LEVERAGING THE GCOIN BLOCKCHAIN FOR DRUG SUPPLY CHAIN OPERATIONS

[#1]Mr.SADULA SANKEERTH, *Assistant Professor*
[#2]Mr.DASARI SHANTHI KUMAR, *Assistant Professor*
Department of Computer Science and Engineering,
SREE CHAITANYA INSTITUTE OF TECHNOLOGICAL SCIENCES, KARIMNAGAR, TS.

ABSTRACT: Blockchain, a transparent, immutable, consensus-based Fintech system, was only recently introduced to the general public. Blockchain functions as a trust system. Blockchain technology, on the other hand, is currently being deployed in industries that require value and trust. In this study, we propose leveraging the Gcoin blockchain to generate transparent data on drug transactions. A surveillance net might replace the inspection-and-examination-only model of drug supply chain control, allowing all units to work together to prevent the sale of counterfeit pharmaceuticals and preserve the public's health, especially patients'.

Keywords: blockchain; drug supply chains; G coin

1. INTRODUCTION

Pharmaceuticals go through foundational research, non-clinical testing, clinical trials, licensing, manufacturing, and distribution/sales from conception to commercialization (Figure 1). Control and inspection are critical to good practice throughout the life cycle.

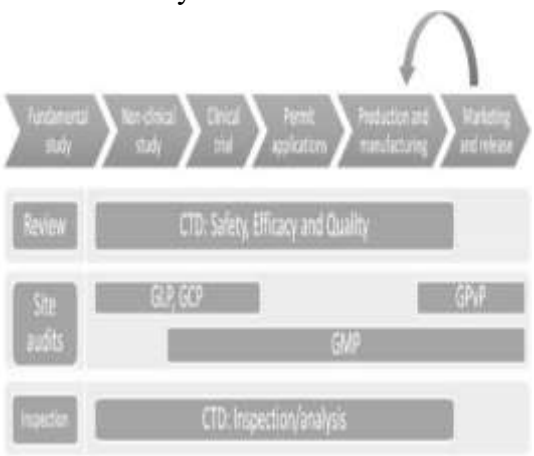

Figure 1. GMP is an abbreviation for Good Manufacturing Practice, GLP is an abbreviation for Good Laboratory Practice, GCP is an abbreviation for Good Clinical Practice, and CTD is an abbreviation for Common Technical Document. On September 6, 2016, the Taiwanese government announced new restrictions on drug monitoring. These constraints govern how and where drugs are distributed. Vaccines, botulinum toxin, and plasma derivatives are the three critical therapeutic commodities covered by the new rules. Twenty high-priced, often used medications are also covered. These medications must be included in tracking and tracing systems by January 1, 2018.

Technology makes it less likely that counterfeit pharmaceuticals will enter the genuine supply chain, drug quality is quickly and effectively regulated, drug recalls are made easier, and consumer security and health are all safeguarded.

If the medicine supply chain is too cumbersome to regulate, the worst-case scenario could involve counterfeit drugs. Counterfeit pharmaceuticals are ones that have been deliberately and fraudulently produced and/or mislabeled with respect to identity and/or source in order to make it appear as if the product is genuine, according to the World Health Organization (WHO).

The economic burden of utilizing counterfeit medications is immeasurable. Globally, basic data such as the number of counterfeit pharmaceuticals are incorrect. However, for

years, the general public and academia have accepted without question the allegation that 10% of medicines sold worldwide are counterfeit. There are methods for avoiding phony drugs. Examples of this include improving supply chain management, improving secondary drug market controls, and, of course, improving tracking and tracing technology for counterfeit drugs.

The most obvious and comprehensive idea is to improve control over the pharmaceutical supply chain. Every stage of the drug supply chain, from ingredient sourcing through distribution and use, has an impact on medicine safety. In this paper, we propose employing blockchain technology to control the pharmaceutical supply chain.

2. MATERIALS AND METHODS

Traditional Technologies Used in the Drug Supply Chain

Because of the extensive use of mobile phones, mobile solutions, including software and hardware, to track pharmaceuticals across the supply chain have evolved and become easier to use.

The pharmaceutical supply chain, on the other hand, is well-suited to barcode scanning or RFID technology. RFID's wireless, one-of-a-kind identification makes data collection along the drug supply chain more efficient. RFID technology may improve medication safety monitoring from the discovery of counterfeit drugs to their sale.

Blockchain Technology Used in Public Health and Its Potential

A distributed, immutable, and encrypted data ledger can be created using blockchain. Previous research has linked its use to stakeholder information exchange while maintaining data integrity and patient privacy in public healthcare.

Blockchain technology is being used in healthcare administration to distribute medical data while protecting patient privacy. The Chronicled Company (San Francisco, CA, USA), I Solve LLC's Block Rx (East Norriton, PA), and IBM's Watson Health artificial intelligence team (Cambridge, MA, USA) demonstrated blockchain-based healthcare and drug supply chain operations.

Blockchain technology provides an immutable transaction record that records every drug in the pharmaceutical supply chain, minimizing the production of counterfeit drugs.

Traditional means for tracking down medications, such as mobile technology, barcode scanning, and RFID, have been proposed, yet there are still cases of fraudulent drugs being sold all over the world. Even in advanced countries like Taiwan, counterfeit Crestor (rosuvastatin, 10 mg pills) was detected in March 2017. The public was horrified by this incident since some patients had been taking fake, ineffective medications for days or weeks.

To guarantee public health, the government must monitor the entire medication supply chain. Because of mistrust, the public requires government oversight. Constant monitoring could be wasteful and time-consuming. As a result, blockchain technology can be utilized to improve the application of laws.

G coin Blockchain

Characteristics of G coin Blockchain

G coin's blockchain governance is remarkable. The G coin represents global blockchain network governance. In this paper, we employ the G coin block chain's double-spending avoidance technique to combat counterfeit pharmaceuticals.

Blockchain is a mathematical and economic mechanism for establishing trust between unrelated parties. There are various approaches to this. Each blockchain implementation has advantages and disadvantages. In the pharmaceutical industry, we use Consortium Proof-of-Work on the G coin blockchain to avoid double-spending and counterfeiting.

The G coin blockchain can be used by coin issuers, full nodes, miners, and traditional nodes in a hierarchical framework.

Identification of Drugs by G coin Blockchain

The G coin blockchain, like the Bitcoin blockchain, can identify every prescription. Every supplier and customer in the drug supply chain, like Bitcoin addresses, has a unique address. The batch or serial number, amounts, and all other drug information should be utilized to generate a hash number that will act as the medication supply chain's public key. This public key can be used to generate an identifying QR code for drugs.

Gcoin Blockchain System Organization Drug Supply Chain Transactions The Functions of the Participants

Producers, wholesalers, retailers, pharmacies, hospitals, and customers are all part of the drug supply chain. As alliance members, the Gcoin blockchain hierarchy recommends that governments monitor transactions and drug data. Alliance members issue credentials to miners and minters. Gcoin should be issued by pharmaceutical companies because they provide drugs that can be identified using blockchain technology. Large corporations and governments should serve as miners, validating and creating blocks. Hospitals, major wholesalers, and other stakeholders could act as backup nodes for previous transactions. Figure 2 depicts the remaining pharmacies and consumers as the normal node (Wallet) that may handle transactions.

Workers in the drug supply chain who deliver, trade, and inspect drugs would all be able to use the same digital signatures. It is recommended that the multi-signature G coin blockchain design certified by the NTU Help Center be used.

Workflow

From pharmaceutical makers to customers, makers send transaction data that is kept in the Gcoin blockchain. The chain verifies the digital signatures of the drug dealer and customer, as well as the drug's specifics (time stamp, location, and so on). The hashed data digest is then posted to the Gcoin blockchain (Figure 3). False information about unspent transaction outputs (UTXO) on the Gcoin blockchain prevents illegal distributors from giving clients with fake Drug IDs in exchange for fraudulent pharmaceuticals. Unauthorized personnel, on the other hand, are unable to utilize this system to purchase medications without a password.

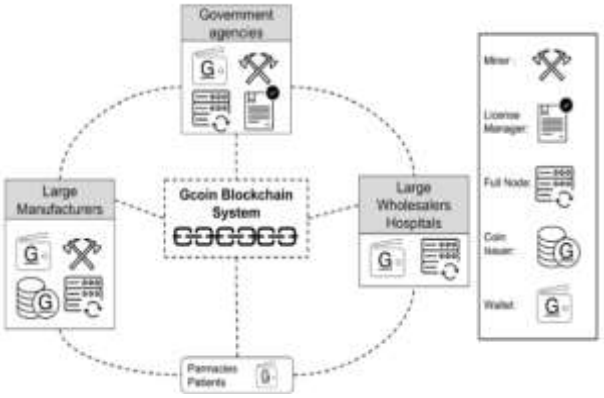

Figure 2. System structure and roles of participants.

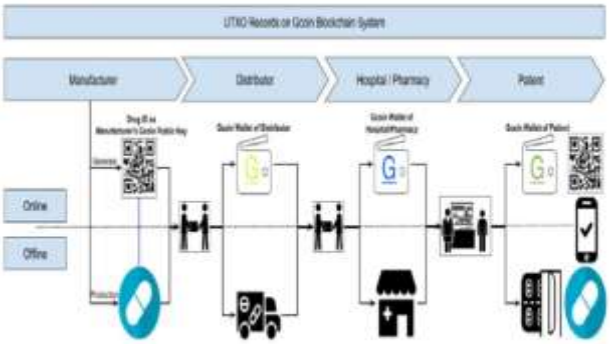

Figure 3. Workflow of the G coin blockchain system applying to drug supply chain.

The Performance of G coin Blockchain System

In a previous study, we demonstrated how the G coin blockchain system may be used in financial areas such as ACH. The typical throughput of ACH transactions is 17.5/26 transactions per second. Because it generates chains every 15 seconds, the G coin blockchain system can handle 1.51 million transactions per day. According to the 2015 report of drug usage analysis by the National Health Insurance Administration of Taiwan [15], the health insurance system utilizes 13,42 billion pharmaceuticals (3,397 items). Gcoin blockchain processing is sufficient for drug alerts that require the establishment and declaration of track and trace data for fewer than 100 items.

Transparency: the Trend of Drug Supply Chains Regulation

Trends in China

According to the Notice on the implementation of the opinions of Two Invoice System in the procurement of pharmaceuticals in public medical institutions (for trial) and Regular press release in January 2017 issued by the People's Republic of China's National Health and Family Planning Commission. Pharmaceuticals must first be distributed from manufacturers to distributors, and then to hospitals from distributors. There are two legal bills.

When obtaining pharmaceuticals, public healthcare facilities must simultaneously verify invoices, products, and accounts. The invoices from the distributor and manufacturer must be verified.

Trends in America

In 2013, the Drug Supply Chain Security Act (DSCSA) was passed. FDA guidelines and policy documents have been released. According to the DSCSA, all drugs in the United States must employ interoperable tracking systems. All parties participating in the medication supply chain must exchange transaction information regarding pharmaceutical goods trade and give instant transaction information as well as all manufacturer/repackager transaction information upon demand from a recognized body. In 2023, the DSCSA will develop a system for tracking pharmaceutical goods along the supply chain.

3. RESULTS

To ensure the safety and transparency of the drug supply, we propose a decentralized autonomous organization (DAO) regulation model, open governance, and the G coin blockchain system. All of these will make it simpler for people to share information.

Drug Supply Chain Security Issues

The purpose of managing medicine supply chains is to increase efficiency and benefit everyone by sharing logistics and financial information to encourage people to collaborate more. According to McKinsey & Company, the cost of supply chain activities accounts for around 25% of the entire cost of the medicine. pharma prices will fall as long as pharma corporations, the government, and medical associations collaborate more effectively.

A recent study compiled various remarks made by researchers about supply chain risk variables between 2003 and 2013. These issues include information infrastructure breakdown , information delays , lack of information transparency between logistics and marketing , lack of compatibility in IT platforms among supply chain partners , as well as Internet security .

Some of the foregoing hazards may be mitigated by the G coin blockchain technology, and drug supply chain prices may decrease as information is shared more efficiently.

Surveillance Net Regulation Model

Because the G coin blockchain can make the drug supply chain more dependable and clear, government groups may reconsider what they believe should be regulated and how. The proposed answer is the Surveillance Net regulatory paradigm, which is a hybrid of the DAO and open government models for government administration.

Open Government

According to the Organization for Economic Cooperation and Development (OECD), open government refers to a culture of governance based on new and long-lasting public policies and practices that promote democracy and growth for all. The foundation of open government is clear government, and the objective of open government is to hold the government accountable. To ensure that everything is apparent and that people are held accountable, an open government regulation framework requires accessible data. This article proposes that all G coin blockchain-protected medicine supply chain transaction data be made available to the public. Third parties,

businesses, stakeholders, and, most importantly, all patients who are legally permitted to view this drug transaction data are included. The Toxics Release Inventory (TRI) case exemplifies how open data has been used to aid in regulatory compliance in the United States. In the case of TRI, the American government made air pollution statistics available to the public. When firms realized they were being observed, they stopped producing hazardous chemicals. Finally, being open and honest is beneficial to public health.

G coin Blockchain System Smart Contract Applying to the Drug Supply Chain

smart contract refers to a computerized transaction protocol that executes the terms of a contract. When certain circumstances in the G coin blockchain system are met, the distributed blockchain system will run the contract code on its own. Many conditions for the drug supply chain can be configured on the G coin blockchain, including the names of buyers and sellers, the amounts of narcotics transmitted, and how frequently drug dealers are audited. A central authority cannot update a smart contract on the G coin blockchain until all full nodes in the G coin blockchain system agree on anything. DAO can now be used to run drug supply chains thanks to Gcoin blockchain technology.

Surveillance Net

The nature of the Gcoin blockchain allows for extremely open drug transaction data that is reviewed automatically as it passes through the drug supply chain. In addition to an open government approach, we propose developing smart contracts (programs that can run independently and control the DAO) and adding a service layer to the Gcoin blockchain. There are numerous methods for improving monitoring work. We'll offer you two examples:

To begin, the Gcoin blockchain technology restricts how many times a medicine can be sold from one address (account) to another. This prevents people from spending the same amount of money twice on drugs. All participants are also notified of each transaction, allowing any transactions that do not appear to be correct to be identified and terminated immediately in accordance with the smart contract's terms. Second, the government may utilize a pattern of transactions discovered through data mining to establish a risk rating or barrier. If a transaction or a company's trading practices fail to satisfy the risk threshold, the smart contract may send a notification to the appropriate government bodies requesting an inspection. The Gcoin blockchain system will then declare that the potentially unlawful transaction is invalid until the inspectors sent by the appropriate officials have examined the medications and provided their digital signature to certify the transaction. The risk standard is automatically updated based on the outcomes of each inspection case. To encourage more individuals to engage and be responsible, the risk benchmark or inspection regularity could be updated manually and on a frequent basis by all Gcoin blockchain system users via a voting method (Figure 4).

Anyone, including government officials, can use the Gcoin blockchain technology to monitor and trace pharmaceuticals throughout the supply chain, even without entering manufacturers, warehouses, or pharmacies.

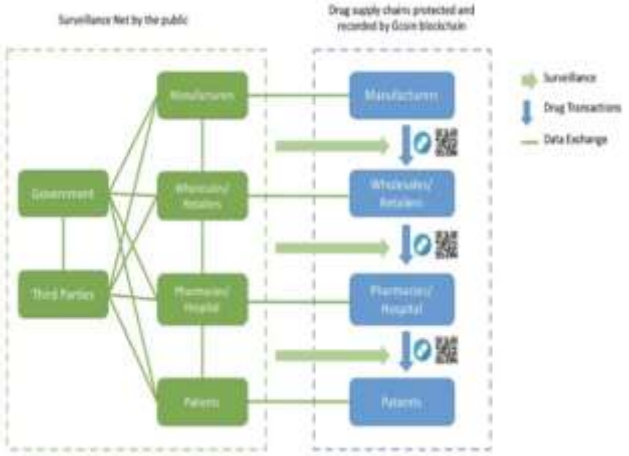

Figure 4. Surveillance net governance model of the drug supply chain.

4. DISCUSSION

Transparency may make evaluating and

monitoring the drug supply chain much easier and more effective. Because blockchain is a relatively new technology, laws and rules are still being developed. Even blockchain technology (for example, smart contracts and Blockchain 2.0) is evolving. This means that future cost-benefit evaluations will need to incorporate more regulatory effect analyses, system simulation stress tests, and stakeholder consultations.

5. CONCLUSIONS

The Groin blockchain has established and safeguarded data that cannot be modified and is based on consensus for the pharmaceutical distribution chain. The Groin blockchain has the potential to transform the drug supply chain from being overseen solely by government reports to being monitored by everyone in the chain.

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Conflicts of Interest: All authors have no conflicts of interest to disclose.

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