

A Distinctive Assessment on Cloud Computing in Health Care System: The Present Era

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Abstract

Background: The most trending computer network system now-a-days is Cloud computing technology (CPT). Through large number of developments and possibilities information and communications technology is the frame work of components that has modernized healthcare sector. Cloud computing is a well-known example in the healthcare industry; it encourages hospitals and clinics to exchange and store electronic medical records. **Applications:** The majority of collaborators and stakeholders in the health care industry value the industry's methodology, which has the unique potential to deliver tremendous capacity and transformative power in the e-healthcare sector. Storage and exchange of medical records of patients fetches a favourable treatment for the patients in all aspects and also in emergencies, thus saving the life of a patient. By sharing the network resources in healthcare sector computer applications need to run on internet or cloud successfully. Depending on their needs, cloud computing can help business server infrastructures into vigorous domain through expansion. This review provides information of some cloud-based e-healthcare design edge technology benefits and adopting cloud computing in health care segments. It addresses the different methodologies, framework along with security and privacy issues that are crucial reasons of enhancing a cloud-based e-health care. **Conclusion:** When many healthcare companies adopt the cloud, a wide range of benefits are offered by cloud computing, and then a bright future takes over.

Keywords: cloud computing, healthcare, benefits, assessment, advantages, disadvantages

Introduction

Cloud computing refers to the availability of computer system resources readily in particular with processing power and cloud storage, without involvement of direct user management. The healthcare sector is experiencing a significant growth in terms of revolution, particularly after the COVID-19 pandemic. The organizations are experiencing tremendous digital conversion, impacting every aspect of

the industry – security, performance, accessibility, affordability and beyond (Ali et al., 2014)^[1]. McKinsey reported that cloud-based healthcare solutions can generate value of \$100 - 170 billion by 2030 (Darwish et al., 2019)^[2]. The key driver of this growing value lies in empowering healthcare companies to innovate, digitize, and realize their strategic objectives more effectively. The growth of cloud computing in the healthcare industry is projected to from USD 34.78 billion in 2021 to USD 100.22 billion by 2027 (Qian et al., 2009)^[3]. As a cost-effective program and to strengthen privacy, healthcare providers are investing more in cloud adoption to facilitate patient care in a better way through teamwork and relationship.

For both the patients and healthcare providers, cloud computing for health care comes with different technological applications, enabling to secure the data at any time, irrelevant of the place to improve the patient care, keeping operations in streamline, and automate various processes (Sultan 2014)^[4]. In case of medical institutions, a frame work and strategy is redesigned to enable high-quality and personal care. The patients seek for instant delivery of healthcare services (Casola et al., 2015)^[5]. There are several market leaders available such as Salesforce, Kinvey, IBM, CloudMine, Amazon and Microsoft. Salesforce, Kinvey, IBM and Microsoft, provide the strongest enterprise cloud systems for healthcare industries (Chintan et al., 2019)^[6].

Practice in Health care related services

The term "cloud computing" in healthcare refers to the method of managing medical data by using distinct servers that may be accessed online, in contrast to hosting the data on a personal computer or setting up a data centre on-site with servers (Kuo 2011)^[7]. To store the information in a secured way, majority of the healthcare industries tend to work with vendors that provide cloud computing solutions which can save and store their digital records (Dilma Morais et al., 2022)^[8].

Necessity in Health care sectors

The following crucial specifications for the healthcare sector are communicated by a cloud-based healthcare system (Nikhita Reddy 2013)^[9].

- Access to computing with large storage data that is not feasible in conventional healthcare systems.
- To contribute large datasets for electronic health record (EHR), radiology images.
- Though resided at different geographic locations, ability to share EHR among authorized doctors, hospitals, and health care-providing organizations is accessible.
- Providing timely access to information that can save lives.
- Duplicate testing can be avoided.
- Improvement in analysing and monitoring the data on diagnosis, treatment, performance and costing.
- In case of emergency services

A logical workflow for better health services will be provided with a cloud-based healthcare system that minimizes operational spending. In contrary, patients receive quicker responses from healthcare system to acquire their healthcare data with better tracking. On an on-premise server, healthcare ecological community system is managed, along with EMR and medical billing systems (Mehrtak 2021)^[10]. Therefore, maintenance of upgrading records, backup and space utilization and load balancing problems cost higher.

Given these disadvantages, choosing a cloud health design requires planning ahead (Metty Paul et al., 2023)^[11]. By means of tele health and telemedicine responses, cloud-based healthcare system develops a well-structured plan in remote patient monitoring areas. Any cloud-based healthcare organisation aims to regulate seamless integration with an organised position. A cloud-based healthcare system that is well-organized raises awareness of healthcare management solutions. Any cloud-based healthcare organisation

aims to regulate seamless integration with an organised position. A cloud-based healthcare system that is well-organized raises awareness of healthcare management solutions (Kuo et al., 2011) ^[12].

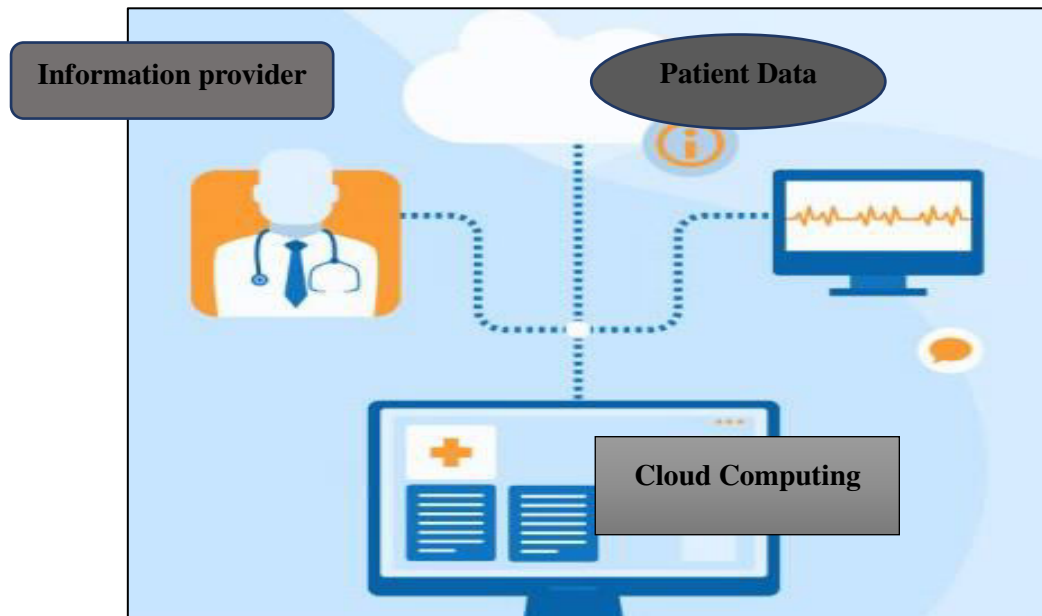


Figure 1: Cloud Computing in Health Care Sectors

Types of models used in Cloud Computing

Healthcare cloud computing comes in two flavours. Platform as a Service, Infrastructure as a Service, and Software as a Service are three possible deployment models for the hardware/software distribution concept. There are four types of deployment models: private, community, public, and hybrid (who own it).

Private cloud

It is operated for only one company/organization or for an individual person. This model is the exact converse to the public cloud deployment model. Single customer has one-on-one domain requires no measurement of hardware with anyone else, refers to the capacity to acquire systems and facilities within a given organization. The cloud platform is operated by a company's IT department within a secure cloud-based domain that is guarded by robust fireproof barriers. More control over cloud devices is available with the private cloud (Griebel et al., 2015) ^[13].

Community cloud

It enhances security and privacy control. It may be positioned both on and off property. It permits the acquisition of services and systems by a collection of institutions. It is a combination of functions of several clouds to satisfy the particular requirements of an organisation. The industry with common issues or responsibilities, may share the community's structure. Usually, a third-party stakeholder or the union representing one or more local enterprises is in charge of managing it. There are advantages of community cloud such as cost effective, safe and secured, shared can be mutually shared, however there are drawbacks like low expandability and firm in alteration (Mehrtak et al., 2015) ^[14].

Public cloud

Usually run by cloud service providers, but accessible to the general public or big industrial groups. The public cloud enables anybody to purchase services and systems. This particular cloud has significant corporate group for general public to access the cloud configuration services. In this cloud paradigm, the framework owns the cloud services, not the user. It's a kind of cloud that sets up users and customers to enable easy access to systems and services. This type of cloud computing has service providers who offer capabilities to different clients. For example, Google App. There are various benefits of public cloud – low investment, no start-up cost and infrastructure management required no preservation essential and dynamic mobility. Conversely, there are limitations like less safety and low alterations (Tahir et al., 2020) ^[15].

Hybrid cloud

A mixed computing environment in a combination of public and private clouds. It contains on-premises infrastructure (public and private services). Hybrid cloud computing provides the finest features by linking the public and private realms with a layer of proprietary software. In this hybrid model, hosting the app in a safe domain is possible which enables the public cloud's cost reduction. Depending on their requirements, industries can move data and applications between different clouds using a blend of two or more cloud deployment methods. There are benefits such as stretchability and command, cost-wise, safety and secure. Alternatively, this type of cloud is difficult to manage and possess slow data transmission (Rosenthal et al., 2010) ^[16]

There are 4 main services in the deployment models - infrastructure as a service (IaaS), platform as a service (PaaS), software as a service (SaaS), and serverless computing.

Infrastructure as a service provider (IaaS)

This is used to store, process, networking and other resources. By means of internet, it can be managed. The primary benefit of adopting IaaS is that it relieves users of the burden and complexity associated with purchasing and maintaining physical servers. There are certain features such as availability of stocks, flexibility of services, lively and scalable, robotic administrative function (Ahmed 2012) ^[17]. As an exemplification few services are available like Amazon Web Services (AWS), Microsoft Azure and Google.

Platform as a service provider (PaaS)

This enables to use specified programming languages and tools. It is used when there is a need to expand, examine, run and handle applications. There exist certain characteristic features such as access to numerous customers and desegregate the web services and databases. Additionally, allowing for simple scaling up or down of resources in accordance with the demands of the enterprise and accommodate a variety of systems and languages (Mohammed and Rafiqul 2018) ^[18]As an example, Windows Azure, Heroku, Force.com, Google App and so on.

Software as a service provider (SaaS)

This is used to acquire the data from various web sources. Here applications are arranged by a cloud service provider. By using internet and web browser customers can gain or obtain these applications. It has features like manageable from a central location, attained from internet, updates are applied spontaneously and pay-per-use is available for the services (Naresh et al., 2019) ^[19].For example ,Google Apps, ZenDesk, Zoomand Goto Meeting.

Deployment models

Cloud computing represents the next major development in the IT sector. Everyone transfers their data to the cloud, from large corporations to the pizzeria next to your house. Data from on-premises systems has already been moved to cloud servers in the zetta byte range, and this amount is still expanding exponentially. As a result, understanding cloud deployment models becomes crucial. With a deployment strategy that changes based on the volume of data wished to store and has access to the configuration, the Cloud Deployment Model functions as a virtual computing domain (Dashti et al., 2020) ^[20].

Types of Cloud Computing Deployment Models

The cloud deployment model is used to connect the specific type of cloud domain according to possession, scale, and examine, along with cloud's nature and intention. It specifies the server's location and the responsible person handling with it. It details the appearance of cloud architecture, the components, builds up right from the scratch. It also defines the association of framework and customers (Al-Jumaili et al., 2023) ^[21].

Multi-Cloud

When a company runs its applications on cloud computing services from two or more cloud providers, it is said to be multi-cloud. It is like the hybrid cloud deployment approach, which collaborates with public and private cloud resources. Multi-cloud utilizes many public clouds instead of combining private and public clouds. While users of public clouds offer a multitude of tools to enhance the precision of their services. It is quite uncommon for two clouds to be observed to be experiencing an issue simultaneously. Consequently, multi-cloud deployment enhances your utility' high availability even further (Dang et al., 2019) ^[22].

There are benefits for multi-cloud model such as low latency and higher service availability, whilst disadvantages are complex and portraits security issues. Conversely, cloud computing itself imposes advantages like low cost and flexibility, broad storage capacity, reinforces security, customize the business applications, reduces energy consumption, maintenance of electronic medical records, simple healthcare management and improvised collaboration and innovation. There are disadvantages also reported regarding the security and privacy and requires internet connection. Indeed, customers are anxious about the saving of information about their medical conditions (Ali et al., 2018) ^[23].

Elaboration of cloud computing for healthcare

Without any discernible errors or complications, cloud computing has transformed healthcare delivery by authorizing a new model for integration of data, applications, and services. The global health cloud market is predicted to thrive at a healthy compound annual growth rate (CAGR) of around 15.5%, and by 2030 reaches a valuation of around USD 115.7 Billion (Aziz et al., 2016) ^[24]. Cloud computing can improve workflows in the healthcare industry by reducing paperwork, safeguarding patient data, and facilitating data sharing among providers. But there are hazards as well, like the potential for data breaches and the requirement for cautious execution to guarantee success. In regard with the infrastructure, software and payments for employees, digital libraries and storage, cloud computing plays a critical role. There is an improved patient experience, as there is an expanded storage, all the healthcare data will be stored. It is also provided with data backup and archiving, disaster recovery, communication and social networking. It also aids in the drug discovery, telehealth/e-medicine, clinical decision support system, population health management and education. Cloud computing helps to access the data, it also helps to store the medical

records and other patient information. Sharing of information between doctors and hospitals is possible in cloud computing (Devadass et al., 2017) ^[25].

Cloud computing in Clinical data management (CDM)

In the matter of clinical data management, it aids in regeneration and analysis of large amounts of information thus improvising the quality of patient care. It maintains the electronic health records, improve population health care management, treatment planning, diagnosis, and treatment by using clinical data to gain insights from healthcare practitioners. By offering practical platforms for clinical data analysis, collaboration, and reconstruction, cloud computing helps in life science research. It sets a platform to analyse big datasets, and latest discoveries in precision medicine. In case of drug development, discovery of new drug molecules and their development process plays a critical role in research and development. Cloud computing services make it easier to manage sensitive research data by assisting with data security and regulatory compliance. However, in healthcare system there are few risks associated with cloud computing such as lack of specialists, restricted ecosystem, migration plan to cloud system is a tedious process. There is a requirement of healthcare area industries to educate everyone about the comfort of technology in everyday job. Pertaining to storage of medical data in the cloud, there is every possibility of to violate the data, this happens because the server houses data from multiple healthcare organizations, segregation techniques might fail to resolve the problem. It results in a condition where industries are unable to protect their cloud configuration against the increasing number of cyber attack occurrences(Kuo2011)^[26].

Cloud computing in Clinical data management (CDM)

Clinical trial sponsors and CROs can better serve their clients with the cloud by facilitating seamless information sharing and increasing operational efficiency. Because of barriers to data sharing, such as patient privacy risks, data distortion, and erroneous secondary analysis, the vast amount of data generated by clinical trials has gone unused. To overcome these challenges, a novel approach to data sharing that safeguards patient privacy and clinical trial investigators' interests has been created. A sophisticated query language for the cloud that let people test theories without having direct access to the actual clinical trial data. Using this query language, users have flexible options for examining clinical data given by various investigators, including running statistical analyses and displaying distributions(Kuo2011)^[26].

Future aspects of Cloud Computing in Healthcare

In regard to the future aspects, a sophisticated technology progress enfolds cloud solutions to manage excess amounts of data, upgrade patient care, and smooth operations healthcare industries.²⁷ Additionally, cloud computing facilitates the integration of artificial intelligence into health care. Cloud computing's role in healthcare is still developing. Securing better patient outcomes makes them to live healthier and profitable lives. Substantially, it helps to grow the own industries in a healthy way (Narkhede et al., 2020)^[27].

Conclusion

The benefits of cloud computing are endless and have completely changed the healthcare industry, providing many advantages to physicians, patients, and healthcare institutions alike.

Cloud computing is becoming a crucial component of the modern healthcare system, providing improved data monitoring and analysis as well as cost savings and improved patient care. Notwithstanding these difficulties, healthcare businesses must use cloud computing to remain competitive and provide high-quality treatment in the age of digital technology. Healthcare companies may create revolutionary change,

seize new opportunities, and improve patient outcomes by creating cloud computing and using its potential.

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