Impact of Cloud Accountability on Clinical Architecture and Acceptance of Healthcare System

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Abstract Cloud computing is a technology that provides facilities to the client to access shared resources, software, and information through Internet from servers on the cloud. It is very interesting to see the way cloud computing will put importance on the health care, since it is a very diverged application as well as complex and unique and presents several challenges such as protecting member health records in addition to the guidelines set based on federal compliance rules and regulations. It is also very important to see how cloud computing will address and contribute toward the issues in the healthcare industry and improve clinical and quality outcomes for patients. The advent of cloud computing technology provides effective and dependable results to support healthcare services. There is a discussion to customize architecture and for a prospective rule of the recent expertise in healthcare information system. Along with this, it represents the global confronts and technical difficulties for the recent technology. The purpose of this paper is to explore the current state and trends of cloud computing in health care.

Keywords Cloud computing · Clinical architecture · Cloud healthcare system Healthcare cloud architecture

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1 Introduction

Most of the organizations in the healthcare industry always fail to adopt new technology compared to the other industries, and the cloud computing technologies are tools that have the potential to justify facilities and clinical benefit expenditure. The cloud computing technology provides facility to access applications that were previously developed but not unattainable which is one of the most desired benefits. Digitizing the vast medical record puts impact as these are managed through cloud services. The organization would have a huge cost to access and store vast medical records but it is different now as you will pay as you will use.

Cloud services can be used to improve the patient care more efficiently. It is possible to review from anywhere to determine various decisions instantly within the very short period. As the patient information is centrally located and accessible to authorized users different group of health professionals can take allied decision. The experts can spend the time and effort to implement the best practices for each component, which ultimately delivers added benefit to the clinical users and their patients. The cloud is such a technology that changes the pattern for the consistent delivery of healthcare information technology services and the hardware and software that are scalable on a pay-per-use model ensuring effective delivery of healthcare information services [1, 2].

2 Background History

In the year 2005, Peter G Goldsmith realizes the widespread adaption of Health Information Technology (HIT) due to the increase in health expenditure and desire to improve in health care [3].

In the year 2006, Richard Lenz and Manfred Reichert describe the current IT solution supports organizational pattern to some extent to support the integration of heterogeneous component and expecting that the system must support distributed healthcare network [4].

In the year 2007, Sing et al. focused on the framework that can inform the design and testing of IT-based interventions to improve the effectiveness of communication [5].

In the year 2009, Sahay analyzes how to resolve the centralized planning to accommodate decentralized healthcare management information system implementation [6].

In the year 2011, Alexander Kaletsch and Ali Sunyaev focused on the framework to protect personal health records to increase the privacy and build trustworthy personal health information system [7].

In the year 2012, Eman AbuKhousa highlighted the different facets that contribute to building e-health cloud under four categories as cloud-based storage solution, platform solution, implementation models, and security solution [8].

In the year 2013, Daniel E. Rivera and Holly B. Jimision illustrated the way systems and modeling approaches that will impact the change and optimizing the behavioral outcomes of health [9].

In the year 2014, Abdul Manan and Imran Ashraf focus on data security, privacy, data ownership, trust, and legitimate access to patients most secure data [10].

In the year 2015, Pavel et al. highlighted on the multiclass computational models ranging from the sensor to behavioral decision for improving better healthcare behaviors [11].

In the year 2016, Hassan A Aziz focused on methods to deal with the increase in patient data. Electronic health record paired with the cloud to bring the solution for the huge data challenge [12].

3 The Role of Cloud in Improving Health Care

Like other industries, health care also concerns with high availability which is a must and also some regulatory compliance issues like security as well as privacy. It also focuses on important data movement across borders and ownership. Most of the organizations in the area of health care are implementing cloud-based solutions or operating them. These technologies are limited but due to the availability of some tool the clinical healthcare system growing rapidly.

Use of cloud computing probably is not a solution for the entire problem. However, it is great amending which will enhance the efforts and results in an improved healthcare system. Cloud technology reduces and even removes the burden of infrastructure management by providing access to all type of resources and services. This provides an environment that minimizes the expenditure and provides an easy way to adapt required technology. It is not the thing that all the provider taking time for adopting new technologies. All the health organizations are looking for digitization because to increase the quality of the patient care or health information system [12, 13] (Fig. 1).

Besides academic researchers, many world-class software companies (Table 1) have heavily invested in the cloud, extending their new offerings for medical records services, promising an explosion in the storage of personal health information online. The demand for health cloud computing is accounted worldwide.

This is only due to the several factors like greater accessibility means information can be accessed easily, also from anywhere but there should be an Internet connection.

Storage is another major concern. Reduced cost because nothing to buy permanently that means we can use as per requirement and also for the required time period. It does not require building infrastructure.

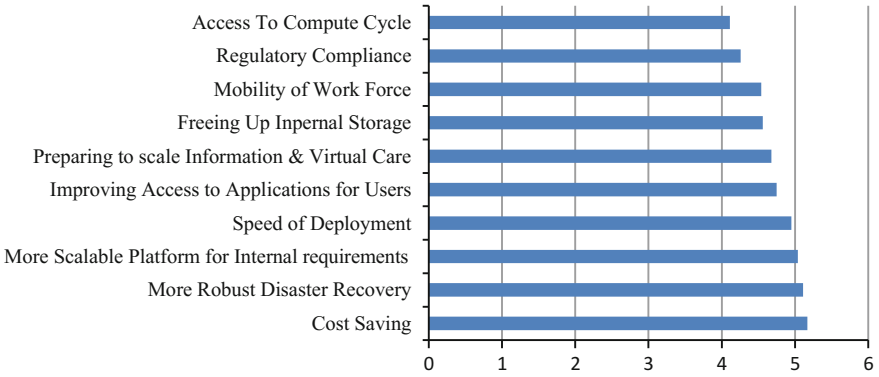

Fig. 1 The given parameters are surveyed and analyzed by taking the value "0" for no-motivating vector and "7" for highly motivating factor (Research and analysis conducted by HIMMS Analytics)

Table 1 Different cloud services provided by different organizations

Organization	Cloud service
Microsoft	HealthVault
Oracle	Exalogic elastic cloud
Amazon	Amazon web services

4 Current State of Health Care

This industry has always underutilized as organizations depend upon on hand-written notes and records to make decisions and notify. Healthcare information in the digital form between departments and applications to access the patient's information is difficult, as it is not impossible. This access to healthcare information wastes millions of dollars every year. Distribution of healthcare information among required stack holders is very complex. The countries with diagnostic imaging seem to have had more success with the components of the patient record.

Most of the information technology departments are familiarized to the traditional technologies as they look for traditional licensed s/w platforms, and complex infrastructures hold up by a large workforce. The organization requires skilled employee or staff in almost all areas of information technology.

As the time progress new expertise are bringing in orders the information technology transportation and due to the demand of time, it starts to expose its limit towards its efficiencies.

Due to the technological advancements in the recent scenario, patients are very cautious regarding their own health information; they are aware of different types of information related to different diseases as well as more alert to their healthcare

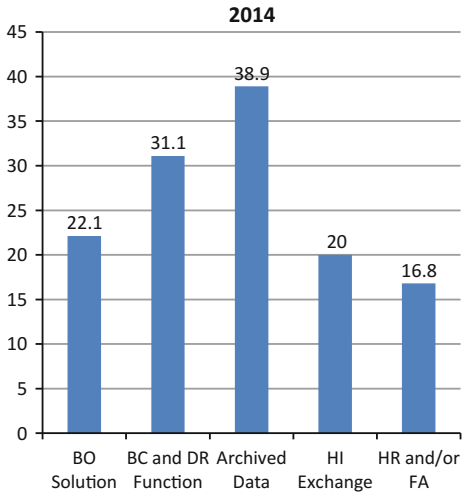

Fig. 2 Use of cloud technology by different healthcare organizations in the year 2014 (Research and analysis conducted by HIMMS Analytics)

problems and rising request to avail the newest technologies. Patient seeks the best health care at a reasonable cost and accesses their health information.

It can be termed as, if everyone is able to go through their personal information in the bank from anywhere, then why not their personal security information regarding health information. To provide such types of facility many developed countries developed data centers for healthcare information, however, still some of them have challenges. According to the Figs. 2 and 3 (Research and analysis conducted by HIMMS Analytics), it shows the approach to use cloud health care increasing exponentially. In the year 2014, the demand for use cloud technology in

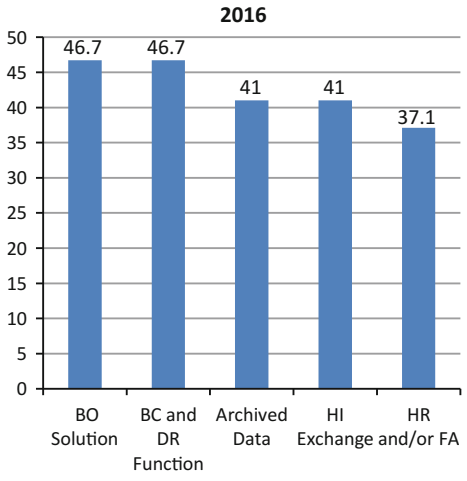

Fig. 3 Use of cloud health care by different healthcare organizations in the year 2016 (Research and analysis conducted by HIMMS Analytics)

the various fields of healthcare organization is very less as compared to the demand of use cloud technology in the year 2016. The diagram shows the growth exponentially in various fields in such type of organization [11, 13].

5 Healthcare Architecture Using Cloud

The architecture of the healthcare system in the diagram shows the collaboration of several entities like cloud infrastructure, cloud services, security, management, and most importantly the organization where it will be implemented. As it is a public domain, more than one user will have the facility to use the same resource also for the different computing as well as storage operation. The data provider and the technology providers interact with each other and these activities are recorded and encrypted before uploading to the space at the cloud. It is uploaded as a jar file. The data owner is provided with the log data through emails in the push mode and they can view log data using pull mode. The communication system holds the picture archive and communication systems as well as digital image and communication. The log data is provided to the data owner by mail [14, 15] (Fig. 4).

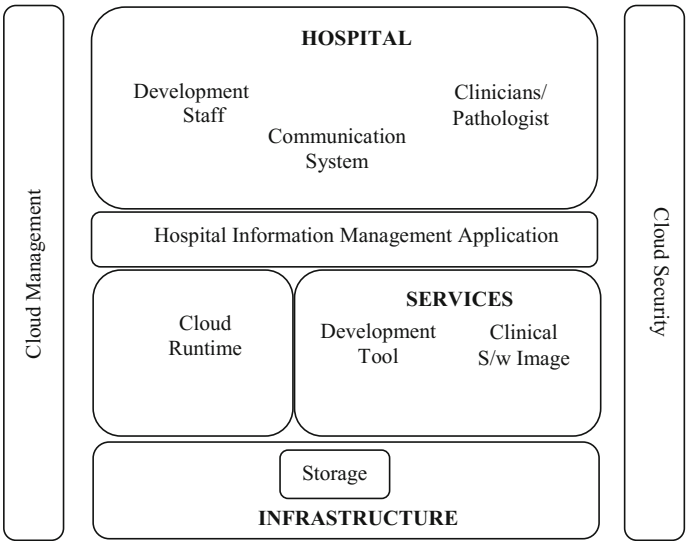

Fig. 4 Architectural building block of healthcare organization using cloud

6 Cloud Healthcare Accountability Criteria

It is always necessary to evaluate the requirement that helps to accelerate the cloud healthcare performance. Several attributes are considered for accountability assess.

Security: It is the major concern when it is associated with the health information system. So it is required to surmount associated risks when dealing with the health information through the cloud, cloud providers must demonstrate security measures need to be deployed so that unauthorized access to health information must be prevented [15–17].

High Availability: Cloud providers should have information of high availability of data or required available requirements and this must ensure the guaranteed delivery of information.

Standards-Based Data Management: Standards-Based Data Management is driving the development of standards throughout many different areas. The use of standards in managing data will future proof the data to ensure that access and migration of data will always be possible.

Table 2 Different cloud services and their dimensions provided by different organization

Attributes	Dimensions
Security	• Make safe access to the facility • Network protection • Data protection • Staff training and regulatory compliance awareness
Availability	• Downtime for maintenance • Sensitivity to data growth • Latency and idleness of network • Redundancy of hardware
Standards-based data management	• DICOM/HL7 • XML metadata • NIST • IHE framework
Scalability	• Provisioning • Plug-and-play growth • Dynamic scaling
Remote access	• Users capacity • Peak access times performance • Mobile device's flexibility
Contractual assurance	• Insurance for breach of privacy • Service-level agreements • Migration assistance • Scalability

Scalability: When the system is online and volume of data grows exponentially, the cloud provider should be able to scale up the requirement so that there should not be any impact on performance and if there is any impact then that should be negligible.

Remote Access: As the data stored remotely, there must be flexibility to access is a major concern for the healthcare organizations as they access through the cloud. So it is required to provide adequate services to the users, for which various aspects are taken into account.

Contractual Assurance: There should be strong conformities like in the agreement which will make sure uninterrupted assured delivery of services (Table 2).

7 Conclusion

The research discovers the various facets of technology like cloud environment and the way providers of health care can go further based on a solution like a cloud. It leads to the emerging, broad-based clinical decision support system. It also will provide broad operational departmental systems with EMR integrations well as emerging data warehousing and analytics solutions. The framework presented here represents the architectural framework which will accompany healthcare system in cloud computing for smooth work and consider accountability from a systematic perspective, with the intent to respond to call for attention to how best to regulate, supervise, and monitor cloud providers.

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