



# Advancing Technology in Healthcare Supply: A Review

Aulia Zikri Rahman<sup>1\*</sup>, Caesar Seta Pandega<sup>2</sup>

<sup>1,2</sup>Logistics Engineering Universitas Pendidikan Indonesia, Indonesia

Correspondence: E-mail: [azikrirahman@upi.edu](mailto:azikrirahman@upi.edu)

## ABSTRACTS

Supply Chain Management has an important role in healthcare services, including in Indonesia where the majority of raw materials used by the pharmaceutical industry are imported. From the world perspective, Indonesia's pharmaceutical and healthcare industry is known to be very expensive. The Indonesian government has struggled to control the pharmaceutical industry due to its complexity. Too many players that take roles in this industry are also extending the supply chain flow thereby increasing the price to be paid by the end customer (patient). In this era of globalization, technology has played a role and helped human life in almost all aspects, including the health and pharmaceutical service sectors, therefore it is hoped that the use of advanced technology can be a solution to overcoming the complexity in Indonesian health services.

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## 1. INTRODUCTION

The development of technology during the current era of globalization is undeniably very fast (Singgih, E, et.al., 2020; Sugita, I. W., Setini, M., & Anshori, Y., 2021). There are also many innovations using advanced technology in people's daily lives in all fields, including the health service sector. Health services have an important role in improving the welfare of the community in its continuity, Health services cannot be separated from procurement activities and Material Requirement Planning (MRP) in the supply chain of medicines and medical devices (Malindzakova, M., Garaj, P., Trpčevská, J., & Malindzak, D, 2022). Procurement and MRP activities in health services certainly require special handling to ensure the availability of medicines and medical devices in these health services to end customers (patients) (Romain G., Caroline T., and Paweł, 2017; Ulewicz R., Nowakowska G., and Jelonek D., 2015) .

In Indonesia itself, the availability of medicines in health services is still often experiencing problems, for example, the availability of generic drugs that are difficult to obtain both in hospitals and at pharmacies and drug retailers (Anggriani, Y, et.al, 2020). This indicates that the supply chain of medicines in health services in Indonesia is still not working efficiently. In this case, technology integration has begun to be emphasized by all parties involved in the healthcare supply chain that is expected to be able to support procurement activities in health services at cost-effectively, availability of medical equipment and needs, as well as improve the performance and safety of medical services. This article reviews the influence of advancing technology in healthcare supply and some examples of advancing technology in healthcare supply: EDI, blockchain and electronic media.

## 2. METHODS

This paper used a systematic literature review method that refers from articles from back two decade period that found on IEEE Explore and Indonesian local university journal site. This review was processed by searching, selecting, relevance screening, and finalized picking and review references were found through the searching process, and finalized using 10 articles references as main after relevance screening process.

**Table 1.** The used literature reference about advanced technology in healthcare supplychain as main sources

Writer	Title	Topics
Fiaidhi, M., & Mohammed, S. (2018)	EDI with Blockchain as an Enabler for Extreme Automation	-The usage of EDI in supplychain -The usage of blockchain in supplychain -Blockchain advantages in healthcare services
Varma, D. T., & Khan, D. A. (2014)	Information technology in supply chain management	-Application of EDI and other emerging technology in supplychain
Mustamu, R, H. (2007)	Supply Chain Management in the Pharmaceutical Industry in Indonesia	-Pharmateucal MRP problems in Indonesia -Advanced technology integration approach in MRP

Yani, A. (2018)	Utilization Of Technology in The Health Of Community Health.	-Electronic media in healthcare services -How electronic media can help patient
Kitsiou, S (2007)	Evaluation of Integration Technology Approaches in The Healthcare Supply Chain.	-Advanced technology in healthcare supplychain classification -EDI integration in supplychain
Jeyaraj, A., & Sethi, V. (2012).	Implementation of Information Systems Infrastructures for Supply Chain Visibility in Organizations	-The usage of direct EDI link in B2B purchase of supplychain activity
Gamage, H. T. M., Weerasinghe, H. D., & Dias, N. G. J. (2020).	A survey on blockchain technology concepts, applications, and issues	-Framework of blockchain technology
Trautmann, L., & Lasch, R. (2020)	Smart Contracts in the Context of Procure-to-Pay	-Smart contract in supplychain bussiness
Zheng, J., Bakker, E., Knight, L., Gilhespy, H., Harland, C., & Walker, H. (2006).	A strategic case for e-adoption in healthcare supply chains	-Usage of electronic media in healthcare supply chains
Omar, I. A., Jayaraman, R., Debe, M. S., Salah, K., Yaqoob, I., & Omar, M. (2021)	Automating procurement contracts in the healthcare supply chain using blockchain smart contracts	-Usage of automation procurement using blockchain smart contracts in healthcare supplychain

### 3. RESULTS AND DISCUSSION

The large population of Indonesia, accompanied by their low purchasing power, often causes health problems to not be a top priority. In the context of the pharmaceutical industry, processes along the supply chain are highly dynamic (Moosivand, A., Ghatari, A. R., & Rasekh, H. R., 2018). As a result, control over all of these supply chain channels is much more difficult than for other manufacturing industries. The longer and more dynamic the supply chain, the more important forecasting and demand planning activities (Boone, T., Ganeshan, R., Jain, A., & Sanders, N. R., 2018). In each part of the distribution chain, pharmaceutical wholesalers have the potential to attract margins of 16 percent, sub-distributors and wholesalers each between 15 percent and 16 percent, and retailers move between 20 percent and 35 percent. Of course, the length of this supply chain greatly burdens consumers with the high selling price of pharmaceutical products (Mustamu, R, H., et al. 2007).

If we refer to the often bitter experience of Indonesia, now is a very good time to explore how the MRP approach and the use of technology in the health care supply chain can actually bring about change for the better. The use of technology-based MRP provides an opportunity for the presence of pharmaceutical products at lower prices through process efficiency and the pharmaceutical industry's work path without disrupting the business performance of the pharmaceutical industry's major players by shortening the supply chain.

The advanced technology integration approach is involved in the transportation and delivery of supplies to healthcare providers, such as ineffective inventory control and material management, inadequate purchase orders, inefficient product movement, redundant processes, and distorted information flows. According to (Kitsiou, S., et al. 2007), broadly speaking, the integration of advanced technology in health services is grouped into 3 parts, namely: Message-Oriented Technologies, include Electronic Data Interchange (EDI), XML, and

the HL7 standard, which facilitates message communication among different applications through a communication server Object-Oriented Technologies, These include Common Object Request broker architecture (CORBA) and the Distributed Healthcare Environment (DHE)/Healthcare Information System Architecture (HISA) Web Services include the Simple Object Access Protocol (SOAP), WebServices Description Language (WSDL), and Universal Description Discovery Integration (UDDI).

### **3.1 Existing Advanced Technology Advantages and Its Impact in Healthcare Supply**

#### **3.1.1 EDI**

According to Jeyaraj & Sethi (2012) electronic data exchange can ensure greater accuracy and prompt notification that enables computers to connect directly with one another rather than sending faxes or emails for each unique event. By adding a portal or cloud layer that partners may safely access without a data integration solution, electronic data exchange can expand to include other collaborating partners. The electronic exchange of structured data between organizations is known as Electronic Data Interchange (EDI).

The use of EDI has revolutionized business-to-business and business-to-consumer communication and ensured that data is protected from human mistake. EDI has emerged as the standard language for exchanging files and data, including activity data, purchase orders, and notification of shipment and billing (Varma, D, T., Khan, D, A., et al. 2014). Without requiring human participation, this procedure can be utilized to transfer electronic files or business data from one computer to another or between trading partners. Through the use of the internet, the EDI procedure offers the chance to manage MRP to the smallest outlets (e-commerce). chance to make the healthcare supply business supply chain shorter. Due to improved speed and precision and a reduced need for work activities, this idea not only saves time but also considerably reduces expenses. Because electronic data processing enables the availability of "tailor-made" processes, using EDI in the healthcare sector enables businesses to offer "personal services" (Fiaidhi, M., Mohammed, S., et al. 2018).

#### **3.1.2 Blockchain**

Blockchain systems form a decentralized ledger, a type of database that is stored in several different physical locations. Processing is distributed among multiple stakeholders, and each party receives real-time updates in a completely secure system. These aspects make a decentralized ledger an ideal system for the creation, issuing, and execution of contracts that can help protect business models and enable collaboration (Gamage, et al. 2020). However, blockchain is not an alternative to EDI systems, although it offers away for trading partners to communicate quickly and clearly without the risk of errors or repudiation.

Consider about how EDI system transactions normally involve a buyer, a seller, and a third-party logistics company. Transactions using an EDI system rely on one-way, point-to-point communication, in which only two of the three parties can communicate with one another. Because blockchain is a shared ledger, all activity is visible to all users. Repudiation would not be necessary, disputes would not arise, and knowledge sharing would be far more effective (Trautmann, L., Lasch, R., et al. 2020.).

The security and integrity of distributed networks is another benefit of blockchain technology (Habib G., et.al., 2022). Blockchain is finding more and more applications in fields like energy and freight, despite its origins as a financial industry disruptor for the decentralized digital currency Bitcoin. However, the usage of blockchain for an industry like healthcare bring us many beneficial advantages. Among these advantages are the following :

1. Transparency and collaboration. Blockchain is a reliable method for capturing and sharing transactional data with stakeholders along the supply chain. The system functions without a single administrator or centralized database.

2. Medical data management. Medical data can be linked across systems and stakeholders thanks to blockchain technology. The Medical Record system serves as an illustration of how well blockchain works for managing healthcare data. Medical Record aims to enhance electronic medical records by enabling secure provider access to patient information. Giving consumers and their healthcare providers access to their complete medical history across all providers they have ever seen is the aim of this project. Additionally, the data would be shared anonymously for research purposes if patients choose to allow researchers access to their individual medical records, which could hasten the development of new medical treatments.
3. Scalability and availability. Blockchain 2.0 is solving the scalability issues for writing transactions. Anyone worldwide can access the decentralized datasets. Security and privacy. Establishing a trust network depends on the healthcare system as an intermediary to establish point-to-point sharing and bookkeeping of the exchanged data.  
A node does not have to reveal the physical identity of the person or organization and the payload can have a digital signature with private cryptographic keys.
4. Patient–provider relationship contract. This contract links two nodes in the system, where one node stores and manages medical records for the other. This relationship could exist between a particular care provider and a patient, but extends to cover any pairwise data stewardship interaction.
5. Summary contract. Each member of the system can use this as a trail of breadcrumbs to find a summary of their connections to other members. A collection of references to contracts governing patient-provider relationships are encoded in the summary contract, revealing both ongoing and concluded interactions with other system nodes. Each relationship also keeps track of a "status" variable that shows when it was formed and whether the patient gave consent.
6. Reduced transaction costs. The use of near-real-time processing would make the system more efficient. Blockchain uses a smart contract, which stores the ground rules of the contract, automatically executes the contract, verifies its compliance, and evaluates the outcome without the need for a third party. Smart contracts are visible to all users and remove the need for a middleman. The supply-chain industry needs smart contracts for the next generation of global distribution systems. As an example, a smart contract starts when a patient schedules surgery (Fiaidhi, M., Mohammed, S., et al. 2018). At this point, the contract sets up the blockchain's foundation and mines for further caregiver nodes that are related. Caregiver partners join the private blockchain, where all partners are a part of a community of practice and no one individual is the data's owner. The blockchain allows for the writing and reading of data by all parties. The consortium can verify the information that partner A enters into the blockchain. The data can be shared with other nodes, including remote repositories, when it has been verified. An EDI and blockchain communication protocol are both used by a smart contract, which is pre-written code.

### **3.1.3 Healthcare Electronic Media**

There are various forms of electronic media, including the internet, television, SMS, and cell phones, that can be used to spread health messages or information. Electronic media's multifaceted role within the healthcare supply chain is notably exemplified by its ability to empower patients with unprecedented access to pertinent information. The integration of electronic media has fostered an environment where patients can effortlessly glean insights into drug availability, health service schedules, and self-service options through user-friendly

health service websites. This equips individuals with the tools they need to make informed decisions about their healthcare treatment. Notably, the utilization of SMS reminders stands as a striking testament to electronic media's efficacy in remind patient compliance by gently nudging them to attend to medication regimens and health control programs. (Yani,A., et al. 2020.).

Electronic media also make it easier for the procurement team to communicate and negotiate when determining medical needs without having to present all of the information at once. For procurement teams, electronic media represents an invaluable conduit for streamlined communication and negotiation. Gone are the days of presenting overwhelming volumes of information at once; electronic media offers the advantage of asynchronous communication, enabling procurement professionals to engage in meaningful discussions regarding medical needs without time constraints.

This enhanced communication flow, underpinned by the immediacy of electronic media, accelerates decision-making, reduces costs, and optimizes the allocation of resources for healthcare service and procurement. An very effective way to reduce costs and time when communicating about healthcare service and procurement is through electronic media (Zheng, J., et al. 2006).

#### **4. CONCLUSION**

The advanced technology integration approach is involved in the transportation and delivery of supplies to healthcare providers, such as ineffective inventory control and material management, inadequate purchase orders, inefficient product movement, redundant processes, and distorted information flows. The usage of advanced technology like EDI, blockchain and electronic media can solve the both healthcare procurement and sevice problems and forming an effectiveness due to shortenen process of supply chain, reduced cost, and end customer (patient) services.

In conclusion, the integration of advanced technologies like EDI, blockchain, and electronic media into healthcare procurement and services presents a transformative opportunity to withstand long-standing issues in the supply chain. By aiming inventory control challenges, enhancing transparency through blockchain, and streamlining communication via electronic media, healthcare providers can achieve a more efficient process, cost-effective, and patient-centric supply chain ecosystem. As the healthcare industry continues to evolve, embracing these technological innovations will be pivotal in ensuring the delivery of high-quality care while optimizing resource utilization and ultimately improving patient outcomes.

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