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CFDD (CounterFeit Drug Detection) using Blockchain in the Pharmaceutical Industry

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***Abstract*— Counterfeit drugs is an expanding serious issue associated with the healthcare industry which causes extreme threats to the society. The traceability of the drugs throughout the pharma supply chain is a difficult task. Another serious issue in combating counterfeit medicines in healthcare systems is the maintenance and sharing of health records. The security of E-health records is of prime concern as they are prone to confidentiality and integrity threats. The negligence of these threats might have severe consequences to the healthcare systems like death of the patient. Thus the need arises to design a blockchain based system which helps in fighting with the falsified medicines and ensuring the security of e-health records. In the proposed system the data integrity is ensured through the posed block-chain technology and authentication is assured by the Keyless Signature Infrastructure which ensures the privacy of digital signature. The advance features of Blockchain makes it capable of giving a basis for complete traceability of medicines from manufacturer to end patients, and the ability to detect counterfeit medicines or drugs.**

Keywords—Blockchain, KSI, Counterfeit drug, drug detection.

I. INTRODUCTION

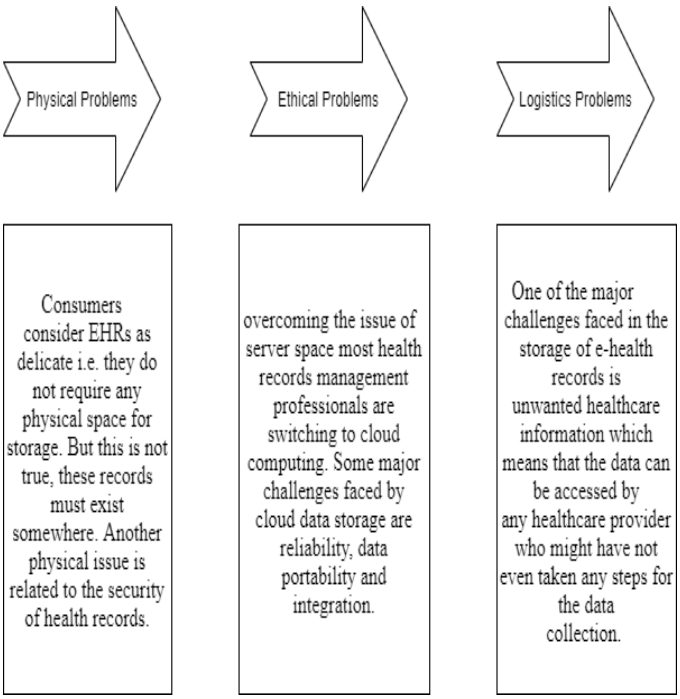
Counterfeit drugs or counterfeit medicines are defined as "one which is deliberately and fraudulently mislabeled with respect to identity and/or source." [1]- [3]. These are basically the pharmaceutical products which either have wrong ingredients or may have correct ingredients but in wrong quantity. Drug counterfeiting is being identified as a serious threat to the users globally. The consumption of these fraudulent products might have serious repercussions ranging from minor deterioration in health to very severe impacts such as death of the patient.

As per the current scenario the number of diseases and patients are continuously increasing and so is the consumption of these fake drugs. One major issue in dealing with the fake drugs is the storage of health records (mainly drug records and transactions) throughout the supply chain. Therefore, in the healthcare industry the maintenance of health records gains utmost importance. The transfer of health data across different organizations faces two major issues- the integrity issue and the privacy of data [4].

Problems associated with the storage of health data records:

Three major problems that are associated with the storage of health data are-

- Physical problems
- Ethical problems
- Logistics problems.



To overcome these challenges Blockchain is being adopted. Recently it is seen that the employment of block-chain technology in the medical and healthcare services is increasing at a rapid rate. Block-chain with its secured nature has been adopted in various e-health sectors such as data access management among medical entities and secure sharing of electronic health records [5]- [6].

In case of block-chain there is no central point of failure as the data is distributed and is stored in blocks. Blockchain technology helps in overcoming the security problems in healthcare. Features which make blockchain reliable for use in combating counterfeit drugs are: -

- Peer-to-Peer Transmission
- Distributed Database
- Computational Logic
- Transparency with Pseudonymity
- Irreversibility of Records

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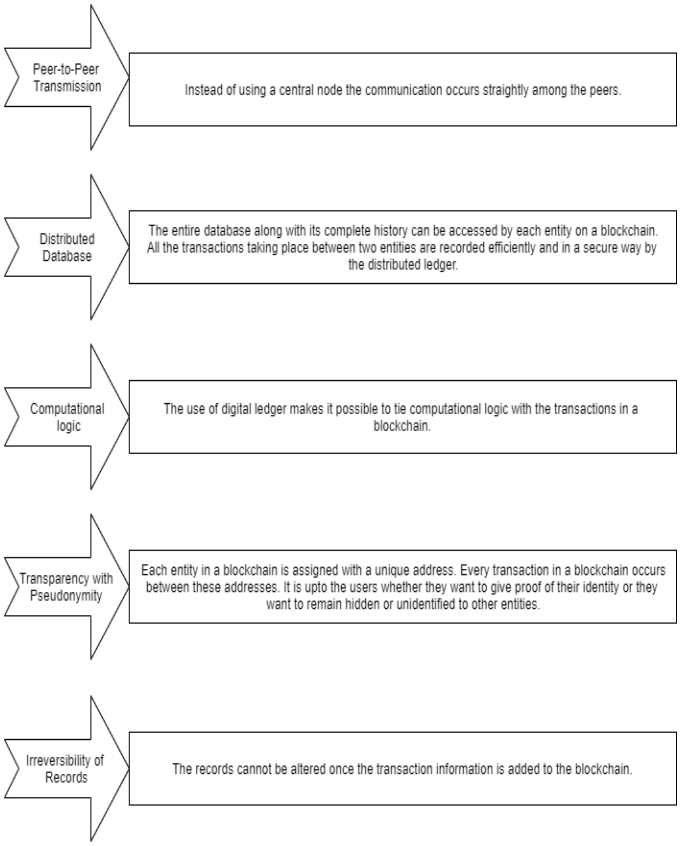

II. RELATED WORK

The challenges faced by current healthcare blockchain are presented in [7]. As per the study, the industry which needs extra efforts or attention is pharmaceutical supply chain. As estimated by WHO- every year nearly $200 billion worth of fraudulent and counterfeit medicines are supplied in the global market. Therefore, many applications working on blockchain platform in the healthcare industry have been launched such as farmatrust [8], blockverify [7], chronicled [9] etc.

In [10] Healthbank is introduced. It is a startup based on blockchain which acquires permission from the patients before sharing their records and personal medical history with other organizations. This application is highly efficient and secure.

Over time various solutions have been provided to deal with the problem of secure transfer of electronic health records over cloud environments. The work in [11] proposed an attribute based encryption (CP-ABE) prototype. In order to achieve fine-grained access-control for secure sharing of EHR's on cloud, an attribute authority is employed for granting keys for data consumer. This study ignored the capability of decentralized access.

The benefits of Blockchain technology in the healthcare industry are outlined by Asad Ali Siyal et al. (2019). Researcher mentioned that by introducing effective diagnosis, this technology has changed the traditional healthcare model. Researchers also note that healthcare using Blockchain helps secure the exchange of information between different entities [12].

A Muthanna et al. planned associate rule to use a Blockchain mechanism in IOT devices for decentralization in an exceedingly trusting manner [13].

In a project called originChain, Xiwei Xu et al. implemented a Blockchain framework. When using this software, traceable data that included high availability were clear and tamper-proof. The structural design of the system [14] has a major impact on the quality of the system.

Paula fraga-lamas et al. suggested the use of Blockchain technology in the automotive industry with a focus on cybersecurity. The exploration has given rise to an opportunity to create a new business model and may even cause a car sharing disruption. For the same purpose, the SWOT analysis was carried out with some recommendations and future developments [15].

Various studies have invested block-chain ability to support sharing of e-health data. To ensure dependable accessibility of EHRs for medical users, block-chain was used in [16]. The authors used smart contracts to manage usage of EHRs by doctors. Since this study focused on theoretical analysis, thus the workability of this proposed system have not been confirmed in the real time sharing of EHRs. Some important features such as availability, identity management and flexibility of EHRs sharing are ignored in this study. In [17] a data management concept based on block-chain was proposed to assure secure transfer of EHRs between health users. The work [18] provided a system- MeDShare which employed smart contracts to design a system that was capable of tracking exchange of data among untrusted parties. The performance of this system was evaluated through network latency estimations with theoretical analysis displaying that this system can achieve efficient data sharing with data privacy.

In [19] a decentralized technique is proposed for managing electronic health records. In this system the patients can easily access their medical data across the providers. It also provides secure sharing of medical data along with managing confidentiality. A new architecture namely ProvChain is introduced in [20]. It helps in validation, retrieval and storage of data. The proposed system uses merkle tree structure which helps in maintaining privacy of data. The timestamp concept is used for the validation of data.

Hyperledger recently launched the "counterfeit medicine project" [21,22]. The main aim of this project is to detect fake drugs in the pharmaceutical chain. Accenture, IBM, Intel, Cisco and Bloomberg are some of the research companies working in direction of this project. As per this project, every manufactured drug is assigned with a timestamp which makes the traceability of drugs feasible along with the drug details and its origin.

III. PROPOSED METHOD

Objective of Proposed method:

To design a framework CFDD (CounterFeit Drug Detection) using Blockchain technology which is capable of tracing drugs throughout the pharmaceutical supply chain in order to combat the issues of fake medicines.

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- Reduced falsification related losses- CFDD can maintain clear track and trace record of entire drugs journey from manufacturer to patient. Therefore, detection of counterfeit drugs would become easy in the supply chain.
- The use of blockchain in the pharmaceutical supply chain can enable exact locations of medicines to be identified. It is possible to send or perform the batch reminders efficiently and quickly while maintaining increased patient health safety.
- The enhanced traceability facilitates the optimization of goods flow and an efficient system of stock management.

Blockchain technology is highly capable of keeping track of the drug history throughout the pharmaceutical supply chain. Two important aspects that makes Blockchain data secure and safe are that the blocks are timestamped and immutable making tampering of information impossible.

Organizations can have either a public blockchain or a private one. The organizations will share a distributed ledger betwee n the parties involved in the manufacture and distribution of t he drug on these blockchains. Moreover, in these blockchains only limited access is provided which depends on the data sharing contract among the two parties.

With Blockchain we can keep complete track of the drugs beginning from manufacturers to end consumers. Every time the drug travels from one entity to another, the data is stored on the block supply chain. This makes the traceability of drugs an easy task and thus helps in combating counterfeits from the industry.

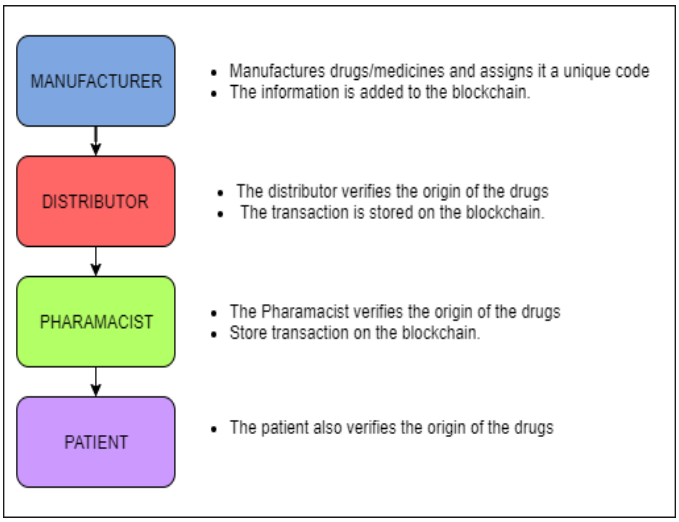

Fig-1: Medical supply chain storage flow for drug safety.

The two main issues which will be overlooked by CFDD are: firstly, pharmaceutical companies will be able to track their products throughout the supply chain, building an airtight circuit prohibiting the entry of counterfeit drugs. Secondly, stakeholders specifically labs will be able to take posteriori action by detecting the exact location of their drugs.

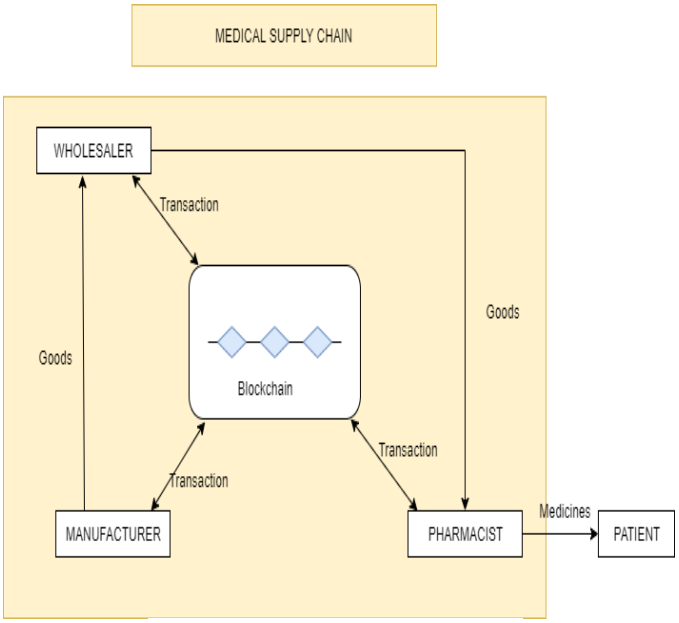

Fig 2: System architecture

IV. CONCLUSION

The proposed framework can provide both manufacturer's authenticity as well as drug security. The current methodologies for combating counterfeit drugs works on third-party trust and thus lacks in terms of security for the drug safety. In comparison to these current methodologies, the proposed framework is based on Blockchain and is hence highly secure and capable of dealing with the fake drugs menace.

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