

Cloud computing in the healthcare industry: a systematic literature review

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Abstract

In today's society, technology has become a dominant critical component in every business, including healthcare. The advantages of maintaining health records electronically have boosted patient care productivity and ease of access and utilization. The creation of cloud-based technology is one of the most recent technological advancements in health care. This study aims to analyze the requirements for cloud computing, to feature momentum challenges/restrictions, and afterward propose potential answers for scientists and application designers by looking at existing distributions zeroed in on cloud computing utilization and applications in the healthcare industry. The study used existing literature in a systematic literature review. This paper gives an outline of the need and handiness of Cloud Computing in the healthcare area by depicting and depicting it as a viable mechanical choice for some healthcare suppliers.

Keywords: Cloud computing; cloud technology; healthcare industry.

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1. Introduction

Each nation has the objective of improving its residents' healthcare and personal satisfaction by offering helpful and simple healthcare services offices. The advancements in the space of Information and Communication Technology (ICT) advance the development of practically all enterprises, including the healthcare area (Sha & Rahamathulla, 2020). Henceforth, the requirement for the utilization of cloud computing in regular day-to-day existence is progressively extending. Cloud computing is turning out to be so broadly utilized that it is in any event, being utilized in the healthcare area (Generalova et al., 2021; Wu et al., 2022). As cloud computing in healthcare propels at a high speed lately, we ought to expect a sizable level of healthcare services frameworks to move to the cloud, setting more consideration on guaranteeing available medical administration to individuals everywhere in the world. The information creation rate in the healthcare services area is currently bit by bit rising. Healthcare information streams from clinics, protection suppliers, and online datasets are different. Healthcare associations throughout the planet look to utilize the cloud's capacity to deal with healthcare information deliberately to build medical care conveyance. The advancement of healthcare administrations utilizing outsider cloud computing instruments would make matters simpler (Aziz & Guled, 2020). Despite the basic conviction that specific limits and security issues of the cloud would prevent the shift, the healthcare industry is showing a drive to move to this cloud-based stage.

As per the definition by the National Institute of Standard Technology (NIST), Cloud Computing is "a model that gives conveyed, quickly provisioned and configurable processing assets (like workers, stockpiling, applications, organizations, and different administrations), which are on-request, fast flexible and estimated, to whom have network associations". In light of the obvious adaptability, availability, and productivity of cloud assets for a minimal price, there has been a quick example of cloud computing appropriation by organizations or for this situation, healthcare-related enterprises lately (Mell & Grance, 2011).

1.1. Purpose of study

Cloud computing can altogether build healthcare conveyance proficiency (Bathelius, 2016). Be that as it may, notwithstanding every one of the advantages, it is yet to be completely executed in healthcare services, with one significant reason being patients' interest in the secrecy and security of their clinical records. The sole point of this study is to give more experience on the requirements for cloud computing, to feature momentum challenges/restrictions, and afterward propose potential answers for scientists and application designers by looking at existing distributions zeroed in on cloud computing utilization and applications in the healthcare industry (Rzȧdeczka, 2020; Amantea et al., 2020). Research Questions were as follows:

- What is the need for cloud computing in the health industry
- Why is it important for the healthcare industry
- What are the major challenges of cloud computing in the healthcare industry?
- What are the Implementations of cloud computing in the healthcare industry?

2. Materials and methods

2.1. Procedure

Recent occasions demonstrate that the cloud is the ideal answer for addressing medical care issues, particularly with the current pandemic, which requests restricted human collaborations and contact to contain the spread. Cloud computing considers strong handling, adaptable capacity, and

prescient investigation of healthcare services records. A few examinations have been led on the utilization of cloud computing administrations in the space of healthcare care.

An intensive and unprejudiced inclusion of the looked-through written works is fundamental for a methodical writing audit. We started by characterizing a portion of the more regularly utilized substitute terms and equivalent words relevant to our investigation to expand the inclusion of our looked-through writings.

First, we conducted a manual search of similar fields such as computer science and healthcare. The databases chosen are primarily Web of Research, Science Direct, and IEEE (in minor). Open-access publications in related fields were also included to include a broader reach. We tried to avoid using website links as far as possible because it is difficult to confirm if the material on those sites is authentic and approved in the testing context. We restricted the publishing year to 5 years since it is the general standard for writing a related paper. Following a general review of the subject areas, the vocabulary of the papers was restricted to English, and obsolete articles were filtered out by reviewing. After a general study of the related areas, the language of the papers was limited to English, irrelevant articles were then filtered out by checking the categories if fell. Search Strings: ("cloud computing" OR "cloud technology") AND ("healthcare" OR "health industry" OR "eHealth" OR "health solution"). The following keywords were used as search strings to search the Web of Science database (figure 1);

Figure 1
Procedure for resource search

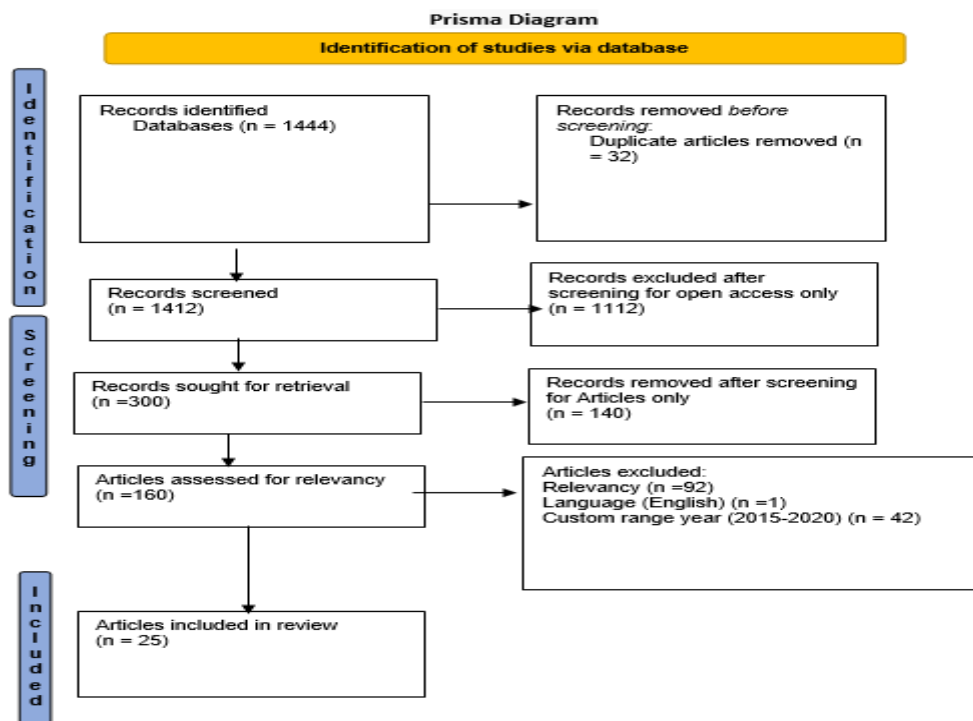


Table 1
Screening

Criteria	Database
Initial search using keywords	1444
Open access	300
Custom range (2015 – 2020)	126
Language (English)	125
Only Articles	160
Research Areas	73
Web of Science categories (Excluded works on Engineering Electrical Electronics, Mathematical Computational Biology & Material Science Interdisciplinary as they were not relevant to my topic)	25

Since various databases have different search string laws, the search string can be subtly changed when looking at them. Our first search using the search string in all of the databases listed yielded 1444 documents. We then limited ourselves to articles with open access, reducing the number of relevant articles to 300. For improved understanding, we then used a custom selection year with only papers published in English between 2015 and 2020. This reduced the number of publications to 125, after which we completed a primary review focused on reading the abstracts of all chosen articles to concentrate on the most important pieces of literature. The assessment is based on the parameters outlined in Table 1 above. The inclusion criterion for selecting the appropriate papers was applied separately for each author (table 2). This assessment selected 25 papers and they are all stated in our detailed report.

Table 2
Include and exclude criteria

Include Criteria	Exclude Criteria
Directly or indirectly related to Cloud computing and Health	Irrelevant to the study of Cloud computing and Health
Cloud computing in Health care, eHealth, and cloud-based designs for the healthcare industry	Cognitive Introductions
Cloud computing solutions used in the healthcare industry	Journals, conference papers, etc
Challenges and Limitations influencing cloud computing in the healthcare industry	Business-related or analysis reports
Year of Publication (2015-2020)	Not written in English
Only articles	
Written in English	

2.2. Analysis

In Summary, the search results were checked manually to confirm that the title and the abstract of the articles are relevant to remove irrelevant articles from search results, and then full articles were reviewed to identify relevant information on the topic of interest.

3. Findings

The results of a thorough analysis of cloud computing and healthcare-related papers were presented and analyzed. The categorization process was used by taking four elements into account: the role of cloud computing in the healthcare sector, why it's essential, challenges, and applications.

3.1. Benefits of Cloud computing in the Healthcare industry

Numerous examinations have shown that clinical mistakes in the healthcare area are regularly ascribed to helpless correspondence and restricted admittance to patient records (Doukas & Maglogiannis, 2014). Registering was viewed as a possible way to improve healthcare services execution and lessen the degree of clinical blunders (Kuo & Danek, 2011), just as improve administration arrangement, clinical examination, and speculation (Godihno et al., 2016; Charalambous, 2020).

From an administrative stance, the fundamental expected benefit of cloud computing is a decrease in healthcare care costs, permitting accentuation on different parts of healthcare service needs (Godihno et al., 2016). Cloud storage can make IT more cutthroat by lessening the need to buy or put resources into actual IT offices. Inner staff is not required for IT issue upkeep because of the cloud model's help for IT arrangements, which additionally lessens costs by limiting faculty and killing the requirement for IT planning (Ahmadi et al., 2018). Additionally, the product would not get excess because of the significant expense of redesigning. At the point when a client signs in, the web program is promptly refreshed (Sadoughi et al., 2020).

3.2. Why Cloud computing is Essential in Healthcare Industry

Aside from cost savings, cloud storage enables quicker usage, accessibility, and connectivity for all users in all countries. This eliminates the need for other service providers to change infrastructures (Griebel et al., 2015), makes data and services more available in less time, and raises the quality and speed of service provision (Mehraeen et al., 2016; Godinho et al., 2016; Lian, 2017; Dautov et al., 2019). Cloud storage allows data to be spread across different networks but is still lacking in many healthcare institutions. Cloud computing can enable doctors' references, orders, EHR, and diagnoses to be replicated across multiple networks. This is also occurring in the radiological sector, where many laboratories have turned to cloud computing to exchange photographs and save money on data. Because of cloud computing, medical providers, hospitals, and pharmaceutical firms will now cooperate to exchange health records, resulting in more reliable and high-quality care. The expected advantage is that decisions would be better informed and promptly, diagnoses are more accurate and appointments are easier to schedule (Ali et al., 2018).

In broader organizations, cloud infrastructure shifts responsibility for IT management and services to a third-party vendor, lowering costs while increasing reach and versatility. Furthermore, when using cloud resources, applications can fulfill the computing requirements of multimedia platforms capable of storing and analyzing large amounts of data and providing meaningful information to public organizations (Saxena & McDonagh, 2020, Garcia et al., 2014). Cloud processing also allows for reduced energy costs depending on demand, making data storage centers less expensive to maintain.

Finally, conventional ICT schemes are unfriendly to the world due to their carbon footprint (Li et al., 2018). This is often seen as a significant incentive for the use of cloud computing in healthcare, as the environmental footprint is reduced.

3.3. Challenges of Cloud computing in the Healthcare industry

From our discoveries, Security and protection issues stay the significant difficulties or misfortune for the full appropriation of cloud computing in the healthcare care industry. Dangers from malware, client misuse, and organization breakdowns are among the security and protection issues in IT

(Mehraeen et al., 2016). Infections, ransomware, and other security dangers are harder to determine in cloud administrations than in customary in-house IT frameworks, especially where the public cloud is utilized (Ali et al., 2018). Therefore, encryption is being given as a support to help cloud specialist co-ops in giving their clients practical turnkey and facilitated security administrations (Cisco, 2015).

To additional support, our cases in discoveries, as per different examinations, most cloud framework customers refer to security and protection as the most unsettling obstacle. The primary security component is programming security, which incorporates staff confirmation (Ramachandran, 2015; Munn et al., 2019). The subsequent factor is stage solidness, which incorporates interfaces and framework parts. The idea of straightforwardness in the feeling of information exercises is additionally appropriate for cloud computing administrations that require rigid insurance and security necessities, particularly those unsettling private healthcare-related or clinical information (Jaatun et al, 2016). At long last, because of lawful guidelines and patient security insurance on close-to-home healthcare and clinical records, healthcare services have more severe assurance necessities (Mehraeen et al., 2016).

3.4. Implementation of Cloud computing in the Healthcare Industry

Ordinarily, healthcare suppliers hold EMRs in their information bases; be that as it may, moving information to the cloud takes into account faster correspondence by permitting the two members to see the required information. Patients should give their consent for their information, like EHRs, EMRs, Personal Health Records (PHRs), and Payer Based Health Records (PBHRs), to be shared and saved in the cloud (Kaur and Chana, 2014). This will permit both territorial and unfamiliar healthcare accomplices to get to the information. This implies fewer slip-ups because all healthcare suppliers will approach similar records, while as yet improving help arrangement and minimizing expenses (Ali et al, 2018). For example, Microsoft's HealthVault, which usually holds x-rays and doctor's reports, may be expanded to enable patients to add data, such as heart rate monitor data, allowing all stakeholders to use the same and multi-faceted data for decision-making.

Cloud computing's increased availability is projected to result in fewer downtimes and more reliable data quality (Botts et al., 2011). The cloud should be controlled to achieve high availability service objectives. While security issues must be well understood before switching healthcare data to cloud storage to understand optimal availability, so systems can be scaled up or down more quickly according to demand (Endo et al., 2016).

Cloud-the-board applications, for example, Cloudkick, Logic-Monitor, and Pandora FMS will help healthcare care offices improve cloud abilities for their expected use. Other general cloud management software, like Amazon Web Services, are valuable for straightforwardly checking cloud assets.

4. Conclusion

This paper gives an outline of the need and handiness of Cloud Computing in the healthcare area by depicting and depicting it as a viable mechanical choice for some healthcare suppliers that are worried about rising healthcare conveyance costs, information sharing, and a lack of healthcare specialists, particularly in this pandemic period. The benefits gained can't be smothered by worries about trust, security, and assurance. The mechanical difficulties should be settled before healthcare services suppliers can embrace and rely upon the e-Health Cloud.

With the cloud framework worldview, security and interoperability difficulties will develop, causing cloud appropriation to move at an icy speed. Despite the entirety of the difficulties, the utilization of

cloud-based frameworks will possibly ascend later on with the presentation of best practices in engineering, joining, and use.

As much exploration has not been attempted in the field of big data healthcare services information mining, the future examination viewpoint researches the management and utilization of big data in healthcare services, digging for better decision-making in healthcare services cloud computing.

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