Clinical Data Exchange and Interoperability using Block Chain

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Abstract : Interoperability in healthcare industry has been traditionally focused around data exchange between business entities, for instance like various hospital systems. However, there has been a recent rush towards patient-driven interoperability, in which healthcare data exchange is patient-mediated as well as patient-driven. Patient centered interoperability, it brings new challenges around security, privacy, technology, and governance that must be addressed for these types of data sharing to succeed at scale. This paper looks at how block chain technology might facilitate the transition through five mechanisms which are: (1) digital access rules, (2) data aggregation, (3) data liquidity, (4) patient identity, and (5) data immutability. blockchain-based solution that facilitates a scalable and secured inter-healthcare Electronic Health Records exchange. These healthcare providers maintain their records on separate blockchain networks and are independent of each other. We then look at other obstacle to blockchain-enabled patient-driven interoperability, specifically clinical data transaction volume, privacy, patient engagement, security, and incentives. It concludes by noticing that while patient driving interoperability is an growing trend in current healthcare, given these challenges, it remains to be whether blockchain can able to make the transition easy from institution-centric to patient-centric data sharing. Privacy and confidentiality of the medical data are in high concerned to the patients and authorized persons to use this data. On the other hand, scalability and interoperability also play an role of importance in problems that are considered.

IndexTerms - **Clinical data, Interoperability, Data exchange, Blockchain, Health Information Exchanges, Electronic Health Records, Patient Data Privacy.**

I. INTRODUCTION

Interoperability is the capacity of various software applications and information technology systems to communicate and share medical data more consistently, effectively, accurately and also use the shared data properly. It is very critical to ensure interoperability in healthcare, particularly for exchanging electronic health records for the following reasons

Prompt and Smooth Access to Patient Information: A variety of care providers, such as public health centers, school clinics, physician groups, urgent care centers, pharmacies,laboratories, and hospitals provide healthcare services to patients. The choice of providers depends on cultural context, quality of care, bedside manner and proximity[1]. Due to provider diversity, the patient's information is scattered, which can lead to otherwise avoidable injuries,a waste of resources and eventually loss of life.

Improvement of the Efficiency of Healthcare Providers: The quality of healthcare can be greatly improved by minimizing excessive paperwork and redundancies through an interconnected healthcare system.

Reducing National Healthcare Costs: A significant part of healthcare costs incurs because of redundant diagnosis and lab tests, resulting from an inadequate information exchange. The availability of the medical data within an inter-operable health system can significantly contribute to the elimination of such redundancies.

Interoperability- Current State: For healthcare, interoperability has several potential benefits. First, well-communicating systems can improve operational efficiency, reducing time spent on administrative tasks like manually entering data received from faxes [2]. Interoperability can also reduce duplicate clinical interventions like imaging studies or lab orders, decreasing overall health system cost, decreasing waste, and improving patient safety by reducing the exposure to radiation or invasive procedures.[3,4].

Why Blockchain

Blockchain gives mechanism to anonymized medical data and ensure that the data cannot be tampered or forged. Blockchain uses public key cryptography to create records which are time stamped and immutable. Copies of these data records are stored over thousands of nodes on a digital network. Changing these records at each and every node becomes an impossible task and prohibitively expensive, making the records reliable. The blockchain creates the trusted networks that have most attractive and reliable features.

Benefits of interoperability in healthcare

- **Easy, fast access to the patient's medical records**: The sharing of information will foster a higher-quality medical attention.

- **More autonomy in the therapeutic process**: The patient will be able to have a more active role in his healthcare, as well as a greater self-management. This fact is very important, especially for patients who suffer from chronic diseases and need a continuous monitoring of their status and progression.

- **Guaranteed medical assistance:** Having interoperating information systems ensures both coordination between different healthcare services, and between the different healthcare clinics located in different places and communities. As a result, any lack of coordination can be prevented in the healthcare process.

- **More information that is more reliable:** Thanks to interoperability, the healthcare professional will receive the patient's information directly and faster, avoiding any error and providing a much more reliable diagnostic, while avoiding delays.

II. Literature Review

The researches suggests that the Health Information Exchange is an important component of the Health Information Technology infrastructure that is designed to facilitate electronic movement of patients health information among healthcare organizations during the health care process [5].

Blockchain technology has the potential to transform health care by placing the patient at the center of the health system and increasing the security, privacy, and interoperability of health data. This technology could provide a replacement model for health information exchange (HIE) by making electronic health records (EHRs) more efficient and secure[6].

An Electronic Health Records is a structure in digital format of a patient's health data that's created and maintained throughout the patient's life and is usually stored by and spread among multiple hospitals, clinics, and health providers[7].

Supporting a trust and sharing mechanism, Blockchain provides a possible future solution for data sharing, which enables the collaborative clinical decision making in telemedicine and precision medicine[8].

EHR contain critical and sensitive information for diagnosis and treatment in healthcare. These health care data are a valuable source of healthcare intelligence. The sharing of healthcare data is a crucial step to make the healthcare system smarter and improving the quality of healthcare service[9].

The method proposed for improving data interoperability is institution driven interoperability [10].

It enables the different medical providers to share medical data. An electronic health record is the systematic collection of patients electronically stored health data in a digital format.[11] These records can be shared across various health care settings. Data exchange between different institutions can be operationally challenging, and it requires significant collaboration between the entities involved.

Complex patient matching algorithms, data sharing agreements,procedures, governance rules are just some of the issues that need to be agreed before data exchange can take place [12].

III. Existing Architecture
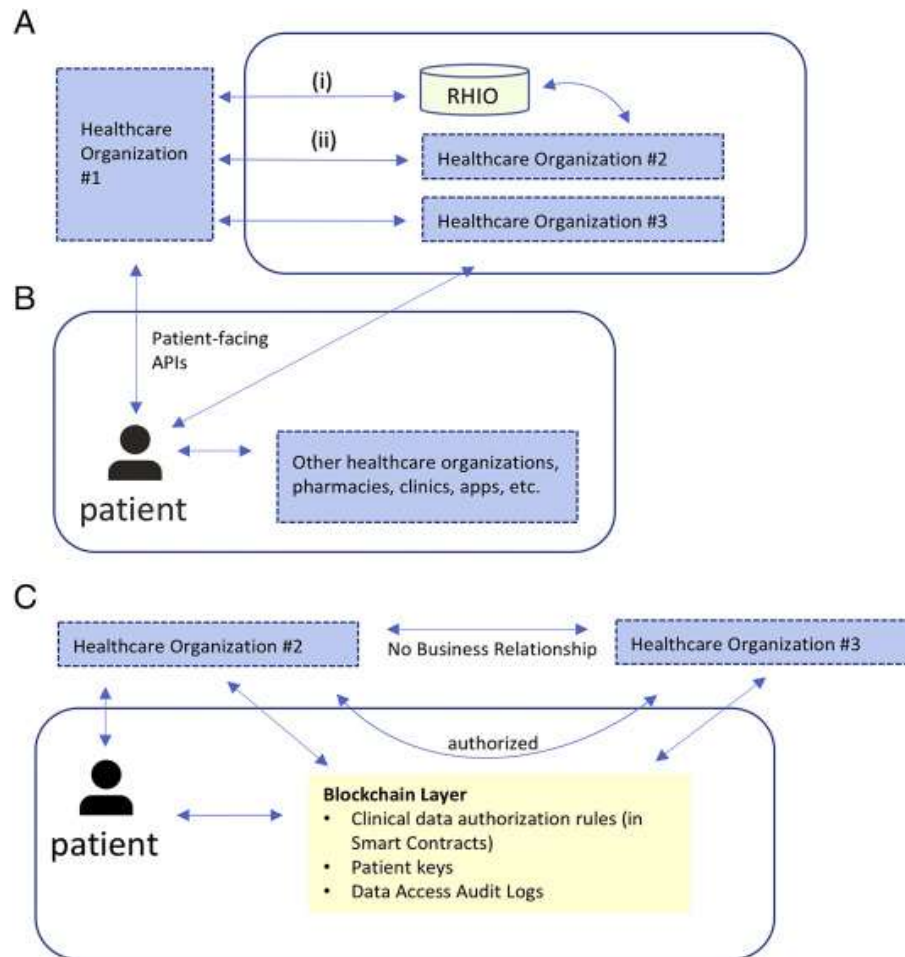
Figure 1 Patient Driven Interoperability

(A) Institution driven interoperability for clinical Electronic Health Records(EHR) data. Bi directional medical data interoperability occurs with two cases (i) through an intermediatory like (RHIO) or (ii) directly between organizations with specific business agreements. In both cases, data interfaces are not entity-to-patient, but are entity-to-entity. In this example,organization 2 and organization 3 does not have a specific relationship, there is no bi-directional data flow providers from organization 2 can request data from organization 3 via one off requests (like fax). If a patient receives care at all these three organizations, their health data will be scattered across all three Electronic Health Records.

(B) Example of patient driven interoperability. in this example clinical data sharing centers on the patient , using patient APIs, a patient can directly recover their clinical data from organization 1 and organization 3. Once patients data is retrieved, the patient can share his data with other organizations directly. Data flow can be bidirectional. Regional Health Information Organizations and entity-to-entity relationships may still exist as parallel functions.

(C) Blockchain enabled patient driven interoperability. In this example, the patient can still able to retrieve data directly from organization 2; however, through blockchain enabled smart contracts, the patient can authorize sharing of clinical Health Record data between organization 2 and organization 3, which do not have a formal business relationship. The blockchain stores the patient public keys,authorization rules which included with data access audit logs. Each and every organization will manage linking a patient public key to their own organizations internal enterprise master patient index system independently, and patients can update the smart contract driven authorization rules as appropriate (example like, adding a new institution if they are seeing a new provider).

IV. Proposed Work
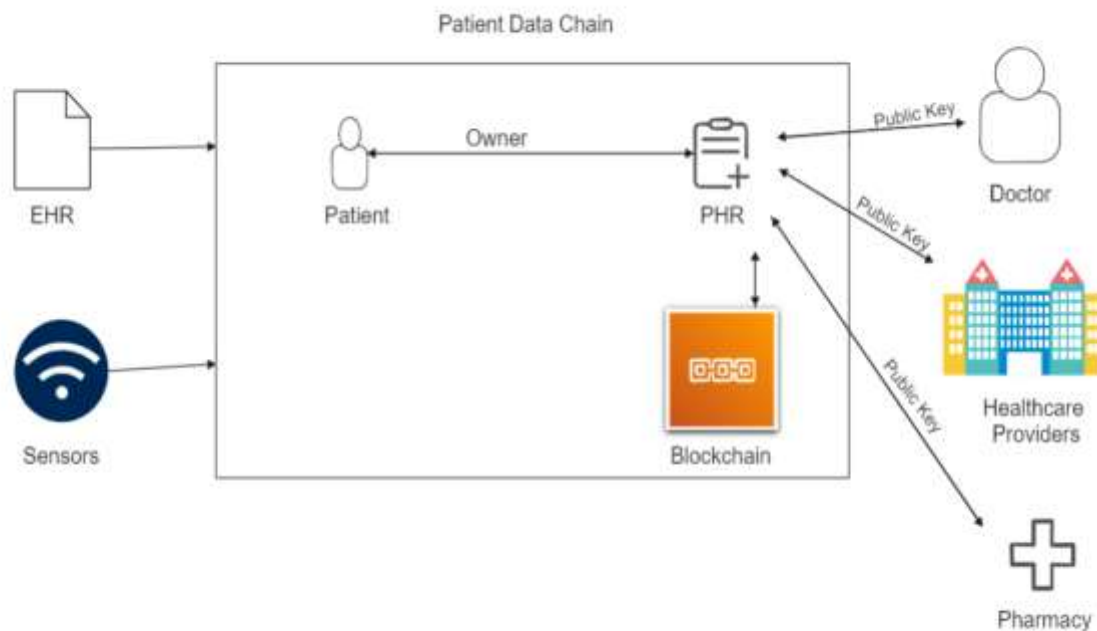
Figure 2 **Patient Data Chain architectural overview**

This block chain-based architecture is to integrate the patient health care records system, by bringing all together the stakeholders in the healthcare vendors. This approach was to create a patient-centered model, where patients are the owners of their medical health data. Based on a permission-based mechanism, patients are able to give healthcare providers access to their data for a certain period of time. This enabled to supply an integrated and interoperable approach, that collects the health data from heterogenous sources (above Figure), such as the patients medical records (EHR systems), different healthcare providers (laboratories, pharmacies), also as various sensors from wearable devices (fitness trackers, smartphones, wearable sensors).

V. Technical Relevance

Health records are storing on healthcare blockchain

Health industries stores information in blockchain - with patient public key health care vendors can store his health records in blockchain. Smart contracts are triggered to store the patient information provided by diagnostic centers, doctors and health insurance companies on the blockchain.

Transactions are uniquely identified - Transactions which contain patients health records are saved in the blockchain with records unique ID along with patient public key. If a healthcare organizations wants to access a patient's public non-identifiable data, the transaction ID need to be matched, and then the information is displayed.If required, patients can share his/her public key with the health organizations. If a diagnostic lab or any other healthcare provider request to access the patient's health records, smart contracts would notify the patients about the request.

Data Capturing - Incoming data can be processed by smart contract using bussiness rule. Each transaction which is stored in the blockcain, containing patient hashed ID.Once the data stored in blockchain it can be consumed by different healthcare vendors using smart contract.

VI. Conclusion

Digital medicine depends on standardized and interoperable data. Interoperable health information can help to realize the full potential of Artificial Inteligence and big data, improve the coordination and communication of medical information, make medical research more efficient and foster international cooperation. As interoperability requires the collaborative efforts of healthcare professionals, researchers, data engineers, and politicians, it is important to make interoperability a prominent topic in medicine and healthcare. Eventually, efforts to enhance interoperability can pay huge dividends. With international standards and medical terminologies, interoperability can pave the way for an interconnected digital health infrastructure that overcomes barriers between individuals, organizations and countries. patients immutable health records stored securely on blockchain and many devices performing precise diagnoses and finding better the longer term of healthcare are often witnessed soon.

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