

## CLOUD COMPUTING IN HEALTH CARE: OPPORTUNITIES, ISSUES, AND APPLICATIONS: A SYSTEMATIC EVALUATION

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**Abstract:** Cloud computing is a modern approach to efficiently delivering IT services. According to existing research, cloud technology can improve the quality of services in a variety of industries, including healthcare. Cloud computing, like any other technological advance, should be thoroughly reviewed before being widely adopted. This research study presents a systematic review of scholarly articles on cloud computing in the healthcare sector. The most powerful architecture of computation is cloud computing, which is based on the Internet. It is made up of a mix of networked and integrated hardware, software, and internet infrastructure. Opportunities, issues, and applications in cloud computing in healthcare. The impact of value-added healthcare services on medical decision-making, cloud service providers' data security, and privacy duties, health monitoring features, and new IT service delivery models leveraging cloud computing are all recognized as areas for future research and practice.

**Keywords:** component; formatting; style; styling; insert

### 1. INTRODUCTION

Financial pressures, management of various partners for service delivery, and aging populations are all problems facing the healthcare business. Greater use of information technology (IT) can help the healthcare industry tackle these problems. IT has been used to help healthcare professionals have greater access to patient records and make better decisions. IT has much more potential to assist the healthcare sector in lowering costs and improving service results[1]. Cloud computing increases the availability of IT services at all hours and from any place[1].

Cloud computing (CC) is an IT service model that allows customers to connect to a shared pool of customizable computing resources such as servers, storage, and applications on demand[2]. Cloud computing provides web-based IT services that may be quickly deployed with minimum administrative work. Cloud computing represents a fundamental shift in the way IT services are developed, delivered, maintained, and paid for as compared to traditional IT. Cloud computing services, when used correctly, may bring several benefits to a

variety of companies. in the healthcare industry that provides care-related goods and services[2].

The CC enables healthcare businesses such as hospitals or clinics with limited IT resources and infrastructure to quickly obtain necessary IT services over a network with a pay-as-you-go pricing model. According to a recent poll, an increasing percentage of healthcare companies want to use Cloud Computing Services to obtain its benefits. The CC, on the other hand, comes with a slew of issues in healthcare businesses, particularly in terms of data management, technology, and security[2].

The operational complexity of medical services and, healthcare organizations are described as highly intricate, it involves a variety of stakeholders with varying interests and industry-specific characteristics. As a result, the cloud computing phenomena in healthcare is complex, and meaningful usage by healthcare organizations can only be guaranteed under particular conditions. Healthcare businesses should exercise substantial judgment and evaluate numerous critical aspects related to those situations when making decisions to utilize Cloud Computing Service(CCS)[1].

The following section provides an overview of current cloud computing services adoption in the healthcare industry. The research methodology follows, with an explanation of our systematic review mapping technique and a presentation of research findings based on a classification framework. Following that, there is a study of current literature in terms of cloud computing prospects, difficulties, and uses in the healthcare industry. Finally, future research and practice implications are discussed[1].

### 2. CLOUD COMPUTING OPPORTUNITIES IN HEALTHCARE

According to much research, medical errors in the healthcare industry are mostly due to inadequate communication and limited access to patient records. Cloud computing was viewed as a potential way to improve healthcare performance and reduce medical errors, as well as increase service delivery, medical research, and investment returns [3].

Data can also be transferred across many systems with cloud computing, which is currently unavailable in many healthcare facilities. Cloud computing could allow doctors' references, prescriptions, electronic health records, and diagnoses to be exchanged across several systems[3]. This is already happening in the radiological field, with many facilities using cloud computing to share images and save money on storage[4]. Cloud computing has enabled medical practitioners, hospitals, and pharmaceutical businesses to collaborate to share patient data, resulting in more efficient and high-quality services. Because of their carbon emissions, traditional ICT systems are not environmentally friendly. Because cloud computing allows for lower energy use based on usage, data storage facilities are less expensive to run. Not only does this save energy, but it also requires fewer materials for cooling, resulting in fewer harmful emissions into the environment. This is also a major motivator for cloud computing use in healthcare because the environmental impact is reduced[3]. In Australia, Telstra and the Royal Australian College of General Practitioners have suggested collaborating on an e-Health cloud (RACGP). This collaboration intends to develop diagnostic and control applications, as well as medical software, prescriptions, education, and referral devices.

When it comes to migrating to the cloud, one of the most important benefits for healthcare organizations is the reduction in IT expenditures. All IT processes will be relocated to a remote cloud-computing infrastructure, where they will be executed and stored, if the cloud model is adopted[4]. Because the cloud computing providers take care of maintenance, security, and replications, there is no necessity for enterprises to invest in expensive hardware infrastructure, software licensing, or to keep/train in-house staff [2].

Human life is valuable and medical resources are limited, cloud-based healthcare services match a cost-effective concept in which patients and health organizations benefit from this new technology by improving patient quality of service through a distributed, highly integrated platform, and coordinating care[2]. coordinating of medical process as well as reducing IT infrastructure investment or maintenance costs which leads to a better healthcare environment.

### 3. SYSTEMATIC APPROACHES

It is very impossible for health practitioners to examine appropriate papers for evidence-based practice due to the enormous amount and regular updating of healthcare publications. Furthermore, healthcare providers should not base their recommendations on the findings of a single study, as such studies may have biases and the results may be ambiguous[5]. Healthcare workers must seek strong evidence of research that informs practice in order to implement evidence-based practice. Systematic reviews are one of the strongest evidence for evidence-based health practice, according to the hierarchy of evidence that rates evidence for

healthcare interventions[1]. As a result, systematic reviews are important because they provide a summary of research implications for practice on a specific topic that is considered robust and reliable in comparison to controlled trials or case studies.

### 4. CLOUD COMPUTING ISSUES IN HEALTHCARE:

Despite the obvious benefits of cloud computing, there are still some challenges that need to be examined further, particularly in terms of technological issues, security and privacy concerns, and legal concerns. A cloud-based system comprising sensors linked to medical devices has been proposed to automatically compile patient data for storage, accessibility, and sharing[6]. This technology can reduce written typos or errors caused by manual data collection, not only simplifying the procedure but also allowing greater access to high-quality data. Nkosi and Mekuria suggested a cloud computing system that not only provides multimodal sensor signal processing but also provides other services. reported on the 'Dhatri' pervasive cloud effort, which used cloud computing and wireless technology to allow physicians to access patient medical information at any time [1].

The Greek National Health Service trialed a cloud-based emergency medical system by merging the emergency system with patient data, ensuring immediate access for clinicians, and allowing them to use all devices while keeping costs low[7]. Despite the numerous benefits of cloud computing, there are still some challenges that need to be examined further, particularly surrounding areas of technological issues, security and privacy concerns, and legal concerns[3].

#### A. Technological issues:

One of the well-known disadvantages of cloud computing is the lack of reliable service delivery methods. Customers are drawn to aspects such as storage capacity and apps, but with ever-increasing demand, cloud service providers face congestion and are unable to meet customer expectations, and as a result, their value is reduced by restricting access or failing to update infrastructure. Poor service is a result of Cloud Service Providers not being audited by a regulatory agency, resulting in a gap between consumer expectations and service performance[1]. Data transport is another area that has to be looked into more. If a CSP goes out of business, businesses may have to switch to a different CSP or return to an in-house IT system[6].

#### B. Security and privacy issues:

This section provides an overview of the concerns posed by e-healthcare clouds in terms of privacy and security. The handling of patient healthcare data involves both technical and legal issues that must be addressed. Any technical mechanism to prohibit cloud providers from exploiting consumer data in all instances appears implausible [8]. Hackers, user misbehavior, and network failures are all security and privacy risks in IT. Poor encryption key management, a public administration interface, and separation failure are all risks associated



with cloud computing service delivery. Viruses, malware, and other security risks are more difficult to combat in cloud systems than in traditional in-house IT systems, especially when the public cloud is used. As a result, security as a service is being offered to assist cloud service providers in providing cost-effective token key and hosted security services to their customers[3]. According to some other research, the majority of consumers consider security and privacy to be the most dangerous barrier in cloud computing. As numerous customers now access data via cloud computing, all appropriate data must be managed to avoid privacy breaches[7]. The first part of security is software security, which includes personnel identification. The platform security component, which includes interfaces and framework aspects, is the second consideration. The concept of accountability in the context of data practices also applies to cloud computing services that require high security and privacy requirements, particularly those involving sensitive health-related or medical data. Lastly, infrastructure security relates to online privacy and storage settings[3]. Within the cloud computing environment, several users share and access resources and environments. In this setting, privacy challenges include a lack of resources to separate storage, reputation, and routing. Because of the store setup and capacity, cloud computing users are at a higher risk of privacy breaches from third parties who also have access to the cloud system[3]. Due to legal obligations and patient privacy rights on sensitive health and medical data, healthcare has stricter security needs. Data confidentiality is a recurring theme, especially from the standpoint of unauthorized individuals gaining access to patient records. Transferring such massive and highly private files is especially difficult, and more security precautions must be taken.

Additional security requirements include access control, data management, and secure storage[5]. User privileges and password enforcement aren't the only aspects of security and privacy in healthcare cloud computing. Cloud computing platforms are multi-domain environments in which each domain has its own set of security, privacy, rules and procedures, and trust requirements, as well as the ability to use a variety of mechanisms, interfaces, and semantics[2].

Established security solutions such as encryption, access management, firewalls, and intrusion detection are used in Cloud Computing. Internal Cloud Computing allows the IT department to deploy any security solutions it sees fit, but external Cloud Computing leaves security to the Cloud Service Provider. Some Cloud Service providers don't let you pick and choose which security solutions you want, while others let you implement client security requirements[8].

These challenges have hampered cloud adoption and must be solved in order for cloud technologies to be trusted. Fortunately, several of the market's largest cloud providers, such as Microsoft, Google, and Amazon, have

pledged to adopt the strongest rules and processes to protect their customers' data and privacy[2].

## **5. CLOUD COMPUTING APPLICATION IN HEALTHCARE**

Pharmaceutical businesses, insurance companies, laboratories, and hospitals are all part of the healthcare system. All components must adhere to government standards and share data in a timely, accurate, and efficient manner while maintaining patient confidentiality[2]. Patient data is extremely sensitive, and the possibility of it being compromised is one of the reasons for cloud computing's delayed acceptance. Any new technology in the healthcare sector that manages sensitive health data must protect patient privacy[2]. As Big Data and healthcare become increasingly linked, the healthcare industry has been undergoing digital transformation. Paper healthcare records are being phased out in favor of electronic healthcare records, or EHRs, as part of the change. These records are sometimes anonymized for research purposes, such as determining the leading causes of hospital readmission. Whether working on DNA sequencing, the molecular structure of a potential medicine or analyzing illness trends, many healthcare companies use cloud computing for research. They may accomplish more in less time and for less money by utilizing cloud resources rather than traditional computing resources. Recently, academics have begun to use cloud computing providers' machine learning and artificial intelligence capabilities, which has resulted in new findings[9].

## **6. CONCLUSION**

The current state of cloud computing research in the healthcare sector has been evaluated and addressed. Several articles were carefully selected from the online database and categorized into three categories, opportunities, issues, and applications. As a guide for future research and healthcare decision-makers, this research study presented implications for research and practice. It's critical to figure out whether the benefits of cloud computing exceed the drawbacks of using it in the healthcare industry. Despite the increased interest in cloud computing in healthcare, few successful implementations have been documented, and many studies just use the term cloud to refer to virtual machines or web-based applications with no explanation of the cloud paradigm's benefits. Involving external cloud partners poses the greatest impediment to adoption in the healthcare domain: numerous issues of data protection and security remain unresolved. Until then, cloud computing is valued for specific, unique characteristics such as elasticity, pay-per-use, and broad network connectivity, rather than as a cloud paradigm in and of itself.

## 7. COMPLIANCE WITH ETHICAL STANDARDS

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### DISCLOSURE OF CONFLICT OF INTEREST

The authors declare that there is no conflict of interest regarding the main research, authorship and publication of this paper

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