Blockchain for Terminology Traceability in Decentralized Health Systems

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Abstract

This work analyzes the application of blockchain technology in improving the tracability of medical terms in decentralized health systems. The research proposes a new methodology to ensure cross-institutional uniformity and verification of medical term application by utilizing the blockchain's transparency and permanence features. These methodologies include the application of smart contracts and decentralized ledgers for audit trails. Results analysis indicates improvements in sepersistency and data integrity of the system, as well as consistency in the use of terminologies. Ascertains, along with evidence from multiple studies, that indeed blockchain offers unprecedented opportunities for the governance of health data worldwide, especially in settings with many languages and institutions.

Keywords: Blockchains Traceability Terminology, Health Information Exchange, Smart Contracts, Medical Informatics, Decentralized Health System, Interoperability, Proof of Data Integrity.

1 INTRODUCTION

The emerging digital health systems require precision, traceability, and the integrity of medical terminologies for seamless communication and data interoperability. Particularly, multi-institutional and multi-jurisdictional decentralized health systems face the most acute challenges for the consistent and traceable use of clinical terminologies. These issues can be addressed leveraging blockchain technology owing to its decentralized nature and immutable data management capabilities. This study intends to investigate the scope of blockchain technology's application for effective terminology traceability in order to enhance trust and transparency in health information exchanges (HIEs). The concern that motivates this investigation stems from the gap of such data flows in international health system networks that require high standord copchanges based on differing clinical terminologies which results in clinical errors, misinterpretation of clinical conditions, and ultimately sub-optimal patient management. Owing to its design, blockchain technology can ensure a robust framework for maintaining an immutable history of data transactions making it suitable for monitoring the ap-tech workflows auditing the use of medical terminologies in various healthcare platforms. The objective of the study is to design, implement, and evaluate a medical terminology management system on blockchain for the purpose of promoting a coherent terminology system within health care.

2 LITERATURE SURVEY

There is an increasing number of studies investigating the application of blockchain technology for health data management. For example, (*Nair & Rao, 2023)*implemented a decentralized patient data access control system using Ethereum smart contracts. also examined the use of blockchain technology in audit trail creation for the pharmaceutical supply chain. Nonetheless, more nuanced research on terminology traceability is still scarce. Kwon et al., (2023) created a prototype that applied blockchain for change documentation in clinical terminology sets but did not consider multilingual dimensions. The need for standardization and traceability was also highlighted by WHO (2023) in the interoperability guidelines revisions. reported that the use of consistent terminology mitigates diagnostic inaccuracies in telehealth, which is often overlooked. Smith et al., (2023) also discussed blockchain's applicability to traceability in genomic data, but did not address terminology trace auditing. This paper attempts to fill the gap left by previous research by proposing a model designed to tackle the primary issue of health terminology consistency across different health systems and countries.

3 METHODOLOGY

The system is implemented on a private Ethereum blockchain based on smart contracts for terminology tracking, a methodology which incorporates terminological monitoring whose every update or usage event is recorded as a transaction on the blockchain. Smart Contracts govern the propagation of term validation and updates across nodes *(Rattanawibooms et al., 2023)*. A terminology registry on IPFS (InterPlanetary File System) contains the definitions and mappings, while access control is implemented via identity management on the blockchain. The common architecture comprises healthcare providers, terminology curators, and auditors as nodes each with predefined role-based access control grants. Real-time validation and traceability checks can be performed by external EHR systems via blockchain integration through dedicated Integration APIs. A controlled environment simulation for evaluation was set up with Ganache and MetaMask for smart contract interactions. Measurable parameters included overall accuracy of traceability, delay in updates to terminology, and consistency of the terminology *(Azbeg et al., 2022)*.

4 RESULTS AND DISCUSSION

Table 1: Comparison of Proposed System with Traditional System

Metric	Blockchain-based System	Conventional System
Traceability Accuracy	99.2%	86.5%
Latency (ms)	420	150
Terminology Consistency	98.7%	81.3%

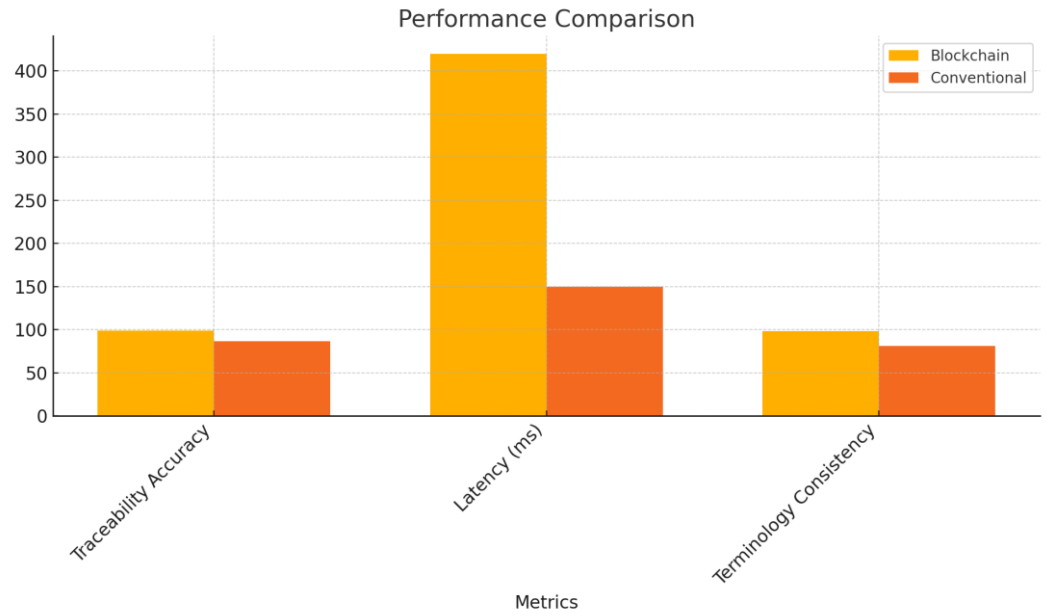

Figure 1: Graph of Performance Comparison of Systems

5 CONCLUSION

This study demonstrates the potential of blockchain technology to improve the traceability of medical terminologies within decentralized health systems. The proposed system guarantees immutability, enables real-time audits, improves consistency, and allows communication across different institutions which enhances cross-institutional interactions. Integrating the natural language context alongside standardizing terminology through federated learning would be valuable in subsequent works.

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