

# Critical issues in Leveraging Blockchain in Healthcare Sector

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**Abstract**—Blockchain innovation has brought various benefits to the healthcare sector. Utilizing blockchains in clinical contexts will reduce handling time since when a patient signs up for a review, the complete collected data will be accessible at once because of accessibility on the distributed ledger. Also, specialists will not need to stress over the patients giving them a legit clinical history, because of their capacity to progressively see the correct, credible, and quality source-recorded information. It eliminates any likely clinical history mistakes. Similarly, the patients will not need to stress over having a second assessment from another specialist, because of the straightforwardness of the information. Having patient records on a blockchain organization will prompt individuals to know and associate with various others, across the globe, with similar ailments as they have, which is not only valuable for their well-being, but also make the patients feel acknowledged, upheld, and have reinforced determination to battle the ailment. Patients will have total independence regarding their information, and they will choose who to impart the information to. In this paper, we present all the challenges and critical issues associated with implementing blockchains in the healthcare sector.

**Keywords**- Healthcare; Blockchain; Pharmaceutical; medical care; smart systems.

## I. INTRODUCTION

The advent of Blockchain is demystifying the overall administration and management of information associated with various medical applications. The manner in which the web reformed the medical care and presented telemedicine comparably, the blockchain innovation is proving helpful in healthcare by lowering the expenses of checking, setting up, and having a focal server for the information, and the organization dealing with the clinical information. Moreover, because of the features of blockchain like versatility and capacities to segment, health information and services are expected to be shared in a secure and an efficient way. Blockchain advancements are at the convergence of significant ongoing projects in the healthcare and service industry. Upcoming medical services and technologies based on blockchain can be coordinated into four layers, viz. healthcare services, input data sources, blockchain technology, and stakeholders.

The medical service industry is tormented due to absence of responsibility and transparency, which frequently leads to misrepresentation. Medical care is an incredible use case for blockchain especially for e-health records and clinical standard compliance, empowering patient information sharing and ongoing accessibility for clinical experts.

## II. RELATED WORK

Healthcare related data has significant issues to address such as data acquisition, digital access controls, patient identity, data liquidity and data immutability. These are related to the shift from healthcare pivoted to patient-pivoted data sharing [1][2][32][35][36][40]. The implementation of blockchain technology in distributed messaging environment incurs few challenges related to throughput, integrity, scalability[3][4][5][33], resource limitation, bandwidth, scalability, lack of standardization, privacy leakage and interoperability [6]. Traceability feature in blockchain is significant while managing pharmaceutical supply chain [7]. Due to the interoperability across multiple domains and multiple stakeholders, the secrecy and security of data belonging to the patient are the prime concerns when it comes to smart healthcare. [9][31][34][37].

For improving integrity and to handle heterogeneous environments to surrounding EHR sharing, several blockchain frameworks, like Medblock [8], BiiMED [10], were developed. The system controls it by offering a non centralized third-party authority to assure integrity associated with data and an access management system that permits the interchange of EHRS between various healthcare providers. For significant features in the implementation of blockchain, key components, applications, opportunities, and obstacles need to be identified.

This results in the ease of decision-making when developing the strategies for using Blockchain in the healthcare industry [11].

Distributed events will help to tackle the issue like bottleneck or single point of failure issue and speed up transaction processing in overall blockchain environment [2]. Framework for healthcare security Blockchain needs to build and deal with multimedia data [12] [13][14][15][16]. Hyperledger fabric is used to develop a blockchain testing scenario that examines several requirements for healthcare applications [17]. Lightweight blockchain[18][19] can be implemented to deal with issues related to complexities of blockchain implementation. The smart patient monitoring using IoT was implemented using private blockchain to revolve security issues associated with remote patient monitoring. It is also provided with automated delivery of notification to all patients [20]. An additional sorting mechanism can be utilized at Sensor level to decide if the data is to be written into blockchain or not. This helps in optimizing the blockchain size & reduce number of coins for transactions [21].

Adding software defined networking (SDN) integration, which ensures network flexibility and efficiency, is another strategy for addressing these problems [22]. Access to SDN's various functional & security technology and services is available to users. Ethereum can be used to create smart contracts that give patients and medical professionals a secure way to sign up for a health programme. [23] [24] [25] [19] [26]. It was proposed that for integrating IOT with healthcare monitoring system, the system can be built using Hyperledger fabric [27][28][5][38][39]. Another agent-based architecture was proposed[29], which utilizes a patient agent (PA) to connect blockchain with RPM data stream.

### III. KEY ELEMENTS IN BLOCKCHAIN TECHNOLOGY

Key elements in Blockchain Technology that may prove essential for its applicability in healthcare sector are shown in figure 1.

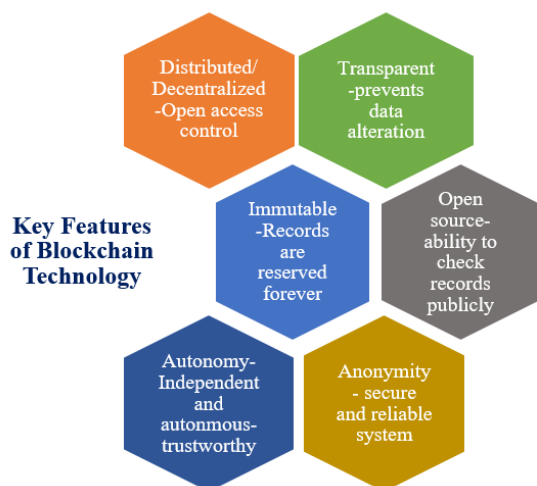


Figure 1: Key elements in Blockchain Technology

- Distributed/Decentralized- Because of the distributed nature of the system, the control is open access, which makes it easy for verifying and maintaining integrity. This keeps the data available all the time and thus avoids single point of failure.
- Transparency-If any of the transaction gets altered, there is provision by which user can check the history of the ledger due to distributed system. The alteration in data can be detected. The transparency feature helps to prevent data alteration.
- Immutable- All the records are immutable and are preserved forever. If at given point any data block gets detached, then. it can be reattached again in the chain with all the updates incorporated in it. The data block is synchronized and all the records are preserved further.
- Open source- Due to distributed nature, the data blocks are always traceable, The data blocks are trackable and hence the user gets privilege to check all the records. Ability to check records publicly of trustworthiness.
- Anonymity- This feature of data blocks make the entire system secure and reliable.
- Autonomy- The data blocks are independent and autonomous which helps to achieve security of the system.

### IV. CHALLENGES IN BLOCKCHAIN HEALTHCARE

Following challenges are identified in the blockchain in healthcare domain and these need to be addressed by the researchers to make the healthcare more efficient.

1. Medical records: These must be persistent and their integrity needs to be maintained. The data become more complex as it grows with every additional medical record. Each healthcare has a unique method of collecting, storing and accessing medical records. It is challenging task for healthcare providers to collect the data from hospitals. The goal of healthcare record keeping companies is to provide patients with their entire medical history and provide an easy one-step access to their medical history, while parallely ensuring data security at priority.

2. Supply chain Management: Supply chain typically in pharmaceutical sector requires blockchain technology of the highest caliber to ensure safety of the product, stability and security. Supply chain management using blockchain can be implemented transparently, securely, lowering time delays and errors. Blockchain can also be utilized to control costs, labor and even manage the waste throughout the supply chain. It can verify the authorization and originality of products by maintaining updates while tracking them and reduce the number of counterfeit trademarks, which would otherwise result in a large loss. There is a special need and assurance in the pharmaceutical

context that certain drugs are not exposed to conditions such as high or low temperatures, which may degrade the quality of the medical products.

3. Genomics Market Management: Many researchers claim that the genomics will be the next big trend and eventually flourish. The major requirements are the techniques to cater the increasing demand for gene therapy, personalized medicine, drug discovery, etc. The genomic market requires the development of blockchain platforms in order to share genomic information safely and securely.

4. Interoperability [6][10][34] is one of the significant challenges in the implementation of blockchain technology in healthcare domain. The ability of different healthcare professionals to exchange, search, and query medical records is a prime concern and is in a state of evolution. The critical issues involved in the system are patient identification and information blockage. Blockchain is trustworthy and genuine. It is not significant to keep tracking information of all the medical records of patients in the healthcare monitoring system or to share the data individually. The consensus technique can be used to reduce the indecisiveness regarding whether data is stored or not and to identify which is the recent record. It turns up very vital when dealing with huge databases, that may contain fragmented data from multiple owner. There is no requirement of interference of any external entity to accomplish exchange of data.

Blockchain interoperability can be viewed as capability of a system to share data across blockchain networks, the ability to view and transact data across multiple blockchain networks without the use of intermediaries, and the ability to share or exchange tokens across these blockchain networks. Interoperability being a significant issue in medical services blockchain can provide consent to computerized access to clinical information, information accessibility, fast access to clinical data, and patient demographics and tackle the issue. Blockchain works on legally binding execution because of smart contracts. Interoperability issue emerges in blockchain on the grounds that the greater part of the blockchain work in storehouses and don't communicate with other companion networks as they are unequipped for sending and getting data from another blockchain based frameworks. This is major reason for incompetency of blockchain to have intersystem communication.

One of the solutions to the issue of interoperability is having crosschain. A crosschain technology is an emerging technology that aims to allow transmission of data across different blockchain networks.

It provides seamless integration and exchange of logic/tokens across networks. It increases user experience, economies of scale of transactions and technical scaling

limitations. It acts as a bridge between isolated ecosystems as most networks deal with specific needs.

Cross chain help in interoperability because of following reasons -

- Allows heterogenous blockchain networks to interact with one another without any intervention.
- Provides a layer to scale transactions on networks, lower gas fees and environmental impact.
- Offers the ability to organizations to transact with clients from other blockchains.
- Builds the entire process with minimum time and cost.

Approaches to achieve cross chain are as follows:

**Shards:** Ensures total validity/availability of every part of the system. Data layer will be chopped horizontally in multiple layer databases instead of one large database. It means that user can access only top shard/layer and through that the user can achieve throughput and ultimately higher performance. It ensures tight coupling with the main chain. There is one challenge that comparatively low throughput is observed in terms of transactions per second because of this tight coupling of the shards, because large quantity of data is involved before the final goal is achieved.

**Plasma:** It is a sidechain, which doesn't hold any custody. The plasma can be killed in case of any attack but won't impact the main chain. In such case, a new plasma can be spinned up. It also accepts all local faults because it tries to limit all the consequences to that particular side chain, within its own plasma. It is loosely coupled and hence is easy to deploy and easy to iterate for new improvements and then communicate back to the main chain. It can also offer higher privacy.

**Sidechain:** All sidechains can't be plasma, but all plasmas are sidechains. The sidechain has the ability to agree on availability of transaction, but is more loosely coupled. It is less complex and it suits for applications with low level security.

The ability of many blockchain networks to communicate and integrate will be critical to blockchain's success.

- Because of the interoperability of blockchains, information will be easily shared.
- Make it possible to see and access data across multiple blockchain platforms.
- The use of cross-chain technology to connect, for example, Ethereum and non-Ethereum blockchains.
- Get rid of middlemen in blockchain network communication.
- Facilitate the creation of multi-token wallet systems to enable multi-token transactions.
- A unified wallet system that makes it simple to store and transfer tokens between blockchains.

The performance of blockchain depends on how will they can accommodate different blockchain networks, their integration and inter-network communication.

## V. CRITICAL ISSUES IN BLOCKCHAIN BASED HEALTHCARE DOMAIN

Critical issues associated with implementation of blockchain in healthcare domain are depicted in figure 2.

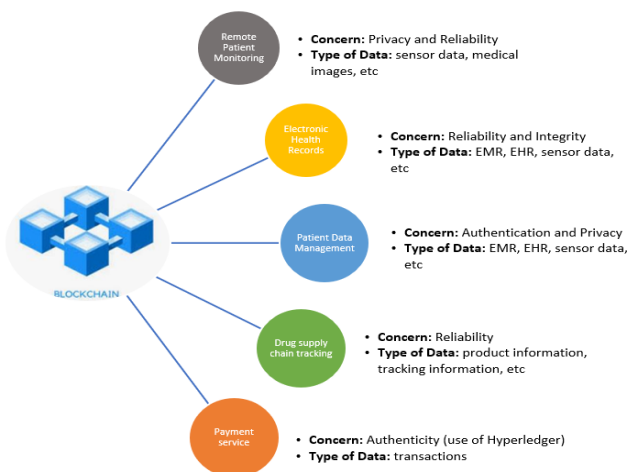


Figure 2: Critical Issues in Blockchain for healthcare domain

Type of data used in mechanisms of IoT in medical data-sensor data, multimedia data, EHR, EMR, PHR, medical records, etc.

The remote patient monitoring deal with IoT data like data from sensors e. g. Temperature, Heart rate, etc. Also some data may be in form of medical images. For dealing with this type of data, and considering the data processing, the utmost concern is privacy of the patient and reliability of the data. This data is needed to keep track of the patients remotely especially for patients like bedbound or old age patients. For EHR, the prime concerns are reliability and integrity. The data blocks maintained in the distributed environment needs to be autonomous and must exhibit integrity. For general patient management module the basic authentication and privacy is needed. For supply chain management, like for the functions like drug supply chain tracking, to keep the tracking information and product information in tact the most important feature is that of reliability. For other services like payment services, the financial transactions need to be authenticated and kept secure, which can be accomplished by using Hyperledger.

Some of the issues need to be handled at priority are inefficient information ingestion, high transfer time, security risks for continuous monitoring, vulnerable to attack security and protection, high computational overhead, absence of transparency are some of the typical concerns in this category. Some other issues in healthcare services and supply chain are

scalability, lack of coherence, high cost of implementation, moreover there is no guarantee of whether or not falsified drugs are tracked, lack of transparency of operational cost, etc.

Some of the major potential contributions by blockchain technology are stated here. Blockchain innovation enjoys likely benefit in further developing the medical services administrations in the space of medical care Security and authentication aspects, Clinical trials and Accuracy Medication. Customizing the Medical services Administrations, general healthcare services, e-Medical services to Clients, Medical care management, Telehealth and Telemedicine, Overseeing Clinical Imaging, Creating Brilliant Medical services Framework, and Medical services Data Framework etc are included in this domain.

Reception of blockchain in medical care helps in laying out clinical records which lessens the expenses and furthermore legitimate wellbeing information usage.

Blockchain can help medical care in keeping up with wellbeing records, drug information, patient information and protection data. Transparency is the fundamental capability of blockchain which helps in keeping the data between clinical offices, protection suppliers, and patients transparent. There are no universal health records or information that fits for health management systems, however blockchain can possibly tackle this issue.

## VI. FUTURE RESEARCH DIRECTIONS

The blend of IoT and blockchain in healthcare domain have a great potential to impact the healthcare sector. In the earlier content we have addressed various critical issues and challenges faced by the researchers, while implementing these technologies. Researchers should be motivated to plan and design the working models in order to adapt the IoT systems more suitably in the blended environment. Also, the issues of blockchain implementation should be given more importance while keeping a trade-off among the features.

The researchers can propose innovative algorithms to deal with IoT systems and also can work on efficient usage of collected data, by keeping privacy at utmost priority. The policies and strategies related to implications of blended system in the healthcare domain should be made clearer and converge to expected solutions. As an extension to IoT and Blockchain, we can create systems that exploit artificial intelligence, big data, fog and cloud computing, thus empowering the decision-making capabilities of the systems. For example, developing more efficient filtering mechanisms which will filter out appropriate and adequate data from the collected pool of data before processing to optimize the computing power and resources. Cloud computing can be employed to ensure efficient data sharing while preserving privacy of the entire system.

## VII. CONCLUSIONS

In this paper, we presented a crisp review of blended mechanism which employs the significant technologies like IoT and Blockchain in healthcare domain. The world population is growing drastically and parallelly, the diseases are evolving which incurs the need of strong healthcare systems for our community. The usage of recent technologies like IoT, blockchain, cloud, AI, etc is growing and the blend of technologies is always a trend to improvise the healthcare systems eventually. Blend of IoT along with sophisticated technology like Blockchain is addressed here for accumulating and passing secure information. It enables the sharing of private data in a secure and reliable way. In paper, we discussed the integration of these significant technologies in the healthcare sector, along with their scope, critical issues associated with it. This study has a great potential for improvising applications, such as remote patient monitoring and tracking, disease prediction, electronic medical records management, drug traceability, etc.

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