Blockchain Technology: Investing in a National EMR Strategy

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Blockchain technology: Investing in a national electronic medical record strategy

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ABSTRACT

Improving the efficiency and sustainability of Canada's healthcare system is a priority of the federal government. In order to achieve these goals, government and non-government stakeholder collaboration will be required to improve integration, universality, and equity of the healthcare system. Although technological innovations pose certain risks, investing in health technologies plays a major role in improving service delivery and cost-saving within healthcare. Canada has historically had a relatively low use of electronic medical records (EMRs) in comparison to other high-income countries, which appears to be partially due to inefficiencies within the fragmented systems throughout Canada. Improving the current EMR infrastructure has the potential to save Canada substantial amounts of money, improve information transfer for patients and practitioners, and enhance the overall quality of medical care Canadian citizens receive. There has been mention of developing a national EMR strategy by various organizations, including the Canadian Medical Association. Blockchain technology appears to have many desired characteristics for developing a comprehensive national EMR strategy to support the needs of our universal healthcare system. This is due to the fact that blockchain is a secure platform to store huge amounts of information and broker data transfers between a diverse group of stakeholders. It is believed that blockchain can provide a unique framework upon which a national EMR system can be built.

BACKGROUND

Improving the efficiency and sustainability of the Canadian healthcare system requires coordinated efforts from government and non-government stakeholders across provinces and municipalities.[1] Canada is guided by the World Health Organization's model for health services: a seamless connection of health sectors to provide an integrated, equitable, and universal continuum of care throughout an individual's lifespan.[1] With the new "ten-year health accord" being developed in Canada, one of the areas of focus will be developing an improved health innovation strategy.[1] An external review in March 2018 suggested health data governance and digital systems are one of the most pressing vulnerabilities of our health system, with numerous federal commission reports and sub-national jurisdictions providing similar recommendations.[1]

Health information technologies can allow for increased efficiency and quality of service delivery for patients, doctors, health agencies, and governments alike, which can lead to cost-savings. However, new technologies and "innovative solutions" at scale do pose certain risks to governments. In some cases,

unforeseen inconveniences may cost billions of dollars to resolve.[2] Nonetheless, the Canadian government has made significant investments into digital health solutions in recent years, including a multi-billion-dollar investment into Canada Health Infoway – a government-funded organization supporting electronic medical record (EMR) capacity-building and uptake.[3] The increase in EMR use has saved the Canadian economy billions of dollars through improved communications and chronic disease management for patients.[3] Although the rate of EMR use is on the rise in Canada, other high-income countries tend to use EMRs significantly more than medical professionals in Canada.[3] This suggests Canadians are not optimally benefiting from improved healthcare delivery and cost-saving that EMRs provide.

Canada's current EMR networks are fragmented and inconsistent across provinces and territories, which prevents patient records from being seamlessly transferred between health providers throughout the patient's life-course.[3] This fragmentation is estimated to cost provinces hundreds of millions of dollars throughout Canada.[3] The Canadian Medical Association has promoted investing into a centralized "cradle-to-grave" EMR system for seamless and coordinated care.[3] This could allow health professionals to retrieve patient medical information regardless geographical location. Developing a universal EMR system could allow for improved governance and organization of digital health records for all Canadians—a massive step forward to improve healthcare delivery for all patients within our "universal healthcare system". A comprehensive EMR strategy would need to be founded on superior digital infrastructure to ensure a highly functional and secure system. Blockchain technology appears to have many desired characteristics that would be required to develop a comprehensive national EMR system.

BLOCKCHAIN TECHNOLOGY

The blockchain is a secure and decentralized information-sharing platform that relies on networks of observers to validate data transferring within the system. Additionally, the scalability of the technology is ideal given the capacity to store data that a national EMR system must have. The "block" refers to the discrete number of "data transactions" that have occurred within a predetermined length of time.[4] This distinct package of information is processed chronologically and connected to the next "block" of information. These time-stamped blocks of information are tied together in a "chain" of events (hence the name "blockchain") that allows for a high degree of data safety and integrity.[5] Any collection of information can be stored in such a "block", including patient demographic information, medical history, and any other type of health information.[6]

The main difference regarding information storage in the blockchain occurs during the "chain" stage. Multiple machines must recognize the data within the 'block' as legitimate at this point (ie, that the data has not been falsified, manipulated, or shared with an entity that does not have permission to access this information). Blockchain technology does not have a single governing body with complete control of the network information.[7] Alternatively, every single user within this system has the capacity to authenticate data transactions within the network—a "decentralized" validation process that ensures blockchain rules are always being honoured.[7]

In a real-world setting, if personal information were to be shared from one computer to another within the same network (eg, a multicomputer network within a hospital), the data could only be shared if the "network policy" allows the information to be shared under those given circumstances.[5] If there were a breach in the "network policy" regarding this information transfer request (eg, data being transferred to a computer that does not have permission to access this information), the multicomputer network would not validate this transaction—the data would not be shared in order to protect the integrity of the information.[7] If the data transaction were instead given permission, this discrete information would be forever "time-stamped" in a "block" within the blockchain system.

A similar process occurs if the data are changed: a new "block" is added within the blockchain, with the original data remaining in their original "block" consecutively. These continuous "blocks" of data remain linked together in a "chain"—and so the information remains anonymous, highly secure, and virtually unhackable within the network.[4]

BLOCKCHAIN-BASED EMR SYSTEMS

A defining feature of blockchain systems is the high degree of security they allow, which is an essential component of healthcare data storage.[8] With blockchain technology, data transactions are permanently recorded within the decentralized network.[9] This creates an "immutable audit trail" for any (and all) modifications made to an original record.[9] This intrinsic property comes from the fact that blockchain only has two main functions available: "read" and "write".[9] Medical records in Canada have conventionally been stored on a single server within a centralized database, which contains three main functions: "read", "write", and "delete". Although medical-legal standards in Canada require EMRs to contain a detailed history regarding modifications to patient medical records, a single server system operating on a centralized database can be vulnerable to unauthorized access and data hacking, particularly as a result of the "delete" function. Cryptographic EMR systems developed on blockchain technology naturally allow for secondary verification points to exist throughout the decentralized network, continuously monitoring activity and providing a truly immutable audit trail with a superior level of security.[9]

The security advantage blockchain technology allows for stems from how input data are stored within the "chain". For example, if an unauthorized entity attempted to access or modify a patient's medical information, there would be an immediate security verification process prior to the approval of the entity's request. This is achieved through an automatic verification of the historical "blocks" of data and rules of the network, which are shared by all of the computers on the same blockchain network.[7] If the request to modify the original record follows the predetermined rules within the network (and therefore receives approval from the majority of the computers on the network), then the entity will have their request to modify the original document approved.

For example, this could be the approval of a family doctor making necessary updates to their patient's EMR after a routine checkup. However, if the physician attempted to share medical information from the patient's EMR with an unauthorized entity (such as for research purposes when patient consent was not properly obtained), all computers on the shared blockchain network would deny this request, since this new "block" does not follow the security protocol of the network. Therefore, the entire system of computers creates a cryptographically enforced consensus, which would ensure that the security of the patient's EMR data are always withheld.[10]

Decentralized EMR data storage using blockchain technology can allow rapid, seamless information sharing between patients, health professionals, and organizations within Canada's health system.[11] Although health data are increasingly being stored electronically, the data tend to be stored in isolated silos within a disjointed system. Blockchain can liberate information-sharing from these entrenched silos, creating a common interface through which data can be accessed.[10] The synchronized digital data sharing within a blockchain network allows for rapid peer-to-peer information sharing on a highly secure medium: information transfer and data requisition always occurs unilaterally within the network, with new "blocks" of data being connected to the ever-growing "chain".[8,11] As a result, this "distributed ledger" shared within the network prevents third-party intermediaries from interfering with data sharing between two parties.

Blockchain-based EMR technology can also allow for patients to have ownership of their personal data that the EMR system stores. Personal health information is currently stored on a central database server, where the patient has no control over their records.[12] As a result, the patient remains unaware of the access and distribution of their personal health information. EMR systems built on blockchain technology could potentially flip this scenario: the patient could be in control of their private information, allowing selective access to health professionals and organizations based on the comfortability of the patient.[12] The patient would have the capacity to know which information was viewed, by whom, and the viewing duration.[12]

Allowing patients to be gatekeepers of their own data is not only empowering, but can also build trust in the medical staff and the health system from whom and from which they receive care.[13] This could also have positive ramifications for public health and medical research, with improved quality of data along with significant cost-savings being major benefits for the Canadian population.[14]

CONCLUSION

The emergence of blockchain technology provides Canada with a unique opportunity to develop an innovative and sophisticated national EMR strategy. Blockchain technology has the potential to resolve major issues currently occurring with EMR systems for patients and health professionals, including aspects of security, privacy, interoperability, and scalability. These are fundamental components for a blockchain-based national EMR strategy that can truly support our universal healthcare system.

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