

ScienceTalk

Is S'pore's healthcare sector ready for blockchain tech?

Once limitations are addressed, it could be a mainstay as industry strives to innovate

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Singapore is making steady progress in the healthcare digitalisation journey.

From telemedicine consultations and triaging robots to wearable devices for monitoring patients, many of these advances are being pushed to the next level with the integration of artificial intelligence (AI).

Recently, SingHealth embarked on a three-year partnership with SGINnovate, an organisation that helps entrepreneurial scientists build deep tech start-ups, to ramp up health science innovations.

Given the exponentially large amounts of data that will be generated with the growing use of AI, it is worth thinking about how it will be handled and protected.

Owing to the advances in financial technology and cryptocurrency, blockchain technology has received increased interest and awareness. This coincides with the digital pivot seen in healthcare institutions globally as we combat the Covid-19 pandemic.

BLOCKCHAIN IN HEALTHCARE

Blockchain is a form of distributed ledger technology where transactions are recorded in blocks which are, in turn, linked to form an irreversible chain.

Whenever a new block is added to the blockchain, every computer on the network updates its blockchain to reflect the change.

By spreading that information across a public network, rather than storing it in one central database, blockchain becomes more difficult to tamper with.

Blockchain's strengths are increased transparency and security, as well as traceability of data

shared across a network.

These are exactly the challenges that AI applications currently face as they require large amounts of data to deliver optimal results.

Blockchain has seen increasing adoption in several non-healthcare-related industries such as supply chain and education.

In healthcare, blockchain has many potential applications as well. The ledger technology could facilitate the secure transfer of patient medical records, manage the medicine supply chain and help researchers to access genetic codes in a secure and verifiable manner.

Access to medical records faces some of the most stringent restrictions to ensure the protection of patients' private information.

But this also prevents more effective use of the medical data that could improve patient care.

Blockchain could be used to support patient medical records systems by authorising direct health data transfer between parties such as patients and insurance firms upon fulfilment of conditions including patient consent.

This could lead to the development of a more patient-centric medical record system in the future, such as patient-controlled access to medical records for insurance or healthcare providers.

This not only prevents fraudulent access by unapproved individuals, but also improves the convenience for data transfer between active parties involved in the patient's care.

When Covid-19 struck, inadequacies of the current healthcare databases were evident.

Pandemic efforts required significant coordination and verification between various parties, and transparency and data integrity.

Blockchain measures up well to these challenges due to its unique characteristics of decentralisation,

peer-to-peer transaction and tamper-proof recordings. Data becomes traceable and the developmental process can be observed from start to finish.

Already, we are in the early stages of using blockchain as an alternative form of storage.

In the not-so-distant future, it could be a mainstay.

KEY TAKEAWAYS

Together with other SingHealth clinicians, we recently published a systematic review study in the *Lancet Digital Health* journal that analysed global research trends and advancements of new blockchain applications in healthcare.

With the objective of identifying areas nearing potential breakthroughs and areas with untapped potential, the study provides a clear view of the concepts, approaches, addressable needs and technical innovations of blockchain platforms to cater to the strict requirements of the healthcare sector.

This review offers a reference for researchers and healthcare stakeholders looking to integrate blockchain into their system.

Fuelled by Covid-19, blockchain applications receiving greatest attention include pandemic control and surveillance, vaccine passports or certificates, and contact tracing. Most of them are at the technical and simulation phase.

To bring blockchain from bench to bedside, several challenges will need to be addressed.

They include awareness and acceptance by all stakeholders, adaptation of cyber-security policies to allow data transfer, IT infrastructure investment and embracing interoperability standards.

HEALTHCARE IN SINGAPORE

In Singapore, the public healthcare sector recognises the need to innovate and adapt to new emerging

digital technologies, in alignment with the Smart Nation Singapore initiative and Research, Innovation and Enterprise 2025 Plan.

SingHealth, too, is actively exploring the use of blockchain in healthcare and research applications.

Earlier this year, the Singapore National Eye Centre and Singapore Eye Research Institute published research on the use of blockchain in regulating data transfer, AI model transfer and testing results for a deep learning system in detecting high myopia and myopic macular degeneration.

This project is a collaboration with the Agency for Science, Technology and Research (A*Star) Institute of High Performance Computing and the study findings were published in the *Lancet Digital Health*.

Data access and control are critical when it comes to research involving AI. For instance, retina research requires large amounts of retinal images to properly train an AI algorithm. Employing blockchain here allows secure transfer of data while tracking every action to thwart any malicious intent.

Training AI algorithms involves many iterations and adjustment of

parameters, which external parties are not privy to.

Without blockchain, external assessors will need to make assumptions regarding the reliability of the developmental process.

The KK Human Milk Bank runs the Temasek Foundation Community Milk Bank Programme, a non-profit initiative by Temasek Foundation and KK Women's and Children's Hospital (KKH).

Collaborating with Certis, KKH is looking to develop and adopt blockchain for traceable, secure transfers of sensitive bio-materials, including donor milk received and dispensed.

Data integrity is inherently maintained as each transfer is tracked in the entire workflow; from milk donation, processing, storage and distribution to recipients.

This ensures the authenticity and security of sensitive and critical transportation data, as well as the source of the human milk, increasing the traceability and transparency of product information.

It also serves as an intelligent inventory management system, which is important in ensuring that milk supplies match demand and remain safe for consumption.

Though blockchain is in its nascent stages in healthcare, early adoption allows for a runway to develop technologies and capability for clinical and research applications.

The benefits of increased transparency and enhanced visibility by all parties, including patients, are improved trust, and quicker processes brought about by automating verification and data transfer.

In SingHealth, we are also exploring other potential areas and partners for blockchain applications such as patients' incentive programmes, supply chain, insurance claims and e-consent.

In the research field, it improves cross-institution and even cross-border collaboration.

This is achieved through ensuring secure and verifiable data trans-

fer/recording, thereby improving security, transparency and trust among collaborators.

By enabling these collaborations, the availability and diversity of research data is expanded, which is necessary to build robust AI systems capable of producing clinical-grade performance in different populations.

End users are also critical to the success of blockchain. It is thus of paramount importance to improve literacy and understanding of blockchain among healthcare professionals in order to pave the way for future acceptance.

OTHER BARRIERS

Other barriers to be overcome include personal data protection issues, the need for costly digital infrastructure upgrading, disruption to current workflows, and user-friendliness for the elderly with less access to digital solutions.

Furthermore, there are scalability issues with respect to blockchain.

To record a transaction on the blockchain, a majority consensus must be reached between all approving parties.

When the number of approving parties increases, the computational load increases significantly, resulting in higher energy consumption and increased lag with the system. To resolve this, more high-powered computers or processing units will be required, which results in escalating operational and capital expenditure.

Finally, a robust system is needed to link data stored outside of the blockchain to the data stored on the blockchain, such as electronic health records of patients that are too big to store on the blockchain.

As the pandemic continues to shape the role of blockchain and healthcare technology and these current limitations are addressed, we may be much closer to seeing it as the main form of data storage and transaction in healthcare.

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