



Research Article

SURVEY ON THE IMPACT OF BLOCK-CHAIN IN ELECTRONIC MEDICAL SERVICES

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ABSTRACT

Block-chain is a technology that introduce the decentralized and distributed ledger that stores the records which can be accessed publicly. The records or data are stored in blocks which are chained chronologically to preserve the integrity of the data stored in it. Unlike any kind of database, the blocks that store the data have two hashes, the hash of the block before it, and the hash of its own which is treated as the fingerprint for the block and protect it from being tempered. The temper-proof and the distributed ledger properties of the block-chain technology have made it to be the most used technology in preserving the integrity and increase the transparency of data in various industries. One of the advantage of using the technology is that despite the data being accessed by anyone in the network, the block that stores the data is immutable. Many misconceptions arose regarding the medical records privacy, risk to the transparency, procedures and other related health issues on the procedures. This paper will review the impact of the block chain technology in electronic medical services to address the issues.

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INTRODUCTION

Electronic medical services has a swift growth and progressively become more prevalent in the healthcare industry. “As the consumer seek fast and cheaper medical intervention, the high cost of private medical insurance, lack of medical expertise and long wait times in public healthcare drives the development” [1]. The use of electronic medical services has an advantage of giving access of patients’ information stored in a database to all healthcare workers including the patients’ past medical records which assist in providing the right treatments to the patients. The system enable the health care workers to provide the services demanded by the patients at any time and anywhere in an easy and fast way. In this way the cost and time are reduced hence the consumers reach their satisfaction for a fast and cheaper services. This sort of systems usually gather patients information and consulted by authorized clinicians and staffs and keep tracks of patients record in one organization.

The block-chain is a technology involving peer to peer clusters that share the information stored in the immutable blocks joined to form a chain. “Block-chain based application are springing up covering numerous field including financial services, reputation system and Internet of Things (IoT) and so on” [2]. The best advantage of block-chain is decentralization and immutability, which in turn increase the security and transparency stored. “One field where block-chain technology has tremendous potential is healthcare,

due to the need for a more patient-centric approach to healthcare systems and to connect disparate systems and increase the accuracy of electronic healthcare records” [3]. Introducing this technology into the medical services system provides the opportunity of patient-doctor trust, privacy and integrity of patients records and transparency of patients information which can be accessible by an authorized practitioners and clinicians outside the organization. This gives another advantage to patients to be able to access their medical information whenever and wherever they need to. The public accessibility of the information may assists the pharmacists to verify whether the recommended prescriptions was given by the claimed doctor before providing the medicines to the patients for consumption. “The technology, therefore, holds an untapped potential to unlock new value, since it reduces information asymmetry by enhancing the transparency of information and knowledge about medical facilities” [1].

Block-Chain Overview

The block-chain technology as the name imply, refer to the chain of blocks compared to small database used to store data in a linked manner so as to ease the validation of the stored data. Fundamentally, the block is comprised of three components which are; the hash of the block before it, the data/transaction and the hash of the block itself. The ‘genesis block’ refer to the first block in the chain with no other hash except the hash of its own block. The hashes assists in verifying the valid blocks and ensure that the blocks has not been tampered. The process is done by verifying that the previous hash contained in a block is the same hash as the hash

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of the block before it. If found that the previous block has different hash from the successor block claiming to contain the hash of the previous block, the process terminate by declaring the preceding blocks to be invalid. Moreover, the technology enable the decentralized environment as the connected clusters that perform, create and prolong the chains are distributed and work in peer-to-peer style. This decentralization allow the transparency of the transactions/data across the network. For instance, the information of who the sender is, who is the receiver of that information and the *timestamp* may be seen publicly. Despite the data being accessed publicly, the technology preserve the privacy and integrity of the data by the use of cryptography system which allow only the authorized users to access the information. "This is similar to the level of information released by stock exchanges, where the time and size of individual trades, the "tape", is made public, but without telling who the parties were" [4]. For example, the sender and receiver use the digital signature approach to validate the information. The validation involves the use of public and private keys to verify whether the receiver of that information is the intended one.

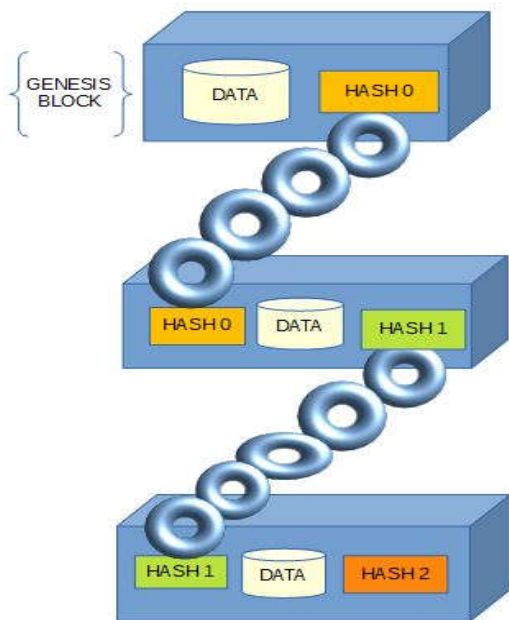


Figure 1 Components of a block

Literature Review

The need of block chain in healthcare is presented by Marko Hölbl, Marko Kompara, Aida Kamišalic and Lili Nemeč Zlatolas in their research paper. The paper focus on the use of block-chain technology in healthcare which include the supply chain management, support drug description, pregnancy and any risk data management. The finding indicated that the block-chain is used mostly in data sharing, health records and access control are rarely used for supply chain management and drug description. The discussion present to what extent the block chain is used in healthcare and how it change overtime. The paper suggest the continuation of use of the block chain technology where it is reasonable and needed [3].

Another paper explain the potential of block-chain in addressing significant healthcare issues. This involves the application of block-chain in medical data management, drug development, clinical trials and data security. The main benefit of block-chain in healthcare industries was identified to be the

“data interoperability and security”. The interoperability allow distributed systems “to interchange and make use of the information. The paper also mention the promise made by the block-chain to unite the disparate healthcare processes, reduce cost, improve patients experience and autonomous monitoring and improving maintenance of medical devices”. The advantage of this paper is when it mention the impact of this technology to healthcare industry as being likely to change care systems as it spot the patients at the center of the health care scheme. The paper conclude that “the healthcare system can take advantage of a beneficial disruptive innovation that will stand the test of time like block-chain. Block-chain has great potential for the future and will cause disruptive changes in the healthcare industry” [5].

Despite the challenge of managing healthcare data “due to its sensitive nature and subsequent trust issues, block chain may enable the efficient sharing of healthcare data while ensuring data integrity and protecting patient privacy. Secure, efficient, cost-effective, and interoperability can be built with its right use alongside with other technologies”. This was described by Katuwal, Gajendr, Pandey, Sandip, Hennessey, Mark Lamichhane, Bisha in their research paper. Moreover, the acceptance of block-chain can send forth the movement of “patient-centric” healthcare model where patients have control over their health records. The authors visualize the block-chain as the “bridge for the integration of medical device data and healthcare internet of things; the healthcare and lifestyle data collected by wearable devices can be critical for correct diagnosis but are underutilized since there is a lack of a proper way for a physician to access the patient-generated data” [6].

Evidently, block-chain incorporate some engrossing features that are advantageous to healthcare applications. This is explained by Agbo CC, Mahmoud QH, Eklund JM. in their paper which also describe “one important feature of block-chain that is clearly beneficial to healthcare applications is decentralization which makes it possible to implement distributed healthcare applications that do not rely on a centralized authority. Additionally, the fact that the information in the block-chain is replicated among all the nodes in the network creates an atmosphere of transparency and openness, allowing healthcare stakeholders, and in particular the patients, to know how their data is used, by whom, when and how. More importantly, compromising any one node in the block-chain network does not affect the state of the ledger since the information in the ledger is replicated among multiple nodes in the network. Therefore, by its nature, block-chain can protect healthcare data from potential data loss, corruption or security attacks, such as the ransomware attack” [7].

Applications of block chain in medical services

Smart Contract

“To solve the problem of data ownership and control, the smart contract require users (patient and hospital) to use private keys to sign transaction for authentication. Thus, the patient can not alter the record without permission of the hospital, but can have control over who can access the record” [8].

Medical Fraud Detection

As one of the application of block-chain is the medical industry is supply chain management, in which the supply chain considered to be vulnerable and contain holes for

fraudulent attack as it involves numerous moving parts and people, “the block chain provide secure platform for eliminating and preventing the fraud occurrence by providing data transparency and improving product traceability as the record can be validated through the smart contract and hence make it difficult for the block chain to be manipulated” [10].

Electronic Health Record (EHR)

As the patients leave their data distributed in diverse health institutions as they are separated from one provider to another, they lose the access to their past data. “Many researcher brought block-chain technology to the EHR to encourage patients to engage in their current and historical health data. Perhaps the reason of global growth of using block-chain technology in medicine is a strong assurance to patients, in using this technology to make his/her healthcare records immutable and unaltered. Any effort of access or adjustment can be quickly labeled and recognized all throughout the block-chain. This isn’t only useful for patient integrity, but also identifies any criminal exercises, including wholesale fraud or adulteration of records “[10].

Benefits of Block-Chain to Medical Services

Decentralization

The decentralization of patients records suits for the distributed stake holders requiring the decentralized management system. “The block-chain can be the backbone for the decentralized health data management where all stakeholders can have controlled access to health record, without anyone playing the role of central authority over the global health data” [7].

Interoperability

“The block-chain, can be realized by the use of sophisticated API to make electronic health record interoperability and data storage a reliable process. With block-chain network being shared with authorized providers in a secure and standardized way, that would eliminate the cost and burden associated with data reconciliation “[11].

Health Data Ownership

“Patients need to own their data and be in control on how their data are used. They need the assurance that their data are not misused by other stakeholders and should have a means to detect when misuse occurs”. The block-chain meet the requirement through the use of cryptography protocol and the use of smart contract [7].

The Use of Crypto-Currencies

“Healthcare providers can save money by using block-chain technology and cryptocurrency. Providers can reduce or eliminate banking fees since cryptocurrency bypasses the middleman, which in this case is the banking institution. The money saved can be significant and might be used to purchase new equipment, remodel the office, or stored in the practice’s digital wallet to hopefully accrue value and interest. The cryptocurrency market is very volatile due to several reasons, such as regulatory concerns” [12].

Limitations of block chain in medical services

Security Flaw

The use of public block-chain may results in security flaws as the attackers could collude in ‘51% attack’ resulting in the

rewriting of the chain structure [9]. “There is no particularly notable security flaw in Bitcoin and other Block chain-based systems. For example, if more than a half of the computers work as nodes to make the network give the incorrect information, that info will become the real info, the truth. When Satoshi Nakamoto launched Bitcoin, he was warning people about this possibility, calling it a “51% attack”. This is exactly the reason why Bitcoin mining pools are closely monitored by the network community to ensure that no one gains this kind of influence over the network “[15].

Cryptocurrency Anonymity

“The primary limitation or concern comes in with pairing certain forms of cryptocurrency block-chain with healthcare operations. Cryptocurrency block-chains have this anonymity that is naturally attached because the actual name of a payer or payee never has to be revealed. For example, someone using something like Bitcoin never has to reveal their true identity during a transaction. Naturally, healthcare block-chains could not exist so anonymously; a patient’s identity would have to be revealed at some point in transactions and during the transmission of patient data to other providers. Therefore, there is a bit of a conflict there that exists between how block-chain technology is meant to function and how it would have to function in healthcare environments” [13].

Need for Collaboration

“A second potential concern regarding the implementation of block-chain in healthcare is the need for the companies supporting patient care to collaborate. The various healthcare entities would be required to embrace information exchange and greater transparency. This could be a roadblock if providers are not willing to embrace change” [14].

CONCLUSION

As the block-chain maximizes and ensure the security and integrity of the information, the block-chain scheme can be utilized in various arena in the medical services provision such as maintaining sensitive patients information, decentralize the information so as to be accessed anywhere and hence increase the chance of availability of the information at the right time when needed. As the block-chain is a new technology, its benefits may result in greater usage in healthcare industry as the outcome is a positive impact of its implementation. “One thing is for sure block-chain has taken healthcare by storm over the past year, and there are significant investments for block-chain. With such wide-ranging possibilities, it is no surprise block-chain seems poised to one of the key pillars in the digital world. And maybe someday, it will transform the big data landscape” [11].

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