Block Chain Technology in Healthcare

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ABSTRACT

Block chain technology is a permanent record of online transactions. It is a distributed tamper-proof database, shared, and maintained by multiple parties. It is a new enabling technology that is expected to revolutionize many industries, including healthcare. It has the potential for addressing significant healthcare issues. The BC technology allows participants to move data in real-time, without exposing the channels to theft, forgery and malice. This paper provides a brief introduction to Block chain. It discusses some of its applications and benefits in healthcare industry.

Key words*: Block chain, Healthcare, Medicine.*

1.   INTRODUCTION

Blockchain (BC) consists of a shared or distributed database used to maintain a growing list of transactions, called blocks. Blockchain technology, often called the chain of trust, can support transactional applications and streamline business processes by establishing the trust, accountability, and transparency. The so-called digital ledger technology was developed in 2008 by Satoshi Nakamoto, who designed it as the underpinning for the exchange of the digital cryptocurrency known as Bitcoin. BC forms the backbone of cryptocurrencies like bitcoin, Litecoin, and Ethereum. They work by keeping track of transactions in a distributed ledger.

   Although blockchain was first largely applied in financial industry as the technology that allowed Bitcoin to operate, it has applications for many industries including healthcare, insurance, pharmacy, manufacturing, healthcare, e-voting, legal contracts, tourism, energy, and travel industry. Healthcare will benefit from the early work in finance and leverage blockchain applications in finance. Appling BC in heathcare serves to improve patient care. BC technology offers patients and care-givers the ability to securely share patient identity and healthcare information across platforms. Imagine a future where patients hold the keys to their healthcare passport. Imagine a better quality of care for both patients and care providers [1].

2. HOW BLOCKCHAIN WORKS

The term "Blockchain" refers to the way BC stores transaction data – in "blocks" that are linked together to form a "chain." The chain grows as the number of transactions increases. Since every entry is stored as a block on a chain, the care you receive is added to your personal ledger.

At its core, blockchain is a distributed system recording and storing transaction records. In a blockchain system, there is no central authority. Instead, transaction records are stored and distributed across all network participants. Rather than having a centrally located database that manages records, the database is distributed to the networks and transactions are kept secure via cryptography. BC eliminates the need for a middleman that traditionally may facilitate such transactions.

The Blockchain was designed so transactions are immutable,i.e. they cannot be deleted. Thus, Blockchains are secure and meddle-free by design. Data can be distributed, but not copied. When it comes to digital assets and transactions, you can put almost anything on a Blockchain. Different scenarios call for different Blockchains.

The BC technology currently has the following features [2,3]:

1.Peer-to-Peer (P2P) Network: The first requirement of BC is a network, an infrastructure shared by multiple parties. This can be a LAN at a small scale or the Internet at a large scale. All nodes participating in a BC are connected in a decentralized P2P network. Transactions are broadcast to the P2P network. Due to some limitations of P2P networks, some vendors have provided cloud-based BCs.

2. *Cascaded Encryption***:** A BC uses encryption to protect transaction data. Blocks are encrypted in a cascaded manner, i.e. the encryption result of the previous block is used in encrypting the current block. The BC is secured by public key cryptography, with each peer generating its own public-private key pairs.

3. Distributed Database: A BC is digitally distributed across a number of computers. Each party on a BC has access to the entire database and no single party controls the data or the information. Since BC is decentralized, there is no need for central authorizes such as banks.

4. *Transparency with Pseudonymity:* Each node or participant on a blockchain has a unique 30-plus-character alphanumeric address that identifies it. Users can choose to remain anonymous or provide proof of their identity to others.

5. *Irreversibility of Records***:** Once a transaction is entered in the database and the accounts are updated, the records cannot be altered. Records on the database is permanent, chronologically ordered, and available to all others on the network.

3. TYPES OF BLOCKCHAINS

There are two types of Blochains: public and private. Public Blockchains are cryptocurrencies such as Bitcoin, enabling peer-to-peer transactions. Private Blockchains use Blockchain-based platforms such as Ethereum or Blockchain-as-a-service (BaaS) platforms running on private cloud infrastructure. A private BC is an intranet, while a public BC is the Internet. Companies will be disrupted the most by public Blockchains.

BCs may be permissioned or permissionless. In a permissioned BC, each participant has a unique identity. Permissionless BCs are appealing because they allow anyone to join, participate or leave the protocol execution without seeking permission from a centralized or distributed authority. However, permissionless BCs, such as Ethereum or Bitcoin, face transaction volume constraints. Both permisisoned and permisionless can be implemented in healthcare [4].

MedRec has been proposed as a novel, decentralized record management system to handle EHRs using blockchain technology. It manages authentication, confidentiality, accountability, and data sharing. It enables patient data sharing and incentives for medical researchers to sustain the system [5]   Healthchain is developed on the foundation of Blockchain using IBM Blockchain initiative.

3. APPLICATIONS

Blockchain has the potential for addressing significant healthcare issues. Here are the most likely applications [6]:

- *Medical Data Management:* The healthcare industry is drowning in data— patient medical records, complex billing, clinical trials, medical research, etc. The goal of BC is to give patients and their providers one-stop access to their entire medical history across all providers. Blockchain is able to securely, privately and comprehensively track patient health records. It makes electronic medical records more efficient, disintermediated, and secure. It also makes health information exchanges (HIE) more secure, efficient, and interoperable. Right now, a patient's medical records are dispersed across multiple providers and organizations due to the fact the health systems are fragmented into hospitals, community clinics, general practitioners, specialists, insurance departments, etc. Patient data is one valuable asset of patient, but patients have no control of their personal data. Some of the record pieces are with the primary doctor, some with specialists, and some on devices that track one's health. Every hospital and every doctor's office has a different way of storing the electronic medical records (EMRs), also known as electronic health records (EHRs). For example, in the city of Boston alone, there are 26 different EMRs, each with its own language for representing and sharing data. This situation is costing us money, professional burnout, and sometimes even lives. Blockchain can help us assemble all of these pieces in real-time. This way care providers can have the complete medical history of the patient. For health care to reap the benefits of a blockchain-based medical record, it must grant access to everyone that might need patient's information [7].

- *Drug Development:* Blockchains can facilitate new drug development by making patient results more widely accessible. It can help reduce the counterfeit drug implications. The issue of counterfeit medicines has become increasingly pressing in view of the economic cost of the global black market and the risk to human life that comes from taking counterfeit drugs. Blockchain technology is an excellent counter to threats that are rapidly approaching (integrity-based attacks) and it is a good forward-looking tool we might deploy to address them. BC will also enable drug developers to run clinical trials and share medical samples more securely [8].

- *Clinical trials***:** Using blockchain can make clinical trials reliable at each step by keeping track and time-stamping at each phase of the trial. This could reduce waste. Another blockchain use-case would be the adoption of electronic informed consent in clinical trials. BC improves accountability and transparency in the clinical trial reporting process.

- *Data Security:* Blockchain technology has the potential to be the infrastructure that is needed to keep health data private and secure . BC requires no one central administrator, and it has unprecedented security benefits because records are distributed across a network that are always in sync.

Other applications include counterfeit drug prevention and detection, validation and payment of claims, clinical trial results, outcome-based payments, reimbursement of healthcare services, exchange of health data, and supply chains [9].

4. BENEFITS

The main benefits of blockchain in healthcare are data interoperability and security. In healthcare, interoperability allows two or more systems to exchange and use information.

BC can enhance interoperability across a global market, eliminating system boundaries and geographic limitations. Blockchain provides a shared and transparent history of all the transactions to build applications with trust, accountability, decentralization, transparency, and immutability.

Besides interoperability and security, BC holds the promise to unite the disparate healthcare processes, reduce costs, improve regulatory compliance, improve patient experience, providing healthcare at lower costs, and autonomous monitoring and preventive maintenance of medical devices. It will speed up the R&D cycle and time to market of new drugs. Healthcare organizations need not compete among themselves because they all have access to the same information. Blockchain technology has the potential to transform healthcare systems because it places the patient at the center of the health care ecosystem, as illustrated in Figure 1 [10]. BC is the perfect solution when we need to document a patient's health record or to secure the movement of drugs through the supply chain. BC has the potential of transmitting patent record across geographies without compromising its integrity, privacy, and security.

5. CHALLENGES

Although blockchain presents many opportunities for healthcare, it is not fully mature yet. Several technical challenges must be addressed before a healthcare blockchain can be adopted nationwide [11]. Data privacy and the ability to access sensitive patient information are the key challenges in the design of a healthcare blockchain application [12]. As they work today, anyone can look at the bitcoin or Ethereum ledger at any time. If someone can identify your records on the blockchain, they know everything about your medical history. By design, BC technology is distributed and storage space is limited, so small data or metadata is preferable.

Critics question the scalability, security, and sustainability of blockchain technology. Blockchain's potential for the health-care industry depends on whether hospitals, clinics, and other organizations are willing to cooperate in building the technical infrastructure required. The system must facilitate the exchange of sensitive health information between patients and providers as well as exchanges between providers, while remaining secure from malicious attacks [13].

6. CONCLUSION

The blockchain revolution has made its way to the healthcare industry, and leaders are now wondering what is possible and how blockchain can solve many issues that plague the industry. BC is the technology that will possibly have the greatest impact on the next few decades; not social media or big data or robotics. Although BC is not fully mature, the healthcare system can take advantage of a beneficial disruptive innovation that will stand the test of time like blockchain. Blockchain has great potential for the future and will cause disruptive changes in the healthcare industry [14].

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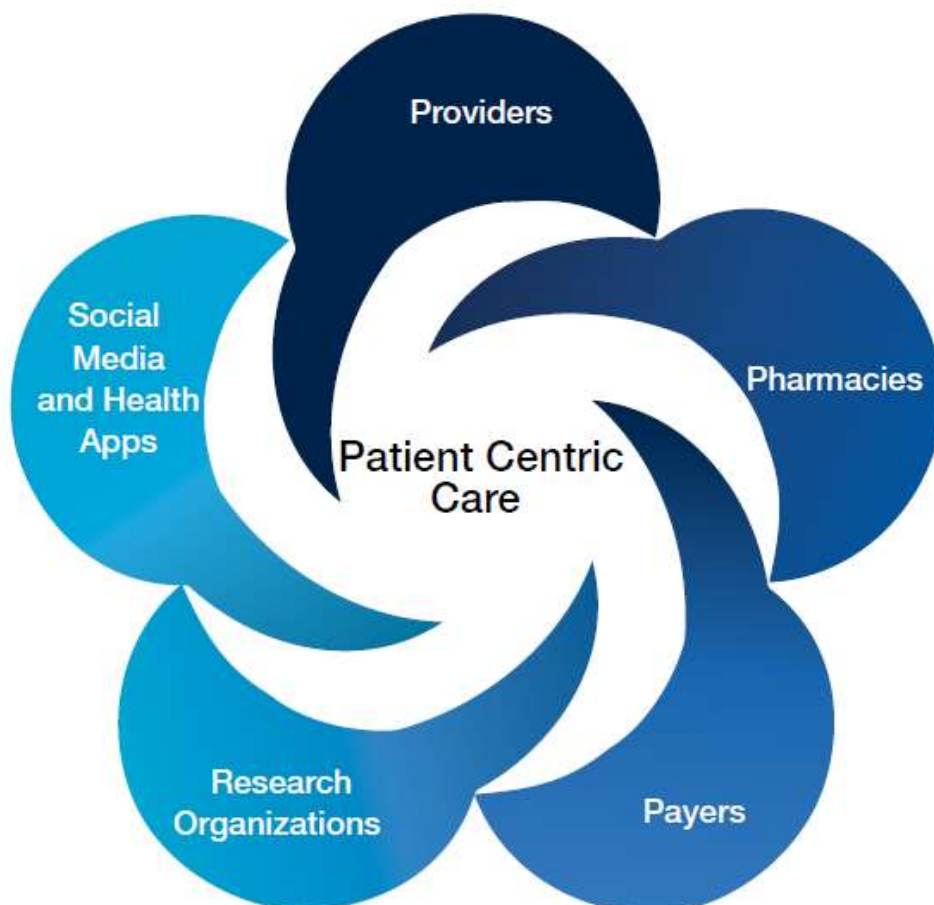

Figure 1   A patient centric heath data sharing [10].