An Overview of Challenges and Opportunities of Blockchain Technology in Healthcare

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Abstract - **Blockchain is a technology designed to manage electronic data that has the potential to support transparency and accountability. A blockchain is a ledger of transactions where an identical copy is visible to all the members of a computer network. Blockchain is an emerging technology being applied for creating innovative solutions in various sectors, including healthcare. A Blockchain network is used in the healthcare system to preserve and exchange patient data through hospitals, diagnostic laboratories, pharmacy firms, and physicians. Blockchain applications can accurately identify severe mistakes and even dangerous ones in the medical field. Thus, it can improve the performance, security, and transparency of sharing medical data in the health care system. This technology is helpful to medical institutions to gain insight and enhance the analysis of medical records. In this paper, we studied Blockchain technology and its significant benefits in healthcare. Finally, the paper identifies significant applications including network infrastructure security, identity verification, authentication along with the uniform patterns of authorization to access electronic health information and challenges of blockchain for healthcare.**

Index Terms - **blockchain technology, medical data, healthcare, innovation, cyberattack.**

1.INTRODUCTION

The Healthcare sector is an essential concern for all the developing as well as developed countries because this sector is directly concerned with the social welfare and lives of people. Research and development in the Healthcare sector should be an ongoing process, as it will help to improve the quality of living by fighting various health issues and diseases. With the advancement and recent developments in technology, the improvement in the Healthcare sector can be seen easily. The existing capabilities of the Healthcare and Medical Sector can be further improved by the introduction of the latest and innovative computer technologies in the Healthcare sector. These advanced computer technologies can assist doctors and medical practitioners in the early diagnosis of various diseases. The accuracy of detecting diseases in the early stages can also be improved considerably using these advanced computer technologies.

Various emerging and revolutionary computer technologies are already being used in other sectors with miraculous results. These technologies include IoT, Blockchain, Machine Learning, Data Mining, Natural Language Processing (NLP), Image Processing, Cloud Computing, and many more.

1.1. The Blockchain Technology

Blockchain is a decentralized and public digital ledger that records transactions on many computers so that no record involved can be altered retroactively without altering any blocks afterward. Blockchain is verified and linked to the preceding 'block,' forming a long chain. After all, Blockchain is the name of the record. As any transaction is registered and checked publicly, Blockchain provides a good deal of accountability. When entered, no one can modify all the information written in the Blockchain. It serves to demonstrate that the data is actual and unchanged. In Blockchain, data are maintained on networks instead of a central database, improving stability and showing its proneness to be hacked. Blockchain offers a fantastic forum to develop and compete with traditional companies for modern and creative business models. Blockchain helps marketers to maintain an overview of the products used in medicine. Health and pharmaceuticals will get rid of counterfeit medications using Blockchain technologies, enabling tracing of all these medicines. It helps discover the cause of falsification.

Blockchain can guarantee the confidentiality of patient records; when medical history is developed, Blockchain can also store it, and this record cannot be modified. This decentralized network is used with all commodity hardware in the hospital. Researchers allow computing estimates for therapies, medicines, and remedies of diverse illnesses and disorders using the resources saved by these devices.

Figure 1 Need of Blockchain

1.2. Working of Blockchain Technology

The working of a blockchain relies on three major principles that have existed too long. Compiled working of these principles allows blockchain to provide secure and safe digital relationships.

- Private key cryptography—In private key cryptography, a secret key is used as a variable along with an algorithm to encrypt and decrypt the code. The key is kept secret even when the algorithm is not. In a blockchain, a reference of the secure digital identity is created, however, the transactions are on the open network.

- Distributed ledgers—A distributed ledger also known as a shared ledger is referred to as a consensus of shared records. In DLT, the ledger is updated in real-time .and no central authority is held responsible to maintain the ledger. Instead, network participants keep the ledger updated. Any changes made in the ledgers are reflected within seconds.

- Authentication—Authentication is a process that proves genuineness. In a Blockchain, all the transactions are authenticated before getting added to the chain. This process takes place through algorithms that validate and verify all the transactions. Once the information is encrypted and stored, the authenticity is sealed.

Healthcare firms, technology innovators, and members of the overall healthcare sector are looking out for ways to find out what's possible in the current times and what blockchain could do to make healthcare better and affordable in the future.

2. ADVANTAGES AND ISSUES WITH BLOCKCHAINS IN HEALTHCARE

Key concerns with blockchain applications in healthcare include:
- Network infrastructure security at all levels
- Identity verification and authentication of all participants
- Uniform patterns of authorization to access electronic health information

DLT can be applied in many healthcare areas, but all activity within healthcare is not linked to transactions. However, public blockchains cannot be used to store private information such as identifying health data, because the data in them is widely accessible. This transparency mandates that providers consider privacy issues to ensure protected health information (PHI).

Secondly, blockchain technology is vulnerable to some types of attacks, though it offers inbuilt protection against others. The blockchain code lays it open to zero-day attacks and bugs, as well as social engineering. Thus, information security must be paid intensive attention especially when used in healthcare. Blockchain technology should not be used indiscriminately in healthcare, since its data is immutable. Large files, or those which change often, may be kept out. All identifying data should be kept off the chain.

DLT experts comment, "With new regulations on the rise, such as the General Data Protection Regulation (GDPR), in conjunction with regulations that have been around for more than a decade, such as HIPAA, patient privacy is now a standard when considering processing any form of PHI."

The benefits of using blockchains, relative to traditional methods of healthcare database management systems, include decentralized management, unchangeable databases, data provenance, traceable data, robust data, availability of data to any authorized user while keeping it out of the hands of unauthorized users by encryption that is dependent on a patient's private key.

3. APPLICATIONS IN HEALTHCARE

Blockchains in healthcare can be envisaged in five primary areas:

- Managing electronic medical record (EMR) data
- Protection of healthcare data
- Personal health record data management
- Point-of-care genomics management
- Electronic health records data management

3.1. Seamless switching of patients between providers

The same information on the blockchain could allow individual patients to easily unlock and share their health data with other providers or organizations, through a shareable private key. This could help to make health information technology (HIT) interoperable and collaborative between different users.

3.2. Faster, cheaper, better patient care

Blockchain can create a single system for stored, constantly updated, heath records for secure and rapid retrieval by authorized users. By avoiding miscommunication between different healthcare professionals involved in caring for the same patient, innumerable mistakes can be prevented, faster diagnosis and interventions become possible, and care can be personalized to each patient.

3.3. Interoperable electronic health records

The blockchain could provide a single transaction layer where organizations can submit and share data through one secure system, by storing a specific set of standardized data on the chain, with private encrypted links to separately stored information such as radiographic or other images.
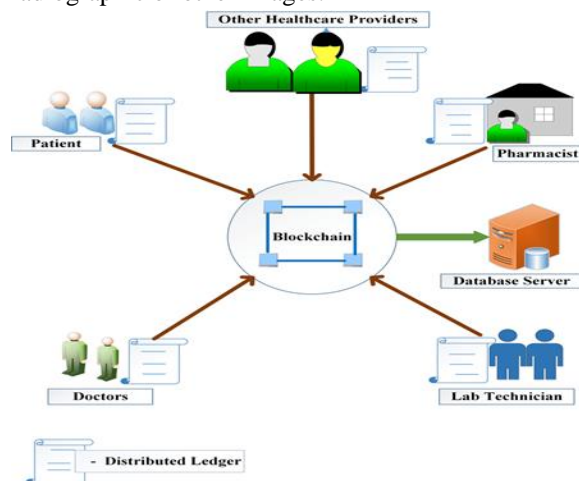

Figure 2 Blockchain in Healthcare

The use of smart contracts and uniform authorization protocols can immensely support seamless connectivity.

3.4. Data security

From 2009 to 2017, over 176 million data breaches occurred concerning healthcare records. The secure features associated with the blockchain can help protect health information much better. Each individual has a public identifier or key and a private key, which can be unlocked only as and for the period necessary.

Moreover, hacking would be limited by the need to attack each user individually to obtain private information. Thus, blockchains can provide an immutable audit trail of health information.

3.5. Mobile health apps and remote monitoring

Mobile health applications are becoming more important nowadays, with advancing technology. In this context, electronic medical records (EMRs) were found to be kept secure in a blockchain network, and the data can be sent to medical personnel rapidly, as well as being available for self-monitoring and home care as well.

This area is particularly sensitive to malware, however, particularly root exploits that can give the hacker access to the patient's private key.

4. INTEGRATION OF BLOCKCHAIN TECHNOLOGY IN HEALTHCARE

The number of patients across the country is increasing day by day and with the increase in the number of patients, it has become difficult to provide full medical care. In the last few years, the quality of medical care has improved with the help of IoT and wearable devices [37]. Remote patient monitoring is the main modality to address healthcare issues. Wearable devices are used for collecting and transferring data to hospitals, and IoT devices play an important role in remote patient monitoring [38]. The main aims of these devices are to provide important information such as breathing patterns of a person, blood glucose level, and blood pressure to health providers [39].

Healthcare devices that are used for data collection data can be categorized into four parts: (a) Stationary Medical Devices: these devices are used for specific

physical locations, (b) Medical Embedded Devices: these devices are placed inside the human body, (c) Medical Wearable Devices: these devices prescribed by doctors, and (d) Wearable Health Monitoring Devices: these devices are worn on the body. The main motive of RPM is to secure the data that are targeted by hackers. To secure the data, Blockchain technology is used. Blockchain helps to secure the data from many cyberattacks by using the concept of decentralization. Blockchain also authenticates the data with smart contracts.
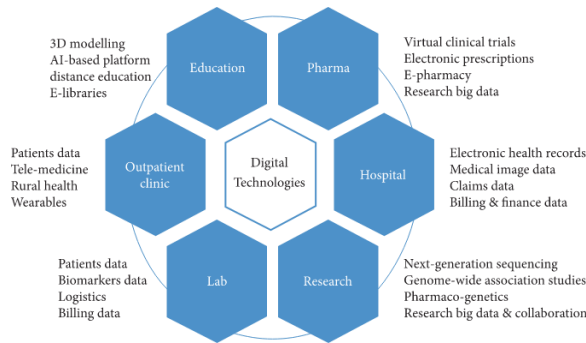

Figure 3 Blockchain Technology

5. CHALLENGES OF USING BLOCKCHAIN IN HEALTHCARE

5.1. Interoperability

Healthcare interoperability means exchanging information with each other in the Blockchain network. It is the main challenge due to the large and varied providers and due to its large open nature [63]. There can be different players like hospitals, insurance companies, physicians, private doctors, etc. In the Healthcare sector, ensuring proper interoperability among them can be a challenge.

5.2. Security

As the concept of decentralization is more secure, there are also some disadvantages associated with it. As in decentralized Blockchain, the data are distributed in a public ledger, which can cause privacy leakage. Blockchain provides an atmosphere where people know or trust each other and can securely share data. However, in some scenarios, it can fail—for example, if 51% of the consensus nodes become malicious. Many patients can be uncomfortable sharing their personal medical information due to security reasons [63].

5.3. Scalability and Storage Requirement Handling

It is not practically possible to maintain the data of every individual. The medical record is usually in the form of documents, images, and lab reports. Digital storage of the medical records of numerous patients will require colossal storage capacity. The medical transactions of every individual stored in a distributed manner with the same record stored in more than one location will require huge storage capacity and could affect the healthcare system [64].

5.4. Lack of Standardization

Blockchain is a trending technology and is adopted in many countries. In domains and networks where the concept of security, trust, and trackability is involved, the Blockchain is used. Proper standardization of protocols, technologies, etc., is very important. Aspects like what data, size, and format can be sent to the Blockchain, and what data can be stored in the Blockchain should be clearly defined.

5.5. Hesitation among Hospitals and Related Entities in Sharing Information

Many hospitals can be reluctant to share their patient-related and other medical records, such as in for-profit situations, as they will want to charge different fees from different customers. Similarly, hospitals and insurance companies can be reluctant to share their data, as it can be competitively advantageous for the hospitals to keep the fees-related data with themselves. It is essential to build trust between the parties and convince them to share their data for a better healthcare system

5.6. Hesitation and Lack of Trust among the Patients to Share Their Medical History

Trust building among one of the key stakeholders, the patients, is very important for the success of this technology-driven medical and healthcare system. Many patients can hesitate to share and disclose their medical records in the public domain with third-party entities. So, it is very much required to build trust and confidence among the patients regarding the security and privacy aspects of this whole Blockchain and IoT-driven healthcare system.

5.7. Lack of Skills among Doctors and Medical Practitioners

Asking doctors and other medical practitioners to shift from paper to technology can be a big challenge. The use of electronic records and prescriptions instead of paper-based prescriptions can be a challenge for many. For instance, doctors usually do not fill the unnecessary fields in their day-to-day practice while filling some forms. However, in the case of electronic records, doctors cannot omit the fields marked as mandatory. Similarly, relying on technology like Blockchain for remote monitoring can raise question marks among many doctors regarding their accuracy and efficiency. This technology-driven healthcare's accuracy, efficiency, and performance will depend on doctors' skills and training. So, before bringing these technologies into practice, proper training and required skills need to be imparted to the doctors to build confidence in using these technologies.

5.8. Data Ownership and Accountability
Data ownership and accountability are other challenges in deploying Blockchain in the Healthcare sector. Who will hold the data, who will grant permission to share people's private health-related data?

6. DISCUSSION

Blockchain technology creates unique opportunities to reduce complexity, enable trustless collaboration, and create secure and immutable information. The Power of blockchain for healthcare highly depends on the acceptance of the new technology within the healthcare ecosystem to create technical infrastructure. Though there are certain concerns and speculations regarding Blockchain's integration with current healthcare systems and its cultural adoption, the technology is still popular in the healthcare sector. It has taken the healthcare industry by storm over the past year and many solutions are being developed to adopt it. With so many potential use cases and possibilities, blockchain is sure to disrupt the healthcare landscape for good.

7. LIMITATIONS AND FUTURE SCOPE

Blockchain technology is incorporated into the healthcare industry, in which specific challenges would have to be addressed. The big problem with the utilization of this advanced technology for medical facilities is the lack of expertise. Blockchain

applications are still in the early stages to explain the outcomes and progress in the treatment process. Blockchain technology is core to validating transactions and transfers of information. In the upcoming days, with the consent of the network members, transactions can be authenticated and registered using Blockchain technologies. Blockchain will provide numerical security by public and private key encryption to the patient's level as the foundation of a new generation of health information sharing. This technology promises to treat patient records, infringement prevention, interoperability improvement, the rationalization of procedures, medication and prescription control, and medical and supply chains monitoring. Blockchain in healthcare is seen with a tremendous performance in the future.

8. CONCLUSION

There are innovative applications of Blockchain in healthcare due to inherent encryption and decentralization. It enhances the security of patients' electronic medical records, promotes the monetization of health information, improves interoperability among healthcare organizations, and helps counterfeit combat medicines. Different healthcare fields can change with Blockchain technology; areas like healthcare, digital agreements allowed by intelligent contracts constitute one of Blockchain's most critical applications. By removing intermediaries from the payment chain, intelligent contracts will minimize costs. The Blockchain potential in healthcare depends significantly on the adoption of associated advanced technologies in the ecosystem. It includes system tracking, healthcare insurance, medicines tracing, and clinical trials. Hospitals can chart their services using a Blockchain framework, even over the entire life cycle, using device tracking. Blockchain technology can well be used to improve patient history management, especially tracking and the insurance mediation process, thereby accelerating clinical actions with optimized data maintenance. Overall, this technology would significantly enhance and eventually revolutionize how patients and physicians treat and use clinical records and improve healthcare services. Based on this study, it can be clearly said that this technology has a huge potential in the Healthcare sector, and once integrated will revolutionize the whole Healthcare sector.

REFERENCES

[1] N. M. Kumar and P. K. Mallick, "Blockchain technology for security issues and challenges in IoT," Procedia Computer Science, vol. 132, pp. 1815–1823, 2018.View at: Publisher Site | Google Scholar

[2] T. M. Fernández-Caramels and P. Fraga-Lamas, "A review on the use of blockchain for the internet of things," IEEE Access, vol. 6, pp. 32979–33001, 2018.View at: Publisher Site | Google Scholar

[3] I.-C. Lin and T.-C. Liao, "A survey of blockchain security issues and challenges," IJ Network Security, vol. 19, no. 5, pp. 653–659, 2017.View at: Google Scholar

[4] Z. Zheng, "An overview of blockchain technology: architecture, consensus, and future trends," in Proceedings of the 2017 IEEE International Congress on Big Data (Bigdata Congress), IEEE, Boston, MA, USA, December 2017.View at: Google Scholar

[5] Ben Fakih, R. and Rahami, M. (2020). Application of blockchain technology in healthcare: a comprehensive study. The impact of digital technologies on public health in developed and developing countries. https://dx.doi.org /10.1007/978-3-030-51517-1_23. https://www. ncbi.nlm.nih.gov/pmc /articles /PMC7313278/

[6] Dorados, G. et al. (2019). Blockchain applications in the biomedical domain: a scoping review. Biotechnology journal. https://doi.org/10.1016 /j.csbj.2019.01.010.https://www.sciencedirect. com/science/article/pii/S200103701830285X

[7] By Reviewed by Sophia Coveney Blockchain Applications in Healthcare Blockchain Applications in Healthcare (news-medical.net)

[8] Review Article| Open Access Volume 2021 |Article ID 7608296| https://doi.org/10.11 55/ 2021/7608296