Toward Trusted Blockchain Technology in Healthcare through Security and Privacy

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Introduction

Overview
"No matter how you look at it, blockchain and healthcare is a match made in heaven. “

Codrin Arsene
CEO of Digital Authority Partners
From drug supply chains to health records, everything is managed through the traditional computer and paperwork system.

Lack of reliability due to lack of parity between the parties involved in the data management system.

In the healthcare sector, critical patient data and information remains scattered across different departments and systems.
Introduction

Current Healthcare System

- 400,000 deaths.
- 80% due to miscommunication of patient-related data.
- Manual documentation by filing 20,000 forms with an average cost of $20.
Introduction

Current Healthcare System

- 50% of unreported clinical trials.
- Up to 40% of healthcare provider data records are filled up with errors or misleading information.
- $380 Healthcare data breaches cost.
- This amount is expected to increase.
Introduction

The impact

- Human loss
- Financial loss
Security

Current Healthcare System

- Patients don’t have any control over their data
  - Identity thefts
  - Financial data crimes
  - Spamming

- Healthcare industry suffers from security
  - Security breaches
Making data interoperable and providing doctors with real-time access to it.

Incorporate a technology that promises to seal all the loopholes.

Securely sharing data.

Blockchain can deliver a promising solution
“An open, distributed ledger that can record transactions between two parties efficiently and in a verifiable and permanent way” (Iansiti and Lakhani) \(^4\)
“Blockchain technology is considered as a trustless distributed ledger to collect, store, share, analyze, and validate medical data exchange among different stakeholders (such as health care organizations, providers, and patients)” (Yue and et al.5)
Blockchain in Healthcare

- 20% of US GDP on healthcare

2020

- 1 in every 5 healthcare organizations use blockchain for information management and patient identity purposes.
- 16% of healthcare executives implement blockchain solution.
- 56% adopt blockchain.

2025

- 55% deploy blockchain for commercial purposes.
- Valuation of blockchain jump from $170 million to $5.61 billion.
Blockchain in Healthcare

Blockchain technology is positioned to be the next big thing in healthcare. ¹

Blockchain can help optimize the spend, save lives and improve health outcomes. ¹
Blockchain Features

Blockchain features

Distributed
Immutable
Transparent
Easily accessible from anywhere

The Fourteenth International Conference on Systems and Networks Communications ICSNC 2019
Blockchain Features

The data can be accessed, monitored, stored, and updated on multiple systems.

Distributed
Immutable
Transparent
Easily accessible from anywhere
The transparent nature of blockchains could certainly prevent data from being altered or stolen.
Blockchain Features

- Distributed
- Immutable
- Transparent
- Easily accessible from anywhere

Data cannot be modified easily without having control of more than 51% of the node concurrently.
Blockchain Features

Distributed

Immutable

Transparent

Easily accessible from anywhere

Each node on the blockchain system can access, transfer, store, and update the data safely
Blockchain Benefits

To improve healthcare for both professionals and patients by

- Decentralizing patient health history.
- Tracking pharmaceuticals.
- Improving payment options.
- Reduce the time to track down information across systems
Why Blockchain is secure

- Integrity-based attacks
- Controlling who should, and who shouldn’t see patient data.
- Controlling access duration through encryption is key
Healthcare Blockchain Applications

Applications and Benefits
Entities

- Hospitals
- Insurance companies
- Patients
- Doctors
- Suppliers
- Researchers
Applications

Drug traceability
Patient data management
Clinical trials
Genomic Medicine
Drug fraud is a major problem faced by many pharmaceutical companies.

According to the Health Research Funding Organization:

- 10% to 30% of drugs are fake
- It’s the underground economy is $200 billion annually.
- 16% of the counterfeit drugs contain the wrong ingredients.
Drug Traceability

Blockchain solution in Drug Traceability
UK’s National Health Service (NHS) falling prey to the WannaCry ransomware. This malware attacked over 300,000 computers globally.

Hacking of America’s HealthCare.Gov website exposed personal data of nearly 75,000 users and Singapore’s healthcare data breach affected more than 1.5 million users.
Blockchain solution in Patient Data Management
Researchers often hide or modify their collected data and information in order to change the outcome. 2

In a survey of authors of clinical drug trials, 17% of them reported that they were personally aware of intentional fabrication in research. 11
Clinical Trials

Blockchain solution in Clinical Trials 12
2018: The Federal Trade Commission announced that they were investigating popular DNA testing companies.  

The investigation stems over concerns on:

- how these types of companies are handling personal information and genetic data
- how they share that data with third parties.
Blockchain solution in Genomic Medicine

Contributor

DNA data

Luna Coins

LUNA

Genetic Discoveries

Luna Coins

Medical Industry

Source: Luna DNA | https://www.lunadna.com
Healthcare Blockchain Security

Security Aspects
Decentralization
Authentication
Authorization
Data Integrity
Peer to peer
Cryptographic protocol for communication
Attacks

“New age security attacks are emerging, which are very sophisticated and can cause huge irreparable damages”

Abilash Soundarajan
business development strategist at Aruba
Attacks

“When hundreds of thousands of patients manage access to their health data with a blockchain and billions of dollars in claims payments through a blockchain then there are huge incentives to attack a blockchain.” 16

Robert Miller
Security

Blockchain Security Attacks

Consensus algorithm

Peer selection algorithm

Participants involved (Honest vs Dishonest)

Broader network cyberattacks
Security

Blockchain Security Attacks

- Peer-to-peer network-based attacks
- Consensus & Ledger-based attacks
- Smart Contract-based attacks
- Wallet-based attacks
Peer-to-Peer Network-based Attacks

**Eclipse attack**

- Attacking a decentralized network through which an attacker seeks to isolate and attack a specific user.  

**Sybil attack**

- One person tries to take over the network by creating multiple accounts.
Consensus Mechanism and Mining-based Attacks

<table>
<thead>
<tr>
<th><strong>Selfish mining attack</strong></th>
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<tbody>
<tr>
<td>• Attempts to withhold an effectively validated block from being broadcast to the rest of network.</td>
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<tr>
<th><strong>Mining malware</strong></th>
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<tr>
<td>• Software programs take over a computer's resources.</td>
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<tr>
<th><strong>51% attack</strong></th>
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<tr>
<td>• Group of miners controls at least 51% of the blockchain network.</td>
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<tr>
<th><strong>Timejack attack</strong></th>
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<td>• Attacker manipulate the timestamp.</td>
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<th><strong>Finney attack</strong></th>
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<tr>
<td>• Attacker creates two transactions: one for victim and one for themselves.</td>
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</table>
Decentralized Autonomous Organization was an ambitious feature of Ethereum. A company called Slock started crowdfunding for a project called “The DAO”. The crowdfunding got an overwhelming response, collecting 12.7 million Ether, valued at $150 million then ($2 billion today).
Parity Multisig Wallet Attack

- The case of a vulnerability with the parity client wallet hacked by an attacker resulting in holding up of 500,000 Ether ($77 million today). Wallet contracts are additional logic than can be built on user wallets for regular automated payments.
Trusted Blockchain Technology

Security Solution
Trust

“Blockchain technology is beneficial in specific industries where people can’t trust one another.”

Michał Chatłas
Current security challenges

Blockchain’s lingering challenges

- Allowing healthcare professionals to quickly and easily access information.
- Controlling information distribution.
- Entering false data or recording a misdiagnosis.
- Adherence to HIPAA regulations.
- Security Attacks.
Trust

Trust is context-dependent

In blockchain context

| The reputation of the participants. | The security attacks prevention. | The privacy achievement. | The correct deployment. |

Trust = Security + Privacy.
Trust

Hierarchy of trust.

Global and local trust.

Trust model selection.
Conclusion

Ongoing work
Blockchain is the future of the healthcare.

Blockchain offers security and privacy.

Errors in blockchain deployment can be very harmful.

The importance of building the trust layer.
Thank you