Invited Review

Blockchain Revolution in Healthcare : The Era of Patient-centered Dental Information System

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Blockchain is at the center of attention recently and it is expected to have a huge impact on healthcare industry including dentistry as well. Blockchain is a fundamental technology behind Bitcoin and itis all about decentralization, security, reliability, and transparency. These characteristics of the technology empower it to disrupt the current healthcare industry in innumerable practices such as supply chain management in pharmaceuticals to prevent the counterfeited medicine, clinical trials to guarantee transparency, healthcare information exchanges or personal health record systems to ensure data integrity and interoperability, etc. It will surely revolutionize the way the current healthcare system works; from provider-oriented to patient-centered. Hence, it is time to seriously consider how we could be a part of this blockchain revolution in dentistry.

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Blockchain Revolution

Cryptocurrency(or cryptoasset)[1]1 represented by Bitcoin has recently become the hottest topic in the world. Bitcoin is the first fully-decentralized electronic asset trading system introduced in 2009 by a person or a group named Satoshi Nakamoto in a whitepaper titled "Bitcoin: A Peer-to-Peer Electronic Cash System".[2] Until Bitcoin was introduced, it was impossible to make a direct online asset transaction between two entities without trusting each other and such transaction was only possible through a trusted third party, such as a traditional bank or fintech services. Hence, through the whitepaper, Satoshi Nakamoto suggested Bitcoin as an alternative to this problem. When Bitcoin was first introduced, almost no one expected that Bitcoin would have the monetary value it has today. Bitcoin has grown tenfold over the past year and now stands at around $10k each. What makes Bitcoin so special?

Bitcoin is based on the technology known as Blockchain. It can be simply called Distributed Ledger Technology that enables a number of unspecified network participants to record transaction details occurring in the system commonly and to compare and verify them consistently. In other words, the essence of Blockchain is a 'trusted common ledger' or 'database'. This "trust" is created through mutual verification of the transaction details (or the information) by multiple network participants, not by any third party. Also, this information is essentially public, so anyone can access it. In

principle, the information recorded in a block can not be deleted or modified. To counterfeit it, a certain number of network participants (in case of Bitcoin, at least 51% of all network participants) must be hacked in a very short time. However, this is considered to be virtually impossible and that is what makes Blockchain a highly secure system.

In recent years, attempts have been made to record contracts through Blockchain so that the technology could have capability than simply recording transaction details. This is what is known as Smart Contract[3] and Ethereum[4] is the one that initiated this wider use of Blockchain. However, for systems like Bitcoin and Ethereum to be really secure, a large number of network participants are required. Public blockchain systems solve this problem by giving the participants a certain amount of incentive depending on the network contribution. Bitcoin in Bitcoin network and Ethereum in Ethereum network are given as an incentives.

Recently, the growing interest in Blockchain resulted in a sharp price increases of cryptocurrencies such as Bitcoin. As a result, various services utilizing Blockchain are emerging explosively in all industries. The healthcare industry, traditionally known as the most conservative, is no exception. Within a year or so, plans for services using Blockchain have started to flood the market. Last year alone, more than 70 teams in the healthcare field issued whitepapers and got funded from the market using cryptocurrencies. This proves that the value of Blockchain such as reliability and transparency well meets the value required by the healthcare field. To be more specific, the technology is more likely to be used in supply chain management in pharmaceuticals to prevent the counterfeited medicine, clinical trials to guarantee transparency, and healthcare information exchanges or personal health record(PHR) systems to ensure data integrity and interoperability. Among these applications, Blockchain's utilization in PHR is expected to make a big change in the whole healthcare industry. In fact, this has long been suggested by the US government as well[5].

Blockchain-based PHR

Healthcare services have always been led by healthcare providers. One of the biggest reasons is the enormous gap between healthcare professionals and patients in terms of the information. However, as the accessibility of information has been improved through the development of technologies such as Internet, the dynamics between healthcare professionals and patients is changing rapidly. From a one-way practice led by the healthcare professionals, the medical treatment is changing to joint effort of both the healthcare professional and the patient.. The pattern of disease is also changing. In the past, major medical demands were for acute diseases; however, as the number of patients with chronic diseases, such as diabetes and hypertensions, increased, the medical demands for chronic diseases surged. This meant that not only the treatment in the hospital but also acknowledging the patient behavior outside the hospital became important. Fortunately, it has become possible for patients to easily obtain more healthcare data by themselves with home medical devices that help patients to measure their own body weight, blood pressure and blood glucose level. For example, wearable devices allow patients to constantly collect their own health info such as heart rate and activity. These patient-generated health data are also becoming increasingly important and growing, but the current hospital-centered healthcare information system is unable to cover such data, making it difficult to respond to changes.

As a result, the need for a personal health record (PHR) centered on individuals, rather than hospitals, has increased strongly. Giant IT conglomerates such as Google, Microsoft, Apple, Samsung, etc have plunged to take the lead in the personal health record market. However, even with their interest, until now, the market seemed to have met an impasse because, for a PHR system to be truly successful, it must address the following five problems. First, in order to gather all data that are fragmented into multiple healthcare providers, it is necessary for the system to attract various stakeholders with different interests, which is not easy. Second, there is no standard in healthcare data format and, hence, it is difficult to have an interoperable data system. Third, healthcare data is a sensitive private information, and posemany legal issues raised in dealing with it. In order to solve this third problem, it is essential that the patient can have the ownership and control of their own data. Fourth, there should be an incentive to allow patients and healthcare providers to participate voluntarily. Fifth, but not the least, data reliability must be assured in order to utilize the collected healthcare data. However, there was no such system that solved all these problems so far.

Blockchain is the only technology that can solve these problems with PHR and here is why. If the system is

configured as an open platform using public blockchain, it will be possible to build a system from which various stakeholders in the healthcare system can benefit. In addition, we can expect a system that accepts and supports various formats. We do not need to rely on the standardization of the data anymore. Also, it is possible to construct a healthcare information economic ecosystem by encouraging their participation using incentives in cryptocurrency. If such an environment is provided, personalized medicine and precision medicine services will be possible based on the holistic view of individuals' healthcare records. Furthermore, the collected data can be used for various medical researches to push the advancement of medicine forward.

Conclusion

In dentistry as well as in medicine, the center of healthcare is shifting to patients. Especially in clinical environment, this shift has already begun and cannot be avoided. Blockchain will accelerate this change. With Blockchain, the change is likely to emerge over the next five years, perhaps even faster. There is always a chance in the moment of change. It is time to recognize this opportunity first and utilize the technology well in the clinic and in the research process.

References

1. Cryptocurrency - Wikipedia. Available at: https://en.wikipedia.org/wiki/Cryptocurrency. (Accessed: 1st March 2018)
2. Nakamoto S. Bitcoin: A Peer-to-Peer Electronic Cash System. Available at: https://bitcoin.org/bitcoin.pdf. (Accessed: 1st March 2018)
3. Catchlove P. Smart Contracts: A New Era of Contract Use. SSRN Electronic Journal *(2017). doi:*10.2139/ssrn.3090226
4. Ethereum Project. Available at: https://www.ethereum.org/. (Accessed: 1st March 2018)
5. Ivan D. Moring toward a Blockchain-based Method for the Secure Storage of Patient Records. Available at: https://www.healthit.gov/sites/default/files/9-16-drew_ivan_20160804_blockchain_for_healthcare_final.pdf. (Accessed: 1st March 2018)