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# Survey on Crypto Pharmacy- Blockchain based Pharmacy Supply Chain

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***Abstract:*** The global pharmaceutical industry is worth more than $1 trillion and supply chain management (SCM) is fundamental for gaining financial, environmental and social benefits in the supply chain industry. Traditional SCM processes, however, frequently experience a wide range of problems, including a lack of information sharing, prolonged data retrieval times, dependability concerns with product tracing, and the inclusion of fake goods. Blockchain technology holds a great deal of promise to address these issues because of its main features, including immutability, transparency, and decentralisation. Blockchain ensures source to consumer traceability and tracking which helps to improve efficiency in the industry by ensuring consumer protection, building trust and improving quality of service.

***Index Terms*** **– Blockchain, Traceability, Counterfeit Drugs, Supply Chain Management.**

## I. INTRODUCTION

The pharmaceutical supply chain network is the mechanism that distributes manufactured prescription medications to patients. However, this supply chain is very complex and consists of multiple stages, which could span over months or longer, across multiple regions around the world. A primary supply chain is made up of numerous entities such as suppliers, manufacturers, transporters, wholesalers, distributors, retailers, and so on. Thus, keeping track of each medical drug throughout the chain and tracing it back to its source becomes a tedious job. Drug fraud is a major issue worldwide. According to the Health Research Funding organisation, between 10 and 30 percent of the pharmaceuticals in underdeveloped nations are bogus. Products that are counterfeit raise serious concerns since they may have negative consequences on human health. About 30% of all medications sold in Africa, Asia, and Latin America are fake, according to the World Health Organization. Contrary to popular belief, the main issue with counterfeit drugs is that they often have different side effects on human health than legitimate medications.

Because of the current system's lack of transparency, it is quite challenging for customers or buyers to understand the worth of the products. When there is a suspicion of unlawful or unethical acts, it is also quite challenging to look into the tampering inside the supply chain. As a result, such supply chains are inefficient in terms of vendors, suppliers, and so on. attempt to link the various entities and determine who, when, and how needs what. Customers and buyers are currently unable to determine the true worth of goods due to a major lack of clarity in the current system. When there is evidence of improper or immoral activities, this tampering within the chain is exceedingly difficult to investigate. They can also be unreliable as retailers and manufacturers struggle to figure out who wants what, when, why, and how. Blockchain is a game-changing technology. Blockchain offers a distributed hyperledger with no centralised control over the system. Each transaction into the blockchain is immutable, which means there is no way sensitive data like Drug/Customer information can be tampered with. Blockchain provides complete transparency, which also brings trust between the various main entities of the Supply Chain, such as, Manufacturers, intermediaries like Distributors and Suppliers, and the end-users like Customers/Retailers/Hospitals. Using an event request-response framework, each product within the chain may be moved across the various authenticated chain entities. Using smart contracts, all interactions between the various entities are documented in the blockchain.

## II. PROBLEM STATEMENT

To improve the traditional Supply Chain Management (SCM) approach by using Blockchain to ensure source-to-consumer traceability and tracking, which helps to improve industry efficiency by ensuring consumer protection, building trust, improving quality of service, and overcoming gaps exploited by anti-social elements to distribute counterfeit medicines.

## III. OBJECTIVES

- Enhance the supply chain to be traceable i.e. raw material sourcing information, drug formulation data, batch numbers, routing paths, storage units, product expiration dates, etc., should be traceable and maintained accurately.
- Improve supply chain transparency, coordination, and information sharing.
- Protect the data authenticity.
- Speed up the data retrieval.
- A distributed database is designed to avoid a single point of failure.

## IV. LITERATURE REVIEW

Over the years, many scholars and entrepreneurs have made many discussions and research on how to use blockchain technology to improve and manage the supply chain's current situation.

G. Perboli et al. [1] describes the standard methodology for developing and validating the overall Blockchain solution and de signing a strategy for integrating it into Business Strategy. They also highlight how blockchain can tackle security challenges in IoT, such as identifying different devices and managing trust, information tracking, authentication and access control, and accountability in IoT-based applications.

R. Kumar et al. [2] proposed a framework that represents a blockchain-based secure infrastructure for the medical supply chains among valid participants, which can provide drug security and the authenticity of the manufacturer. PKI and digital signatures are used to prevent replay and man-in-the-middle attacks.

Jamil et al. [3] suggested an application built on a user service framework that employs distributed ledger technology and smart contracts as middleware. The proposed system is built on a permissioned blockchain, which allows only valid participants to join and participate in the blockchain network, thus separating it from the other blockchain-based systems. The transaction is utilised by the suggested smart contract-based application, which also executes a number of queries, updates the ledger state by appending transaction blocks, and returns the modified result to the application as a response.

Hackius et al. [4] have described four use cases of blockchain in logistics, and SCM explored both theoretically and practically. The use cases are easy paperwork processing in ocean freight, identifying counterfeit products, facilitating origin tracking, and operating the Internet of Things.

Q. Zhu et al. [5] focus on linking the product deletion decision-making process, which is a process of deleting a product and all its related information from the company's portfolio with Blockchain technology. The process of product deletion has been broken down into four basic steps: recognition, analysis and rejuvenation, assessment and decision-making, and implementation. Blockchain technology improves communication and collaboration among various entities in the supply chain and thus increases information efficiency, effectiveness and reduces conflicts.

Prachi Shrikant et al. [6] focuses on the significance of Blockchain technology in tracing and detecting counterfeit products throughout the supply chain. The information contained in the blockchain makes it simple to track the medication every time it transfers from one entity to another, lowering the risk of counterfeit goods. Because each new transaction is time-stamped, companies can track their products in the supply chain, which helps to solve the main issues. Allowing stakeholders to take actions in case of any issues by identifying the exact location of the drug.

K. Toyoda et al. [7] proposed the need to develop anti-counterfeit systems that will work when the RFID tag's information will be cloned in the post supply chain. Hence through the paper, they proposed The Possession of Products scheme. The counterfeits can be detected if any entity is unable to prove the possession of the particular product. They have suggested blockchain, as Bitcoin allows users to prove their ownership without the need for any authentication and centralized authority.

Huang et al. [8] describe the significance of the Drug Ledger, a fully scenario-oriented blockchain system for drug traceability and regulation. Drug ledger uses the UTXO-based transaction model combined with the supply chain to construct the entire workflow that includes drug packaging, repackaging, unpackaging and drug transaction cancellation, the arrival and exit of the drug supply chain, and

so on. As a result, the Drug ledger successfully separates the drug traceability service from data modification, ensuring data authenticity and privacy.

J. Ma et al. [9] describe the need for a fully-functional blockchain system to prevent product counterfeiting to ensure that the products can be identified and traced in the supply chain. They propose using Ethereum, a Blockchain platform and suggest that users write smart contracts using Solidity and deploy them on the network. Through the proposed anti-counterfeit system, the users do not have to be concerned regarding acquiring counterfeit products.

Leng et al. [10] proposed a public Blockchain with a double chain architecture to improve the efficiency of agricultural supply chain systems. They demonstrated how their approach gives public service platforms adaptive rent-seeking and matching mechanisms. It protects the privacy of company information while also ensuring the security and transparency of transaction data. The main drawbacks are the size of the underlying Blockchain network and the related performance issues.

Mao et al. [11] proposed a Blockchain-based credit evaluation system to improve food supply chain supervision and management effectiveness. They collect trader credit evaluation text specifically via blockchain smart contracts. Additionally, a deep learning technique called Long Short-Term Memory is used to analyse the text (LSTM). The system's drawback is that they show the effectiveness of their method, but they do not consider the overall system costs and benefits explicitly.

## V. SYSTEM ARCHITECTURE

### 5.1 System Overview

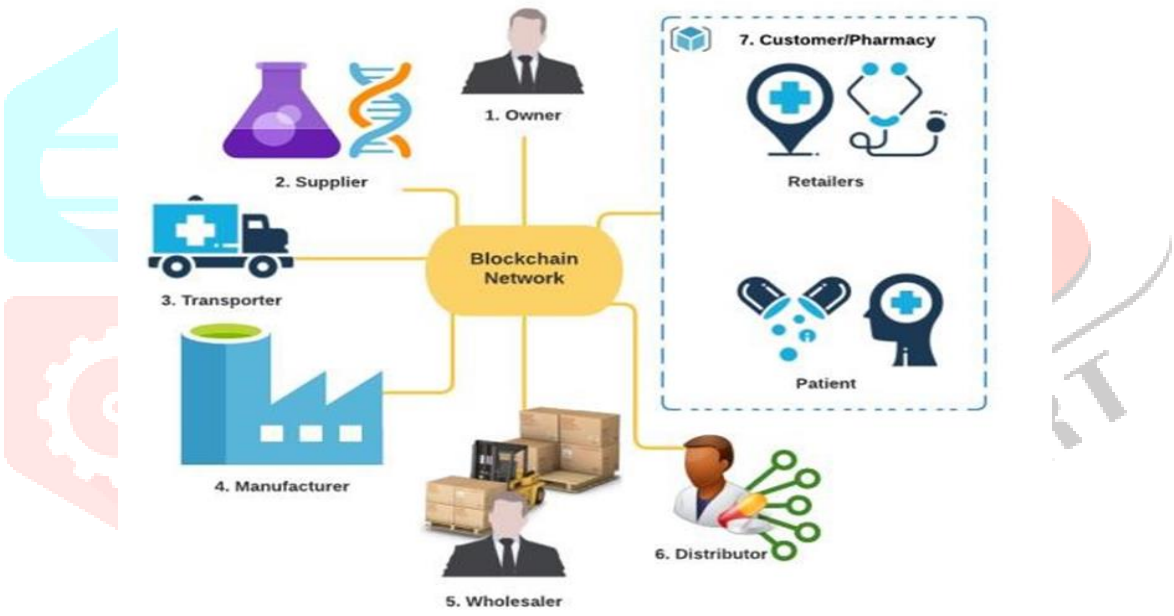


**Fig. 1 - Overview of the Proposed Architecture.**

As shown in Fig. 1, the proposed system consists of many entities like suppliers, transporters, manufacturers, wholesalers, distributors, and customers/retailers and is connected through a decentralized network. Each of the supply chain entities listed above is a node on the public blockchain. Each of these nodes has its own Ethereum account, which is used for representing its identity. The following are the specific roles and functions of each:

1. Owner
   a. CREATE a new user that is to be added to the chain.
   b. READ the information of any user.
   c. UPDATE the roles of a user.
   d. DELETE a user from the chain.
2. Transporter
   a. Verify the package (Raw Material or Medicine).

b. Pick the package from an entity (based on transporter type).

c. Deliver the product to an entity.

3. Supplier

a. CREATE a Raw Material.

b. GET the addresses of the Raw Materials created.

4. Manufacturer

a. Receives the Raw Material from the Supplier via the Transporter.

b. Verify the source of the product received.

c. CREATE a new Medicine using received raw materials.

5. Wholesaler

a. Receives the medicine from the manufacturer through the Transporter.

b. Verify the source of the medicine.

c. Transfer the ownership of the medicine.

6. Distributor

a. Receives the medicine from the Wholesaler through the Transporter.

b. Verify the source of the medicine.

c. Transfer the ownership of the medicine.

7. Customer

a. Receives the medicine from the Distributor through the Transporter.

b. Verify the source of the medicine.

c. Get medical drug information.

## VI. PROPOSED OUTCOMES

- Identifying issues in the pharmaceutical industry's existing SCM system (lack of information sharing, long delays for data retrieval, unreliability in product tracing and inclusion of counterfeit products).
- Enhanced product traceability and tracking.
- Ethereum's blockchain framework is being used for supply chain management.
- Avoiding counterfeit medicines in pharmaceutical chain (eg. In upcoming situations, avoiding counterfeit covid vaccines to protect people’s health)

## VII. CONCLUSION

Based on blockchain technology and artificial intelligence, the paper proposes a smart anti-counterfeit drug supply chain system. By using smart contracts and product registration and transferring, all product transferring records are permanently registered in the unchangeable ledger. The integration of smart contracts enables product tracking. Consumers can take part in preserving information flows as well. The proposed system has prominent decentralized characteristics, which significantly reduces the possibility of privately tampering with data. Furthermore, an event request-response process was created to verify the identity of all parties signature found in the event in order to determine whether or not the event is authentic. All events can be recorded and stored in the blockchain as a log, which can be viewed in real-time.

## VIII. FUTURE SCOPE

By using Image Processing we can add face verification at time of issuing identity documents and most often combined with other biometric technology such as fingerprints. By AI we can add Chat bot for tracking medicines order and verifying retailers and sellers details.

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