Blockchain: A Panacea for Electronic Health Records?

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Introduction

- Healthcare is a data-intensive discipline in which large scale data is generated, disseminated, stored, and accessed daily.
 - 2017 16.5 million patients globally exploited remote health monitoring (a <u>41% growth from 2016</u>).
 - **2021** This panorama has the potential to reach **50.2 million**¹.
- O Most of the time, healthcare are scattered across different systems.
- 2014 15% of U.S. patients who visited a healthcare provider reported having to bring their medical test results to their appointment, and 5% required to have a procedure or a test replicated due to the lack of access to a prior test result.

Polls show that about 80% of patients are willing to share their medical information, provided their confidentiality can be ensured.

Blockchain - Background



Decentralization Immutability Consensus



"Blockchain" in "Healthcare"

With growing recognition of the distributed nature of health services and health records, Blockchain technology has recently reached the impetus of the healthcare domain.

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Research Questions

- RQ1. What are the present scenarios in discussion for the potential usages of blockchain in healthcare?
- RQ2. What are the benefits of the adopted scenarios of blockchain in healthcare?
- RQ3. What are the challenges of incorporating blockchain in healthcare?

RQ1.1 Who are the actors involved in a discussed scenario?

RQ1.2 When applicable, what is the medical condition which is addressed by a scenario?

RQ1.3 Which healthcare transactions are intended to be stored within a distributed ledger according to a scenario?

RQ1.4 Which areas of healthcare are addressed through an emerging scenario?

RQ1.5 In which depth a scenario was further leveraged in practice?

RQ1.6 Was a particular blockchain technology utilized for a discussed scenario?

Systematic Literature Review Process



Search Sources

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Penn State LionSearch engine (integrating over **Electronic Databases** 950 databases / search engines) Journal, workshop, magazine and conference Searched Items papers (peer reviewed items) Full text - to not miss relevant papers where the keywords were not Search applied on in the title or abstract. Language English From the beginning of the **Publication Period** time till December 2018

Overview of Studies



46 were published in journals, **2** in conference proceedings , **3** in magazines and **1** study was published in an Open Research publishing online platform.

23 in venues specialized in medical studies , 9 in computer/software specialized venues and 19 papers were published in interdisciplinary venues relating the emerging information/software systems methods and applications to healthcare settings.

22 countries are represented.

It is also interesting to observe how the research on blockchain is evolving from addressing healthcare generically towards more specialized aspects. **13** of the extracted studies discussed blockchain to address either a particular medical illness, a medical specialty or a medical procedure.

Classification of the Extracted papers



Electronic Healthcare Records



Most of the studies discuss the possibility of constructing a single shared ledger to store patients' medical data history for sharing or serving other purposes among stakeholders. Storing Radiological Images- block transaction links a public key to a uniform resource locator (URL) and establishes a source of medical imaging data ³.

Storing Encrypted dermatologyrelated images ⁴.

Healthcoin ⁵.

Drugs Supply Chain

In United States, there is a relatively large unregulated 'grey market' of medicines populated by secondary wholesalers, traders, and re-sellers, where counterfeit drugs are sourced.

Drug Avastin® in 2012 demonstrates when a falsified drug was possibly administered to thousands of US patients.

This type of pharmaceutical crime has more severely affected low and lower-middle-income countries.

It is estimated that 1 in 10 drugs in these countries are counterfeit ⁶.

In 2003 the Philippines, 30% of inspected drugs were found with substandard or falsified drugs ⁶.

- With blokchain based application, a consumer can receive a code (to be scanned with a mobile phone camera) along with drug product purchased ⁶.
- After scanning the code, the consumer could be directed then to the portal which displays the distribution history of the drugs.
 - The system is capable of detecting anomalies along the chain: 1) Missing nodes, 2) Incomplete distribution chain, 3) Invalid node certificates, 4) Unregistered products, 5) Discrepancies in Primary data point (e.g., drug-related date) and 6) Timestamp anomalies.

11

Clinical Trials



During clinical trials, it is estimated that 85% of research resources are wasted due to findings being exaggerated or even entirely false ⁷.

While U.S. FDA regulations require that the data of all clinical trials be made available, a recent study suggests that fewer than half of trials comply.

- The "provenance" feature of blockchain can save the cost of the "Source data verification" which is currently estimated at 20% to 30% of the overall clinical trial budget ⁷.
- Blockchain's ability to store transactions anonymously while still enabling participants to authenticate themselves when required is also a critical feature that will benefit the clinical research.
- Entities can use unique key pairs to manage each study, while the private keys are kept secure.







Research Discussions Gaps

This literature review suggests that we are still at the beginning of the road toward commercialization of blockchain technology and its application in the healthcare field.

- 33% of the overall primary studies provided an actual implementation for blockchain systems in the sphere of healthcare.
- 25% of the studies provided an implementation for healthcare records management, making it the most popular scenario.
- While none of the extracted studies provided an actual validation on a large-scale in practice, our review of the grey literature also turned up several additional examples of prototypes, presentations, use cases, and initiatives that are currently under development.



Research Discussions Gaps

- ③ 33% of the studies is discussed concerning the Ethereum environment, rather than any other Blockchain environments.
- There are currently over a hundred of existing blockchain technologies.
- It is necessary to research the possibilities of using other blockchain projects.

It can reveal and produce better alternative models and scenarios for doing different sort of healthcare transactions.

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Any questions?

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