

## Implementation of Blockchain Technology in the Supply Chain Management of Pharmaceutical Industry: Bangladesh Perspective

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### Abstract

**Purpose:** In the pharmaceutical industry, a disrupted supply chain directly impacts patient health & safety results. Blockchain technologies can help improve the drug supply chain's privacy, reliability, data authenticity, and effectiveness. In this research paper, we have examined the prospects of employing blockchain technology in the supply chain management of the pharmaceutical industry in Bangladesh to detect counterfeit and low-quality pharmaceuticals. We have also discovered the mechanism of this technology's application in pharmaceutical activity.

**Methodology:** We have adopted a qualitative approach for our research and our data type is mainly qualitative. We have conducted a narrative analysis by reviewing the findings of numerous related research papers, case studies, financial reports, and other sources of data to discover blockchain related solutions.

**Findings:** The findings illustrate blockchain-based information systems' disruptive strength and role. It reveals that traceability and transparency are two of the most important advantages of using

blockchain technology in the pharmaceutical sector. Based on our findings, we have proposed a Blockchain Enabled Pharma Supply Chain.

**Practical Implication:** Data security is provided via encrypted data stored on a blockchain which is accessible only with a private key. Every transaction that has been approved is encrypted and linked to the preceding one. Rather than using a single server, data is stored over a network of computers. For which, hackers will have a hard time breaking into the system.

**Keywords:** Blockchain, Counterfeit medical products, Drugs, Fake Medicine, Healthcare, Medical, Pharmaceutical, Supply Chain, Transparency

## Introduction

Blockchain is one of the most popular and fastest-growing IT talents today. Globally, it is estimated that roughly 44% of businesses have used blockchain technology. Using cryptocurrency, blockchain technology enables customer-to-customer transactions while maintaining anonymity and security without the help of third parties. In other words, blockchain technology is the only means of direct transaction that does not rely on third parties via internet technology. Blockchain technology can ensure that records are accurate, tamper-proof, and come from a trusted source. Instead of keeping their own ledger/database, each stakeholder in a blockchain-based system receives access to a controlled and shared database, assuring consistency, correctness, and transparency. To amend a single transaction record, all future records would have to be changed as well, and the entire network would have to agree. Transactions in supply chains are likely to be more visible, resulting in enhanced transparency and confidence among stakeholders.

Blockchain facilitates data sharing without compromising anonymity, while also allowing pharmacists to authenticate the source of the medicine. By confirming the provenance of medicinal supplies, blockchain could offer pharmacists an adequate level of patient safety.

**1.1 Introduction to the Problem:** Bangladesh is not immune to counterfeit goods circulating in the country. Several pharmaceutical businesses' licenses have been revoked in the last five years due to suspicions of creating counterfeit medicines of poor quality. According to reports,

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counterfeit pharmaceuticals are distributed in Bangladesh across all distribution channels, including drug stores and major hospitals.

Consumers need access to product information across the supply chain, from manufacture to consumption, to dissuade criminal gangs from advertising, manufacturing, and selling counterfeit pharmaceutical items in Bangladesh. Blockchain has enormous potential to bring various transparency benefits if properly used in the supply chain of Bangladesh pharmaceutical industry. Blockchain, in combination with traditional technologies like RFID, barcode scanning, and mobile technology, can be used to track and trace pharmaceuticals from the time they are created to the time they are delivered to the patient.

**1.2 Significance of the Problem:** Adulterated or substandard medications account for more than Tk1,500 crore in annual sales in Bangladesh, accounting for 20% of total sales. A total of 370 incidents of fraudulent drugs were reported in the first half of 2019. Recently, 18 persons were detained for allegedly selling counterfeit pharmaceuticals that claimed to be the same as those imported from the United States and Canada.

The country's large network of unlicensed pharmacies, which number in the thousands, has made counterfeit pharmaceuticals easy to come by. Consumer mistrust and lack of confidence has resulted from the widespread use of counterfeit pharmaceutical items in Bangladesh. Bangladesh's objective to acquire 10% of the global generic market may be harmed because of this.

**1.3 Objective of the Research:** The goal of this research is to look at the possibilities of blockchain technology in securing patients' access to high-quality pharmaceuticals. The objective of this paper is to highlight a few key points:

- To evaluate the possibilities of blockchain technology in Bangladesh's pharmaceutical industry.
- To give an overview of blockchain's role in maintaining supply chain transparency.
- To determine the challenges associated with the use of blockchain technology in Bangladesh's pharmaceutical industry.
- To make recommendations on how to improve the pharmaceutical industry even further using blockchain.

## 2. Literature Review

Among the most successful business sectors of Bangladesh Pharmaceuticals will be the top of them. This sector is moving forward at a great pace to meet 98% of the medicine demand in Bangladesh. Bangladesh ranks 71 among 134 countries when it comes to the export of global pharmaceuticals export (Hossan, 2021). The Pharmaceutical industry contributes almost 1.83% of Bangladesh's GDP. And the market size is almost 3 billion USD. There are around 5300 registered brands and 4% meet the demand for anti-cancer drugs. Major players in this sector are Square, Beximco, Renata, Incepta, etc. Square leads the board with 16% % market share in terms of revenue. This industry has the potential to grow 15 percent every year and this can reach 51.1 billion by 2023 (Naik, 2022). Bangladesh is going towards self-sufficiency in terms of meeting the local demands which means we can produce enough medicine for the citizens of this country. According to Research and Markets, the pharma market will expand by 114 percent by 2025, which reach more than six billion dollars. Additionally, in the 2019-20 fiscal year, Bangladesh was able to make 136 million dollars by selling medications to 147 nations around the world. Bangladesh's pharmaceutical sector is currently attempting to grab around 10% of the global market. Six of the country's organizations have already received clearance from important regulatory agencies such as the World Health Organization (WHO), the World Trade Organization (WTO), and the World Intellectual Property Organization (WIPO). The remarkable transformation that drew the attention of the rest of the world to Bangladesh is the result of innovation in the fields of science and research and development (Chakma, 2020). SM Shafiuzzaman, secretary-general of the Bangladesh Association of Pharmaceutical Industries (BAPI) said that "Local businesses' capacities are growing, and they're expanding their facilities and investing in R&D, which will help the sector flourish," which represents roughly 250 local drug-marketers.

We must agree with the fact that the world is changing at a fast pace as new innovations in technology to make things easier for people are coming around every day. These technologies provide a wide range of services for different industries that can be useful to enhance performance, transparency, efficiency, and security. Blockchain is a technology that fits the description just

right. Blockchain is a database of data in blocks which are chained together. When a box is filled with data it gets chained to the previous data box (Intellectsoft, 2021). Blockchain's advantages speak for themselves. Whether it's drug development, research, and testing, or delivery to pharmacies, the pharmaceutical sector is one of the fields that deals with a lot of data. As a result, the solution's benefits may be able to assist the industry in overcoming some of the most pressing issues. Blockchain can increase traceability by expanding the supply chain's end-to-end visibility with data." Because the stakeholders verify the record's authenticity, blockchain has the advantage of not requiring a single central owner of all information, so companies don't have to share their internal systems or proprietary information; only the data needed to verify the record or transaction must be shared transparently across all supply chain participants (Wilson, 2021).

Blockchain can assist ensure that every stakeholder within the pharmaceutical manufacturing and supply chain has access to trustworthy, accurate data and a single dependable version of the truth. With data, it can improve the supply chain's end-to-end visibility. By providing all stakeholders with the same, real-time, accurate perspective of the supply chain, blockchain can help to break down barriers between them. This is a critical aspect in guaranteeing the durability of industrial and supply chains. The pharmaceutical industry's supply chain is complicated, with medications passing via different stages including distributors and wholesalers before reaching the customer. Manufacturers have little to no visibility into the legitimacy of their products across the supply chain. The counterfeit drug problem, as well as ineffective recall and return processing methods, are all consequences. These inefficiencies lead to financial losses and a loss of consumer trust (Schöner et al.,2017). Customers will be able to trace pharmaceutical products along the supply chain, making the blockchain a promising platform for increasing trust and transparency. A bar code could be scanned on a drug's packaging at any moment when the drug's ownership changes. Only authorized parties are allowed to make changes to the blockchain. The information is published in real-time on the blockchain. Manufacturers and end-users can read the history by scanning the bar code. The platform should, in theory, ensure drug identification, tracing, verification, and communication in the event that an unauthorized drug is discovered. Blockchain can help in the Bangladesh scenario too. It can ensure supply chain security, product recall management, cold chain management, transforming developing markets, and trade finance by

automating business logics and bringing efficiency. As a result, the circulation of blockchain will improve community health and build trust within the industry (Rahman,2022).

### **3. Methodology**

#### *3.1 Research Type and Source of Data*

We have conducted qualitative research for this study. Our main source of data is different research papers and case studies. We have also collected information from government websites, international websites, newspapers, financial papers, and other reliable sources. We will explore their findings, review, and analyze them and then propose a standard model.

Qualitative Data is mainly used in this research. As for the timeline of our collected data, we focused on information published from 2005 to 2021. Both the perspective of Bangladesh and other countries have been taken into account for analysis, evaluation and finally proposing a model.

#### *3.2 Data Analysis*

As we are focusing on qualitative research, it will be heavily based on the more descriptive and narrative aspect of the research, as currently Block Chain technology have not been applied, so there is not enough data available around it in Bangladesh, other than the government report, where there is planning on executing the Block Chain in RMG and business strategies existing in the country.

So based on the technology and its benefits, we can actually have business information secured online without the information being compromised. The data and information being stored online will make the business model to be more efficient. And this model will help to keep track of the products being manufactured, under development and ready to be sold. As a result, this research will make the concept more approachable.

Our research is authentic. Ideas and concepts can be adopted but not copied. This approach of our research is not similar to any of the prevailing research and reports. So, the research report prepared

is from our understanding of the business strategy. Our research is mainly the Normative analysis of why we must use Blockchain in pharmaceuticals.

### 3.3 Research Design

The goal of our research is to find the answer to question through qualitative narrative analysis of our collected secondary data, proposing a supply chain model using block chain technology and discuss the reasons of the importance urgency and challenges of incorporating blockchain in pharmaceutical's supply chain of Bangladesh.

The purpose of our qualitative research design is to discover the whys and hows of our research question. In addition, because data was compiled and documented in a written form, it was classified as subjective. We have not taken statistical approaches to assess the data we have collected for qualitative research. We will explore through the published results, reports, real-life applications, and others and then, we will propose a model based on our evaluation and analysis.

The study's progress is shown in the Gantt chart below considering weeks as the unit of time-

| Tasks No. | Particulars                                                                 | Week 1-2 | Week 3-4 | Week 5-6 | Week 7-8 | Week 9-10 | Week 11-12 |
|-----------|-----------------------------------------------------------------------------|----------|----------|----------|----------|-----------|------------|
| 1         | Establishing Research problems and Defining Research Approach and Questions |          |          |          |          |           |            |
| 2         | Collecting Research Data using selected Data Sources                        |          |          |          |          |           |            |
| 3         | Conducting Secondary Analysis                                               |          |          |          |          |           |            |
| 4         | Developing Model                                                            |          |          |          |          |           |            |
| 5         | Discussion and Recommendation                                               |          |          |          |          |           |            |
| 6         | Completion of Research writing                                              |          |          |          |          |           |            |

## 4. Analysis

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#### *4.1 Investigation and Evaluation*

Different research and studies on Block Chain in pharmaceutical's supply chain of different countries have been conducted. Block chain helps manage product integrity, medicine recall, safety warnings, traceability, and supply chain security from raw material through manufacture to final dispensing to clients. Tracking solutions with barcode scanners or RIFD provide a superior technique to ensure accuracy (Srivastava et al., 2019). Blockchain can be used in neurology, electronic health records (EHRs), genetic medicines, biomedicine, clinical testing, vaccine distribution and traceability in the pharma business (Jayaraman et al., 2019). It facilitates collection of data, storage, as well as recommendation, enhances medicine and vaccine traceability, enables brain augmentation and simulation, along with enabling transparent share of data during the clinical trial management system and also during drug recalls (Kirkner, 2018, Yong et al., 2019, Gurtu and Johny, 2019).

Tseng et al. (2018) describe a Gcoin blockchain system, wherein G stands for global governance, that primarily solves double-spending as well as counterfeit issues related with pharmaceutical supply chain management. It is a decentralized consensus-based network of nodes without a central authority to approve transactions. Bryatov and Borodinov (2019) proposed a relational model by analyzing the leading features of blockchain systems' functioning, followed by an investigation of a designed concept of a pharmaceutical turnover control system built on blockchain technology Hyperledger Fabric through Hyperledger Composer development environment while observing the Russian pharmaceutical product turnover market. Abbas et al. (2020) produced a Smart Pharmaceutical Industry system with two key modules: a blockchain-centered drug supply chain system and a machine learning-based medicine recommendation system for customers. In the first module, Hyperledger fabrics are used to create a medication supply chain management system capable of continually monitoring and tracking the drug delivery process throughout the smart pharmaceutical business. The N-gram and LightGBM models, on the other hand, are utilized in the machine learning module for suggesting top-rated or best drugs to pharmaceutical sector customers.

Additionally, the deployment of blockchain technology was explored with an emphasis on the data integrity, access, and management of health information in the biomedical field (Drosatos and Kaldoudi, 2019). Furthermore, blockchain technology seeks to eradicate the global trade in counterfeit medications by enabling easy and secure storage and exchange of data (Mackey and Nayyar, 2017). The issues of protecting the health supply chain seem well suited for blockchain deployment. Adopting blockchain can contribute to combating counterfeit drugs and positively affect health supply chain. Nevertheless, most blockchain initiatives are still proof-of-concept or pilot projects. Blockchain technology has the potential to improve this supply chain, but more research, evaluation, and policy alignment is required (Clauson et al., 2018).

#### *4.2 Proposed model*

It is notable that blockchain's innovation is about to fundamentally change the overall structure of diverse industries considering how this technology has progressed and continues evolving. The blockchain will find incredible opportunity within the pharmaceutical industry its focus on industrial development, product research and development, supply chain, manufacturing, and others (Puth, 2017).

The present Bangladesh pharmaceutical supply chain has been explored to establish a model. Haque and Islam (2018) stated that active pharmaceutical ingredients (APIs) along with other raw materials are largely imported. This industry's major players ship their pharmaceuticals via their own distribution routes to depots across the country, where their sales representatives pick them up and sell them to wholesalers or retailers. Small and medium-sized businesses sell their pharmaceuticals to wholesalers who pick them up from their factories. The current supply chain is depicted below-

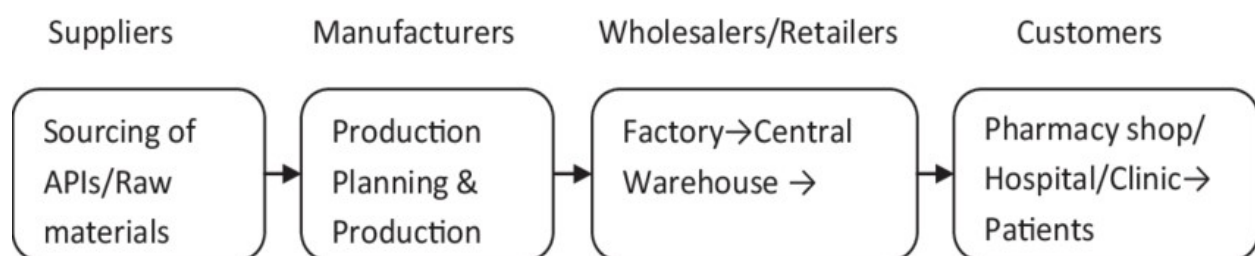


Figure: Pharmaceutical Supply Chain of Bangladesh | Source: (Haque and Islam, 2018)

Bangladesh is not exempt from the problem of counterfeit goods. Several pharmaceutical businesses have had their licenses revoked during the past five years due to charges of creating counterfeit or inferior drugs. Counterfeit pharmaceuticals are reportedly offered in Bangladeshi drug stores and top hospitals alike, according to reports. There were 370 cases in the first half of 2019 of fraudulent drugs. Recently, 18 persons were detained for allegedly selling counterfeit medications that claimed to be identical to those imported from the United States and Canada. As many as 80,000 unregistered pharmacies operate in the country, making it easier for counterfeit pharmaceuticals to enter the market (FinancialExpress, 2021). Consumers' trust has been shaken as a result of the prevalence of fake pharmaceuticals in Bangladesh. The best solution is Blockchain technology which can modernize this industry. Blockchain is vital in the pharmaceutical sector, as supply chain visibility, transparency, efficiency, traceability along with coordination are significant for delivering safe and effective goods. It will help with the industry's rules, policies, and privacy, as well as with worldwide regulations in general. As a result, pharmaceutical companies can use blockchain to track and trace their products. The proposed model for Bangladesh's Pharma Supply Chain is depicted below –

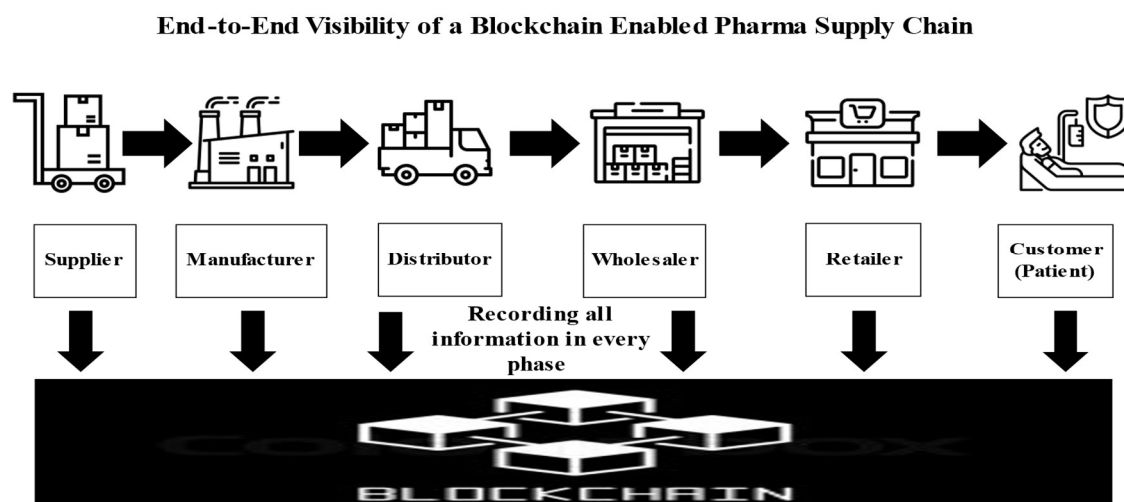


Figure: Proposed Blockchain Enabled Pharma Supply Chain

Because the entire system is not open, it is extremely difficult to track the occurrence of drug counterfeiting and drug quality in the conventional pharmaceutical supply chain. The product can be recognized with a global trade item number (GTIN), expiration date, as well as serial number using an IoT integrated blockchain system, which can be viewed by anybody connected to the supply chain network. The medications are handled as a digital asset in this approach, allowing organizations to monitor digital assets from the maker to the end client (Aich et al., 2019).



Figure: Workflow of Blockchain-Based Pharma-Applications | Source: (Khezzr et al., 2019)

Blockchain technology has four primary layers (healthcare raw data, blockchain technology, healthcare application, and stakeholders) (Khezzr et al., 2019) that have gained global recognition. The ledgers get automatically updated and both parts with dual information process faster. As an open-source technology, it is also regarded more transparent and less expensive. It is the most reliable technology that has no malfunctions at any step of information sharing.

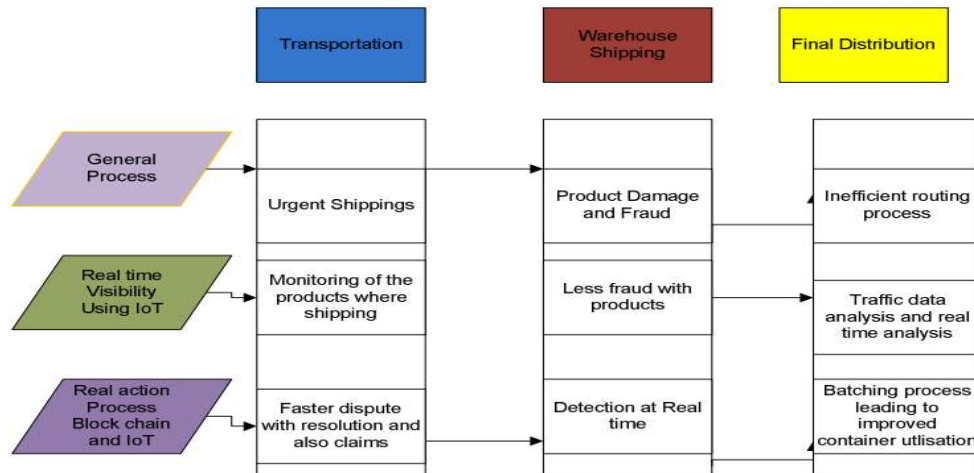


Figure: Crucial Arguments in the Pharmaceutical Sector are depicted using blockchain.  
Source (Premkumar and Srimathi, 2020).

The trustworthy functionalities make Blockchain technology a growing possibility for applications in various industries, namely healthcare and pharmaceutical supply chain processes globally. With the process of trusting the supply chain, these reliable features reduce the vast number of messengers. This increases the trustworthiness of the entire supply chain. With the advancement of technology, Blockchain looks to be created in a trust economy where the supply chain is paramount (Premkumar and Srimathi, 2020).

## 5. Discussion

Some of the benefits of Blockchain Enabled Pharma Supply Chain are as follows (FinancialExpress, 2021) -

- Supply chain security: Data security is provided via encrypted data collected on a blockchain which can only be viewed with an encryption key. Traceability enabled by blockchain technology aids in the verification of pharmaceuticals, resulting in the eradication of counterfeit drugs and the reduction of patient harm.
- Product recall management: In the occurrence of a manufacturer-caused recall, data storage on blockchain would aid in quickly accessing all important information about a specific

pharmaceutical batch. In addition, warnings are sent all through the network about pharmaceuticals that have been recognized as undergoing evaluation, investigation, or recall, preventing the items from being shipped or dispensed further.

- Transforming developing markets: The market in emerging countries is fragmented, with hundreds of manufacturers and large numbers of merchants. Authenticating pharmaceuticals and improving consumer trustworthiness by tracking them on a blockchain enabling transactional validity at smaller businesses.

There are many challenges and problems that have to be solved before the concept becomes widespread in all industries. Because blockchain has the potential to break down all boundaries and provide more efficiency, accountability, and transparency, garnering industry acceptance has become the most important hurdle for the technology. The involvement of intermediaries will aid in the technological advancement of the system and the revolutionization of business models. Within the organization, technological growth and exploration are continuously required. As a result, industries should embrace the concept of embracing new blockchain-based solution opportunities to proactively push organizations toward change. With the continuing rise of IoT facilitated data sharing, there is a major shortage of information on regulating difficulties and policy decisions, less growth in sharing data, a lack of awareness of the legislation in using IoT based data, and a lack of awareness of policy plans (Srivastava et al., 2019).

The possibilities and prospects for the pharmaceutical supply blockchain appear to be limitless, but still only time can tell whether the heavily controlled and specialized healthcare and pharmaceutical sector can fully utilize all of blockchain technology's capabilities. Technology has the potential to play a critical role in helping to alleviate the current health crisis while also speeding up the recovery of the economy. One of these technologies is blockchain. In the service and manufacturing sectors, blockchain technology has the potential to resuscitate Bangladesh's economy by enabling secure transactions around the world. Bangladesh is on the road of implementing Blockchain in different sectors including pharmaceutical industry. Bangladesh has made the first formal effort to acknowledge the need to investigate blockchain technology in effort to expand its technological ability, improve e-Government efficiencies, and stimulate creativity. They'd want to highlight our exceptional goal of guiding Bangladesh toward becoming a

blockchain-enabled nation. With this view in mind, National Blockchain Strategy delves into several components of the vision, with a special focus on developing strategies and setting various long, mid, and short-term goals to attain it (Ferdous and Sultana, 2020).

## **6. Conclusion**

Each year, almost 100,000 lives are lost worldwide because of the use of counterfeit drugs. They represent around 10% of the worldwide pharmaceutical market, causing the pharmaceutical sector to lose more than \$200 billion annually (Schöner et al., 2017). Patients stand to benefit by being able to independently verify products, which can be made possible by putting our solution into practice with blockchain technology's assistance. While patients may benefit from being able to independently verify items with the help of this solution, pharmaceutical supply chain participants may be able to significantly boost their efficiency in case of distributing verifiable pharmaceuticals throughout the country.

The study attempted to review different research papers and data sources and establish a Blockchain-Enabled Pharma Supply Chain for Bangladesh. Supply Chain Management has reached the era of big data, and blockchain is a disruptive technology. The effectiveness of global and local supply chain operations, data management, transparency, accessibility, and smart contract administration are all thought to be improved by blockchain. Blockchain technology has given companies, governments, and other organizations a competitive edge. By altering the way that personal information is maintained and how goods and services are acquired, it will make life simpler and safer.

Blockchain technology allows for the permanent and immutable recording of every transaction. This impenetrable digital ledger makes it impossible for fraud, hacking, data theft, and information loss to occur. The technology will have an impact on all industries, including manufacturing, retail, transportation, healthcare, and real estate as trillion dollars' worth of industries could be transformed by blockchain (Taskinsoy, 2019).. So, technology will be highly beneficial for our

industry as well. Our pharmaceutical industry will benefit greatly from the help of Blockchain technology. And our research encompasses around just that approach

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