy, 23, 719-740.

[29] Miles, J. 2012. Correlation And Regression. Research Methods In Psychology, 243.

[30] Moh 2013. Annual Report 2013. Jordanian Ministry Of Health: Jordanian Ministry Of Health.

[31] Ndubisi, N. O. & Jantan, M. 2003. Evaluating Is Usage In Malaysian Small And Medium-Sized Firms Using The Technology Acceptance Model. Logistics Information Management, 16, 440-450.

[32] Oliveira, T. & Martins, M. F. 2011. Literature Review Of Information Technology Adoption Models At Firm Level. The Electronic Journal Information Systems Evaluation, 14, 110-121.

[33] Paiti, T. 2013. What Are The Opportunities And Challenges Of Cloud Computing Technology In The Healthcare Information Systems.

[34] Pallant, J. 2007. Spss Survival Manual.

[35] Pardamean, B. & Rumanda, R. R. Integrated Model Of Cloud-Based E-Medical Record For Health Care Organizations. 10th Wseas International Conference On E-Activities, 2011. 157-162.

[36] Piliouras, T., Yu, P. L., Su, Y., Siddaramaiah, V. K. A., Sultana, N., Meyer, E. & Harrington, R. Trust In A Cloud-Based Healthcare Environment. Emerging Technologies For A Smarter World (Cewit), 2011 8th International Conference & Expo On, 2011. Ieee, 1-6.

[37] Rahimli, A. 2013. Factors Influencing Organization Adoption Decision On Cloud Computing. International Journal Of Cloud Computing And Services Science (Ij-Closer), 2, 141-147.

[38] Rolim, C. O., Koch, F. L., Westphall, C. B., Werner, J., Fracalossi, A. & Salvador, G. S. A Cloud Computing Solution For Patient's Data Collection In Health Care Institutions. Ehealth, Telemedicine, And Social Medicine, 2010. Etelemed'10. Second International Conference On, 2010. Ieee, 95-99.

[39] Rui, G. 2007. Information Systems Innovation Adoption Among Organizations-A Match-Based Framework And Empirical Studies.

[40] Sekaran, U. 2003. Research Methods For Business: A Skill Building Approach. 2003. John Willey And Sons, New York.

[41] Sulaiman, H., & Magaireah, A. I. (2014, November). Factors affecting the adoption of integrated cloud based e-health record in healthcare organizations: A case study of Jordan. In Information

Technology and Multimedia (ICIMU), 2014 International Conference on (pp. 102-107). IEEE.
[42] Tehrani, S. R. & Shirazi, F. 2014. Factors Influencing The Adoption Of Cloud Computing By Small And Medium Size Enterprises (Smes). Human Interface And The Management Of Information. Information And Knowledge In Applications And Services. Springer.
[43] Wang, C., Wang, Q., Ren, K., Cao, N. & Lou, W. 2012. Toward Secure And Dependable Storage Services In Cloud Computing. Services Computing, Ieee Transactions On, 5, 220-232.
[44] Wu, R., Ahn, G.-J. & Hu, H. Secure Sharing Of Electronic Health Records In Clouds. Collaboratecom, 2012. 711-718.
[45] Zhu, K. & Kraemer, K. L. 2005. Post-Adoption Variations In Usage And Value Of E-Business By Organizations: Cross-Country Evidence From The Retail Industry. Information Systems Research, 16, 61-84.
[46] Zhu, K., Kraemer, K. L. & Xu, S. 2006. The Process Of Innovation Assimilation By Firms In Different Countries: A Technology Diffusion Perspective On E-Business. Management Science, 52, 1557-1576.
[47] Pallant, J. (2005). SPSS Survival Manual: A Step By Step Guide to Data Analysis Using SPSS for Windows (Version.)
[48] Schwab, D. P. (2013). Research methods for organizational studies. Psychology Press.
[49] Al-Nassar, B. A. Y., Abdullah, M. S. & Osman, W. R. S. 2011b. Overcoming Challenges To Use Electronic Medical Records System (Emrs) In Jordan Hospitals. Ijcsns, 11, 51.
[50] Bayer, R., Santelli, J., & Klitzman, R. (2015). New challenges for electronic health records: confidentiality and access to sensitive health information about parents and adolescents. Jama, 313(1), 29-30.
[51] Raghupathi, W., & Raghupathi, V. (2014). Big data analytics in healthcare: promise and potential. Health information science and systems, 2(1), 3.
[52] Zhang, Y., Qiu, M., Tsai, C. W., Hassan, M. M., & Alamri, A. (2017). Health-CPS: Healthcare cyber-physical system assisted by cloud and big data. IEEE Systems Journal, 11(1), 88-95.