

Introduction

Despite a rapidly advancing healthcare information technology (Health IT) landscape over the past several decades, there are still many barriers to effective technological adoption and implementation in the United States. Based on the current U.S. Health IT infrastructure, implementing a patient-centric focus in healthcare is daunting. However, novel technological systems are emerging that alter the concepts of information exchange, data ownership, and security. Blockchain-based systems and distributed ledger technologies have the potential to shift focus to more patient-centric medicine, and significantly improve data transfer, cost efficacy, and security in healthcare.

Methods

We examined the role of blockchain and distributed-ledger technologies in healthcare globally, and within neurosurgery specifically. We present the theoretical impacts of blockchain technology in healthcare, so as to inform the neurosurgical practitioner and educate on its future roles in neurosurgery.

Benefits of Blockchain	
Decentralization	Parties transact without a third-party intermediary, reducing financial bias and fraud
Trustlessness	Financial balances secured on the blockchain, payments made only when balance available
User-centricity	Individuals, rather than institutions, in control of personal financial data; identity verification
Transparency	All transaction data publicly available on the distributed ledger
Immutability	Distributed ledger contains precise history of all prior transactions and balances, making alterations impossible
Speed	Inefficient transaction verification process between financial institutions unnecessary; transactions processed 24/7
Simplicity	Single distributed ledger contains all current balance and transaction histories
Cost	Removing intermediaries saves on transaction fees

The benefits of blockchain technology. Although these general categories were initially employed for use in financial transactions, they can theoretically be implemented to facilitate health care data transfer.

Blockchain Applied to Neurosurgery	
Medical Data	No single institution "owns" medical records; patient becomes steward over data
EMR Interoperability	Patient medical data secured and cryptographically transmitted between parties
Patient-centricity	Patient provides discrete access to medical providers; patients able to tokenize medical data for use in clinical trials
Value-based Care	Use of "smart-contracts" to reimburse only when specific quality criteria are met
Research	Medical data highly auditable; improves validity of large clinical trials
Medical Devices	Intellectual property rights can be traced more accurately
Supply chain	Automated regulation of supply chain; ensure accurate stocks of medical supplies

The theoretical benefits of blockchain technology as applied to health care in general and neurosurgery specifically

Results

At its most elemental level, a "blockchain" is a decentralized, distributed ledger of digital transactions that allows a trustless exchange of money or data. While initially developed for financial transactions (Bitcoin, 2009), this technology has evolved to generally store and access sensitive data, for which a publically auditable log of data edits is maintained and distributed securely throughout the network. In health care, these intrinsic properties can be applied to enhance patient privacy, encrypted data sharing, and value-based payment schemes. Using blockchain-based records would allow more effective record sharing for medical research, and even allow patients to monetize their data as incentive for participating in clinical trials. For the medical device industry, product development would benefit from a tightly regulated patent network, and distributed ledger technology would automate and vastly simplify the medical supply chain.

Conclusions

Neurosurgeons have always integrated technology into practice. Blockchain and distributed ledger technologies have emerged into the mainstream, and given the intrinsic benefits of enhanced security, protected data sharing, and device and supply chain efficiencies over incumbent technology, they will likely continue to broadly foray into healthcare. As this occurs, it is essential that the neurosurgeon understands this technology and is open to adoption for use cases in healthcare generally and neurosurgery specifically.

Learning Objectives

Understand the potential applications of blockchain technology as it applies to healthcare and in neurosurgery, specifically

References

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