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Block chain in Health Care

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Abstract**—***By the entry of Blockchain in Healthcare it is considered to be the new Era of opportunities. Blockchain in the Healthcare can provide a new and various models for HIE i.e. (Health Information Exchange) by making the medical records that are generated electronically more efficient, secure and disintermediated. Blockchain in Healthcare is expected to improve record management of medical and advance biomedical and healthcare data ledger. It is expected to bring out the massive development in this ecosystem as it can bring specific changes for the patient's healthcare management. With the help of this technology, the power will come to the people's hand back. By this it is meant that the individuals will be responsible for getting the overall control of their own data.The Blockchain can also provide the solution for the growing need of both i.e. securing the patient's health data from an unauthorized access and secondly make the access to such a data easier to the patient. In this paper, we will study about the things to be in this, the real Use cases of Blockchain in Healthcare, opportunities and applications and challenges, and the protection of the data of the patient through the Blockchain.*

Keywords—Blockchain, Digital health, Drug traceability, Healthcare, Healthcare interoperability.

I. INTRODUCTION

Blockchain alleviates the dependence on a methodical reservation of authority at central points, and the support of secure and trustless transaction between interacting entities directly[1]. This record are often shared among a network of computers, and users on the network can increase the record of transactions. The distribution of the database is made between the networks instead of a database that is located centrally and that maintains and manages the medical records. Transactions are kept secure via cryptography, and approval of the transaction need to be done and verified by the network during a process called mining. Each transaction are often thought of as a block, and therefore the links that is done by theledger and is put together are often thought of because the chain. Since users' transactions are directly added to the current present ledger, it eliminates the necessity for a middleman that traditionally may facilitate such transactions. Process called mining is then used to link the blocks together in the chain, by using this process the pending transactions are turned into a mathematical puzzles.People, called miners, need to solve the puzzle (typically using computer systems) and produce what's called a hash, a sequence of letters and numbers unique to the block. A block's hash is developed using the hash of the previous block, therefore ensuring that each block is valid. The hash of the before or previous block is used to produce the corresponding hash block which in turn becomes a digital version of a wax seal. It confirms that this block — and each block after it — is legitimate, because if you tampered with it, everyone would know. This technology could become very effective within the industry of the healthcare, too. It offers a way to interoperate since all users of a network can access that network and every one pieces of data are verified and show the history of transactions. Potential healthcare application is population health. Middleman can be eliminated by the organizations and access patient databases on an outsized, population scale, instead of relying on health information exchanges or other ways to aggregate data.

The healthcare researchers struggle with the fragmented or the data which are in pieces and the isolated data, communication delay and the different workflow tools. Therefore the providers hesitateto share the data. The first issue is that the perception of the provider about the safety keeping regulation for preventing the patient health and the information about the identification. And the other is potential liability and the financial consequences that is associated with the sharing of the data [2,3].The health systems which are the vendor specific create gaps in the communication in healthcare,which makes it very difficult to coordinate and provide the patient centric care[4].The important distinctive issue of a blockchain is that the data is added to the distributed ledger after a bit and nobody can alter it. The data that is hold on a blockchain in its entireness it is totally secure. Health care suppliers will leverage blockchain to firmly store their patient medical records. Once a medical record is

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generated and signed, it are often written into theblockchain that provides patients with the proof and confidence that the record cannot be modified. These personal health records may well be encoded and hold on the blockchain with a non-public key, so they're solely accessible by sure people,thereby making certain privacy. So as for anyone to create an amendment in one block, it's obligatory to create changes to all or any the next blocks when it.

Blockchain technology is very beneficial for healthcare because you can actually track who is accessing it, when they accessed it, and not to worry about not been able to delete the data.Recording digital informationis allowed and distributed and it is not to be edited is one of the goal of blockchain. Blockchain has conjointly garnered interest as a platform to boost the credibility and transparency of aid information through several use cases, from maintaining permissions in electronic health records (EHR) to streamlining claims process.

A blockchain powered health information exchange may unlock verity worth of ability. Blockchain-based systems have the potential to cut back or eliminate the friction and prices of current intermediaries. The promise of blockchain has widespread implications for stakeholders within the health care system. Capitalizing on this technology has the potential to attach fragmented systems to get insights and to raise assess the worth of care. Within the future, a nationwide blockchain network for electronic medical records could improve efficiencies and support higher health outcomes for patients.

By the healthcareremodeling potential of the Blockchain technology and by placing the patients at the middle of the ecosystem of the healthcare and by increasing interoperability i.e. ability of health data and privacy and security i.e. safety. This technology may offer a replacement model for Health Information Exchange (HIE) by creating electronic medical records more efficient, disintermediated, and secure. Whereas it is not a solutioin, this new, rapidly evolving field provides fertile ground for experimentation, investment, and proof-of-concept testing. Blockchain technology is predicted to enhance anamnesis management and the insurance claim process, accelerate clinical and medical analysis, and advance biomedical and healthcare ledger of data. These expectations are based on the key aspects of blockchain technology, such as decentralized management, immutable audit trail, knowledge cradle, robustness, and improved security and privacy. Although several possibilities have been discussed, recovery of information subjects right is the foremost notable innovation that may be achieved with blockchain. By the colossal breakthrough in the healthcare ecosystem the specific changes in the healthcare management of the patient can be brought out with the ability of the blockchain. The ability can return to people's hands with the aid of the blockchain technology. Meaning people are accountable for handling their own records which means, getting the control of data of their own. The technology could enable better privacy protections, more efficiency and easier information exchange, by giving patients control over their data. The technology holds the ability to successfully improve quality care of patientwhereas maintaining the funds at an affordable rate. All the challenges and hindrances that occur in multiple level authentication is eliminated through blockchain. Blockchain has made its way in the healthcare sector with the increasing in the adoption rate. The technology is being accepted positively by people in healthcare ecosystem.

In this paper, we will study about the things to be in this, the real Use cases of Blockchain in Healthcare, opportunities and applications and challenges, and the protection of the patient data through the blockchain.

II.METHOD AND MATERIAL

2.1HEALTHCARE BLOCKCHAIN APPLICATIONS

The main areas of interest in the healthcare industry are :-

- Hospitals, clinics, doctors and Care Services
- Patients, Insurance companies and customers
- Pharmaceutical companies
- Biotechnological companies
- Medical technological companies

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The applications of blockchain in healthcare can be in:-

- Digital Identification – here patient identity validation is done, identity validation of healthcare provider is done, and validation of drug identity is done.
- Smart Contracts – where healthcare data backed research/treatment and healthcare regime obedience tracking is done.
- Record Keeping – where medical treatment history tracking, medical devices usage, drug supply chain tracking and history tracking and is done.
- Financial Transactions – wherehealthcare service paymentsand healthcare regime gratification is done directly.
- Marketplaces – where healthcare service provision bidding and medical product and service customization is done.

2.1.1USE CASES BLOCKCHAIN IN HEALTHCARE

Here are the couple of use cases that utilize the potential of technology which will make the healthcare industry more secure, accessible, reliable and describing existing issues in the sector and considering possible solutions through the use of this technology.

Blockchain in healthcare include the following usage:-

- **Drug traceability:-**The main feature is the security which will be effectively use in drug traceability of blockchain technology. The block will be immutable as well as timestamped whenever the new transaction is added. The tracing of the product will become easy and we should make sure that the knowledge can't be altered inside block. Pharmaceutical companies that register any specific drug on the blockchain got to be trustworthy in order to make sure the trace and authentic of medical drugs.Therefore, the usage of personal blockchain during which the control is within the hands of a central authority would add up in such cases. When such companies are given access to the precise drug blockchain, they might have a symbol that the drugs manufactured by them are authentic.The pharmaceutical companies have the proper to settle on among actors of the availability chain who are going to be acting as miners they can be, manufacturers, distributors or retailers pharmaceutical companies that register any specific drug on the blockchain got to be trustworthy. Every individual can have different rights or accessibility options. The permission is given to the wholesalersto verify transactions while the labs can register the drugs.Moreover, every block containing the drug information will have a hash attached thereto which can be linked to a different block. When drug moving along the availability chain among different entities, it are often easily tracked.

- **Data security in clinical trials:-** Clinical trials are conducted in order to ensure and analyze the effectiveness of any particular medicine that is developed and proposed for curing a specific disease. The proposed drugs are often tested and supported the success of the trial, they will be implemented on a bigger scale and to conduct a clinical test, huge amounts of knowledge sets are required. The researchers specialize in these data sets and conduct regular tests under different circumstances to get reports, statistics, and effectiveness ratio. Based on these reports, the data is analyzed and further decisions are taken. In many cases, however, most of the pharmaceutical companies today show interest in recording the results which will assure certain benefits for his or her firms. In such cases, the researchers often hide or modify their collected data and knowledge so as to vary the result. So as to make the clinical trials more fair and transparent, to record secure, unbiased and transparent clinical trials researchers can make use of blockchain technology. On the opposite hand, for the businesses who believe conducting authentic clinical trials, everything must be secure and transparent. To accomplish this, the documents created and used in the process such as informed consent, research plans, regulations and study protocol need to be time stamped. This means that the documents should have a symbol and details of their creation time. For pre-planned endpoints, it's especially important to stay this information timestamped to make a symbol that showcases that the agreement was there even before the trial started. Blockchain technology would increase the credibility of clinical trials and results. These documents are often stored as smart contracts on the blockchain acting because the digital thumbprints.The blockchain also will keep the supply chain management of the pharma also because the accountability of drugs tracking.

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- **Patient Data Management:-** HIPPA, insurance Portability, and Accountability Act has strict regulations round the privacy of a patient's data. To be secure from breaches and modification PHI (Patient health information) is required. Patient data can't be restricted despite of the safety regulations. Healthcare requires sharing of data by the patients and medical records across the ecosystem despite being the posh system with multiple entities. For instance, patients while going for the treatment or merely buying the medicine, they have to share their health related information with doctor as well as the providers. Additionally, the more and more data management by the healthcare providers is resulted with the increase in the number of patients. Therefore the difficulties in managing the patient information within the clinics are led by the growing data .Many issues are resolved by introducing blockchain to this data-centric system. A blockchain system would create a hash for individual patient health information blocks in place for patient data management and on a theoretical basis a collective system would constitute a patient ID. Even patients are allowed to reveal their necessary data to 3rd parties while their identity been secret by the blockchain system. The patients can even control the deadline and access permissions for data sharing with 3rd parties.

2.1.2INTEROPERABILITY

The power for heterogeneous information technology is described by the healthcare interoperability and software application which are used to communicate, exchange data and use the data which has been exchanged[6]. Information systems are been allowed for figuring organizational boundaries are paramount within or across it to enhance healthcare effectively for people and communities[5]. Providers are enabled by the interoperability to securely and scalable share the medical record of patient with each other, no matter the location of the provider and the trust relation between them.Secure and scalable data sharing is important to supply effective collaborativetreatment and care decisions for patients. For improvingdiagnostic accuracy[7], data sharing helpsby gathering confirmations or recommendationsfrom a gaggle of doctors, also as preventing inadequacies [8]and errors in treatment plan and drugs [9,10]. Likewise, aggregated intelligence and insights [11-13]help clinicians understand patient needs and successively apply simpler treatments.Despite the importance of medical data sharing, today's healthcare systems frequently require patients to get and share their own medicalrecords with other providers either via physical paper copies or electronichard disk copies.Patients getting and sharing their own medical records via paper copies or electronic hard disk copies with other providers is frequently required by todays healthcare systems despite the importance of medical data sharing.

For the following reasons obtaining and sharing medical records is ineffective:-

- The medical data is prepared, delivered and picked up by the patients since the process of sharing is ***slow***[15].
- ***Insecurity*** is also the reason for the sharing of medical data because during the physical transmission of data by patients from one location to another the data copies may get lost or stolen.
- The sharing of medical records is ***incomplete*** as patient health history may be fragmented because the medical records and data of the patient are stored in disparate and soiled systems.
- The patients are prevented from taking control of their own health data or records and also the patients have no knowledge about of what is done to their and who has accessed it. This happens because the process ***lacks the context*** since all the healthcare systems are provider centric instead of patient centric [16].

Lack of trust between the providers and the lack of interoperability between health systems and applications has caused the ineffectiveness of the data sharing process in the healthcare. Foundational, structural and semantic are the three levels ordered in lowest it highest fidelity [17] which are comprised of Healthcare Interoperability.

Exchanging of data between healthcare systems are enabled by ***Foundational Interoperability***. Interpretation of the data is not required by it for the providers who are receiving it. Formats for exchanged clinical data is additionally defined by ***Structural Interoperability***and ensures that preservation is done of the received data and see that if the data is at field level using predefined formats.The interpretability of the exchanged data not only by the syntax but also by the semantics is demanded by the ***Semantic Interoperability***.For the *semantic interoperability* the *foundational interoperability* and *structural interoperability* are prerequisite, to advance the quality of care it is most desired but hardest to achieve. Delivery of information with requisite data quality and safety from the disparate health systems and the applications is ensured with the help of the 3 levels.

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TABLE 1

VARIOUS APPLICATIONS AREAS OF BLOCKCHAIN BASED HEALTHCARE SYSTEMS

Sr. No.	Application Area	Target Research Challenges	Description
01.	Sharing Clinical Data	Securing Data Accessibility	Should secure medical data and must be ensured by it and sharing and storing medical data among various involved stakeholders.
02.	Global data sharing	Securely global data storing and sharing	Should provide secure healthcare data even outside the respective Country or from anywhere in the world at global level.
03.	Maintaining Medical History	Availability of medical data or records	Should guarantee for the continuous availability of medical data to maintain the medical history for better treatment and avoid extra resources and costs.
04.	Healthcare Data Access Control	Managing access control	It promises to give patients more secure access control to manage their healthcare data.
05.	Drug Supply Chain Management	Counterfeiters and pilfering of supply chain process	It can provide secure means of handling and monitoring the availability chain processes in healthcare systems.

2.1.3IDENTITY AND ACCESS MANAGEMENT

TABLE 2

IMPROVING SECURITY AND EFFICIENCY IN HEALTHCARE

Key issues in identity and access management	Explanation	Challenges with the current system	Description
Information authenticating the subject's identity	Information to verify that someone is who he/she claims to be.	Current identity-management techniques in hospitals believe password-based systems, which involve shared secrets that are exchanged and stored on insecure systems.	In blockchain-based identity authentication, each transaction must be signed by the right private key. Only the patient has the private key.
Information describing the information	Information about different pieces of data flow among participants and records of data transaction.	There are not any audit trails of who accessed patients' data. Some hospitals still believe paper medical records.	The presence of an audit trail means there's complete documentation of events associated with the creation, modification, and deletion of electronic records.
Actions that are authorized to perform by various participants	It specifies access rights and privileges of every participant.	Various parties are authorized to take actions supported patients' data. Patients often haven't any control over their own data.	Blockchain prevents unauthorized and illegitimate access to data. Patients hold ownership and ultimate control over their information.

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III. CONCLUSION

Blockchain technology offers a platform that would be used for several potential applications in health care. Solutions were proposed by many organizations that have the potential to extend operating efficiency and transparency of data within the early stage of the design and development.However, the scalability, security, and price effectiveness of blockchain technology would require further research before large-scale production deployments. The longer term of this technology in healthcare and other industries remains being written, and therefore the applications in research and clinical care aren't yet established. In spite of a distributed system that eliminates intermediaries, it has substantial potential to disrupt many current processes in health care and research. The acceptance of the new technology within the healthcare ecosystem is the case on which the blockchain for healthcare highly depends. The technology remains popular within the healthcare sector, though there are certain concerns and speculations regarding blockchain's integration with current healthcare systems and its cultural adoption. Blockchain has taken the healthcare industry by storm over the past year and lots of solutions are being developed to adopt it. With numerous potential use cases and possibilities, blockchain is certain to disrupt the healthcare landscape permanently.

We have seen the good potential of blockchain technology in creating secure and effective healthcare ecosystems with its inherent unique properties. In addition we have also observed the importance of integrating domain-specific concerns and wish into blockchain-based designs. Overall, blockchain features a wide range of possibilities in healthcare, which invites many research opportunities in this space.

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