

The Assessment of Cloud Computing Technology in Health Care Records Management: Opportunities and Challenges

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Abstract: *The major purpose of this research was to carry out assessment on challenges and opportunities of cloud computing technologies in health care records management in Kampala International University in Tanzania Teaching Hospital (KIUT-TH). The case study research design was used because a case study is a comprehensive description and analysis of a single situation or a number of specific situations. A self-designed structured questionnaire was used to collect data from 150 respondents selected randomly from Information Technology (IT) experts, faculty administrators from the school of allied sciences, and Students of KIUT-TH. The researchers collected 150 completed questionnaires from the respondents. Data were analyzed using percentage, frequency and statistics. The findings of this research indicate that the management of the security of Patients' data and its privacy is a critical challenge in many hospitals where the common data security challenge and privacy address issues stemming from fraud, and theft, from both internal and external threat actors, of a particular data set of information. Constant medical supervision of chronic patients or habitants at remote, isolated and underserved locations, and readily available healthcare information updates was found to be a very good opportunity of integrating cloud computing technologies in healthcare records management. It is therefore recommended by the researchers that the standard security measures such as Intrusion Detection systems (IDSs) and Biometrics systems should be put in place to minimize data and information insecurity. The researchers also recommend that staff training on how to use the cloud computing system be conducted and the use of secure supported applications should be implemented as a mechanism to prevent internal and external patients' data loss.*

Keywords: Cloud Computing Technologies, Security, Health Records, Management System

1. Introduction

The realization of health information management through mobile devices introduces several challenges, like data storage and management (e.g., physical storage issues, availability and maintenance), interoperability and availability of heterogeneous resources, security and privacy (e.g., permission control, data anonymity, etc.), unified and ubiquitous access. One potential solution for addressing all aforementioned issues is the introduction of Cloud Computing concept in electronic healthcare systems. Cloud Computing provides the facility to access shared resources and common infrastructure in a ubiquitous and pervasive manner, offering services on demand over the network to perform operations that meet changing needs in electronic healthcare application. In this context HealthCloud is a pervasive healthcare information management system for mobile devices utilizing Cloud Computing and Android Operating System (OS) (Upkar Varshney, 2003).

In United States (US), cloud computing technology is used in various health sectors for patients' record and management purposes. The US Department of Health & Human Services' Office of the National Coordinator for Health Information Technology recently chose Acumen Solutions' cloud-based customer relationship management and project management system for the selection and implementation of Electronic Health Record (EHR) systems across the United States. The software enables regional extension centers to manage interactions with medical providers related to the selection and implementation of an EHR system (Editorial Staff, 2010)

In Europe, a consortium including IBM, Sirrix AG security technologies, Portuguese energy and solution providers Energias de Portugal and EFACEC, San Raffaele Hospital (Italy), and several European academic and corporate research organizations contracted Trustworthy Clouds computing which provide health care services and a more patient-centered home health care service to remotely monitor, diagnose, and assist patients outside of a hospital setting. The complete lifecycle, from prescription to delivery to intake to reimbursement, will be stored in the cloud and will be accessible to patients, doctors, and pharmacy staff (IBM Press Room, 2010).

In Australia, Telstra and the Royal Australian College of General Practitioners announced the signing of an agreement to work together to build an eHealth cloud computing for health care services. Telstra is one of the leading telecommunications providers in Australia; the College is the largest general practice representative body in Australia with more than 20,000 members and over 7000 in its National Rural Faculty. The eHealth cloud computing will host health care services applications including clinical software, decision-support tools for diagnosis and management, care plans, referral tools, prescriptions, training, and other administrative and clinical services (Korea IT Times, 2010)

In Africa, it is understood that maintenance of cloud computing and other technologies is usually one of the major problems in the public and private health sectors, as everybody's property is usually no one's, and therefore no one takes responsibility for keeping it up to date and making repairs. African countries have to embrace cloud computing

technology to close the health care gap, and private-public partnerships which can help with that. It is also reported that many African countries spend less than 10% of their Gross Domestic Product (GDP) on investing in healthcare technologies like cloud computing. Also, there is a shortage of trained health care professionals from Africa because many of them prefer to live and work in places like the U.S. and Europe (Lily B. Clausen, 2015).

It is reported in Uganda that several hospitals fail to work together because of the incompatibility of cloud computing equipment and software related technologies. Related to this is the presence and availability of experts in real time. In cases where consultations have to be made across continents, there is also the issue of time difference and presence of experts when they are required. Also problems associated to cost of accessing the internet, maintaining the equipment and buying new ones is also challenge. In other cases costs of installing internet facilities and maintaining it is also as challenge for poor countries like Uganda (Kasozi, M. and Nkuuhe, J, 2003)

2. Purpose of the Study

The major purpose of the study was to carry out assessment on challenges and opportunities of cloud computing technologies in health care records management in Kampala International University in Tanzania Teaching Hospital (KIUT-TH). The following research questions guided the research.

- 1) What are the challenges of cloud computing technologies in health care records management at KIUT-TH?
- 2) What are the opportunities of cloud computing technologies in health care records management system at KIUT-TH

3. Literature Review

Related Studies

Saldarriaga et al (2013) pointed out that a mobile application developed for ambulatory electrocardiographic monitoring based on Android and iOS (iPhone Operating System) helps medical personnel to guide diagnose procedures efficiently using their smartphone and manage the daily activities connecting different zones. Kardia board is used to acquire Electrocardiogram (ECG) data from patient and this data is sent to smartphone (Android phone or phone use Apple IOS). The developed application at smartphone analyses, process, and uploads data to remote server in cloud where further processing is done. The application helps doctors and patients to access, view and monitor the patient health status. By using this application, doctors are able to receive ECG waveform from data bases in smartphones which may lead the diagnosis to serious problems. Doukas et al (2011), state that they have developed a wearable – textile platform based on open hardware and software that collects motion and heartbeat data and stores them wirelessly on an open Cloud infrastructure for monitoring and further processing. Sensors are attached to patient body which collects bio-signal (heart rate, pulse rate, blood pressure and temperature), motion data of the patient and send data to the smartphone of patient using Bluetooth link. Smartphone forwards data to Google Cloud Service centre using REST Web services.

Unbualim et al (2012) stated that through cloud computing technology, the communication between patients and doctors can be improved by using social media such as facebook or twitter or any other social networking sites. The communication will be between patient to doctors, doctors to doctors and patient to other patients. Doctors communicate with other doctors to share information about health or medical cases that they handle. It will give benefit to doctors to increase their knowledge and to improve their capability in patient treatment. Two way communications will also be formed between doctor and patient. Patient can consult about his or her illnesses that patient suffered, so did the doctor can give advices and health information that will be useful for patient. Communication between patients is also formed. Patient can share his experiences about the illness to other patients.

Rolim CO et al (2010) analyzed that a cloud-based system automates the process of collecting patients' vital data via a network of sensors connected to legacy medical devices, and to deliver the data to a medical center's "cloud" for storage, processing, and distribution. The main benefits of the system are that it provides users with 7-days-a-week, real-time data collecting, eliminates manual collection work and the possibility of typing errors, and eases the deployment process.

According to Amazon Web Services (2011), The Laboratory for Personalized Medicine of the Center for Biomedical Informatics at Harvard Medical School took the benefits of cloud computing to develop genetic testing models that managed to manipulate enormous amounts of data in record time.

Opportunities of using cloud computing technology in Kampala International University

Baliga et al (2011) suggested that cloud computing has advantages for so-called *green computing* which means the more efficient use of computer resources to help the environment and promote energy saving. Usage of ready-made computing resources tailored to an organization's needs certainly helps it to reduce electricity expenses. While it saves on electricity, it also saves on resources required to cool off computers and other components. This reduces the emission of dangerous materials into the environment.

Chandrani R (2014) noted th at cloud computing has many opportunities in health care records management. He stated that for better treatment constant medical supervision of chronic patients or habitants at remote, isolated and underserved locations is needed. In this context, advanced electronic healthcare services are required to be made available through a network anytime, anyplace and to anyone. He further stated that Cloud computing can be used for storage and processing of huge medical records. If these records will be available at cloud then can be easily shared. Doctors can use these records to track and monitor patient health status. They can also provide suggestion and health alert to their patients. Patients can also view their records. Health sector and social media can be integrated to provide better communication between doctors, patients and health care clinic.

Kamadjeu R et al (2005) reports that in Africa, despite there are some challenges, other authors have documented benefits of the use of such technologies in sub-Saharan Africa; these include greater data accuracy, improved timeliness, and availability of routine reports and reduced data duplication

Challenges of implementing cloud computing technologies

Ibnualim et al (2012), stated that the greatest challenge of integrating health sector with cloud computing is that it does not solve the problem of direct communication between doctors to doctors, doctors to patients and patients to patients. They stated that some researchers integrate health sector with social media to compensate the gap of communication. There are two problems in the integration of social media with health sector. First, the data in social media is unstructured while in health sector it is structured. Secondly as the social media is public so the data is insecure and not reliable. Again social media do not have any data processing applications which process the health records to provide the different types of services. So when a new health care system is to be designed by integrating cloud and social media the above challenges must be considered.

According to Data System (2012), Privacy and security rank at the top of the list of reasons for using cloud computing for healthcare records management system. Putting personal health information into a 3rd-party, remote data center raises red flags where patient privacy laws are concerned. The possibility that patient data could be lost, misused or fall into the wrong hands affects the use of the system. It has happened, and it has the potential to be a very expensive problem to resolve. Violation of patient confidentiality carries heavy fines, including significant costs of recovery and patient notification.

Kamadjeu R et al (2005) observed that, there are several attempts in Africa to deploy technologies such as cloud computing, and Electronic Health Record (HER) to provide healthcare services but these technologies are hindered by several challenges such as the major documented challenge to the establishment of EHR as the high cost of set-up and maintenance. This is due to poor existing infrastructure, frequent power outages and network failure. In facilities with cloud computing technologies, use was sub-optimal because of the need for parallel entry of data to paper and computer which increased the work-load of over-stretched staff.

For the case of Uganda, Kasozi, M. and Nkuuhe, J (2003) reported that the poor ICT infrastructure status in the country currently is unable to adequately support cloud computing technologies, the potential benefits of ICTs in the health sector. Very few hospitals are computerised, and when they are, internet access is limited. According to them, Most hospitals, including big national hospitals like the Mulago hospital, still use manual systems of recording and storing patient information.

4. Methodology

The researcher used case study research design because a case study is a comprehensive description and analysis of a single situation or a number of specific situations. A self-designed structured questionnaire was used to collect data from the 100 respondents selected randomly from Information Technology (IT) experts, administrators and students in the school of Allied Science.

Table 1: Distribution of the sample population of the study

Respondents	Number	Percentages (%)
Information Technology (IT) expert	30	20
Administrators	20	13.3
Students	100	66.6
Total	150	100%

Source: Primary field data (2017)

Closed questionnaire was designed to collect data from the respondents, it was used to collect data from a wide range of individuals as it provided a direct answers since it comprised of written questions that were filled by the respondents.

The face validity of questionnaire was established by giving the questionnaire to research experts for scrutiny on its validity. The questionnaire was administered to 150 respondents as indicated in table 1 above.

5. Analysis of the Findings

Table 2: Patients Data security risk

Category	Frequency	Percent (%)
Strongly disagree	1	0.6
Disagree	10	6.6
Undecided	18	12
Agree	32	21.3
Strongly agree	89	59.3
Total	150	100%

Source: Primary field data (2017)

The table 2 above shows that the management of patients' data security is very challenging as it is indicated by majority of respondents where 59.3% of the respondents strongly believe that data security management due to regulations regarding data security and privacy is very difficult in hospitals as a whole. Hospitals have to address issues stemming from data fraud, and theft from both internal and external data set of information. Increasing data-breach reports have shown the gaps and holes in the security posture of many health centers and other companies as well. Criminal organizations are using these security shortfalls to gain sensitive information of patient for profit. Due to these, senior hospital management and superintendents are held responsible for the security of the patient data that is within a hospital. However, 12% of the respondents neither agree nor disagree with this case.

This finding is supported by research conducted by ENISA (2009) which states that there are many data security risks in the use of IT, such as hacker attacks. Cloud computing is usually accessible to many different customers. If the provider fails to separate the resources, it could cause very serious security risks. For example, a customer requests to

delete data stored in the virtual infrastructure; as with most operating systems, this may not result in true erasing of the data immediately. The data are still stored on the disk but are just not available.

Table 3: Unreliable and ineffectiveness

Category	Frequency	Percentage (%)
Strongly disagree	1	0.6
Disagree	16	10.6
Undecided	12	08
Agree	42	28
Strongly agree	79	52.6
Total	150	100

Source: Primary field data (2017)

The table 3 above showed that 52.6% of the respondents strongly agreed that cloud computing is not effective and efficient. They believe that the system can be implemented but it lacks the assurance whether it will work and perform the expected tasks effectively and efficiently without any compromise, this is a big challenge and pose a security risks, threats and vulnerability to the information, network and the entire systems of the hospital. This justifies why most health sectors (hospitals, dispensary e.t.c) loose many sensitive information and data of patient despite they have a well implemented system and regulated policies on data security within the hospital. Other respondents (08%) however are not aware and not sure if such case exists in health sectors within Tanzania. Some respondents were not in agreement with such issues to exist as 10.6% of the respondents did not agree. They are hopeful that once the system is implemented, they are sure about its performance to be effective and efficient.

This finding is seems to be consistent with research conducted by Jansen W &, Grance T (2011) who stated that more concerns arise when patients sensitive data and mission-critical applications move to a cloud computing paradigm where providers cannot guarantee the effectiveness of their security and privacy controls. Also, Everett C (2009) is in support of this finding where he observed that the main challenges in adopting cloud computing technologies in healthcare include lack of trust in data security and privacy by users, organizational inertia, loss of governance, and uncertain provider's compliance.

Table 4: Constant medical supervision

Category	Frequency	Percent (%)
Strongly disagree	2	1.3
Disagree	08	5.3
Undecided	22	14
Agree	28	18.6
Strongly agree	90	60
Total	150	100

Source: Primary field data (2017)

From the table 4 above, majority of the respondents believe that, by integrating cloud computing technologies in healthcare services, there is believe that constant medical supervision of chronic patients or habitants at remote, isolated and underserved locations is achieved as it is indicated by 60% of the respondents who strongly agree with that. They believe that this possible because of the

readily available patients' data and information over the network system of the health facility. Some respondents were not sure whether it is possible since sometimes the network system is not reliable to facilitate constant patients monitoring as it was indicated by 14% of the respondents

6. Conclusion

The study was conducted purposely to carry out assessment on challenges and opportunities of cloud computing technologies in health care records management in KIUT-TH.

The findings of this research indicate that the management of the security of Patients' data and privacy is a critical challenge in many hospitals. The common data security challenge and privacy address issues stemming from fraud, theft, and malfeasance, from both internal and external threat actors, of a particular data set of information. Increasing data-breach reports have shown the gaps and holes in the security posture of Patients data. Most criminal organizations can use these security shortfalls to gain access to Patients data and any other sensitive information for profit making. In effect, senior management is being held responsible for the security of the data that is within the health sector.

Based on the results of this research, many hospitals are faced with security challenges which it is essential that hospital management needs to implement data security mechanisms to secure their data and information including the entire healthcare system. It is also critical that they conduct periodic risk assessments of the entire system and networks and in order to monitor system security of the healthcare services and also to help adapt to the ever-changing security environment.

The findings also point out the unreliability and ineffectiveness of the healthcare system. It is believed that once the system is implemented, there is luck of assurance whether it will work and perform the expected tasks effectively and efficiently without any compromise, this is a big challenge which poses security risks, threats and vulnerability to the healthcare data and information, network and the entire systems of the hospital. This justifies why most health sectors (hospitals, dispensary e.t.c) loose many sensitive information and data of patient despite they have a well implemented system and regulated policies on data security within the hospital. Other respondents (08%) however are not aware and not sure if such case exists in health sectors within Tanzania. Some respondents were not in agreement with such issues to exist as 10.6% of the respondents did not agree. They are hopeful that once the system is implemented, they are sure about its performance to be effective and efficient

The findings also showed that by integrating cloud computing technologies in healthcare records management, there is the opportunity of better treatment, where there constant medical supervision of chronic patients or habitants at remote, isolated and underserved locations is needed

7. Recommendations and Further Studies

7.1 Recommendations

The researchers recommend that practicing strong governance and security practices will minimize vulnerability, and will also create fewer chances of security incidents from occurring while taking a proactive stance when a true security incident occurs.

The hospitals need to conduct periodic staff training and workshops on matters relating to technologies and data & information security for easy management and supervision on the side of management

7.2 Further Study

Basing on the findings of the research, the researcher identified the areas that still needed to be studied and provided some recommendations which will be of great help for future research.

During the research as well as the analysis process several other ideas turned up that could be of interest and worthwhile to be investigated more thoroughly. It would be interesting to study more closely the relationship between the information management system and cloud computing technologies in health sectors in Tanzania. The study would clearly demonstrate mechanisms to protect control and prevent both passive and active attacks to the systems.

The researchers also recommends that research need to be conducted to implement and establish Directive on attacks against information systems which aim to strengthen the fight against cyber-crime

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