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An Impact of Digital Technologies Transforming In Healthcare Using Cloud Computing

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ABSTRACT: Healthcare is one of the vital complex domains flooded with huge amount of data about patient, sensitive information and need of exchange of information between different environments. An impact of digital technologies shifted healthcare industry to serve quality of service in different dimension, enables more integration through the common platform and provide high security to huge amount of data. There have been plenty of technologies involving in transforming healthcare industry from conventional to digital. We have ideal to discuss the novel technology and their major contribution to digitalization such as cloud computing, picture archiving and communication system (PACS) and Radio Frequency Identification. The healthcare technology revolution is around in the world. And when it arrives, it will change and enrich our lives in ways we can only begin to imagine. Doctors will perform blood pressure readings via video chat and nutritionists will analyze diet based on photos taken with cell phone cameras. The health care combines healthcare, technology, and finance in an innovative new way that explains the future of healthcare and its effects on patient care, exploring the emergence of electronic tools that will digital technology transform the medical industry.

KEYWORDS: Cloud Computing, PACS, RFID, SaaS, IaaS, PaaS,

I. INTRODUCTION

Cloud computing is one of the most modern advancements in technology which is growing rapidly. “Everything as a service” is the foremost theme of cloud computing. Most of the industry adapted cloud computing to make the benefits of this model. Many healthcare organizations use cloud computing in some form, primarily for online medical records. Cloud computing technology helps to make electronic health record available across to different providers, any providers can log in to the application and update the information. Cloud computing technology is environment independent. It is possible for end users to access the information without any specific environment through computers or other gadgets like ipad, mobile etc., Data virtualization is one of the excellent features of cloud computing under “IaaS as Infrastructure as a Service. For any organization can host the data and patient related information in cloud computing. Thus, organization can reduce the cost for any patient information and data can be stored across the cloud thus the data are safe and available at anytime.

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Cloud computing enables computers and various other devices in different geographical locations to access shared computer services or applications over the “cloud” or internet rather than a local environment. Cloud technology is at the heart of health care’s transformation and health care industries are now, more than ever, utilizing various cloud technologies.. With tablets and EMRs replacing paper medical charts, private clouds are now being used to access medical records and promote information sharing among medical professionals. Cloud technologies are rapidly transforming and changing the way health care information is being handled and processed in a positive way, but it comes with its own way.

Cloud computing is a method of providing a set of shared computing resources that includes applications, computing, storage, networking, development, and deployment platforms as well as business processes. Cloud computing is Internet-based computing, whereby shared resources, software and information are provided to computers and other devices on-demand, like the electricity grid. Cloud computing calls for understanding three main cloud computing process models: (Figure 1a.Cloud.1.b.Cloud Computing Process model.)



Figure 1 a. Cloud

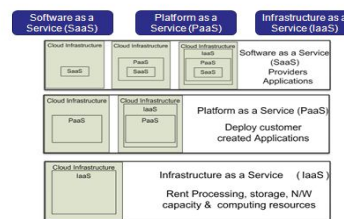


Figure 1.b.Cloud Computing Process model

A) **IaaS:** The delivery of services such as hardware, software, storage, networking, data center space, and various utility software elements on request.

- ❖ In the public IaaS, the user needs a simple sign-up mechanism to acquire resources.
- ❖ In a private IaaS, the IT organization or an integrator creates an infrastructure designed to provide resources on demand to internal users and sometimes partners.

B) **PaaS:** A mechanism for combining IaaS with an abstracted set of middleware services, software development, and deployment tools that allow the organization to have a consistent way to create and deploy applications on a cloud or on-premises environment.

C) **SaaS:** A business application created and hosted by a provider in a multi-tenant (shared) model. The SaaS application sits on top of both a PaaS and foundational IaaS. In fact, a SaaS environment can be built directly on an IaaS platform.

Third party API’s and application frameworks are exposed to application developers in form of Platform as a Service. This facilitates Healthcare application developers to integrate the other party applications quickly for example payment transactions for provider application use API’s for secure transactions. This helps organization to reduce cost by avoiding the development of already available components.

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Healthcare provides information on some of the challenges facing PACS (Picture Archiving and Communication System) and RIS (Radiology Information System) end-users in the healthcare. healthcare providers need a better desktop solution to address the ever-changing requirements of radiology professionals, including x-ray technicians, referring physicians, as well as radiologists.

The most important challenged with in-depth knowledge regarding the current health care system and the various problems that still exist, such as the rapidly-increasing health care costs, number of uninsured individuals, questionability of the ongoing health care reform, shortage of primary care physicians, etc. The novel age of increasing technological advancements, though phenomenal and advantageous, has also brought with it more complexity problems to resolve, most especially in the health care industry.

A solution part of the health care reform involves the use of technology to address a number of health issues such as access, value and cost. Hospitals, if not fully transitioned yet, are now transitioning from paper records to Electronic Medical Records (EMR), a digital and portable version of the medical records used in health care systems that allow storage, retrieval and easy modification of records. To support health reform’s goal of collecting data on providers, determining what treatments are improving outcomes, linking care to payments, determining quality measures, etc., computer support systems are being used everywhere.(Figure 2).

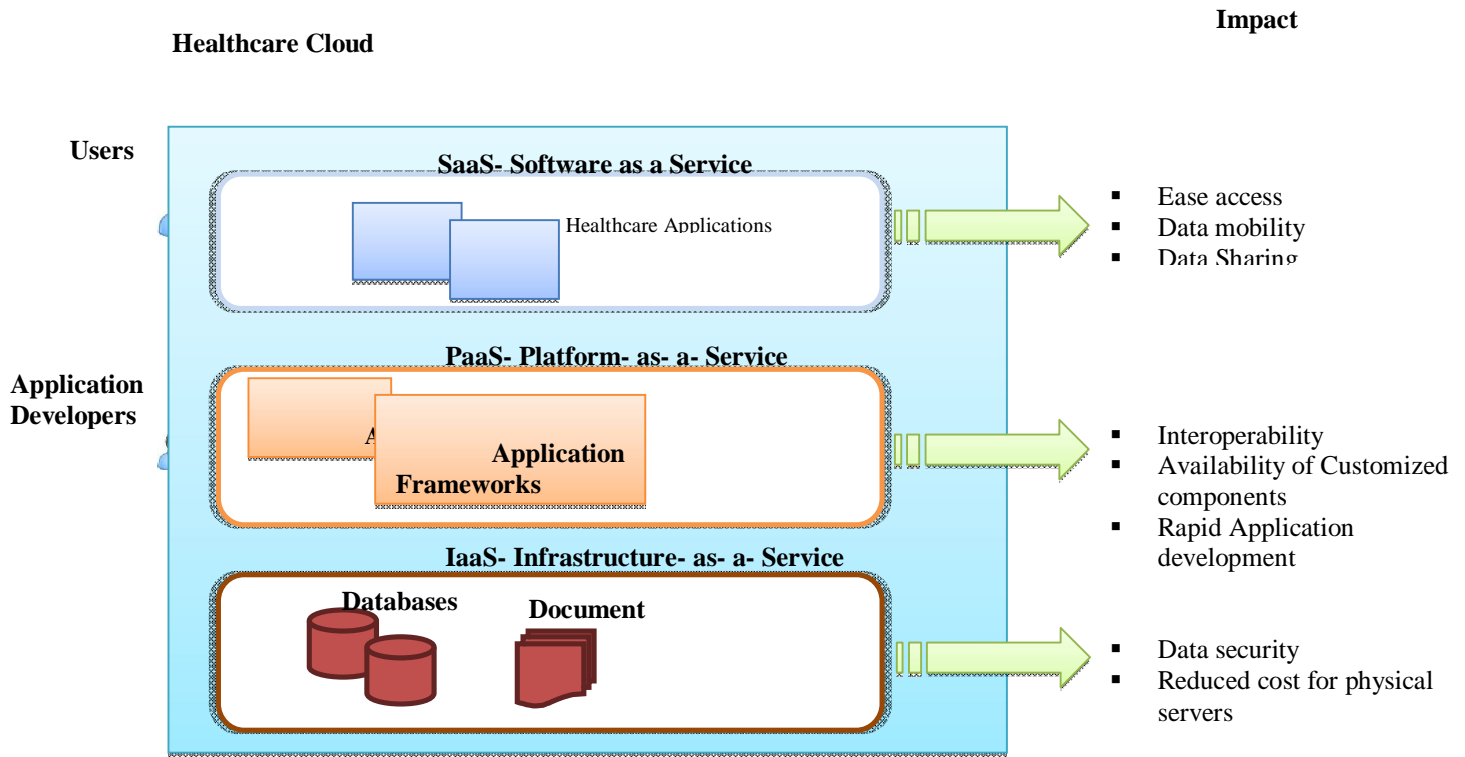


Figure 2. An architecture of Healthcare Domain



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II. CHALLENGES IN HEALTHCARE DOMAIN

1. **Picture Archiving and Communication System (PACS):** This technology captures and integrates diagnostic and radiological images from various devices (e.g., x-ray, MRI, computed tomography scan), stores them, and disseminates them to a medical record, a clinical data repository, or other points of care. PACS is advancement in medical imaging technology, it is effective way of storing, retrieving the medical images that are transferred from medical modalities. PACS offers economical storage and convenient access of medical images. All the electronic medical images are verified and encapsulated for DICOM standards then persisted in PACS server. The major impacts of PACS to healthcare industry are.
 - **Elimination of Hard Copy Handling-** PACS provides economical cost for storing digital copy, thus handling the films and other hardcopy can be replaced. Removes all the cost associated with hard films. This improves the accuracy information for patient and can maintain information for long time period.
 - **Distributed and Quick Access** – Since the images are stored as digital copy, it can be accessed in cross locations. It enables different providers at different location can access the documents simultaneously. Accessing information will be fast and helps providers to provide care faster.
 - **Standards and compliance** – The entire archiving and retrieval process is automated, it is easy to adapt the complaint like HIPAA and DICOM standards, even if there is any revision in standards it will be easy to implement and follow.
2. **Radio Frequency Identification (RFID):** This technology tracks patients throughout the hospital and links lab and medication tracking through a wireless communications system. It is neither mature nor widely available, but may be an alternative to bar coding. Radio frequency identification is the method to store and retrieve data using devices called RFID tags or transponders. RFID plays vital role in shaping the “Smart hospital” which is the future hospital model. Radio frequency identification can enhance patient’s care, optimization of workflows, reducing operating costs, Avoid misidentification. Some of the hospitals tested and implemented RFID system. The following are the major benefits from RFID.
 - **Reduce Manual Error in Patient Identification:** In growing number of patient population, healthcare providers are primarily concerned about patient misidentification. Improper patient identification may lead to improper medication etc, even some time it could be challenge the life of patient. RFID based identification will help in identifying the right patient.
 - **Tracking:** Radio frequency certainly used for tracking of the inventories, patient and documents. In pharmacy RFID is use to identify the expired products. Similarly this finds very useful in tracking the patient and documents. In smart hospitals, patient will get RFID tagged wristband. This wristband contains the relevant information about patient. Even in case if patient entered wrong to operation theatre, provider will be warned about the mismatch.



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- **Remote Monitoring and Continuous Evaluation of Patient** – RFID could able to transmit the data from patient to providers remotely and RFID observers patient vital signs in regular intervals this will help providers to provide continuous diagnosis and avoid last minute emergency rush.

III.LITERATURE SURVEY

The Impact of Electronic Health Records on Time Efficiency of Physicians : A systematic review of the literature was performed to examine the impact of electronic health records (EHRs) and Electronic Medical Records (EMR) on documentation time of physicians and nurses and to identify factors that may explain efficiency differences across studies. A key part of the health care reform involves the use of technology to address a number of health issues such as access, value and cost. Hospitals, if not fully transitioned yet, are now transitioning from paper records to Electronic Medical Records (EMR), a digital and portable version of the medical records used in health care systems that allow storage, retrieval and easy modification of records.

To support health reform's goal of collecting data on providers, determining what treatments are improving outcomes, linking care to payments, determining quality measures, etc., computer support systems are being used everywhere. Increased medical knowledge has brought about more technological advancements in treatment and devices that require computer support. Increases in medical/research data has brought about the need for highly complex computer support systems to analyze and retrieve information.

The increase in patient-centric care and social media popularity has also required health care systems and providers to become more technology-savvy. The cloud, social, mobile, consumer, apps, enterprise technologies and more are needed, more than ever, to support these technologies. The electronic health record (EHR) is increasingly being deployed within health care organizations to improve the safety and quality of care.

Search Strategy: Current Health databases. Search strategies were specific to the database and included the Medical Subject Headings (MeSH) associated with key words that reflected EHRs and workflow. Search strategy included the following terms: health informatics, electronic records, medical records systems, information systems, computerized patient records, workflow, time and motion, task performance and analysis, work redesign.

A study of some the existing methodology is done and the results are tabulated. The methodologies and the complete information of the approaches indicating whether they used a manual approach or automatic approach done. We have studied a four different paper and different techniques, methodologies are used in the table summarized.



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Title of the Paper	Goal	Techniques	Methods	Results
Cloud Computing Bible By Barrie Sonsinsky.	To Understand an Infrastructure Architecture and Organization of Cloud Framework	Cloud Reference Model	Architecture Reference Model	User Behavior search results.
Cloud Computing – A Collection of Working Papers By Thomas B Winans And John Seely Brown.	To Understand the Service Grids And Applications of Cloud Technology to Business Industry I.E Healthcare	Cloud Business Model	Service Grids, Business Model, Working Model	Manually calculated an EHR and good results.
Cloud Computing Guide For Healthcare – Focus Research.	Applications of Cloud in Healthcare Industry	Cloud Healthcare	Healthcare in Cloud Process Model	To increase the system performance and Evaluate patient details.
The Digital Transform of Healthcare –Current Status and the Road Ahead.	Impact Based on The QoC and Efficiency and Performance	Cloud Based Applications	HIT Adoption Method.	EHR and EMR to improve the safety and Quality of Care.

IV . SaaS- SOFTWARE AS A SERVICE COMPONENT

SaaS is a business application created and hosted by a provider in a multi-tenant (shared) model. The SaaS application sits on top of both a PaaS and foundational IaaS. In fact, a SaaS environment can be built directly on an IaaS platform. The following technologies and terms are often included in discussions in health care industry:

i). Electronic Health Record (EHR): EHRs were originally envisioned as an electronic file cabinet for patient data from various sources (eventually integrating text, voice, images, handwritten notes, etc.). Now they are generally viewed as part of an automated order-entry and patient-tracking system providing real-time access to patient data, as well as a continuous longitudinal record of their care. For electronic health records (EHRs, also known as electronic medical records, automated medical records, and computer-based patient records, among other names), multiple definitions exist, depending on the constellation of functions that are included .They can be used simply as a passive tool to store patient information or can include multiple decision support functions, such as individualized patient reminders and prescribing alerts.

ii).Radiology Information System (RIS): is a solution incorporates a computerized database used by radiology departments to store, manipulate, and distribute patient radiological data and imagery. The system also generally provides patient tracking and scheduling, result reporting and image tracking capabilities.

Most RIS solutions today support the following features:

- ❖ Patient registration, scheduling, Tracking and list management.
- ❖ Interface with modality via work lists.
- ❖ Request and document scanning.



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- ❖ Results entry.
- ❖ Report, printout, faxing, and emailing of clinical reports.
- ❖ Interactive documents and custom reports.
- ❖ Modality and material management.

iii). Electronic Medical Record (EMR): Health information sharing between patients and providers helps to improve diagnosis, promotes self care, and patients also know more information about their health. The use of electronic medical records (EMRs) is still scarce now but is increasing in Canada, American and British primary care. Healthcare information in EMRs are important sources for clinical, research, and policy questions. EMRs can reduce several types of errors, including those related to prescription drugs, to preventive care, and to tests and procedures. Recurring alerts remind clinicians of intervals for preventive care and track referrals and test results. Clinical guidelines for disease management have a demonstrated benefit when accessible within the electronic record during the process of treating the patient.

iv). Application Program Interface (API): The piece of well tested code that are ready to integrate through application. Application programming interfaces (APIs) allow communication to occur between products and/or services. For example, if you've developed a gaming application you can write an API that allows other developers to write to your application. The API specifies how one application can work together with another one.

v). Application Frameworks: Software framework is a platform for developing software applications. This streamline process since developers doesn't need to reinvent on already available components.

vi). Digital Imaging and Communication (DICOM): in medicine is a standard for handling, storing, printing, transmitting information in medical imaging.

V. CONCLUSION AND FUTURE DIRECTIONS

In past few years healthcare industry went through drastic change due to the impact of digital era. Some of the notable remarks due to digital technology are Reduces the error and provide quality care, Reduced paper works and replacement of hard copy document with soft copies, thus processing rate is high and patient could get quick care, Accuracy in patient data and effective diagnosis and Smart or Intelligent hospitals helps to track every individual patient data, documents and improves to reach to decision quickly. Furthermore, any technology implementation in healthcare must deal with privacy and security issues. Hospital staff has to feel comfortable with the fact that they can be tracked and located every time. Maybe some "RFID free zones" should be delimited in order to fight the "big brother" effect and to preserve the freedom of individuals. The healthcare technology revolution is just around the corner. It will change and enrich our lives in ways we can only begin to imagine. Doctors will perform blood pressure readings via video chat and nutritionists will analyze diet based on photos taken with cell phone cameras. In digital technologies transforming in healthcare industry combines healthcare, technology, and finance in an innovative new way that explains the future of healthcare and its effects on patient care, exploring the emergence of electronic tools that will transform the medical industry.

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