An Implementation of Health Care Industry through Cloud Computing Technology

R. Anand¹, Dr. S. K. Srivatsa²

¹Research Scholar, Sri Chandra Sekarendra Viswa Maha Vidyalaya, Enathur, Kanchipuram-531 602, Tamil Nadu, India.
²Sr.Professor, St. Joseph College of Engineering, Chennai-600 119, Tamil Nadu, India

Abstract: In this paper we deal with the advantages of cloud computing technologies in health care information systems. In the last few years, expectations about patient privacy information, medical services, data retention, and health care provider availability have risen dramatically. The healthcare industry is facing significant pressures to lower the costs associated with providing healthcare, adopt new systems that support electronic medical records (EMR), and share data quickly and securely with other healthcare and government agencies. Reducing service time for patient care is another aspect in the fight to keep costs low, and every delay in getting back results from a lab, or having to manually convert patient information from one format to another, creates more problems for the healthcare provider. For solving these kinds of issues we address the electronic health care systems using cloud computing techniques. Using advanced technologies, we reduces the time delay and we are given more attention to patient care. The Cloud has become an everyday resource that helps enable our daily routines. In this article we explains that the cloud computing evolution, how the health care industry uses the cloud computing and improving the patient care, Challenges of cloud in health care and benefits of cloud techniques in health care industries.

Keywords: Health Care, Cloud Computing, EMR, PHR, IAAS, SAAS and PAAS

I. INTRODUCTION

There is a strong demand for medical and health care service systems for the public under the new computing model. They can provide remote health consultation, remote real-time monitoring, remote diagnosis, personal health record (PHR), network-based health care education, and other personalized services for the public through personalized medical information management and services configuration and integration. Thus, they can help us realize the integration of health care prevention, medical services, and health management. For the past 50 years, the world’s population was growing rapidly. Meanwhile many developed countries are also facing the trend of population aging. These make the shortage of health care and medical resources more and more obvious and severe. The contradiction between per-capita level of medical resources and the growing demand from people for health care is increasing. Thus, how can we best utilize the limited medical resources to provide more efficient health care services for people and to construct new medical service systems becomes a serious and urgent problem. The problems faced in the field of medical and health care such as the aging of the population, the increase of chronic patients, the rising medical expenses, and the needs to improve the quality of medical services are common around the world today. In order to solve them, information technology must be deployed to this field. In recent years, medical information systems play an increasingly important role in supporting doctors and nurses, enhancing the quality of medical services, reducing the medical expenses, and improving the care of chronic patients. In India health care sector is given more consideration and particularly the Tamil Nadu government introduces several schemes to take care of the people’s health care.

II. CLOUD COMPUTING TECHNOLOGY EVOLUTION

Cloud is a new computing paradigm. In Cloud, IT resources and services are abstracted from the underlying infrastructure and provided on-demand and at scale in a multi-tenant environment. **Infrastructure as a Service (IaaS)** provides users with processing, storage, networks, and other computing infrastructure resources. The user does not manage or control the infrastructure, but has control over operating systems, applications, and programming frameworks. **Platform as a Service (PaaS)** enables users to deploy applications developed using specified programming languages or frameworks and tools onto the Cloud infrastructure. The user does not manage or control the underlying infrastructure, but has control over deployed applications. **Software as a Service (SaaS)** enables users to access applications running on a Cloud infrastructure from various end-user devices (generally through a web browser). The user does not manage or control the underlying Cloud infrastructure or individual application capabilities other than limited user-specific application settings. Deployment of a cloud can be done in the following ways:
Private clouds are operated solely for one organisation. They may be managed by the organisation itself or by a third party, and they may reside on-premises or off it. Public clouds are open to the general public or a large industry group and are owned and managed by a Cloud service provider. Hybrid clouds combine two or more clouds (private or public) that remain unique entities but are bound together by technology that enables data and application portability. Community clouds feature infrastructure that is shared by several organisations and supports a specific community. They may be managed by the organisations or a third party and may reside on-premises or off it.

III. HEALTH CARE ON CLOUD

More and more vendors are offering healthcare solutions and services such as telemedicine, electronic medical records, medical imaging, and patient management that can be consumed or integrated by healthcare providers, payers and customers over a cloud. We expect majority of the larger healthcare players to set up their own ‘private’ cloud in the near future. The primary focus would be to offer IaaS to their internal stakeholders. This will help healthcare organisations to reduce costs and increase its agility in provisioning, orchestrating and managing the applications and the infrastructure. Mid-tier and smaller players are expected to move their administrative applications like Registration, Billing, Scheduling, and Reimbursement, to the cloud. As the cloud adoption in healthcare evolves, we expect a major chunk of healthcare services to move into cloud; and this would let healthcare players focus on providing cost effective and efficient healthcare services. Service providers play a major role in adoption of cloud in any industry, and healthcare is no exception. Cloud can enable service providers to rapidly and cost-effectively integrate their applications, endpoints, and operations capabilities into a set of cloud services that can be deployed to customers, be it providers, governments, payers, or patients, using a wide range of network connections. In many cases these services can be composed of existing applications, infrastructure, and workflows that may be located anywhere in a cloud configuration to a set of consumers that can either be permanently or temporarily connected into the cloud. The service connections can be provisioned for high levels of security and can be monitored to precise endpoints to enable accurate billing, usage and metering information for the individual services. Fig.1 represents how the health care system using cloud computing technologies.

IV. HEALTHCARE SYSTEMS AND CLOUD COMPUTING

Several studies have demonstrated that the limited access to patient-related information during decision-making and the ineffective communication among patient care team members are proximal causes of medical errors in healthcare. Thus, the pervasive and ubiquitous access to healthcare data is considered essential for the proper diagnosis and treatment procedure. Cloud Computing is a model for enabling convenient, on-demand network access to a shared group of configurable computing resources that can be rapidly provisioned and released with minimal management effort or service provider interaction. The major characteristics of Cloud Computing can be summarized into the following:

![Health Care Using Cloud Computing](Source: IEEE TRANSACTIONS ON SYSTEMS, MAN, AND CYBERNETICS: SYSTEMS, VOL. 43, NO. 4, JULY 2013)
On-Demand Self Service
A consumer can unilaterally obtain access to computing capabilities, such as server computing time and/or network storage, as needed automatically without requiring human interaction with each service’s provider.

Resource Pooling
The provider’s computing resources are pooled to serve multiple consumers using a multi-tenant model, with different physical and virtual resources dynamically assigned and reassigned according to consumer demand. Examples of resources include storage, processing, memory, network bandwidth, and virtual machines. Given the characteristics of Cloud Computing and the flexibility of the services that can be developed, a major benefit is the agility that improves with users being able to rapidly and inexpensively re-provision technological infrastructure resources.

V. HEALTH CARE IMPROVEMENT USING CLOUD
It is no secret that healthcare organizations lag behind most other industries in adopting new technologies, by some estimates by as much as 10 years. Providers must modernize their IT infrastructures and massively overhaul their paper-based workflows, all while dealing with budget cuts and government reforms. It’s no wonder that healthcare organizations are often slow to move. Healthcare providers invest a mere 10% of revenue into IT compared to other industries that regularly invest 25%. That's not to say that all providers are slow to adopt new technology; however, to date, the IT focus has been primarily around the digitization of images with picture archive and communication systems (PACS), payment and reimbursement applications and maintaining regulatory compliance. In addition, government incentives are driving providers to look at electronic health records, health information exchanges and business intelligence or analytics tools as a way to drive efficiencies, streamline workflow and increase the breadth and quality of patient care. The reality is, these types of initiatives can mean huge upfront capital expenditures, sizable ongoing operating expenses and a huge investment in change management in adjusting to the workflows of the digital era. All this is happening in an industry that has been historically reluctant to change. As with any new technology, there are concerns that are both unique to healthcare and common to all industries. Security and privacy become regulatory compliance issues, while high availability is a must for systems that deal with life-and-death situations. Data movement across borders and ownership of that data are also important. Reports show as many as 30% of healthcare organizations are either implementing or operating cloud-based solutions, and the result is a wealth of vendors moving their applications to cloud models. Although these cloud technologies are mostly limited to email applications and collaboration tools like Microsoft Live Meeting, the movement to clinical systems is starting to grow. Electronic health records, diagnostic imaging, analytics and the introduction of health information exchanges all lend themselves to be cloud-based with a clinical focus.

VI. ISSUES OF HEALTH CARE USING CLOUD TECHNIQUES
Privacy Issues
Privacy and security rank at the top of the list of reasons for slow adoption rates. 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 adoption. What recourse does an organization have should a cloud provider lose data? 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. A potential solution is a private cloud model. In this case the data still resides at the customer data center and a certain degree of control still exists for organizations to manage patient privacy. The organization can also ensure that the data center complies with certain standards. This model may be more expensive, but security and privacy are more visible.

Security Issues
This may be a moot point where healthcare providers are concerned. One of the benefits of cloud technology is the ability to access resources that would otherwise be unattainable. A cloud provider will have security experts deploying the latest patches and software to its data center. Secure access to the physical property will be well guarded, and many policies, processes and mechanisms will be in place to ensure data security. Add to that the fact that any applications operating through the cloud will store all their data in the cloud. This means there is no protected health information (PHI) residing on hospital computers, which is a more secure situation than today’s current environment. Health and human services studies show that PHI violations have come from the theft of computers taken from facilities, loading docks and even physicians’ vehicles. These thefts have been more for the computer and less for the PHI. This raises the question: Wouldn’t it be better to have everything in the cloud?
Workflow Issues
As it can be difficult to enact change throughout healthcare provider organizations, we may assume that adoption of a cloud model would present significant change management issue for providers. Current processes are often inefficient, relying on paper in many cases to manage patient care. Any transition to a cloud would require significant support from the technology partners to ensure a smooth transition for users. Take for example, the current practice of requesting a diagnostic exam. A physician fills out a request form with patient details, history and reason for exam. This gets sent to the radiology department for scheduling. The clinical staff books the exam and informs the doctor, who advises the patient, who has a conflict with the appointment time. Back and forth it goes. Now, consider an electronic scheduling system based in the cloud, whereby the doctor enters all the relevant information and the system determines the most appropriate exam and notifies the patient directly of possible options. The patient logs in, selects the best time for the exam, and the system books the exam. It seems simple, but change management is required to ensure the transition is smooth. As a part of this workflow transition, serious consideration should be given to staffing needs within the organization’s IT department. As the cloud starts to permeate the clinical environment, no longer will the same skill sets be required. Different technology will need to be supported, new training will be required and new skill sets will need to be defined. An organization that had staff working on managing backups and archiving will now migrate to network connections and clinical applications.

IT staff will focus on the rollout of the electronic medical record (EMR) instead of managing the storage layer the EMR sits upon. Access to this kind of skill set is in high demand today. These challenges contribute to slow adoption of cloud technologies but should not stop cloud progress. Organizations are weighing the benefits against the risks. As more providers migrate to the cloud, we will see these challenges overcome with new and innovative solutions.

VII. BENEFITS OF CLOUD COMPUTING IN HEALTHCARE
“Patient centricity” has become the key trend in healthcare provisioning and is leading to the steady growth in adoption of electronic medical records (EMR), electronic health records (EHR), personal health records (PHR), and technologies related to integrated care, patient safety, point-of-care access to demographic and clinical information, and clinical decision support. Availability of data, irrespective of the location of the patient and the clinician, has become the key to both patient satisfaction and improved clinical outcomes. Cloud technologies can significantly facilitate this trend. Cloud computing offers significant benefits to the healthcare sector: doctor’s clinics, hospitals, and health clinics require quick access to computing and large storage facilities which are not provided in the traditional settings. Moreover, healthcare data needs to be shared across various settings and geographies which further burden the healthcare provider and the patient causing significant delay in treatment and loss of time. Cloud caters to all these requirements thus providing the healthcare organizations an incredible opportunity to improve services to their customers, the patients, to share information more easily than ever before, and improve operational efficiency at the same time.

Clinical Research
Many pharmacology vendors are starting to tap the cloud to improve research and drug development. The ‘explosion of data’ from next generation sequencing as well as the growing importance of biologies in the research process is making cloud-based computing “an increasingly important aspect of R&D”. Currently, pharma firms do not have the capacity to run large datasets – especially DNA sequencing - as the size of the data can overwhelm their computers. Commercial cloud vendors have developed pharma-specific clinical research cloud offerings with the goal of lowering the cost and development of new drugs.

Electronic Medical Records
Hospitals and physicians are starting to see cloud-based medical records and medical image archiving services coming on line. The objective is to offload a burdensome task from hospital IT departments and allow them to focus on supporting other imperatives such as EMR adoption and improved clinical support systems.

Collaboration solutions
Early successes of cloud-based physician collaboration solutions such as remote video conference physician visits are being trialed. Extending such offerings to a mobile environment for rural telehealth or disaster response is becoming more real with broader wireless broadband and smartphone adoption. Cloud technology supports collaboration and team-based care delivery and the ability to use applications based on business model requirements and a common set of clinical information.

Telemedicine
With the increase in availability of mobile technologies and intelligent medical devices, telemedicine has grown to include not only tele-consultations and telesurgeries, but also health record exchange, video-conferencing,
and home monitoring. Cloud computing and the related ease of services deployment and data storage is an enabler for telemedicine.

**Health Information Exchange**

Health information exchanges help healthcare organizations to share data contained in largely proprietary EHR systems. CIOs may accelerate the deployment of HIE via a linkage to a strategic cloud implementation.

**VIII. CONCLUSION AND FUTURE WORK**

Through the research it is believed that, an e-health care application model can be created based on cloud computing mass data storage, high-speed computing capabilities, as well as its ideal allocation and the sharing mode of resources. The sharing of medical information resources is a key factor playing an important role towards the successful adoption of pervasive of healthcare systems. The concept of Cloud Computing and applications similar to the one presented in this article will attract the interest of scientists, developers and industrial partners working in the field of biomedical informatics. Most healthcare organisations today need to modernise their IT infrastructure, to be able to provide safer, faster and more efficient healthcare delivery. This requires massive upgradeation of their existing IT infrastructure and involves huge upfront capital expenditure and sizeable operating expenses. Cloud technology mitigates the need to invest in IT infrastructure, by providing access to hardware, computing resources, applications, and services on a ‘per use’ model, which dramatically brings down the cost and simplifies the adoption of technology. Several EMR vendors are offering their solutions as a cloud-based offering, providing an alternative approach to help hospitals better manage the otherwise massive capital IT investments that would needed to support EMR implementations. As the cloud computing become increasingly widespread, e-health care will certainly usher in a new era of cloud computing. However, there is an ongoing debate within healthcare as to the viability of cloud-based solutions given the need for patient privacy and sensitive personal information. In considering cloud computing for health care organisations, systems must be adaptable to various departmental needs and organisational sizes. Architectures must encourage a more open sharing of information and data sources. Many HIS and clinical systems deal with processes that are mission critical, and can make the difference between life and death. Cloud computing for healthcare will need to have the highest level of availability and offer the highest level of security in order to gain acceptance in the marketplace. Hence there might be a need to create a “Healthcare-specific Cloud” (Health as a Service) that specifically addresses the security and availability requirements for healthcare.

**REFERENCES**


