

Secure Blockchain Based Pharmaceutical Supply Chain Management

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Abstract— The importance of improving the distribution structure of the products has increased worldwide over the past few years. Distribution prices are therefore now disclosed and information about the product is shared with consumers. Distribution channels, however, are complex and supply chain management (SCM) is conducted autonomously in each company. For this reason it has been frequently pointed out that the method of distribution is not straightforward and the margin of distribution high. In this paper we propose a system that ensures drug delivery process transparency by implementing blockchain and monitoring portion of supply chain management systems. This approach enables businesses to monitor their trades by improving SCM transparency, thus preventing businesses from excessive profits. Moreover, by automatically storing delivery data in a blockchain network and handling information more efficiently, organizations can cut management costs. Therefore, businesses can minimize management costs by automatically storing delivery data in a blockchain network and handling information more safely. And our solution to this problem is to monitor the system right from the manufacturer to the customer, minimizing counterfeiting of the drug that the manufacturer produced. This system is mainly useful for the manufacturer as compare to other modules of the system.

Keywords: Blockchain, Information Security, Counterfeiting, Pharmaceutical Supply Chain

I. INTRODUCTION

In a recent report by the world health Organization, drug counterfeiting has been identified as a global problem. It estimates that in low- and middle-income countries, every 10th drug in market circulation is counterfeit or has a poor quality [1]. The use of such substandard products may have a negative impact on the mortality rate. Medicines move through a supply chain in which several participants participate. These usually include the manufacturer, wholesaler, retailer, pharmacist and consumer. They are engaged in the production, transportation and sale of these products There is also a key participant in these processes- the regulatory authority responsible for moving batches of goods throughout the chain at each level. At the state level in particular, this individual may be some approved body of the state apparatus, for example, a special agency for the monitoring of medicinal drug turnover.

The main task is to transfer the rights to produce pharmaceutical products in compliance with state standards and to control the movement of all units of goods ever produced. As for the user, there's another question drug regulation, which is provided by prescription only. Dispensing without a prescription is illegal, but regulating retailers ' integrity as well as for falsified drugs is not easy and requires a special approach

Many pharmaceutical companies have already begun application of blockchain technology in the management of the drug supply chain[2]. Blockchain is an electronic cryptographic ledger based on a decentralized model of the network in which information is distributed and synchronized among all the network nodes. This functionality is supported by a consensus algorithm implemented in the network to remove duplicate transactions problem, allowing nodes to check information truth before it is written directly to the registry. This system also has a high degree of fault tolerance. The criterion for the number of nodes failed before a complete failure of the network depends on the total number of nodes connected to the network. Therefore, the more nodes in the blockchain network run, the less likely a complete system failure occurs.A properly designed blockchain-based system will dramatically simplify the product turnover management process for approved government bodies[3-5].

At the same time, a decentralized approach has a number of benefits which increase the information security of such systems compared with centralized counterparts[6].The main characteristics and operating methods of blockchain systems will be discussed in section 1 of this study. Section 2 is dedicated to the study of the definition of the structured drug turnover control system with state-level regulation.

The goal of choosing this subject is to reduce the drug piracy created by the manufacturer and to provide transparency in the pharmaceutical industry's supply chain management.

II. LITERATURE SURVEY

Blockchain technology was developed specifically for making cryptocurrency (i.e. bitcoins) and other financial services. After some years of that invention, many more blockchain implementations were proposed in various fields, and blockchain became more effective after the introduction of smart contracts. Despite Blockchain's immense ease, proposals have been proposed to cope with its medication and healthcare apps. Benchoufi and Ravaud have clarified how blockchain is used to improve the additive effect of the standard of clinical research.We told about the overall use of blockchain in healthcare and medicine but there is no reason for the use of blockchain in the drug supply chain. Med Share is another research paper that has a reason to use blockchain technology in health care to share medical data from one individual to another in a secure environment [9].

Med Rec, a white paper released that proposes a framework for the collection and potential distribution of confidential medical data to researchers for study purposes. This provides a mechanism for storing patient data and making th is easy to access the data by integrating protection in blockc hain [10]. M. Mettler also discussed the use of blockchain in the pharmaceutical supply chain but lacks information

about implementation[11]. Besides that, several articles and academic journals on this topic have been published, Those interested in reading the papers can read it from the following references.[12][13][14].

Apart from hospital services, health care product supply chains are important contributors to the healthcare system. Various healthcare goods are marketed and traded differently and vary in quality, criticality to patient care delivery, and possible effect on service improvement (Zheng et al., 2006). Medicines account for 20–30 per cent of global health spending by healthcare products (World Health Organization, 2010). The United Nations Millennium Development Goals also describe the pharmaceutical industry as one of the healthcare sector's main engines. For the healthcare system, therefore, efficient management of the pharmaceutical supply chain (PSC) is essential. While activities at the consumer / physician level and health spending are areas of tremendous research interest in the pharmaceutical industry, supply chain management (SCM) and research and development (R&D) have also emerged as important research avenues (Narayana et al. 2012). However, Shah (2004) observes a low focus of healthcare research on the PSC, which historically addresses sales / marketing or discovery of drugs, which form the two extreme ends of the chain. Recent reviews are also limited to specific PSC issues such as optimization (Shah, 2004), just-in-time implementation (Jarrett, 2006) or issues in specific countries such as healthcare reforms (Yu et al., 2010), sourcing decisions (Pazirandeh, 2011), and so on. The research efforts on SCM in the pharmaceutical industry need to be reviewed, among other areas of research (Narayana et al., 2012). Thus, this study's overall objective is to include a systematic analysis of current trends in PSC management science.

The paper aims directly to:

- 1) Analyze the development of the research topic in recent PSC literature through study themes and across the PSC framework.
- 2) Analyze the research interest in pharmaceutical supply chains across geography and through methodological approaches applied in literature.
- 3) Explore the contribution of work in the pharmaceutical supply chain to final value provided to the end customer

III. PROBLEM DEFINITION

The production and distribution of counterfeit drugs is an urgent and increasingly critical worldwide issue, especially in developing countries. The market value of pharmaceutical counterfeiting has reached billions of dollars annually. One of the reasons for drugs counterfeiting is the imperfect supply chain system in pharmaceutical industry. Drugs change ownership from manufacturers to wholesaler, distributor and then pharmacist before it reach the customer. In current supply chain system, information is not shared between systems, manufacturers don't know what happened to their products, drugs regulatory authority has no visibility of the system, recalls are complicated and costly, and companies cannot follow-up patients. So, The proposed system will be used in pharmaceutical industry to track the drugs from its manufacturing until its delivery to patient.

After the usage of a drug, its effect on patient will be recorded to a database for future statistics. A permissioned blockchain will be used for storing transactions and only trusted parties will be allowed to join the network and push data to blockchain.

IV. IMPLEMENTATION

A key pair does not contain any clue about the participant, but additional information (e.g. name, contact or professional credentials) may be associated with this but the best approach is to keep this additional information off-chain and merge it with on-chain data (key pair) using IDs there.

1) Manufacturer Login

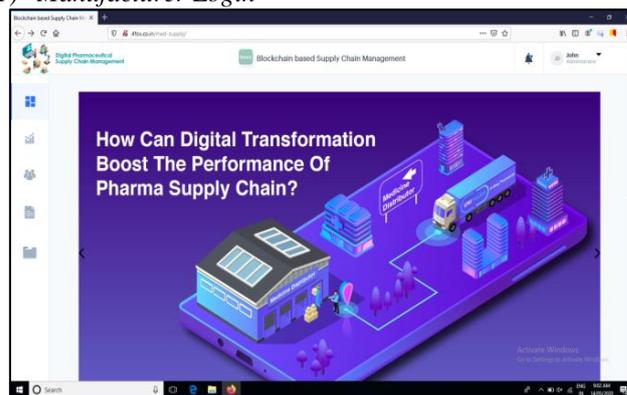


Fig. 1: Manufacturer Login

The participants would be the manufacturer, packager, distributor and doctor etc. in the sense of controlling the pharmaceutical supply chain. Growing of those participants will be listed on the network via their specific key pair. Drugs will be considered the properties, each of which will have a unique key (or hash). The ID will be attached in the form of QR Code with drug.

2) Company Report

The proposed framework can be implemented in various ways depending on one's needs, while keeping in mind the basic architecture. There are also several third-party APIs that can be used to transfer data and transactions to the blockchain network, some of which are available.. Every of these APIs provides various types of services. Whatever programming language or API we use, our system's basic architecture will be identical.

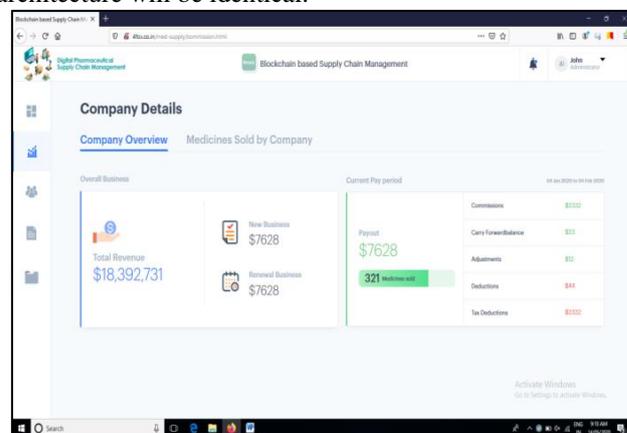


Fig. 2: Company Report

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