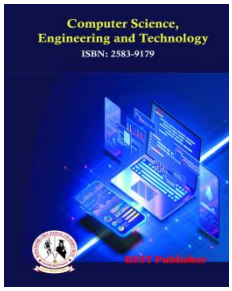
Computer Science, Engineering and Technology

Vol: 1(1), March 2023

REST Publisher; ISSN: 2583-9179 (Online)

Website: https://restpublisher.com/journals/cset/

DOI: https://doi.org/10.46632/cset/1/1/18



Development of Cloud Computing in Healthcare for Improving Patient's Care Services

***M. Dhurgadevi, R. Kiruthika, P. K. Sasikumar, K. R. Sathish Kumar**

Mahendra Engineering College, Namakkal, Tamil Nadu, India.

**Corresponding Author Email: dhurgadevim@mahendra.info*

Abstract: *Cloud computing (CC) is known as a game changer in healthcare as well as biomedical sciences, providing scalable, on-demand capabilities to handle massive data. The combination of mobile computing as well as CC has the possibility to transform the delivery of healthcare by giving ubiquity access to sources while also facilitating novel services implementation and delivery models. Although CC has undergone extensive research in fields like genomics as well as molecular medicine and its application in healthcare outside these areas is slightly unknown. Electronic health records, Robotic surgery, monitoring remote patient devices, predictive analytic tools, telemedicine, and virtual health assistants are only a few instances of how Artificial Intelligence (AI) technologies is used in healthcare to improve the health of patients along with offering solutions with patient-centered. To strengthen patients by integrating tools with AI-powered solutions that facilitate decision making in healthcare. Minimize the resource allocation and cost in healthcare by utilizing AI for early identification of medical problems, consequently encouraging preventative measures. The AI-powered patient interaction strategy is a game changer for the provision of healthcare. AI-powered Patient Engagement efforts have highlighted a bright future for the revolution of healthcare. Patient participation has enhanced AI technologies by individuals adopting more responsibility in managing their well-being. AI-enabled patient interaction has emerged as an influential force in healthcare. It has been demonstrated that AI-driven patient engagement can lead to improved results, more patient autonomy, and substantial savings on expenses.*

Keywords: *Cloud computing, Artificial Intelligence, patient care, mobile computing, healthcare*

1. INTRODUCTION

Healthcare in the 21st century has undergone an essential transition, driven by technological developments particularly AI and participation by patients' programs. Consider the shifting nature of patient care and an approach of healthcare revolution [1]. The preceding section provides an outline of the changes in fundamental beliefs about ideas and research. Participation from patients is an established strategy that has been used by pharmaceutical as well as medical device businesses for enhancing the desire of patients to conform for treatment protocols over clinical trials. Moreover, care operations, healthcare decisions, and treatment plans have been considered with the entire healthcare system [2]. Patient involvement and fulfillment are essential indicators of a hospital's administration approach [3]. Patient participation involves behavioral, affective and cognitive are the components for patient's transparency, collaboration and engagement which have became the critical components of efficient engagement among patients. To assist individuals in controlling their own healthcare has resulted with improved results and satisfaction. AI technology and approaches may be integrated into current structures, processes, or competences to improve functionality and efficiency. Everyone needs a good quality of life. When an individual visits the hospital whereas sick person is consider as the patient engagement process, which includes symptom discovering and an approach to diagnosis, as well as MRI and CT scans for determining the patient's health disease. This even help to determine treatment types that patient should receive, as well as plans for a healthy operation, and ultimately the patient's discharge stage as well as good health avoidance exercise. Ultimately, patients actively participate in the healthcare engagement method. The MC and CC integration over healthcare business has the possibility to alter the delivery of healthcare and improve outcomes for patients. The potential of MC, CC, and AI in healthcare is just starting to be appreciated [4]. Mobile medical applications such as electronic health records (EHRs), which enable users for accessing their data from everywhere through mobile devices, have already provided numerous real benefits. These technologies have dramatically enhanced the security of patients by sharing data in real-time as well as providing fast accessibility

to medical information and analytics. Applications have additionally allowed the development of care plans based on real-time data from patients' independent systems like home monitoring systems, wearable devices and collaborative systems namely EHR leading to efforts toward enhancing the life quality for patients who suffer from neurological conditions such as Parkinson's disease. The following summary seeks to offer a complete review of its integration benefit and significance as well as the present status of research in the topic. The MC and CC technology have changed several industries, including healthcare whereas the technologies provide chances for enhancing the efficiency, quality and accessibility of HCS [5]. The MC an CC combination can harness the authority of Fast Healthcare Interoperability Resources (FHIR) and AI to create novel opportunities. FHIR establishes a standardized platform for transferring healthcare data, whereas AI delivers sophisticated analytics, predictive modeling, including healthcare decision assistance [6]. This publication discusses several healthcare applications of FHIR and AI over three scenarios encompassing clinical decision assistance, predictive modeling, as well as patient safety enhancements [7, 8]. This paper discusses the benefits, problems, and implications of integrating MC, CC and AI in healthcare [9]. Electronic health-based CC networks are regarded as a part of the forming HCS that have the potential to transformation the medical field by providing benefits such as economical infrastructure, less energy conservation, rapid deployment, mobility, rapidity, collaboration of resources, and scalability. This network type is simple to utilize and may be constructed in any place for better coordination, interaction, and collaboration among diverse HCSs. Natural language processing (NLP) is a type of AI technique employed by chatbots for effectively carrying out every day jobs. In real life, clients may be asked questions with multiple answers by chatbot, text, image, or video. Chatbots as well as virtual assistants have strengthened customer service, enhanced productivity, as well as optimized interactions between humans and machines across domains. The global chatbot business was valued $1.25 billion in 2020, and it is expected to expand at a CAGR of 25.4% between 2021 and 2028. These AI-powered systems are utilized to interpret and respond with consumer requests, which make them valuable tools in a wide range of businesses, like e-commerce, healthcare, and numerous service sectors. These industries have now utilized AI technology to achieve positive results. Advanced cloud-based health care systems can be utilized for a variety of HCS like hospital information systems, EHR, medical diagnostic systems, and monitoring healthcare [10]. This sort of digital HCS can offer storage resource allocation and computer technology. The credit card business is gradually expanding and is expected to be worth approximately US$225 billion by 2020 [11]. Multinational corporations such as IBM's Active Health Management and Aetna have developed unique clinical data management systems in accordance with the CC framework. Google and Microsoft have both created services for storing medical records, including Google Health and Microsoft HealthVault [12]. CC systems integrated e-health networking are particularly appropriate since they are flexible and portable, economical, and are able to used in remote areas. AI enables users to gain previously unachievable information on treatment fluctuation, care routines, diagnostics, as well as outcomes for patients. AI is rapidly being used in pathology and radiology for image processing, which helps with disease diagnosis early on. By analyzing large databases as well as forecasting medicines. AI technologies assist medical professionals to make diagnostic and therapeutic decisions by providing evidence-based recommendations [13]. Its various consequences include patient participation, administrative responsibilities, diagnosis, and therapy. By analyzing prior and existing patient data, AI may anticipate outcomes for patients and promote prompt treatment as well as preventive treatments by supporting medical practitioners to recognize persons who are at risk of acquiring diseases or health problems. It is used to manage chronic diseases and reduce hospital readmissions.

2. LITERATURE REVIEW

Most of the problem in healthcare sector are caused due to miscommunication or not centralized communication. This is where cloud computing help and try to minimize the miscomputation which in turn results less issues related to communication. For example, where there is shift transition there is change of gap in understanding for switchover between staff. As per study of West Monroe report, “35 percent of healthcare industry was included in survey related to cloud service and almost 50 percent of them confirms that they are using some or more part of cloud-based services and application” [14]. Another study called “Cloud computing in healthcare bad weather or sunny forecast” elaborate how critical is cloud computing and application is for healthcare services. Though security is major concern of healthcare providers when they want to decide on transition from traditional system to cloud based system but in reality, Cloud service provider provides the best out of the world security controls on their server and data by using most robust algorithm and firewall and other methods to prevent and secure their cloud servers [15]. To maintain such high-end technology and upgrade continuously and that level of touch monitoring is not easily possible for nay healthcare service provider or they need to expand lot more for such level of advance tools and technology. It is always challenge for hospital and healthcare service provider to store so much data as it involved patient care data, inventory, supply chain, purchasing, medical record, patient portal, applications data, and insurance related information and data. This data is growing rapidly and it is difficult to manage or store such data. This is where cloud computing helps and provides data storage services which is easy to upscale or downscale. AI algorithms can anticipate patient needs, identify possible risks to health, and provide

customized suggestions regarding lifestyle modifications along with therapy options. Furthermore, chatbots powered by AI and virtual assistants provide 24/7 accessibility to healthcare data by making appointments, scheduling time for patients, including remembering them to consume their meds. These AI technologies are also helping reduce the burden on medical care. One of the primary advantages of patients interaction powered by AI is its capacity to encourage proactive care [16]. AI-enhanced patient interaction is more effective with patients. AI technologies use NLP to assess patient data, diagnose signs and symptoms, and generate tailored suggestions for therapy and treatment, improving the delivery of healthcare efficiency, and providing coherent and readily available data on the issues facing patients [17] [18]. AI will improve the patient-provider connection by allowing for better knowledgeable, compassionate, and successful care as healthcare evolves. Patients may interact easily and spontaneously with NLP-powered chatbots as well as virtual assistants to inquire about questions, book appointments, as well as acquire healthcare data [19]. This additionally improves efficiency in administration, but it also allows patients more control in managing their own health. Furthermore, NLP can help overcome language barriers and improve the accessibility of healthcare [20]. It is able to translate as well as interpret many different languages, ensure patients from every cultural background get the help and data they require. In general, NLP interaction with patients is transforming healthcare by increasing efficiency, ultimately and communication improving healthcare results for individuals across worldwide.

3. RESEARCH METHODOLOGY

CC has lately gained traction in academic and therapeutic settings due to capabilities such as vast, quickly readily available, and changeable resources. Health care providers expected virtual cloud-based services to replace time-consuming paper-based records as well as handle, archive, share, and employ massive amounts of health data. However, there are significant economic and security considerations regarding CC in health care settings. The main goal of cloud-based solutions when aligned with any HCS is to provide easy, scalable right-to-use technology and IT services in accordance with regulatory laws that ensure the confidentiality and safety of patient data and limit usage to those who are authorized. CC services used to store based on images data have evolved from an organization to provide economical recuperation for stored information to a fully integrated PACS. Further, supplier-based independent storage capabilities that can meet the needs of healthcare personnel. Global healthcare providers are actively evaluating the cloud for the purpose of remote disseminating health data like images/reports data for patients or physicians/radiologists using enhanced reading capabilities.CC services can significantly cut infrastructure and service costs while also allowing for remote management of operations. HCS integration with cloud services allows for secure retention of additional information, which is conveniently available for end users and health care providers. Healthcare data is clinical radiological imaging, necessitates increased storage, robust connectivity, high quality, and adequate display features for end users. These qualities can be gained using cloud-based technologies, which allow medical information and images including X-rays, ultrasound, CTs, as well as MRI images with reports to be saved, analyzed, maintained, and made available to image workspaces. Distributing imaging tests from the cloud to zero-footprint monitoring applications allows imaging investigations to be performed whenever they may be required.

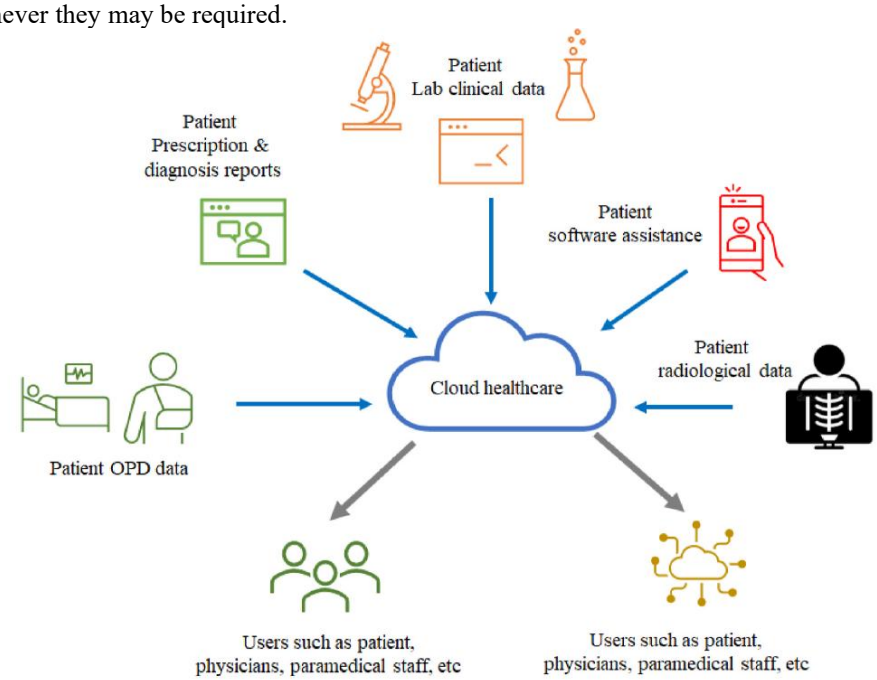


FIGURE 1. Basic activities of cloud healthcare

Integrating MC and CC in healthcare permitted real-time accessibility of patient data, seamless communication, as well as remote monitoring. It also allowed data to be kept saved in cloud storage, retrieved on the cloud, as well as accessed through mobile devices. MC and CC have already provided numerous tangible benefits. These technologies have dramatically enhanced patient safety by sharing data in real-time and providing fast utilization of medical data and analytics. The mobile applications additionally permitted the development of care regimens that incorporate real-time data from patients' own systems like home monitoring systems, or collaborative systems, like as EHRs. Such initiatives have increased the life quality for those suffering from neurological illnesses like PD. Health care professionals can easily access EHRs and share health data via mobile devices as well as cloud platforms. This connection increased the availability and accessibility of patient data, resulting in better decision making along with more efficient operations in healthcare.

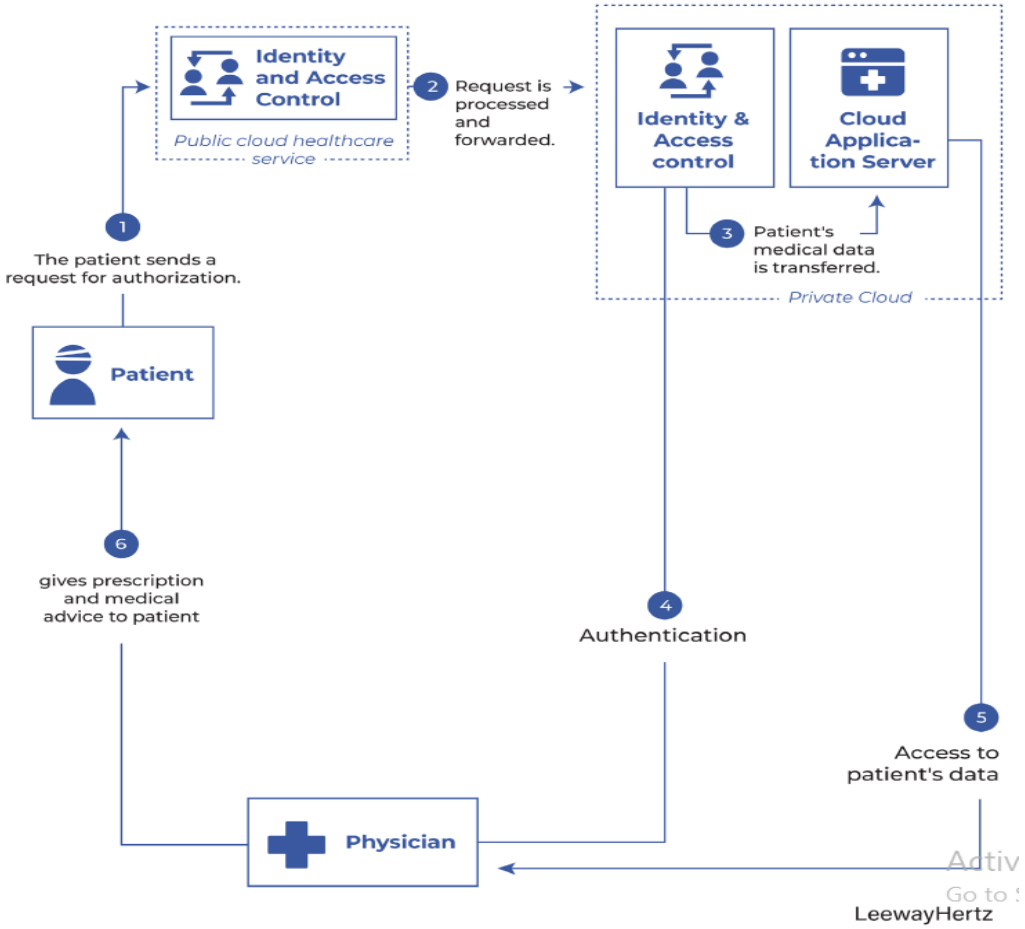


FIGURE 2. cloud computing services used in healthcare

Figure 2 depicts a CC architecture and provides a comprehensive overview of the operational process and the process in cloud services is shown through a combination of both public and private cloud communication scenarios. The private cloud platform comprises software as well as hardware elements which fulfill all defined healthcare criteria, and the key functionalities in this pipeline are authorization, data durability, authentication, data confidentiality and data integrity. The use of FHIR created a standardized platform to share healthcare data. This enabled data exchange and smooth integration across many HCS and its applications. FHIR offered a unified structure for the sharing and incorporation of healthcare data across multiple platforms. It streamlined the data interchange procedure, potentially leading to enhanced efficiency, cost savings and scalability. Furthermore, the systems included security mechanisms as well as established interfaces to assure confidentiality and integrity of data protection. It supplied rich metadata for describing complicated Healthcare Terminologies (HCXML) schemas, allowing for the finding and comprehension of inter-system interactions. Using FHIR allows the exchange of organized health data including patient demographics, test findings, medication data and vital signs. As an outcome, health care professionals now have access to comprehensive as well as current patient data, which improves support for clinical decisions along with outcomes for patients.
CC-based PACS, also known as CC PACS, is a PACS technology that consists of three major components are

1. image archiving system
2. image visualization function
3. workflow engine

This assist to hosted in the cloud and accessible for users as well as administrators through Internet-based user interfaces. Cloud PACS provide the benefit of both site and device flexibility. During Cloud PACS access, the radiologist needs have an efficient computing terminal as well as a fast internet connection. Radiologists in imaging facilities are now granted complete authority over the devices' hardware and software, along with their information technology systems to meet their specific needs. However, CC allows customers to utilize IT-related networks without knowing or influencing the infrastructure that runs and assists them. Furthermore, cloud-based IT infrastructures enable radiology customers to review pricey technology and software stored remote in the cloud from places far away. The cloud-based network provides a user interface through which customers are able to utilize many services, including PACS, remote image analysis (teleradiology), RIS, revolutionary 3D-workstation application, and invoicing application. Moreover, allow radiology center administrators to continuously install as well as uninstall services, and download and upload data with no compromising software or hardware. Hence, data may be safely saved with frequent application upgrades, and vulnerabilities, malware, or hazards can be easily tracked and fixed remotely. Establishing these imaging-based virtual cloud radiologists doesn't involve expensive software and hardware. Thus, a single central processing unit might be adequate. This cloud-based E-network allows radiologists to focus on their practice and dealing with patients rather than dealing about the way of service is processed and hosted, or routed. Figure 4 depicts a usual CC-based radiology unit workflow. Cloud medical data permits customers like physicians, patients, hospitals, paramedical staff, and other networks to securely access and transfer patient data, thereby improving collaboration among users as well as increasing convenience for patients. During six iterations, the basic questions are refined. The most notable adjustments performed during these versions included lowering the number of questions and simplifying the often esoteric Picker concepts. The use of solely level B1 keywords from the Common European Framework of Reference for Languages increased comprehension. In addition, patients prefer to see illustrations of the functionality that was intended by each component. The Picker Institute provided multiple instances that included with each question. The subsequent questions are

- Q1 – Whether the information is provided with possible testing, prognosis and treatment?
- Q2 – Whether the personal approaches like listening to the patient preference, decision making and emotional supports?
- Q3 – Whether the collaboration among healthcare professionals with you, your family doctors or other hospital?
- Q4 – Whether the healthcare organization of care about making appointment, availability by phone?

4. RESULT AND DISCUSSION

This study's findings support the hypothesis that the combination of CC, MC, FHIR and AI has the capability to transform the delivery of healthcare. Incorporating AI, CC, MC and AI offers numerous advantages to healthcare professionals while improving the treatment of patients. These programs allowed healthcare professionals to view patient data in real-time while also easing data sharing across several systems. Furthermore, mobile devices and cloud platforms permitted the structured FHIR data sharing and improved utilization of extensive patient data. This has resulted in greater assistance in clinical decisions as well as higher life quality for individuals who suffer from neurological diseases like PD. These technologies not only improved patient care but also helped healthcare providers understand illness development. The findings of this study are consistent with earlier research that has highlighted the advantages of incorporating MC, CC, and AI in healthcare. The addition of FHIR as a standard framework improves the accessibility and interoperability of healthcare data. Furthermore, the findings of the current investigation are consistent with previous research highlighting the benefits of AI in modeling forecasts having access with patient data, as well as clinical decision assistance. CC has been embraced in several different fields and domains of health, including telemedicine, health management, bioinformatics and information management are illustrated in figure 3. Applications of CC involved in Telemedicine are utilized for providing primary health care that influence patient prescription and treatment with 38%, monitoring as 29%, diagnosis as 24%, and education as 10% and the overall percentage involved while compared with other three fields is 46%. In the case of health management, the overall field's involvement from CC incorporate is 17% whereas management of business processes management is 63% that involves billing or payment of patient as well as healthcare quality assessment over existing recommendation and standards is 38%. Similarly, the activities like medical record access, storage, use and data exchange over information management is 60% and trans-disciplinary data repositories is 40% in which overall information management while compared with other three healthcare fields is 22%. Bioinformatics field with least involvement in CC application with 15% in which digital image processing is 57%, research is 29% and molecular modeling is 14%.

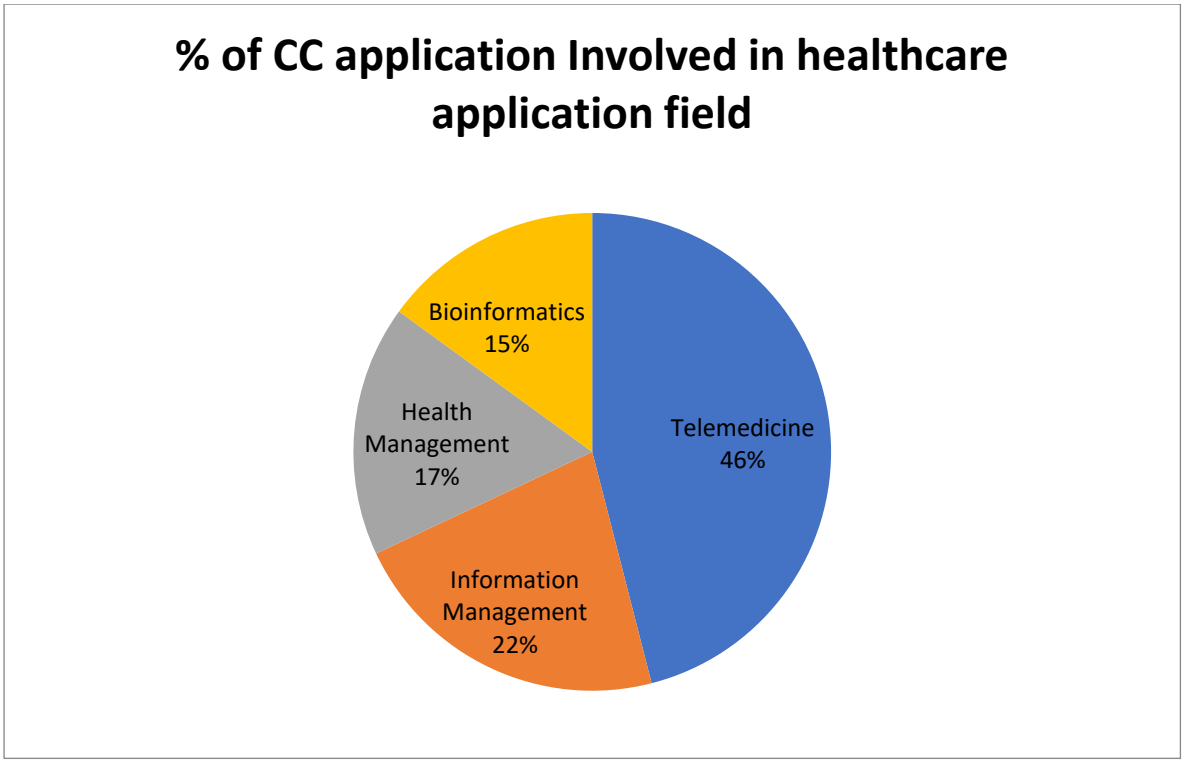


FIGURE 3. CC application fields in healthcare sector

Based on the four questions, the model AI powered model in CC can able to determine the true positive rate and false positive rate of patients responses for these four questions. The responder of PD patients with in the respective healthcare involves 385. Based on the reply from the questionnaires, the significant of AI empowered with CC in healthcare sector has improved the performance and minimize the cost of hospital readmission. Predictive analytics as well as remote monitoring powered by cloud and AI techniques have demonstrated the ability to reduce hospital readmissions. Healthcare practitioners can avoid difficulties as well as avoidable readmissions through recognizing high-risk patients and implementing preventative measures in PD diagnosis and treatment. Overall analysis in usage of CC with AI empowered in healthcare is shown in figure 4. The benefit of healthcare with usage of CC with AI powered application has minimized the expense in healthcare activities.

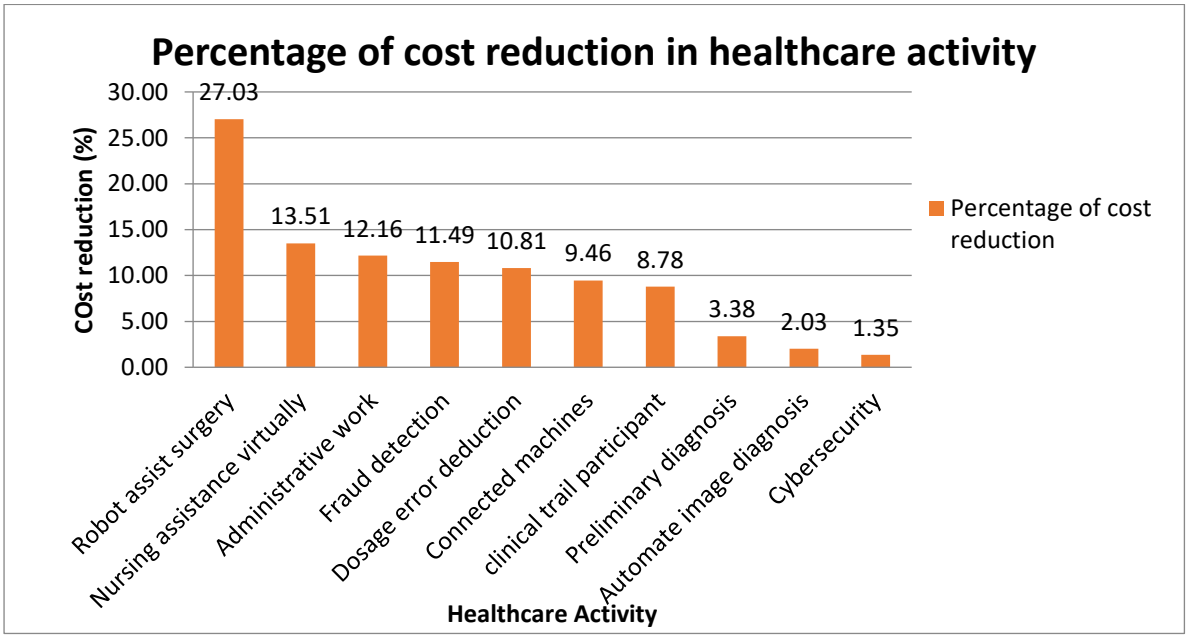


FIGURE 4. Cost reductions in usage of CC with AI in healthcare activities

5. CONCLUSION

In conclusion, the integration of CC and AI in healthcare represents a transformative force that is reshaping the landscape of patient care, operational efficiency, and medical research. Throughout this article, we have explored the multifaceted impact of these technologies, from enhancing data management and accessibility through cloud-based EHR systems to revolutionizing diagnostic accuracy and treatment personalization with AI-driven tools for PD patients. The case studies and research findings presented underscore the tangible benefits of these innovations, including improved patient outcomes, cost reductions, and streamlined administrative processes. However, as we advance into this new era of healthcare, it is crucial to address the challenges of data privacy, regulatory compliance, and ethical considerations that accompany these technological advancements. The convergence of MC, CC, FHIR, and AI has enormous potential to transform healthcare delivery. The AI-PREM tool is a comprehensive method that includes a verified questionnaire with open-ended questions with high-performance NLP pipeline, and visualization. By thematically arranging and measuring patient feedback, medical professionals can spend less time evaluating and prioritizing the experiences of patients without being constrained to the response alternatives of closed-ended questionnaires. Thus the AI empowerment with CC in healthcare has improved the diagnosis and treatment life quality and also minimizes the cost of patients as well as healthcare by saving energy.

REFERENCES

[1]. T. Davenport. (2019). The potential for artificial intelligence in healthcare, doi: 10.7861/futurehosp.6-2-94.

[2]. S. Marzban. (2022). Impact of Patient Engagement on Healthcare Quality: A Scoping Review, doi: 10.1177/23743735221125439.

[3]. N. Clavel. (2021). Patient engagement in care: A scoping review of recently validated tools assessing patients' and healthcare Professionals preferences and experience, doi: 10.1111/hex.13344.

[4]. Naseem, M., Akhund, R., Arshad, H., & Ibrahim, M. T. (2020). Exploring the Potential of Artificial Intelligence and Machine Learning to Combat COVID-19 and Existing Opportunities for LMIC: A Scoping Review. Journal of Primary Care & Community Health, 11 . https://doi.org/10.1177/2150132720963634

[5]. Majeed, A., & Hwang, S. O. (2022). Data-Driven Analytics Leveraging Artificial Intelligence in the Era of COVID-19: An Insightful Review of Recent Developments. Symmetry, 14, Article No. 16. https://doi.org/10.3390/sym14010016

[6]. Asan, O., & Choudhury, A. (2021). Research Trends in Artificial Intelligence Applications in Human Factors Health Care: Mapping Review. JMIR Human Factors, 8, e28236. https://doi.org/10.2196/28236

[7]. Mbunge, E., & Muchemwa, B. (2022). Towards Emotive Sensory Web in Virtual Health Care: Trends, Technologies, Challenges and Ethical Issues. Sensors International, 3, Article ID: 100134. https://doi.org/10.1016/j.sintl.2021.100134

[8]. Chattu, V. K. (2021). A Review of Artificial Intelligence, Big Data, and Blockchain Technology Applications in Medicine and Global Health. Big Data and Cognitive Computing, 5, Article No. 41. https://doi.org/10.3390/bdcc5030041

[9]. Gastounioti, A., Desai, S., Ahluwalia, V. S., Conant, E. F., & Kontos, D. (2022). Artificial Intelligence in Mammographic Phenotyping of Breast Cancer Risk: A Narrative Review. Breast Cancer Research, 24, Article No. 14. https://doi.org/10.1186/s13058-022-01509-z

[10]. G. McLean. (2021). Alexa, do voice assistants influence consumer brand engagement? Examining the role of AI-Powered voice assistants in influencing consumer brand engagement, doi: 10.1016/j.busres.2020.11.045.

[11]. G. Aceto, V. Persico, A. Pescap´e, Industry 4.0 and health: Internet of things, big data, and cloud computing for healthcare 4.0, Journal of Industrial Information Integration 18 (2020) 100129.

[12]. S. Shamshad, et al., A secure blockchain-based e-health records storage and sharing scheme, J. Inf. Secur. Appl. 55 (2020) 102590.

[13]. S.-C. Chang, et al., Evaluating the E-Health Cloud Computing Systems Adoption in Taiwan's Healthcare Industry. Life 11 (4) (2021) 310.

[14]. R. Arora, S. Gera, M. Saxena "Mitigating Security Risks on Privacy of Sensitive Data used in Cloud-based ERP Applications"; Proceedings of the 15th INDIACom; INDIACom-2021; IEEE Conference ID: 51348 2021 8th International Conference on "Computing for Sustainable Global Development", 17th - 19th March, 2021.

[15]. M. Hadidi, M. A. Rashdan, S. Hadidi and Y. Soubhi, "Comparison between Cloud ERP and Traditional ERP," Journal of Critical Reviews, vol. 7, no. 3, 2020.

[16]. N. Clavel. (2021). Patient engagement in care: A scoping review of recently validated tools assessing patients' and healthcare Professionals preferences and experience, doi: 10.1111/hex.13344.
[17]. Smith, J.K. (2020). AI-Enhanced Patient Communication: A Promising Approach to Improve Healthcare Outcomes, doi: 10.2196/17813.
[18]. S. Abbasgholizadeh Rahimi. (2019). Patient Engagement and its evaluation tools, Current challenges, and future, doi: 10.1517/ijhpm.2019.16.
[19]. V. Carchiolo. (2019). Medical Prescription classification: an NLP- based approach, doi: 10.15439/2019F197.
[20]. A. Saiyed. (2022). Technology-Assisted motivational interviewing: Developing a scalable framework for promoting Engagement with Tobacco cessation using NLP& Machine learning, doi: 10.1016/j.Procs.2022.09.09