Blockchain to Overcome Counterfeiting of Medicines

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Abstract— **The production and distribution of falsified drugs, especially in developing countries, is a pressing and increasingly important global issue. The pharmaceutical duplication market estimate has crossed billions of dollars annually. The fragmented supply chain network in the pharmaceutical industry is one explanation for forging medications. Medications change possession from maker to distributor, wholesaler, and pharmacist before it arrives at the end-user. Data is not exchanged between systems, suppliers don't have an idea of what is going to happen to their products in the current supply chain environment, drugs administrative authorities have zero system perceptions, evaluation procedures are complicated and expensive, and organizations can't catch up patients. In this paper, we discussed how to use the blockchain innovation in the pharmaceutical supply chain to include traceability, accessibility, and protection in the drug processes. In the pharmaceutical industry, the proposed system will be used to track medicines from development to delivery to patients. Authorized blockchain is used to store transactions, and only trusted parties are allowed to join the system and push information to the blockchain.**

Keywords—Blockchain, pharmaceutical supply chain, falsified drugs, traceability, transparency.

I. INTRODUCTION

Drug research and development is a very complicated process that takes years to complete its journey of new medication from initial discovery to the marketplace, and it is costly as well. When the whole procedure is done, and a drug is made, the main challenge for businesses is to sell the medication in its pure form to the intended consumer and to ensure that the customer gets the genuine product that the authentic manufacturer has produced, not counterfeiters. But the current Supply Chain Management (SCM) system of the pharmaceutical industry is obsolete and doesn't provide visibility and control for manufacturers and administrative authority over drug distribution and cannot cope with the cybersecurity threats of the 21st century. This SCM situation contributes to the production, distribution, and use of counterfeit drugs. India's pharmaceutical market is the world's third-largest in terms of volume. The bad news, however, is, according to the World Health Organization (WHO), 35% of fake drugs sold all over the world emanates from India. The problem of counterfeit drugs within the supply chain costs the pharma industry billions. Another upsetting is the way that it puts patients at higher risk, particularly in developing nations where the WHO estimates that one in 10 medical products (E.g., pills, vaccines, and diagnostic kits) is substandard or fake. Every year over a million people are killed after consuming counterfeit drugs globally. In the light of its higher domestic demand and lower manufacturing costs, India is a leading global manufacturer of low-cost generic medicines Drug manufacturers struggle to find a reliable way to track the origin of these products safely, straightforwardly, and promptly; or to access information needed to fight counterfeit drug sales. The Indian government has been exploring a mechanism to ensure that all medicines manufactured and exported from India are made available in real-time. It also wants to provide patients and regulators worldwide, the means to check the validity of drugs that are manufactured in India. Another inspiration for the project is the unexplored specialized treatment in the field of medical science called 'Gene Therapy.' Patients have to provide samples of their DNA (or stem cells are withdrawn), and then the medication is made explicitly for that individual patient. But throughout that entire process, samples have to move from the patient to the drug manufacturing facility and then from the facility back to the hospital, where it is stored and finally administered. There are a lot of chances of errors with these many physically tested steps. Even right now, although there are only a handful of treatments utilizing this specific case-by-case approach, in the next five to ten years, that number will increase exponentially. Every measure of risk currently faced will only continue to develop, so a growing number of individual details

will need to be correctly processed and analyzed. The structures that we have now are no longer sufficient to address the actual situations of life or death that follow these dangerous procedures. That's where blockchain comes in. The pharmaceutical business needs a robust supply chain management system to avoid counterfeit drugs, and Blockchain technology is the most exciting way to develop a perfect supply chain management system. Blockchain is a distributed ledger network that, in recent years, has shown widespread adaptability and has used its strengths to increase efficiency by several market sectors. Mostly used in the financial industry, but now other areas, such as healthcare, energy, and legal firms, have started using blockchain. Supply chain security is the sector that needs blockchain the most. Any product which has a delicate production process and widespread reputational issues are associated with the final product, the benefits of blockchain are useful. Blockchain is the best fit where transparency and security are the most important.

II. OBJECTIVES

A. EXISTING SYSTEM

The modern supply chain of drugs is complex. Medicines are made from imported ingredients from different countries. The final formation is then exported. Drug authority changes many times between the manufacturer and patient; every transaction is an opportunity for substandard or falsified products to infiltrate the market. FDA has promoted the SNI (Serial Number Identification) as a way of preventing counterfeiting of a drug.

The SNI should be a serialized National Drug Code for pac kets of a prescribed drug. The SNDC consists of the National Medication Code (NDC), which refers to a universal serial number for a particular drug product, generated for each package by the supplier or repackager. Serial numbers should be binary (numbers), or alphanumeric (including letters and/or numbers), and not more than 20 characters should be used. An example is shown below with a 10-character NDC. However, the transaction of multiple hands cannot be traceable by this SNI system.
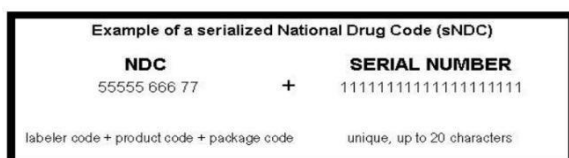

Fig 1. Explanation of sNDC[6]

The existing system has many loopholes that are out of reach of the traditional approach. These loopholes include Diversion of Drugs, Unregistered Pharmacies, and Pilfering and Heists of Drugs. Apart from these the conventional system also fails due to its drawbacks such as, the traditional system uses individual database for all the nodes there is no immutable storage, i.e. any node can change the data at its end, No common database for all

nodes as each node preserves its own data there is no common truth, Difficult to track through customs as it involves lots of trusted third parties, Too many trusted intermediaries are involved which increases the overall cost, and lastly data is filled manually, main receipts are maintained, thus there is a chance of human error.

Blockchain technology initially became very popular (i.e. Bitcoins) and other financial services for cryptocurrency realization. Later several blockchain applications were suggested in different fields, and after smart contracts were introduced, blockchain became more productive. Despite blockchain's massive adaptability, several proposals have been proposed to integrate its functionality in the field of medicine and healthcare. Benchoufi and Ravaud[1]explained how they use blockchain to improve the quality of clinical research. They addressed the use of blockchain in health care and medicine in general, but they don't explain the use of blockchain in the drug supply chain. Healthcare data is susceptible and vulnerable to different types of attacks, MedShare is another initiative that aims to use blockchain technology in healthcare to share medical data in a trustless environment from one individual to another[2]. When a supplier produces a drug and records it on the network, it will become a digital asset in the supply chain of medication. It could be passed to other participants just as cryptocurrencies would. The last and most important reason for using blockchain in the pharmaceutical SCM system is the Smart Contract, which is a part of the code that includes the real rights and obligations that include the terms and conditions for the distribution of the goods, and is decided by all the signatories and can be enforced automatically. A smart contract will add more knowledge to the blockchain and more strength. We can be used to render customizable blockchain-based applications state-of-the-art and cutting edge.

B. IMPLEMENTED METHODOLOGY

The proposed system aims to transform the supply chain management of medicines and to make it clear and transparent, enabling control and authenticity throughout the supply chain. Blockchain provides a solution to the challenge of co- ordination across suppliers and supply-chain members, as well as giving a liable and verifiable log, held in a secure electronic form that cannot be altered by any means environment.
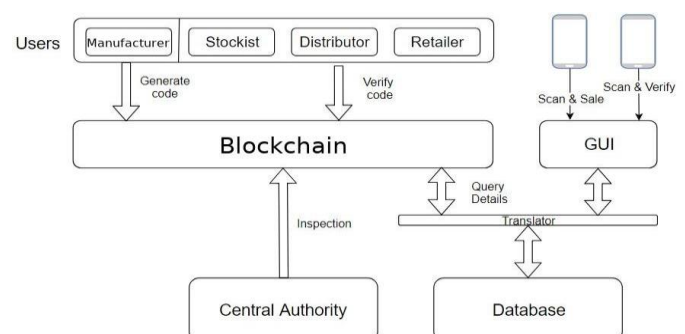

Fig 2. System Architecture

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The above figure represents the System Architecture of the proposed solution. The user consists of two categories: the first one is manufacturers who produce a batch of medicines and generates a hash code for every batch and pushes these hash codes into the blockchain. In contrast, the second set of users, which consists of stockists, distributors, and retailers, can track and verify the origin and authenticity of the drugs. The central unit is the blockchain where are all the details of the transaction after validation by specific nodes are stored and added to the existing chain. The Central Authority is responsible for inspecting the supply chain, and track the details as the batch of medicines moves through the supply chain from the manufacturer to the retailer. The GUI unit, which can be a mobile app with the camera, provides a platform for the retailers to scan and sell medicines and for the customers to scan and verify the origin and journey of drugs in the supply chain. The translator unit takes care of displaying blockchain data in GUI with the help of the database. 4.

FEATURES OF IMPLEMENTED SOLUTION:

In comparison to the traditional system, the proposed system offers the following benefits :
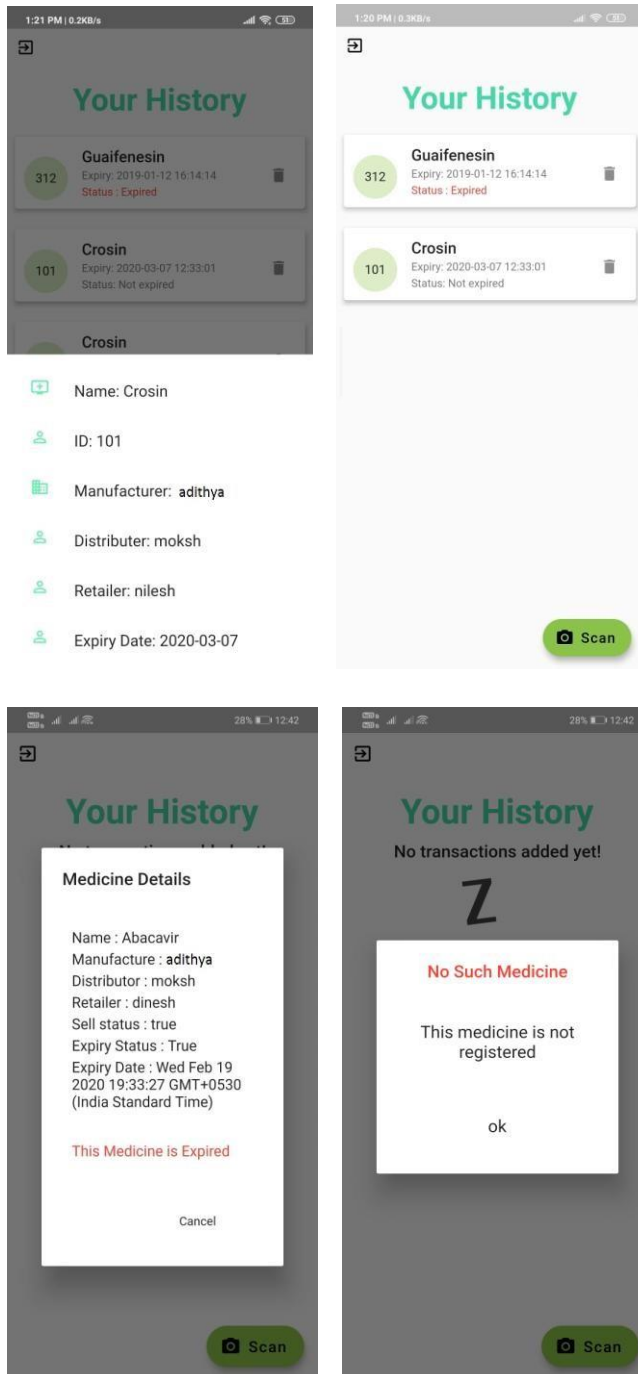
● As blockchain is immutable storage as it is a distributed ledger, it will ensure a permanent record of transactions.

● Each new transaction is validated by every node of blockchain.

● Transparency will ensure easier tracking of goods through customs.

● Removes the need for intermediaries and replaces it with cryptographically secure protocols – like SHA-256 cryptographic hash function used by BlockChain for generating the hash value of a block.

● Reduces errors and increases efficiency

● More comfortable for the Central Authority to monitor all the transactions and ensure authenticity.

● Independent Verification of Authenticity

● Rapid conflict resolution as blockchain provides non- repudiation as it requires all the nodes in the network to validate the transactions in a block

● Creates Transparency and Visibility in the supply chain.

III. RESULT

With the help of the Ehereum network, we implemented a web application where manufacturers can add a batch of medicine and generate a hash for the same saved in the Blockchain network, which can be verified and updated by distributors and retailers. Every user of the web application must have an account in Metamask.

.If any medicine is expired before it is sold to the end-user, then the current holder must return the medicine to the manufacturer. The Central Authority monitors every step of the supply chain.
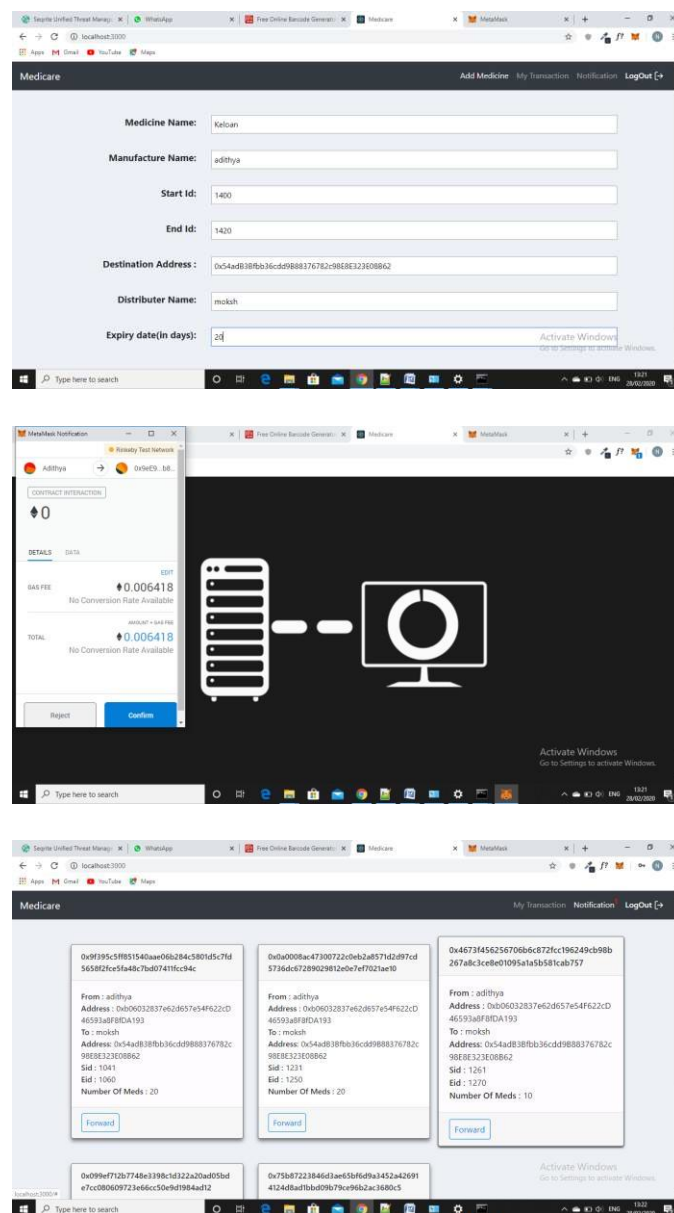
The end-user can check the status and verify the source of medicine with the help of a mobile application that can scan the barcode to get the details of medication. Users can store the details in history for future use.

Apart from logistics, tracking the volume of consumption of medicines by location can also be used to identify the development of pandemics and also helps in improving the efficiency of the supply chain. Finally, better trackability and authenticity of medicines will improve patient safety. The process of immediate tracking of faulty medication and accountability based on origin will ensure that patients face minimal risk, and they can trust the quality of medicine.

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IV.CONCLUSION

 Consequently, through this paper, we proposed the utilization of blockchain in the pharmaceutical sector. We called attention to the problems in current medicine supply chain management. We clarified the use of blockchain to add tracing ability and visibility to medicine supply and solve the issue of counterfeiting. We featured the potential techniques that can be used to implement a supply chain.