Traceability of Counterfeit Medicine Supply Chain Through Blockchain

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The counterfeit medicine supply chain deals with a main issue on safety of drug. During the actual manufacture of drugs, it is a difficult process to trace the accurate pharmaceutical ingredients. Drugs that contain inactive ingredients and that do not contain calculated active ingredients can ultimately lead to harming the end consumer and also death of end consumer. Blockchain's technology has the capability to completely trace the drugs, from manufacturer to end consumer, and provides the basis to identify counterfeit-drug. This paper aims to address the issue of drug safety using Blockchain and encrypted security. The methods used are SHA algorithm, AES Rijndael algorithm, Blockchain TCP Remoting concepts.

Keywords: Blockchain, drug counterfeit, tracing, medical care, trust, security, drug safety, medical supply chain.

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1 Introduction

According to World Health Organization (WHO) counterfeit medicine is defined as "one which is deliberately and fraudulently mislabeled with respect to identity and/or source". Counterfeiting of various products creates problem to different manufacturing industries and it causes serious threat to pharmaceuticals products. This threatens the public health and also causes revenue loss to the legitimate manufacturing organizations. It has been reported that the annual sales of counterfeit drugs in the world sums to U.S. $ 650 billion by the International Chamber of Commerce of Geneva. Patients, hospitals, pharmacies, distributor, manufacturer and raw material suppliers are all considered as the complex network of several independent organization in the medical care supply chain. On account of several factors like, lack of information, centralized control and competing nature of stakeholders, it is significant to track the supplies through the network. These complexities also provoke the challenge of mitigating against counterfeit drugs along with the results in in-efficiencies such as COVID-19 pandemic highlights as these can easily penetrate the medical care supply chain. Counterfeit drugs are miscategorized with respect to identity, to make the products appear to be a legitimate, they are intentionally and dishonestly produced.

In the society medicines counterfeits causes the serious threat. The counterfeited medicines make an adverse effect on the health of the people and also cause revenue loss to the legitimate medicine manufacturing organizations. Several anti-counterfeiting techniques have been proposed in the latest years.

Within existing supply chains counterfeit drugs is one consequence of limitations which has unpleasant impact on human health and also causes severe economic loss to the industry of healthcare. Therefore, across the pharmaceutical supply chain an end-to-end product tracking system is predominant to eradicate counterfeits and in certifying product safety.

In Lots the drugs are packed by the manufacturer or sent to a re-packager. The product is received by the primary distributor and under his/her responsibility, based on the product demand the drugs are transferred to pharmacies or secondary distributors who transfer drugs to pharmacies. Ultimately, based on doctor's prescriptions the drugs are distributed to patients by pharmacy. UPS or FedEx are the third party logistic service providers who facilitate the transfer of drugs all over the supply chain. In some cases, the drugs are transported by distributors through their own fleet of vehicles. Due to the complex structure of a medicine supply chain counterfeit drugs reaching the end-user marketplace will be the primary reason. With little or no trail of information and document verification, medications can easily pass through the complex distribution process. Hence, to prevent counterfeits in medicine supply chain it is fundamental to monitor effective control and tracking of products.

Centralized existing track and trace systems leads to data privacy, transparency and authenticity issues in medical supply chains. Existing schemes are not secure and are prone to various attack such as replay, man-in-the-middle attack. Although conventional technologies, such as RFID, barcode scanning, and mobile technology, have been applied for tracking and tracing of medicines, counterfeit medicine is still significantly high.

2 Related Work

Corrado and his colleagues Supriya and Djearamane, as well as Jamal et al., have developed traceability methods, but they rely on a centralised database, making tampering with products information relatively straightforward and difficult to detect. Furthermore, the employment of several types of centralised databases may result in a lack of compatibility and scalability in the proposed solutions.

Huang et al introduced Drug-ledger, a drug traceability system that mimics the supply chain's practical drug transaction logic and creates both authenticity and privacy of stakeholders' traceability information without jeopardising the system's robustness. The enhanced UTNO data structure, particularly that of package, repackage, and unpackage, is used by Drug-ledger to complete its workflow. Recent research have raised concerns about the adoption of the UTXO data structure due to its lack of programmability, high storage costs, and low state space use.

Filial et al. developed a Hyper ledger-based system for pharmaceutical supply chain drug traceability. The authors claim that their technique boosts throughput and reduces latency while consuming fewer resources; however, their solution was not fully evaluated and was implemented in a small-scale network. Similar considerations are relevant for Hulseapple's approach, which established a private blockchain simultaneously with Bitcoin and uses it as a ledger to hash particular data to safeguard chain transactions.

Each product has its own permanent record on the blockchain, making tampering with private keys unattainable. The system was developed to secure every phase of product transfer throughout the supply chain, resulting in a comprehensive, trustless system.

3 Method

In proposed framework, pharmaceuticals organization will manufacture the drug with details such as drug name, location, timestamp, ingredients, usage of drug, and side effect and get approved by regulatory authority.

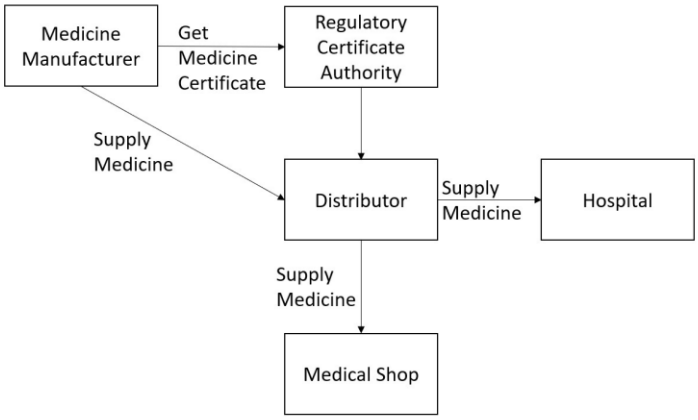

Fig. Workflow of Medicine Supply Chain

Manufacture medicine transaction, distributor transaction & medical shop transaction details are secured using SHA algorithm & blockchain concepts. Medicine supply chain will be traced completely to avoid counterfeit-drug & maintain transparency in medicine transaction. Manufacture company gets medicine patent approval from FDA for manufacturing medicine. Medicine ingredients details will be encrypted using AES Rijndael algorithm. SHA algorithm is used for transaction verification. QR-Code image will be used to secure the information related to medicine & store it in blockchain for security purposes. A particular block's Hash value generated using the SHA algorithm will be stored in the previous block.

Each block's information will be stored as a particular row into the database. The same database will be replicated. If the database gets tampered, the replicated database can be used for recovery purpose.

4 Result and Conclusion

We have investigated within pharmaceutical supply chain highlighting the challenge of drug traceability and its significance to protect against counterfeit drugs. Blockchain-based solution has been used to develop and evaluate the tracking and tracing of drugs in the healthcare supply chain. Especially, to accomplish tamper-proof logs we have used cryptographic fundamentals underlying blockchain technology in our proposed system. To enhance the efficiency of medical supply chains, to accomplish the drugs verification and end-to-end transparency, we continue to focus and envision on extending the proposed system.

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