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Blockchain Technology Application in Healthcare

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Abstract - *There is currently no system in place for tracking patient health records across various providers, specialties, and biometric health devices/wearables, leaving an individual's health history in a fragmented puzzle to be solved by each provider they interact with.*

If medical records and wellness data were put on a blockchain, providers and patients would have secure access to the digital picture of a patient as they move through the healthcare system and evolve in treatment and progress.

The blockchain would allow for more efficient medical data management and patient care by minimizing duplicate medical workups and testing, saving both the practitioner and patient time and money.

Personal information, including healthcare data, continues to build in value as we move forward. Currently, a patient does not know who sees their health data or how it is being used, creating mistrust within the system, reducing data agility and ultimately impacting healthcare decision. Having health records on a blockchain would allow the patient to track where their data goes and what is done with it.

Key Words: Blockchain, Healthcare, Medical-records, Security, Mobile-platform, Data-sharing, Decentralization.

1. INTRODUCTION

A blockchain, by design and definition, is a particular type of database. It is constructed as a to-read-only-once database. This means that blockchain databases are designed to be only-ever-created, and not edited or deleted. Data stored in a blockchain decentralized ledger (computer file asset) is a transactional type of data that requires space of 1 kB or less, and no one is able to access it as long as the owner holds the private keys. Moreover, the owner can use the Interplanetary File System (IPFS) to access the data and transfer it from one computer to another much faster and more securely and economically in comparison to centralized databases.

The rationale for the use of blockchain technology in healthcare is the fact that maintenance of a typical healthcare information system involves various operations including but not limited to performing backup storage services, having recovery mechanisms in place, and ensuring up-to-date fields. In a blockchain, data are distributed across the network, and there is no single point of failure leading to an inherent backup mechanism. Also, a single version of data is copied on every node of the blockchain. This reduces the volume of transactions that occur between information systems, thus reducing the burden on the healthcare ecosystem.

If blockchain technology in healthcare then patients get immutable log and easy access to their medical information across providers and treatment sites, because blockchain properties, manages authentication, confidentiality, accountability and securely data sharing when handling sensitive information.

2. BACKGORUND

The characteristics of the blockchain, which are its decentralized nature, openness and permission less, may offer a unique solution for healthcare. Wider applicability of the technology paves its way into different aspects of healthcare, including wearables and progress of medical research. Healthcare sector has growing demands for blockchain developments and a recent survey shows that the traditional industry is actively explores new avenues for the use of the blockchain to address its critical needs. Immutability of the blockchain is the vital option for healthcare data. It can secure health records, the results of clinical trials and ensure regulatory compliances. Employment of smart contracts demonstrate how blockchain can be used to support real-time patient monitoring and medical interventions. Such systems ensure security of records while providing access for patients and medical professionals in a Health Insurance Portability and Accountability Act (HIPAA) compliant manner.

3. BLOCKCHAIN TECHNOLOGY

Blockchain can be defined as a data structure that holds health records and ensures decentralization (authority from local to central government), transparency and security. In simple words, you can think of it as records stored in the form of blocks which are not controlled by single authority. Typically, this storage is referred to as a 'digital ledger.' Every transaction in this ledger is authorized by the digital signature of the owner, which authenticates the transaction. Hence, the information the digital ledger contains is highly secure. Distributed ledger as the parent technology of the blockchain, or blockchain as an advanced version of the distributed ledger.

Sequence: In blockchain technology, you can find all the blocks in a particular sequence. Distributed ledgers do not require a specific sequence of data. This sequence of blocks is what makes blockchain different from any other distributed ledger technology.

A blockchain is a distributed database that is completely open to any and everyone on the network. Once the information is stored on a blockchain can be verified but you cannot change or alter it. The blockchain is a simple yet ingenious way of passing information from A to B in a fully automated and safe manner. One party to a transaction initiates the process by creating a block. This block is verified by thousands, perhaps millions of computers distributed around the net. The verified block is added to a chain, which I stored across the net, creating not just a unique record, but a unique record with a unique history.

4. BLOCKCHAIN IN HEALTHCARE

Medical care has become an indispensable part of people's lives, with a dramatic increase in the volume of medical data (e.g., diagnosis certificates and medical records). Medical data, however, is easily stolen, tampered with, or even completely deleted. If the above occurs, medical data cannot be recorded or retrieved in a reliable manner, resulting in delay treatment progress, even endanger the patient's life.

Patients need to own their data and be in control of how their data is used. Patients need the assurance that their health data are not misused by other stakeholders and should have a means to detect when such misuse occurs. Blockchain helps to meet these requirements through strong cryptographic protocols and well-defined smart contracts.

Keeping our important data safe and secure is the most popular blockchain healthcare application at the moment. Blockchain's ability to keep a decentralized and transparent log of all patient data makes it technology rife for security applications.

This application allows patients, doctors and healthcare providers to share the same information quickly and safely. This application provides management of patient medical records in a regional environment. Our mobile application is developed for Android platform. Users of smart mobile devices can use those services by installing the application on their devices. After introducing this application, it makes his/her medical information at anytime and anywhere by using his/her mobile phone. The mobile healthcare communication between patient and healthcare professionals will increase efficiency and reliability significantly.

5. BENEFITS OF BLOCKCHAIN TO HEALTHCARE APPLICATION

Decentralization: The very nature of healthcare, in which there are distributed stakeholders, requires a decentralized management system. Blockchain can become that decentralized health data management backbone from where all the stakeholders can have controlled access to the same health records, without anyone playing the role of a central authority over the global health data.

Improved data security: The immutability property of blockchain greatly improves the security of the health data stored on it since the data, once saved to the blockchain cannot be corrupted, altered or retrieved. All the health data on blockchain are encrypted, time-stamped and appended in a chronological order. Additionally, health data are saved on blockchain using cryptographic keys which help to protect the identity or the privacy of the patients.

Health and ownership: Patients need to own their data and be in control of how their data is used. Patients need the assurance that their health data are not misused by other stakeholders and should have a means to detect when such misuse occurs. Blockchain helps to meet these requirements through strong cryptographic protocols and well-defined smart contracts.

Arability/robustness: Since the record on blockchain are replicated on multiple nodes, the availability of health data stored on blockchain is guaranteed as the system is robust and resilient against data losses, data corruption and some security attacks on data availability.

Transparency and trust: Blockchain, through its open and transparent nature, creates an atmosphere of trust around distributed healthcare applications. This facilitates the acceptance of such applications by the healthcare stakeholders.

Data verifiability: Even without accessing the plaintext of the records stored on blockchain, the integrity validity of those records can be verified. This feature is very useful in areas of healthcare where verification of records is a requirement, such as pharmaceutical supply chain management and insurance claim processing.

6. USE CASES OF BLOCKCHAIN IN HEALTHCARE

Blockchain use cases in healthcare include the managements of electronic medical records (EMRs), pharmaceutical supply chain, biomedical research and education, remote patient monitoring (RPM), health insurance claims, health data analytics and other potential areas of healthcare applications.

Traditionally, patients' records are stored separately in different databases across different service providers, with

little or no interoperability. This leaves the control of the health data mostly in the hands of the service providers and also limits the collaborative sharing of such data among healthcare stakeholders. By applying blockchain to the management of EMRs, patients will be in control of their own health data and be able to decide how they are used. Data sharing between healthcare stakeholders will be easier, better controlled, transparent and trustworthy. However, using blockchain to store EMRs brings up concerns about the security and privacy of patients' sensitive information.

Similarly, blockchain use cases in pharmaceutical supply chain management, biomedical research/education and remote patient monitoring have received considerable research attention with example prototype implementations. There is also one example implementation of prototype application relating to health insurance claim processing. However, other use cases are still mostly at the conceptual level.

Some companies and research projects, such as Guardtime and MedRec have developed blockchain-based EMR applications.

7. ELECTRONIC HEALTH RECORDS

One of the popular use cases of blockchain in healthcare is the management of electronic medical records (EMRs). EMRs, which are sometimes used interchangeably with electronic health records (EHRs) or personal health records (PHRs), have to do with the electronic creation, storage and management of patients' personal, medical or health-related data. Blockchain's property of decentralization, immutability, data provenance, reliability, robustness, the smart contracts, security and privacy are being canvassed as the features that make it very suitable for storage and management of patients' electronic medical records (EMR).

Guardtime, a company that uses a blockchain-based platform to secure over 1 million patients records in Estonia is cited in other reviews as a popular example of the use of blockchain for the management of EMR. Another such example is the MedRec project, a project of MIT Media Lab and Beth Israel Deaconess Medical Center, which aims at giving patients agency over their own data, to determine who can access them, through some fine-grained access permissions built on blockchain. The Gem Health Network (GHN) is yet another example, which is developed by the US startup, Gem, using the Ethereum blockchain platform. GHN allows different healthcare practitioners to have shared access to the same data. Healthbank, a Swiss digital health company, is similarly working on empowering patients to be in full control of their data using blockchain platform. In, the author discusses the Medicalchain project, whose blockchain-based platform will facilitate the sharing of patients' medical records across international healthcare institutions, and the Healthcoin initiative, which aims at constructing a global EMR system. Other players working on different initiatives and projects based on blockchain-enabled patient-centric EMR include Factom, HealthCombix, Patientory, SimplyVital, IBM's Watson, BurstIQ, Bowhead, QBRICS and Nuco.

Some of the barriers to blockchain-enabled patient-centric electronic medical records include interoperability among disparate blockchain-based EMR solutions (because of lack of standards), scalability (high volume of clinical data), patient engagement (not all patients are willing and able to manage their own data), data security and privacy, and lack of incentives. Some workarounds have been proposed to tackle some of these challenges. For example, as a countermeasure to the challenge of scalability, given the large volume of clinical data involved, the trend is to store the actual healthcare data on the cloud and store only the pointers to the data on blockchain, along with their fingerprints. In the area of security and privacy of the sensitive data stored on blockchain-based EMR, some cryptographic schemes are proposed to strengthen the security and validity of the EMRs stored on the blockchain.

8. Methodlogy

We took an online survey with the help of goggle form. The link of the form was circulated in social media platforms. The questionaries in the form were designed to test the proposed hypothesis and result.

Hypothesis: If we use blockchain in healthcare then patients get immutable log and easy access to their medical information access providers and treatment sites, because blockchain properties, manages authentication, confidentiality, accountability and securely data sharing when handling sensitive information.

9. EXPERIMENTAL RESULTS

Figure shows the result of hypothesis we proposed, the data presented here are drawn from the survey.

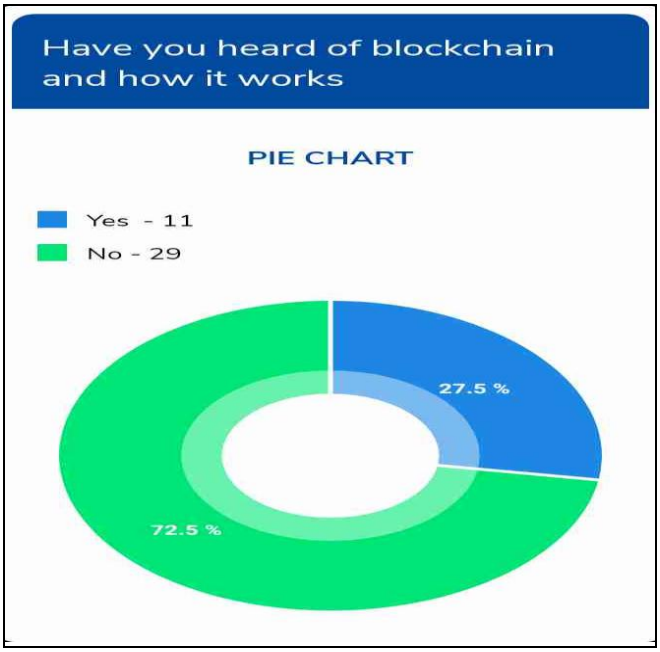

Fig -1: Pie Chart

Fig (1) show that how many peoples knowing about the blockchain technology and result which had come is only 27.5% of people heard of blockchain technology and how it works.

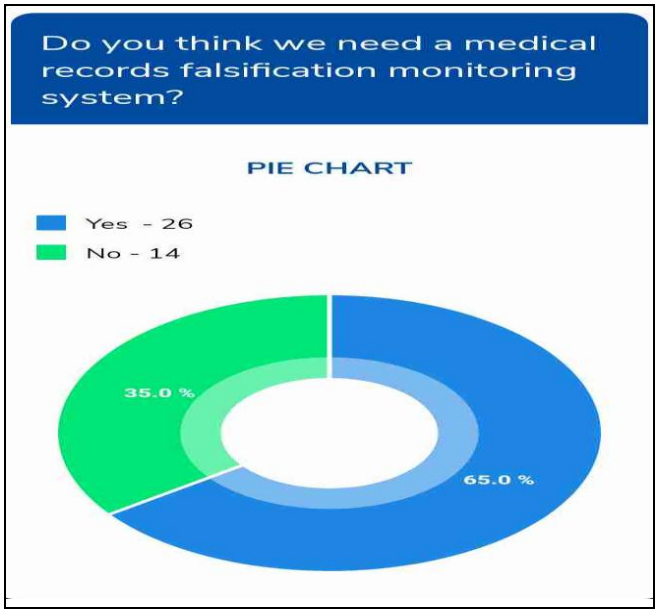

Fig -2: Pie Chart

Fig (2) show that how many people need a medical records falsification monitoring system and result which had come is 65% of people need a medical records falsification system. Falsification monitoring system protect the medical data which is change, stolen or tampered with, or even deleted by healthcare providers, stockholders.

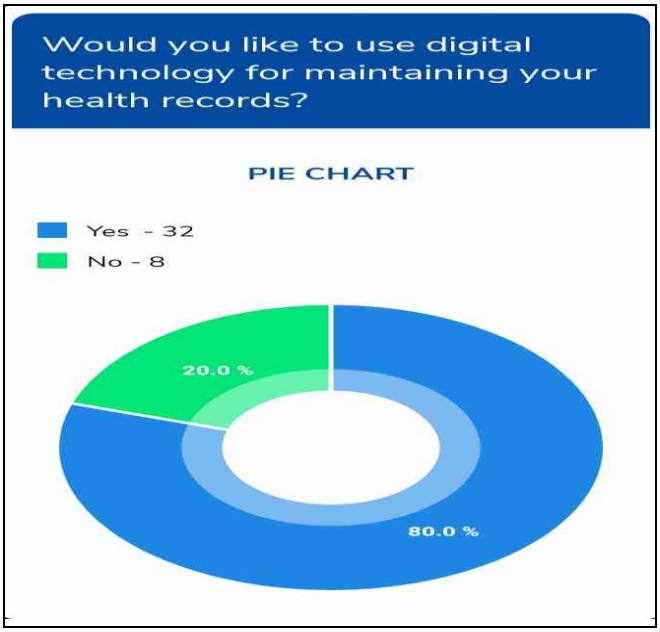

Fig -3: Pie Chart

Fig (3) show that how many people agree to use digital technology for maintaining their health records. Result shows that 80% of people agree to use digital technology for maintaining their health records and 20% of people disagree to maintaining their records in digital way.

10. CONCLUSIONS

On a blockchain, it is cheap to verify the integrity of an individual transaction. A single piece of information can be audited in real time; moreover, its integrity is available to any participant in the network. As a result, costless verification can be economically implemented. For example, healthcare accounting information that can be built up with integrity from the simplest units of transactions has previously constituted a time consuming and costly audit. Now, with blockchains, this process can run continuously in the background in compliance with regulations.

There are five potential benefits of blockchains in comparison with traditional healthcare database management systems. First, blockchains enable decentralized management; they are suitable for applications where healthcare stakeholders (e.g., hospitals, patients, payers, etc.) wish to collaborate with one another without the control of a central management intermediary. Second, blockchains provide immutable audit trails; they are suitable for unchangeable databases to record critical information (e.g., insurance claim records). Third, blockchains enable data provenance; they are suitable for use in managing digital assets (e.g., patient consent in clinical trials). The ownership can only be changed by the owner, following cryptographic protocols. Also, the origins of the assets are traceable (i.e., the sources of the data and records can be confirmed), increasing the reusability of

verified data. Fourth, blockchains ensure the robustness and availability of data; they are suitable for the preservation and continuous availability of records (e.g., the electronic health records of patients). Finally, they increase the security and privacy of data; data is encrypted in blockchains and can only be decrypted with the patient's private key. Even if the network is infiltrated by a malicious party, there is no practical way to read patient data.

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