# The Impact of IoT Supply Chain Integrated Blockchain Technology Advancements in the Healthcare Sector: A Literature Review

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## A B S T R A C T S

This literature review article focuses on an in-depth analysis of the Influence of Blockchain Technology Integrated with IoT in Healthcare Supply Chain. The purpose of this scholarly article is to formulate a strong hypothesis on how the advancement of blockchain technology affects the efficiency and effectiveness of supply chains in the healthcare sector. In order to achieve this goal, the research applied a meticulous desk research method, collecting references from various reliable online sources such as Google Scholar, IEEE, and other academic online media. The results outline the significant impact that the integration of blockchain technology and IoT can have in the context of the healthcare sector. The discussion in this article addresses how blockchain technology connected with the Internet of Things (IoT) can provide concrete benefits in optimizing the healthcare supply chain. The practical implications of the integration of these technologies are revealed in the form of improved operational efficiency, information transparency, more accurate product tracking, and reduced risk of human error.

## A R T I C L E   I N F O

## 1. INTRODUCTION

Technological advances that are increasingly developing have a good impact on human life. Human life today has begun to be unavoidable with technological advances, its influence varies from time to time where with its sophistication information can be accessed and spread without limits via the internet (Rais et al., 2018). Technology has begun to penetrate into various fields of life, not only information but also the health sector (Setiaji & Pramudho, 2022). The development of technology in the health sector provides a good change in facilitating all human activities. Various technologies have begun to be applied and researched in the health sector, especially in the supply chain.

The supply chain in the healthcare sector involves various stages that include production, distribution, storage, delivery, and finally consumption of healthcare products (Jamaludin, 2022). Information security, reliability, and accuracy are the main factors that define the success of the supply chain in the healthcare sector. However, challenges such as the risk of drug counterfeiting, efficient inventory control, and coordination between the various parties involved in the supply chain are often obstacles.

Supply chain technology in the health sector is one of the technological advances that continues to be developed in the health sector with the hope of helping human activities (Wibowo, 2020). For this reason, researchers continue to develop advances in Supply Chain technology in the health sector so that it can be applied as effectively as possible. This article will discuss the advances in supply chain technology in the health sector that have begun to be applied.

Blockchain technology and the Internet of Things (IoT) have an increasingly important role to play. Blockchain technology provides a secure and decentralized framework for recording, verifying, and storing transactions and information (Guustaaf et al, 2021). In the context of supply chains in the healthcare sector, it can be used to secure data related to the origin, distribution, and authenticity of healthcare products.

Combining blockchain technology with IoT allows physical objects, such as medical devices or medicines, to connect and communicate in real-time through the network. Data generated by IoT devices can be recorded and verified using blockchain technology, thus creating transparency and trust in the entire supply chain (Noor, 2020). For example, an IoT device attached to a medicine package can provide information about the temperature, humidity, and location of the product during the distribution journey. This data can be accessed by all interested parties, including manufacturers, distributors, authorities, and end consumers, with security guaranteed by blockchain technology.

The study of supply chain technology advancements, especially in the healthcare sector, needs to be studied as an important learning material. This literature review will investigate the impact of advances in blockchain technology integrated with IoT in improving supply chain efficiency, security, and transparency in the healthcare sector. Through a comprehensive literature analysis, this article will summarize related research results, identifying trends, challenges, and benefits associated with the use of this technology. The formulation of the problem that will be discussed in this paper to further focus on the literature review, results and discussion later, is "Does IoT-integrated blockchain technology affect healthcare supply chain technology". As such, this article will provide valuable insights for practitioners, academics, and industry players in the healthcare sector in understanding the transformational potential of integrating blockchain technology with IoT in optimizing supply chains and improving overall healthcare delivery.

## 2. METHODS

The method of writing this article adopts the literature review approach as the main foundation. In this approach, the author in-depth examined relevant theories and investigated sources in academic journals related to the advancement of supply chain technology in the healthcare sector. The review involved a careful analysis of scholarly articles that have proven credibility, as well as those that may not be well known in academic circles. Sources accessed included Google Scholar and IEEE (Institute of Electrical and Electronics Engineers) databases, with publication dates ranging from 2012 to 2022.

The main focus of the discussion is contained in the results and discussion section, where relevant concepts and theories are comprehensively analyzed. The emphasis on using reputable journals helps to ensure that the theoretical framework used as the basis for this article has a strong foundation. In the review, the authors formulate hypotheses that will serve as benchmarks to compare the results of previous studies. By adopting this method, this article aims to contribute more in-depth thinking in exploring issues related to the advancement of supply chain technology in the healthcare sector, as well as building a solid framework of understanding for further research in the future.

## 3. RESULTS AND DISCUSSION

### 3.1. Health Supply Chain Technology

The rapid development of communication and information technology has opened the door for the creation of an era of automation supported by various advanced innovations, such as applications for tracking assets or shipments in the context of logistics, as well as monitoring systems that focus on security and safety aspects (Eva et al., 2022). The healthcare industry, with its vital role in the provision of health services, is particularly a sector that utilizes the potential of information and communication technology (ICT) significantly.

In an effort to apply ICT technology in the healthcare industry, supply chain development is an area that invites attention. Advances in supply chain technology in the health sector provide a paradigm shift and facilitate the process for health workers in providing medical services (Premana et al, 2020). Healthcare supply chains consist of complex networks that stretch across organizational and geographical boundaries, which often become major obstacles in providing services essential to daily life. This phenomenon is exacerbated by the widening gap between the growing demand and available supply for high-quality, cost-efficient, and timely healthcare services (Jahatigh & Makmir, 2015).

However, it needs to be recognized that adopting technology in the healthcare sector presents a variety of challenges that must be overcome. The use of technology in the healthcare supply chain is not just about operational efficiency, but also changing the fundamental way in which healthcare is accessed and delivered (Liza at al, 2022). The adoption of these technologies can optimize the delivery process of medicines and medical equipment, ensuring that patients receive timely and quality care. In addition, technology-based approaches also have the potential to overcome geographical and infrastructural constraints that are often barriers in deploying healthcare services to remote areas.

Nonetheless, while harnessing the potential of technology, it is important to keep in mind issues of medical data security and patient privacy, and to ensure that these digital solutions cover the entire spectrum of society, so that no group is left behind in access to improved healthcare. With a deep understanding of these complexities, the application of technology in the healthcare supply chain can be a milestone in improving the quality of healthcare across different population levels and regions.

## 3.2. IoT Integrated Blockchain Technology

Blockchain technology integrated with the Internet of Things (IoT) framework plays a crucial role in overcoming the challenges faced by conventional systems in various industries (Aich et al., 2019). In the context of supply chains, the application of blockchain technology has undergone significant development, serving as a distributed computer system that stores transaction records from production to consumption in a decentralized manner. This approach enables the creation of a transparent and secure trace that can be accessed by all parties involved in the supply chain.

In addition, there are studies that focus on the application of blockchain technology in product traceability systems. In this scheme, each product has a record that is permanently recorded in a distributed ledger using smart contracts. This concept enables an accurate and reliable traceability system, where the history of product delivery and movement can be recorded precisely and irreversibly. Through smart contract cooperation, the process of product registration, delivery, and tracking can be automated and carried out with high transparency.

The use of blockchain in the supply chain shows great potential in improving efficiency, transparency, and security in product management. Integration with IoT technology broadens the scope and supports more timely and accurate information flow. However, despite the significant benefits, the implementation of this technology also needs to consider regulatory aspects, data security, and the involvement of all stakeholders in order to ensure the full success of this solution.

In addition to its application in product traceability systems, blockchain can also bring about a transformation in contract and payment management in the supply chain. Traditionally, transactions and contracts in the supply chain involve multiple parties, often resulting in complicated processes and potential uncertainty. By adopting blockchain technology, auto-executed smart contracts can facilitate and oversee the transaction process precisely and without the involvement of intermediaries. This can reduce operational costs, minimize the risk of human error, and speed up the process flow in the overall supply chain.

However, it should be recognized that the implementation of blockchain technology also presents a number of challenges. The technology's scalability, initial implementation costs, and unestablished regulatory approach can be barriers to mass adoption. In addition, due to the decentralized nature and the inability to alter data that has already been recorded, caution in designing and managing smart contracts is crucial.

Collaborative efforts between technology developers, regulators, and industry stakeholders need to be made to overcome these obstacles and ensure that blockchain technology truly adds significant value in improving overall supply chain efficiency and transparency.

Table 1. Previous Research

| No | Author (Year) | Review | Equation | Difference |
|---|---|---|---|---|
| 1. | Aich *et al*., (2019) | IoT's integrated blockchain-based supply chain system eliminates problems and makes the system more efficient and trustworthy by a varietyof automotive, food, and pharmaceutical industries | Blockchain-based supply chain systems are influential in healthcare | More focused on the health sector |
| 2. | Musamih *et al* (2021) | An Ethereum blockchain-based approach that leverages smart contracts and decentralized off-chain storage for efficient product traceability in the healthcare supply chain. | Etherium's blockchain approach provides secure transactions | Differences regarding the general utilization of blockchain technology |
| 3. | Sutandi, (2018) | Blockchain has many aspects and features in implementing healthcare big data management | Describes the features in blockhain in the field of health | Leading to the influence of blockchain usage on healthcare supply chains |
| 4. | Bodeis et al., (2021) | Blockchain implementation and integration in healthcare. | Describes the application and application system of blockchain in healthcare | Connecting with the supply chain |
| 5. | Chakraborty et al., (2019) | IOT and Blockchain as transaction management and access systems and also the right medium to put accurate and trusted data to serve with deliberate medical care and benefits to patients throughout. | Explain the usefulness of IoT and Blockchain in precise and accurate data access | Provides detailed blockchain-related information in the health supplychain |

### 3.3. The effect of advances in IoT integrated blockchain technology on the supply chain in the health sector

Advances in technology provide new innovations that enable health services and also the cure of diseases (Arafat & Wagino, 2019). The use of IoT and other smart equipment and systems means that smart healtcare continues to be developed to track drug shipments for example in the supply chain or to manage supply chain procurement using smart contracts. Blockchain technology can be a solution in solving problems in service when conducting the procurement process in hospitals to transact with suppliers and distribution partners to make it easier and save costs. The blockchain technology allows sharing data to be easy because every member in the network receives a copy of all valid transactions that occur on the network. Transactions are added in blocks where each block stores a list of valid transactions (Omar et al., 2021).

The benefits of IoT blockchain in a supply chain are as follows (Kshetri, 2017 ; Aich 2019):

(1) Tracking information: Blockchain is irreversible and immutable whichhelps in the process of sharing information among atasan to ensure the product is in good condition
(2) Accessibility of information: Blockchain is transparent which can help the processof checking large da ta during the supply chain process
(3) IoT can assist in connecting information and material flows in supply chainnetworks to improve efficiency
(4) Reducing code of conduct and fraud violations: the existence of transparentfeatures on the blockchain can hinder the process of detecting fraud in everysupply chain activity

The benefits of Iot blockchain in the supply chain, especially in the health sector, based on the general explanation above are as follows:

(1) Accurate and Transparent Tracking: The integration of IoT and blockchain enables the tracking of medical products and equipment with a high degree of accuracy. Each product can be equipped with sensors that collect valuable data about its location, temperature, humidity, and other conditions. This data is automatically recorded in an immutable blockchain, ensuring that the tracking information remains accurate and reliable. This is crucial in ensuring the quality and safety of healthcare products during their entire journey in the supply chain.

(2) Information Transparency and Reliability: Blockchain technology brings transparency to the entire healthcare supply chain. Every transaction or data change that occurs within the network is visible to all authorized parties. This reduces the risk of human error and ensures that any health product-related information, such as source, production date, and distribution journey, can be verified easily and quickly.

(3) Product Quality and Condition Monitoring: With IoT sensors attached to healthcare products, parties involved in the supply chain can monitor product conditions in real-time.

This information helps in detecting changes that could potentially damage product quality, such as inappropriate temperatures or adverse environmental changes.

(4) Data Security and Anti-Fraud: Blockchain provides a high layer of security to data and information in the supply chain. Information recorded in blocks cannot be changed without the consent of all parties involved. This helps prevent fraud and data manipulation, resulting in a more trusted and fair business environment.

(5) Operational Efficiency: The integration between IoT and blockchain can improve efficiency in supply chain processes. Real-time and verified information enables faster and more informed decision-making.

The integration of IoT and blockchain in the healthcare supply chain results in a more trusted, efficient, and secure system. The quality and accessibility of health products can be improved, and the risks associated with distribution can be better managed, leading to better and more responsive healthcare for the people.

## 4. CONCLUSION

In an era of technological advancement, challenges and changes are emerging in various aspects of life, and one of the areas that has been positively impacted by these developments is the supply chain in the healthcare sector. Through the analysis of the problem statement, literature review, and discussion, it can be concluded that technological development plays a crucial role in the transformation of supply chains in the healthcare sector, with blockchain technology as one of the clear examples of how this innovation can shape significant changes in optimizing processes and services in the healthcare industry.

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