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Drug Supply Chain Supervision System

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Abstract- *The problem of fake drugs has spread to every country and is now so severe that everyone is paying close attention to it. According to a report, the phoney medication industry is worth $10B annually. According to WHO, over a million people every year pass away from using bogus medications. A major problem is the distribution of counterfeit medications. A major contributor to drug counterfeiting is a broken supply chain. Our medicine supply chain has numerous flaws. In the current supply chain environment, either no essential information is transmitted between the parties during the hand-off process or only a little amount of useless information is given, which has resulted in counterfeiting. Not only does the use of a fake medication harm patients' health, but it also costs the real manufacturer money. In this scientific paper, we've described how we used blockchain to address this issue and summarised the entire procedure using several diagrams. Traceability, visibility, and security are all been added to the medication supply chain using blockchain technology. The medications will be tracked by this planned system from their point of creation to their final destination that is the customer.*

Keywords: Blockchain, Pharmaceutical, Supply chain, Counterfeiting, Drug

1. INTRODUCTION

Counterfeit drugs industry is worth billions of dollars and continuously expanding. As per the estimations given by WHO, more than a million people die every year due to illicit and fake drugs making it one of the main contributors to global deaths. Pharmaceutical industries are struggling to tackle this issue due to major loopholes present in the supply chain. The Narcotics Control Bureau, the central law enforcement agency of India responsible for combating drug trafficking, has recently asked young engineers of India to come up with a prototype system which could be integrated into existing pharmaceutical supply chains to overcome the loopholes. In the present supply chain, tracking of information only exists from the manufacturer, after they have received the raw materials. But the most effective way to tackle counterfeiting is to establish records from the source of raw products itself. This proposed system will track the drugs from origin of raw materials to the end consumer, incorporating traceability, visibility and security into the drug supply chain.

Drugs are chemical substances formulated for different purposes. They are used as medicines to cure/control any illness or for recreational use to induce such a state in which a person who has taken it feels a sense of enjoyment or leisure. One can only get medicinal drugs if you have a proper prescription given by a doctor. Pharmacists verify the authenticity of the prescription before handing out the medicines to the patient. There are already existing systems to keep track records of prescription drugs from store to patient. To track supply from the manufacturer to the final consumer, there is, however, no reliable mechanism.

1.1 Objective

The project's fundamental aim is to maintain the safety, security and reliability of pharmaceutical supply.

- It will help reduce the risk of drug shortages.
- It will reduce illegal trafficking of medicinal drugs.
- It will ensure the drug is sold to the person with prescription only.
- To reduce supply of illicit and recreational drugs.
- To track the supply chain of drugs from manufacturerto end user.
- To develop a decentralized track and trace system for data privacy, transparency and authenticity.

1.2 Need for System

- **Shipment visibility**: Lack of tracking and visibility of shipments can cause problems and jeopardise demanding delivery operations like same-day and one-hour delivery. Supply chain and logistics operations may suffer from poor freight visibility. Reduced revenue, ineffective delivery processes, subpar customer service, and higher transportation risks are possible outcomes.
- **Mutable and Invalid source:** Due to themanufacturing and supply company's centralised administration of all supply chain facts, there is a significant risk that data will be altered in the company's interest and used to mislead customers.

- **Loss of reputation due to fake products in market:** As mentioned above, the centralised design of the system makes it vulnerable to forged authentication and access. Hackers or middlemen may also alter data, harming the company's reputation.

- **Slow Process and Error prone paperwork:** When managing a worldwide supply chain in the twenty-first century, the traditional methods of separating manufacturing from marketing and shipping from accounting don't function well. Organizations that are networked can collaborate on supply chain management more successfully than siloed businesses. The time-consuming paperwork is another aspect of the old method.

1.3 Problem Statement

Indian law states that a pharmacist may only dispense prescription medications with a doctor's prescription. In addition to the name of the drug(s), its potency, dose, and period of use, a prescription must also include the doctor's name, address, and registration number. Prescription medications and the "precursors"—the ingredients—are increasingly being diverted for use in illegal drug recreation. As a result, the NDPS statute covers these medications. However, we lack a means to monitor the movement of these pharmaceuticals and the legitimacy of the delivery to the final consumer. The suggested approach would make it possible to trace the movement of these prescription medications from their maker to their final consumer. The proposed solution would ensure that the drugs are delivered only to the person with the doctor's prescription.

1.4 Present Theory

In the current system, there is a way for consumers to quickly determine whose firm made the goods by just scanning the QR code. Drug supply chain performance management is essential for meeting the growingconsumer demand for products that are reliable, high- quality, sustainably produced, and have a provenance. Drug supply chain performance management attempts to guarantee the product's safety, quality, and authenticity for customers and businesses. The availability of fake medications is likewise growing in tandem with the rise in drug demand. Therefore, it must be reduced immediately.

2. LITERATURE REVIEW

1. Prasad Nayak B, Preetham VK, Rutika Shinde (2022) In this initiative, they introduced a fresh use of blockchain technology in the healthcare industry. They talked about the issues with the current pharmaceutical sector supply chain management system and how blockchain technology may be utilised to fight drug supply fraud by enhancing transparency and visibility. It is explained how the identity mechanism of the blockchain operates and how exchanging medical data is made feasible by protecting data about the products' sources. In order to build a blockchain-based pharmaceutical supply chain, they underline the various techniques, blockchain variations, and third-party solutions that can be used. They concluded by outlining the operation of the suggested system and giving an example of how different participants will find it straightforward to use. In order to enhance the current supply chain, management model, and supply chain commodities, a blockchain strategy is described in this article. Additionally, supply chain items help connect people from various geographical locations. As a result, a distributed ledger must be created by the supply chain. The distributed ledger contains all of the transactions and transportation data from the aforementioned drug supply chain. Nobody will make an assault attempt, that much is certain. In addition, we recommended using a manufacturer-provided QR code system to communicate with users. The benefit of this is that anyone may learn about the product's integrity, from the maker to the consumer, and how to use it properly.

2. Joeke Kootstra, Tineke Kleinhout-Vliek (2022)

This realism review describes partial or complete PTTS implementations. They examined 21 papers on the deployment of such systems in Turkey, which served as our benchmark country, as well as in Denmark, Ethiopia, Germany, Hong Kong, India, Iran, Pakistan, Poland, Taiwan, the UK, and the USA. They specifically draw attention to the political, social, and economic backdrop variables that have been identified as facilitating or impeding the (planned) implementation in these mostly high- and middle-income contexts. Government backing is the primary political contextual component, followed by legislation and regulation. Supply chain actors' support is the first social contextual component, followed by awareness, knowledge, and skill. Investments are the primary economic contextual component, followed by technical and digital requirements. Overall, they draw the conclusion that PTTS adoption is significantly impacted by the interaction of contextual factors.

3. May Alnafrani , Subrata Acharya (2021)

The record-keeping feature of blockchain has transformed several economic sectors, bringing immense value and upheaval in the global economy. Blockchain technology has made it possible to do away with expensive intermediaries in the healthcare industry, which has led to the elimination of antiquated and ineffective cross-organizational processes. Additionally, the invention has given patients back control of their data by allowing them secure access to their prescription and medical records.

One of the lessons learned from developing and implementing the SecureRx framework for prescriptions is the potential of record-keeping technology to foster effective and efficient sharing of information about prescriptions while ensuring security. The SecureRx framework has highlighted the role of the decentralised and shared permission blockchain in enabling healthcare providers to access data banks without needing approval from the framework.

4. AHMAD MUSAMIH, KHALED SALAH (2020)

In this article, they looked into the issue of drug traceability within pharmaceutical supply chains and highlighted its importance, particularly to guard against fake medications. They successfully created and tested a blockchain-based pharmaceutical supply chain solution that enables decentralised drug tracking and tracing. Their suggested approach, in particular, makes use of smart contracts within the Ethereum blockchain to ensure automated recording of events that are accessible to all involved stakeholders. These smart contracts enable tamperproof recordings of occurrences along the supply chain. In terms of the quantity of gas used to carry out the various operations that are triggered within the smart contract, they have shown that our suggested method is economical. Additionally, the security analysis performed has demonstrated that our suggested solution achieves protection against malicious attempts targeting the availability, integrity, and non-repudiation of transaction data, which is crucial in complex multi-party settings like the pharmaceutical supply chain. As part of our ongoing work to improve the effectiveness of pharmaceutical supply chains, they intend to concentrate on expanding the system that has been presented in order to achieve complete transparency and verifiability of drug use.

5. Monalisa Sahoo, Sunil Samanta Singhar and Sony Snigdha Sahoo (2020)

There is a pressing need to improve medical health care services in light of recent advancements in network and Internet technology. Various topics pertaining to the management of the medication supply chain have been explored in this study. This article also addresses how blockchain technology can solve these problems in a transparent and safe way. To combat the problems with drug counterfeiting, blockchain can be utilised to add traceability and visibility to the drug supply chain. A shared ledger model with a decentralised blockchain architecture has also been presented, which not only stops drug fraud but also strengthens, makes transparent, and increases the reliability of the drug supply. Loopholes in the present drug supply chain can be closed using the suggested paradigm. Additionally, the blockchain framework model that has been developed can be effective for real-time tracking, such as scheduling product deliveries, in addition to preventing the sale of counterfeit pharmaceuticals.

3. DESIGN

3.1 Software Components used in Prototype

- Solidity - Solidity is the principal programminglanguage for assembling smart contracts utilized in the Ethereum blockchain. It is a contract-based language, which implies that smart contracts are liable for putting away the entirety of the programming reasoning on which the Ethereum blockchain runs Wheel assembly.
- Metamask - Users of the cryptocurrency wallet Metamask can control their digital assets using a browser extension or a mobile app.
- Goerli test network - Goerli is an Ethereum test network that allows for blockchain development testing before deployment on Mainnet, the main Ethereum network.
- Truffle - Truffle is the ecosystem's development, asset pipeline, and testing framework.
- Infura - Infura is a Web3 backend and Infrastructureas-a- Service (IaaS) provider that offers a range of services and tools for blockchain developers. This includes the Infura API (Application Programming Interface) suite.
- Web3Js - Web3.js is Comprehensive. Everything you need to start interacting with the Ethereum blockchain Community-driven. Opensourceand continuously updated since 2015 Modular.
- Angular - The Angular Team at Google and a network of people and businesses are the driving forces behind the TypeScript-based free and opensource web application framework known as Angular.

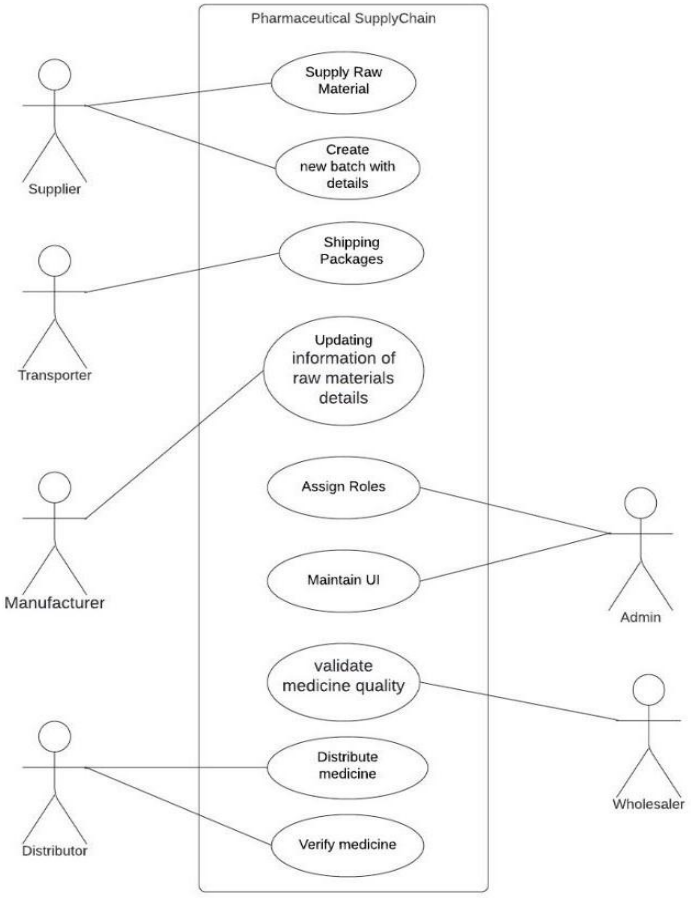
3.2 Hardware Components

- Intel Core i5/i7
- 4/6 GB Ram
- 500 GB Hard disks

3.3 Implementation

As shown in the given figure, the admin deploys the smart contracts to the Ethereum Blockchain and authenticates and registers the entities of the chain. Supplier registers a new raw material and the raw material contract is deployed for the newly created raw material. Corresponding Transaction Contract is also deployed for the newly created raw material. The raw material is then registered successfully.

Supplier transfers the raw material to the Transporter. Supplier updates the product status and creates a Transaction in the Transaction Contract. Transporter transfers the raw material to the manufacturer. Manufacturer verifies the source of the raw material and also updates the product status and creates a transaction in the transaction contract. The manufacturer registers a new medicine. Medicine Contract is deployed for the newly created medicine. Corresponding Transaction Contract is also deployed for the newly created medicine and the medicine is registered successfully. Manufacturer transfers the raw material to the Transporter and updates the product status and creates a transaction in the transaction Contract. Transporter transfers the raw material to the Wholesaler and the wholesaler verifies the source of the raw material. Wholesaler updates the product status and creates a transaction in the Transaction Contract. Then the wholesaler transfers the raw material to the Transporter and updates the product status and creates a transaction in the Transaction Contract. Transporter transfers the raw material to the Distributor. And the distributor verifies the source of the raw material. Distributor then updates the product status and creates a transaction in the Transaction Contract. The distributor transfers the raw material to the Transporter. and updates the product status and creates a transaction in the Transaction Contract. Distributor transfers the raw material to the Pharma.



There are complex interactions and flow of data among the pharma and the customer of the supply chain. The process is divided into 4 parts i.e., managing customer information, managing drug information, managing sales and generating stocks. Pharma is responsible to provide right medicine to customers as per doctor prescribed and update medicine status. Due to lack of transparency in the current system, it is extremely difficult for customers or buyers to know the value of the products. It is also very difficult to investigate the tampering within the supply chain when there is suspicion of illegal or unethical practices. But now using our system the customers can view the whole transaction of drugs and be assured about the reports of the medicine they are purchasing resulting in increase in customer satisfaction and transparency in the system.

3.4 System Description

Admin: Admin register new users and assign roles according to their work.

Supplier: Supplier supplies raw materials by creating a new batch with details of the farm.

Transporter: Transporters are responsible for shipping packages/consignment from one stage to another.

Manufacturer: The manufacturer is in charge of producing fresh batches of medication for delivery to wholesalers or distributors by updating information about the raw material details (such as batch ID and consumption units that are utilised to produce new batches of medication and amount).

Wholesaler: Wholesaler is responsible to receive medicine from Manufacturer and validate medicine quality, then transfer to Distributor.

Distributor: Distributor is responsible to distribute medicine to pharmacies and do verification on medicine quality andcondition.

Pharma: Pharma is responsible to provide the right medicine to customers asper doctor prescribed and update medicine status.

4. FUTURE SCOPE

In Future, we will develop an android version of the system. Keep on adding new smart contracts so as to remove any remote possibility of security breach. Continuous upgradation of UI to provide user friendly interface. Our methodology shows how blockchain technology has the ability to promote efficient prescription data sharing while upholding the security of the original data sources. Our project can be expanded to solve further interoperability problems in the healthcare industry. Additionally, it can give patients quick, safe access to their medication history.

Moreover, there is potential for using it to offer identity management for stakeholders in the healthcare industry. Blockchain applications for identity management hold great promise but further research is needed.

5. CONCLUSION

Through this project, we have looked into the difficulty of drug traceability within pharmaceutical supply chains, emphasisingits importance in particular to guard against fake medications. We have created and tested a blockchainbased pharmaceutical supply chain solution that enables decentralised drug tracking and tracing. Our suggested solution specifically makes use of smart contracts within the Ethereum blockchain to achieve automated recording of events that are accessible to all participating stakeholders as well as the cryptographic principles underlying blockchain technology to achieve tamper-proof logs of events within the supply chain. In terms of the quantity of gas used to carry out the various operations that are triggered within the smart contract, we have shown that our suggested method is economical. Additionally, the security analysis performed has demonstrated that our suggested solution achieves protection against malicious attempts targeting the availability, integrity, and non- repudiation of transaction data, which is crucial in complex multi-party settings like the pharmaceutical supply chain. In order to achieve end-to-end transparency and verifiability of drug use, we intend to extend the suggested system as part of our ongoing efforts to improve the efficiency of pharmaceutical supply chains.

REFERENCES

[1] Prasad Nayak B, Preetham V K, Sandeep Kulkarni, Sreejith, Mrs. C K Vanamala, Drug Supply Chain Management Using Blockchain, IJRES, 2022

[2] Joeke Kootstra, Tineke Kleinhout-Vliek, Implementing pharmaceutical track and-trace systems: a realist review, IEEE, 2021

[3] May Alnafrani, Subrata Acharya, SecureRx: A blockchain-based framework for an electronic prescription system with opioids tracking, Elsevier, 2021.

[4] Prashant Gajera, Akshay Gondaliya, Jenish Kavathiya, A Blockchain-Based Approach for Drug Traceability in Healthcare Supply Chain, IEEE, 2020.

[5] Prashant Gajera, Akshay Gondaliya, Jenish Kavathiya, A Blockchain-Based Approach for Drug Traceability in Healthcare Supply Chain, IEEE, 2020

[6] Monalisa Sahoo, Sunil Samanta Singhar, A Blockchain Based Model to Eliminate Drug Counterfeiting, Springer, 2020

[6] A. Bougdira, A. Ahaitouf, and I. Akharraz, ‘‘Conceptual framework for general traceability solution: Description and bases,’’ J. Model. Manage.,vol. 15, no. 2, pp. 509–530, Oct. 2019.

[7] K. Al Huraimel and R. Jenkins. (2020). Smart Track. Accessed: May 26, 2020. [Online]. Available: https://smarttrack.ae/

[8] A. Seiter, ‘‘Health and economic consequencesof counterfeit drugs,’’ Clin. Pharmacol. Therapeutics, vol. 85, no. 6, Jun. 2020.