Exploring a new frontier in health care technology: Non-fungible tokens for secure health data management

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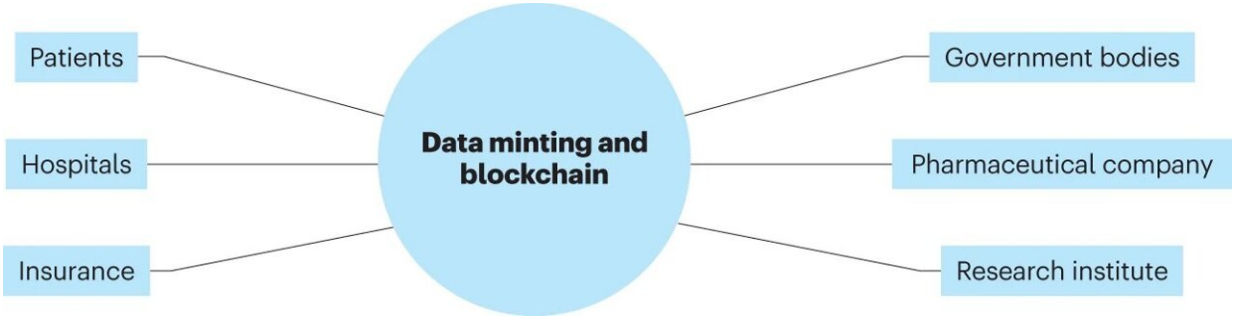

Potential privacy-preserving network of biological data. A blockchain-enabled 'biodata' platform will serve as a decentralized and secure collaborative network for health data. This will enable the secure exchange of healthcare data among multiple stakeholders, including patients, hospitals, government bodies, pharmaceutical companies, research institutes and insurance companies. Credit: *Nature Medicine* (2023). DOI: 10.1038/s41591-022-02125-2

Digital transformation in health care has been greatly catalyzed by the COVID-19 pandemic, which resulted in the accelerated adoption of digital health solutions such as telemedicine, remote monitoring and the Internet of Medical Things (IoMT), robotics and artificial intelligence (AI).

This caused an upward surge in the generation and flow of health data,

which is expected to continue as health care providers and patients grow more accustomed to digital solutions, and health care systems gear up with emerging technologies to tackle the challenges of the future.

With this increase in digital health data, a team of clinician innovators from SingHealth anticipate a growing need for privacy-preserving solutions to empower patients to take greater ownership of their health and to enhance the applications of data for medical research and clinical care purposes. In a recently published editorial piece in the journal *Nature Medicine*, the team explored the use of non-fungible tokens (NFTs) as a potential data management solution to bridge this gap and revolutionize data exchange in health care.

An NFT is a unique digital data unit stored on the blockchain, under a single ownership that is irreplaceable, and which can be traded. Like digital assets that are traded as commercial NFTs today, health data can be minted, exchanged and stored using blockchain technology, bearing the same features of uniqueness, transparency and interoperability.

This means that patients will be able to own their personal health data and exchange it as digital assets with multiple stakeholders, such as health care providers, using the same blockchain technology. Similar to how cryptocurrencies are traded with mobile wallets, each patient can own, store and share their health data in the form of NFTs using a health wallet hosted on a secure web-based or smartphone application, making this mode of data management easily accessible, yet secure and private.

The key difference between existing commercial NFT marketplaces and a blockchain ledger dedicated to the exchange of health data is that the health data ledger can be programmed to disallow public viewing of its data. When a patient needs to share their health data with a health care provider, they can give the health care provider access to and allow them to view the required information. This preserves patient privacy, only

allowing data owners—the patients themselves—to permit the access and sharing of their personal health data.

Empowering patients and improving care

Presently, patient data is safe kept and shared when necessary by institutions such as health care providers, research institutes, insurance companies and government bodies. Transiting to the use of NFTs will require a paradigm shift in mindset for patients and caregivers. Managing health data as NFTs will give the full ownership of personal health data to patients, entrusting them with the responsibility of storing the data and sharing it when necessary.

This ensures accurate and complete health information from each individual, and empowers them to engage in their health journey more proactively, which has shown to produce better health care outcomes in the long run.

Patient ownership of health data may also allow for greater fluidity of health care information. Currently, patient data is protected under strict data privacy rules. The use of NFTs will shift the onus of sharing individual patient data to each patient, thus fostering a closer relationship between the health care provider and the patient.

Ensuring data authenticity for better research outcomes

When personal health data is owned by patients, any unauthorized access and use of data stored in personal health applications and institutional databases can be mitigated, as the owner of every piece of data has to give permission before it is shared. This gives patients full autonomy over their personal health data and who they wish to share it with, for

research or any other purposes.

In addition, sharing health data as NFTs ensures complete transparency and accuracy of health care research data, due to the traceable and unalterable nature of the blockchain. This means that researchers can be certain of the authenticity of data being used in their research, leading to greater data integrity and better research outcomes.

The same technology can also be applied to other areas of health care, such as pharmaceuticals, where every drug produced can be encoded and stored on a blockchain ledger. From point of production to delivery to the end-user, the drug can be tracked throughout the entire supply chain. This enables drug verification to prevent counterfeit drugs, as well as prevents the misuse of drugs by health care providers and patients.

Dr. Teo Zhen Ling, the lead author of the paper and Ophthalmology Resident, Singapore National Eye Centre said, "Using NFTs and blockchain technology to build a secure health care data exchange platform will greatly impact the way data is handled in both health care research and clinical pathways."

"At present, we see great potential for its application in areas such as clinical and pharmaceutical trials, where the ability to verify the authenticity of patient data is extremely vital to the accuracy of research findings. It will also enable us to ensure patient compliance in research trials where IoMT is being used to monitor and collect data on health activity and vital signs. Importantly, beyond research settings, the ability for patients to access and own their data supports patient autonomy and increases patients' engagement in their own care."

Associate Professor Daniel Ting, Director, Artificial Intelligence Office, SingHealth and Head, AI and Digital Innovation, Singapore Eye Research Institute, who is also the senior and corresponding author of

the paper, said, "In this age of health care digitalisation and Industry 4.0, the generation and exchange of health data is expected to grow exponentially."

"From securely obtaining patient data for diagnosis and treatment, to the verification of the origin of massive data sets, strategic applications of blockchain technology, or other alternative privacy-preserving or enhancing technologies, in health care can bring about a stronger and safer infrastructure for health data management. Over time, it will also herald a paradigm shift in patient care and health care research as digital technologies and their applications continue to gain sophistication and become more broadly utilized in different industries."

As with the introduction of any new technology, there are many important considerations to make and obstacles to overcome. Exploring the potential adoption of NFTs as an alternative privacy-preserving technology in health care is no different.

These include assessing the ability to establish the proper technological infrastructure, such as a blockchain-enabled 'biodata' platform, as well as putting in place different forms of safeguard to ensure data security and mitigate risks such as theft of NFTs—which is not unheard of in the commercial NFT market. Nonetheless, NFTs in health care have many exciting potential benefits and could revolutionize the management of health data in time to come.

More information: Zhen Ling Teo et al, Non-fungible tokens for the management of health data, *Nature Medicine* (2023). DOI: 10.1038/s41591-022-02125-2

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