Editorial

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Blockchain Technology and Healthcare

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A blockchain is a distributed, public ledger, recording transaction and tracking assets, and of which immutability is guaranteed by a peer-to-peer network of computers, not by any centralized authority. Assets can be tangible, such as homes or cash, or they can be intangible, such as patents or copyrights. A blockchain consists of ordered records arranged in a block structure. Each data block contains a hash (digital fingerprint or unique identifier), timestamped batches of recent transactions, and a hash of the previous block [1]. With this design, each block is connected in chronological order and the connected blocks are called a blockchain. It is practically impossible to modify one of the blocks in the middle of the chain because all of the blocks after the modified block must be modified at the same time. With this mechanism, the data on the blockchain network are immutable.

A smart contract is a computer protocol that runs automatically when the prerequisites are met, and it is an entity separate from the original blockchain technology. The smart contract was adopted as a key function of Blockchain 2.0, expanding the application of blockchain technology beyond cryptocurrency, such as Bitcoin of Blockchain 1.0. The term Blockchain 3.0 has recently emerged, but the concept does not appear to be clearly defined yet. Some say that Blockchain 3.0 will revolutionize the throughput of blockchain technology, which is currently one of the most important challenges of blockchain technology [2].

Many aspects of blockchain technology, such as the immutability of the data stored in a blockchain, are drawing the attention of the healthcare sector, and rosy prospects for many available cases are being discussed. Blockchain technology is expected to improve medical record management and the insurance claim process, accelerate clinical and biomedical research, and advance biomedical and healthcare data ledger [2]. These expectations are based on the key aspects of blockchain technology, such as decentralized management, immutable audit trail, data provenance, robustness, and improved security and privacy. Although several possibilities have been discussed, the most notable innovation that can be achieved with blockchain technology is recovery of data subjects' right.

Medical data should be possessed, operated, and allowed to be utilized by data subjects other than hospitals. This is a key concept of patient-centered interoperability that differs from conventional institution-driven interoperability. There are many challenges arising from patient-centered interoperability, such as data standards, security and privacy, in addition to technology-related issues, such as scalability and speed, incentives, and governance.

Blockchain technology can facilitate the transition from institution-driven interoperability to patient-centered interoperability [3]. Blockchain technology allows patients to assign access rules for their medical data, for example, permitting specific researchers to access parts of their data for a fixed period of time. With blockchain technology, patients can connect to other hospitals and collect their medical data automatically.

In addition, these functions, which can be implemented with blockchain technology, may be useful for ensuring the

rights of data subjects as defined by the EU General Data Protection Regulation. Because of the typical size and sensitivity of medical data, it is generally believed that the tag information of medical data, not medical data itself, will be stored in data blocks. However, some important information, such as information on drug allergies, can be published in a public blockchain.

Blockchain technology is constantly improving rather than completed, and it has several potential challenges that must be addressed for it to be adopted for biomedical and healthcare applications. The first challenge involves transparency and confidentiality. Everyone can see everything on a blockchain network. Many believe that medical data itself is stored off-chain and only the hash of the tag information is stored in a blockchain. The second challenge involves speed and scalability. In a proof-of-concept study, transaction processing speed is expected to be only a few hundredths of the conventional way, such as credit card. Considering that the number of transactions in the healthcare sector is enormous, a blockchain technology revolution is needed. The last challenge is the threat of a 51% attack. It is a theoretical but possible risk and a clear solution for this should be suggested [2].

Many believe that blockchain technology can change medicine and beyond, but no one sees evidence to support their belief. What we need is not rosy expectations, but a real case that provides evidence for the potential of blockchain technology.

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