A literature survey on healthcare supply chain management

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Abstract
Supply Chain Management (SCM) is a practice that has rapidly spread across industries. SCM may boost output while simultaneously satisfying customers. Despite SCM's recognition as a key factor in enhancing healthcare efficiency, widespread adoption remains in its infancy. Hospitals, a crucial element of the healthcare supply chain (HSC), have failed to fulfill the primary goals of lowering costs and providing high-quality treatment due to their inadequate knowledge of supply chain management (SCM). This research was conducted to fill in the blanks in the current HSC literature. Achieving the healthcare supply chain's goal of reducing costs will be greatly aided by the thorough literature study completed for this report. This review of healthcare supply chain management can quantify the benefits of supply chain initiatives and identify opportunities for improvement. Healthcare institutions can make informed decisions on optimizing their supply chains by understanding customer and supplier needs. This includes making strategic decisions on how to improve inventory management, streamline processes and reduce costs. The focus of this study is on the relationship between supply chain practices, the efficiency of supply chain performance, and the financial outcomes for healthcare organizations. By highlighting certain key research issues that are shared by supply chain management and healthcare management, this article contributes to the literature in both areas.

Keywords
Supply Chain Management (SCM), healthcare, Healthcare Supply Chain (HSC), supply chain performance (SCP), organizational performance (OP), healthcare organization, hospital supply chain, safety practices

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I. Introduction
Most businesses nowadays employ some form of “Supply Chain Management (SCM)”. The “healthcare industry” has struggled with rising prices for decades. Researchers and practitioners alike have been giving more attention to different supply chain techniques for SCM to adapt to the ever-shifting nature, context, and requirements of the industry. Supply chain strategies allow healthcare systems to strategically manage and continually control their targets, making them a crucial management tool and the engine for success. In addition to lowering the overall quantity of resources needed to deliver the requisite level of customer service, efficient SCM may boost customer satisfaction by lowering prices and increasing product availability, and decreasing the time it takes to place an order. The growing importance given to creating and preserving beneficial connections with channel partners—who might include “suppliers, middlemen, service providers, and even customers”—can be credited with SCM’s rise to prominence. The supply chain of a hospital is very different from a regular manufacturing supply chain. It’s a convoluted system that relies on a constant stream of goods and services to meet the demands of its service providers. High operational efficiency in the healthcare industry is impossible without the adoption of “Supply Chain Management (SCM)” procedures due to the industry’s vast product diversity, fluctuating product life cycles, growing outsourcing, emerging IT trends, and widespread corporate globalization. Implementing “healthcare supply chain management (HSCM)” is more challenging since it is a matter of someone’s life, just as healthcare organizations and hospitals must carry out incredibly precise activities. However, it was noticed in the literature that the supply perspective is not thoroughly investigated and explored when it comes to the implementation challenges of HSCM procedures. Healthcare service redesign and healthcare program implementation are common practices in this setting with the goals of maximizing the efficiency of available resources and improving the quality of treatment provided. In the past decade, numerous impressive literature reviews have emerged in fields related to healthcare to better utilize resources and improve healthcare service. These disciplines include, among others, “decision-making, cold chain, internal medication distribution, operations, management roles, operation research, and outsourcing, agility, and facility maintenance management”. However, each study was conducted independently. Healthcare supply chain (SC), pharmaceutical supply chain (SC), hospital supply chain (SC), drug supply chain (SC), lean supply chain management (SC) in healthcare, and agile supply chain management (SC) in healthcare are all terms that have been used by researchers in their studies of SC in the healthcare sector.

This research follows the following structure: Section II contains the healthcare supply chain. The challenges facing healthcare supply chains are described in Section III. Section IV contains the vital role of supply chain management in the healthcare industry.

II. Healthcare supply chain
Improve therapeutic results and keep costs down by using the HCSC, which was defined as data, tools, and cash flow across the supply chain from manufacturer to customer. The Healthcare Supply Chain Consortium (HCSC) is an innovative approach to improving therapeutic results and controlling costs across the healthcare supply chain from manufacturer to customer. By leveraging data, tools, and cash flow, the HCSC provides the necessary resources to ensure that healthcare products are delivered effectively and efficiently. The focus of HCSC is hospitals. Whether an organization is for-profit or nonprofit, it can be categorized as a service provider. The healthcare value chain comprises five primary players. They function as providers, buyers, sellers, product intermediates, and financial mediators. Numerous kinds of research evaluated the effectiveness of the HCSC in terms of costs, and supply chain management is suggested in the literature as a strategy for lowering costs. Healthcare provides performance measures for operations such as ordering and inventory management, receiving, storage, and replenishment because it acknowledges the value of “supply chain performance” assessment in the “healthcare industry”. It emphasizes how crucial internal client satisfaction is to the healthcare supply chain. They point out that techniques like internal customer satisfaction surveys can result in changes in healthcare delivery, which eventually enhance the entire performance of the supply chain. We used five healthcare-inspired metrics to evaluate the performance of the supply chain. These include i) adaptability, ii) integration, iii) patient response, iv) physician performance, and v) partnership quality, and via these aspects, an integrated model was developed. HCSC is viewed as a networked constellation made up of medical professionals, advisors, experts, hospitals, clinics, pharmacies, and health-related plans. This constellation’s overarching goal is to contribute value via cooperation. Customer value in the healthcare industry is produced by suppliers, clients, hospital staff, strategic partners, and others via mutual collaboration, coordination, and teamwork. Each care bundle in the healthcare supply chain is made up of resources that are supplied and used by actors including suppliers, clients, hospital staff members, business partners, and others that collaborate to add value for the client. Due to interdependencies across several business partners in the supply chain, there is an increase in the creation of customer value. The healthcare supply chain is highly interconnected, with multiple business partners providing essential services, supplies, and support to ensure the successful delivery of patient care. This interdependency has resulted in an increased focus on customer value and experience. As businesses increasingly rely on each other for the delivery of services, products, and support, there is a greater emphasis on creating a seamless customer experience that maximizes the value of the services and products.
delivered. To create customer value, healthcare supply chain partners focus on improving customer experience through improved customer service, better product quality, and increased product availability. By optimizing the customer experience, healthcare supply chain partners can ensure that they can provide the best possible care to patients and maximize the value of each transaction. Additionally, by creating a positive customer experience, healthcare supply chain partners can drive customer loyalty and build strong long-term relationships with their customers.12,25

III. Challenges facing healthcare supply chains

There was a lot of progress made in the supply chain industry throughout the 1990s. Given the importance of logistics in modern society, this invention was based on that field. Up until that point, it was thought that managing, storing, and transporting things was the organization’s agenda.25 The majority of practitioners, consultants, and academics believe that the ideas of supply chain management and logistics management are similar.15 The notion of Supply Chain Management (SCM) has recently been reframed from the integration of logistics throughout the supply chain to the integration and management of essential business activities throughout the supply chain. The new SCM concept focuses on the use of effective management practices to reduce production costs, maximize customer service levels, and increase market share in a competitive global marketplace. SCM has been reframing since the early 2000s, as organizations began to recognize the need for a more comprehensive approach to the management of their supply chains. Consequently, the SCM concept has become a critical component of an organization’s strategic planning process. Furthermore, the focus on SCM has allowed organizations to access new markets, expand their competitive advantage, and reduce costs.14,15

A. Supply Chain Planning

Wieland examined hospital-supplier cooperation in the healthcare supply chain to determine common goals and strategies for reaching them.17 In that trial, some businesses pooled resources to pay for full-time professionals to oversee logistics.18 The results of the study suggested that improving patient care may be achieved by collaborating with other organizations. The two companies weighed the merits of sharing information and learning about one another’s operations.19 The authors highlight the difficulties and constraints of blockchain technology implementation while outlining the potential advantages in supply chain operations, such as better transparency, improved efficiency, and lower prices. The article further discusses the need for additional studies to fill in knowledge gaps and establish best practices for the supply chain implementation of blockchain technology.20 By reducing the time and effort spent searching for a suitable alternative to an out-of-stock item, these delay management strategies can enhance patient care. Their focus was on pharmacists’ roles in both primary and secondary care settings. According to Yu et al., and Queiroz et al., to achieve patient outcomes at the lowest feasible cost, medication management should be a collaborative effort between patients and clinicians that considers all aspects of patient usage.20,21 To aid the new service in identifying areas that may be improved as part of the ongoing process of hospital quality improvement,22 they propose an integrated management of pharmaceuticals within the hospital that seeks to cover the main components and analyze the effect of their administration. Researchers considered the whole course of a patient’s hospitalization; from the moment they were admitted to the moment they were discharged.

B. Demand Forecast

Several factors, including the nature of the injury, the patient’s age, and the patient’s financial situation, among others, contribute to an inaccuracy in the demand forecast for materials and medications, as stated by Venkatesh et al.23 This is especially true in the case of medical supplies, where different types of supplies are used on different schedules depending on the individual’s condition. For this reason, people frequently rely only on their expertise while shopping for medical products. Due to the ambiguity in how demand is defined, Rowan et al., found that there are occasionally surpluses and other times there are shortages of medical supplies.24 To address this issue, they first suggested using the Activity Based Costing (ABC) curve, a technique that divides items into three groups and emphasizes 80% of the company’s most crucial products. A hospital’s inability to accurately estimate demand is further complicated by the absence of quantifiable metrics that would enable smart buying, according to Govindan et al.25 According to the authors, a common cause of medication supply inconsistencies is the lack of reliable logistic data to support the hospital’s scheduled procurement plan.25 They recommended obtaining accurate and quantifiable information from three sources: (1) a study of “internal and external processing” times of prescription drug instructions that ensure safe stock levels; (2) a list of standardized medications with “descriptions, units of supply, and spreadsheets to track monthly” samples to utilize each piece of equipment in the hospital and (3) an ABC classification of the meds.26,27 The hospital can enhance its inventory control and management procedures by obtaining precise and quantifiable information from the sources mentioned, such as the internal and external processing times of prescription drug instructions, a list of standardized medications with descriptions and units of supply, and an ABC classification of medications. This can have several advantages, including lowering waste and stockouts, increasing inventory efficiency, enhancing patient safety, and lowering expenditures related to outdated or unused pharmaceuticals. Ultimately, these advancements may help HSC perform and operate more effectively.25
C. Purchasing

The public sector purchases medications through a competitive public auction procedure, which was the subject of research.\textsuperscript{27} According to the Tönnissen & Teuteberg, overstocking frequently resulted from a lack of integrated systems to manage supply, distribution, and consumption.\textsuperscript{28} The environment is not suitable for public service, as noted by.\textsuperscript{28} There are a few things they recommend doing to work better with vendors: (1) gathering out pertinent information about the vendor and compiling a shortlist of credible candidates based on such research “information system that addresses legal capacity, suitability, financial standing, and technical suitability”; and (2) learning about the product itself. Medicines are an example of a product category with a lot of technical details. The logistics process requires the participation of qualified specialists, including pharmacists and trained technological workers. Additional indications of the quality of the inputs should be employed, such as the verified “observations of individuals who use the product in the organizations”. The healthcare supply chains in Sri Lanka are managed by several different organizations, all of which report directly to the Ministry of Health.\textsuperscript{29} These organizations are responsible for providing the necessary medical supplies to healthcare facilities, as well as ensuring the quality and safety of the services they provide. Registration with the Cosmetics, Devices, and Drugs Regulatory Authority (DRA) is required for all pharmaceutical companies wishing to submit bids to the State Pharmaceutical Corporation (SPC).

IV. Supply chain management vital role in the healthcare industry

A. Healthcare Stakeholders

Providing patients with high-quality, cost-effective care requires a well-oiled supply chain in the healthcare industry.\textsuperscript{30} According to their roles in the healthcare supply chain, the various participants may be divided into four broad groups: manufacturers, buyers, distributors, and providers (\textbf{Figure 1}).

Logistics is concerned with a wide range of tasks, including but not limited to: managing demand and supply, controlling manufacturing, operating, stocking inventories, distributing goods, and transporting people and goods.\textsuperscript{31} The first function of logistics is resource management, which includes things like wheelchairs, stretchers, and ambulance availability, as well as the storage and distribution of medical supplies and pharmaceuticals (patient, wheelchair, stretcher, ambulance). Logistics duties, such as managing resources, are essential to healthcare stakeholders, such as wheelchairs, stretchers, ambulance accessibility, and medical supplies. Healthcare supply chain stakeholders are essential in managing these resources. For instance, to meet patient needs, hospitals, and clinics must ensure that they

\textbf{Figure 1. Stakeholders of healthcare system.}
have sufficient medical supplies and medications. To ensure they are used successfully and efficiently, they must control the distribution and availability of other resources, including staff, beds, and medical equipment. Moreover, the transportation of patients and medical supplies between facilities such as hospitals, clinics, and warehouses may involve coordination between healthcare stakeholders. Rigorous planning and coordination are required to guarantee that resources are deployed effectively and that they reach their intended destination on time.25–27

B. Healthcare Information System

The management of resources and cost optimization in healthcare nowadays revolves around maintaining patient health. The hospital tasks are carried out via a variety of subsystems. Electronic Health Record (EHR) systems—Data about patients, such as medical history, lab results, and medication records, are managed through these systems. Picture Archiving and Communication System (PACS) - this system is used to manage medical images. Hospital Information Systems (HIS) - hospital operations are managed by this system, including admissions, scheduling, and billing. Pharmacy Information Systems - it oversees medication orders, inventory, and dispensing. Clinical Decision Support Systems (CDSS) - the purpose of these systems is to assist healthcare professionals in making decisions based on patient information.32 Most healthcare organizations are moving away from unit procedures and toward supply chains to save money and make better use of available resources.33 This study examined many hospital procedures to illustrate the significance of supply chain management, including medical strategy and service excellence, patient admission and reception, diagnosis and treatment, medical record maintenance, patient release, and rehabilitation services (Figure 2).

The administrative pillars of a hospital include check-in details (critical patient information), inventory management, billing and collections, patient medical records, staff information systems, and patient information security (Table 1).

C. Pharmacy Supply Chain

The hospital’s ultimate focus is to provide patients with high-quality medical care. What’s needed is a robust stock of high-quality pharmaceuticals available in local drugstores. Supply chain management is essential for the hospital pharmacy to ensure the timely availability of drugs at the most cost-effective purchasing price. Different Suppliers, “Vendor Agreements,” “Floating of Tenders, rounds of negotiations, and freezing on processes of product delivery” are required in the supply chain since some medications can only be carried at specific temperatures. It is challenging to foresee the precise demand for medications. To determine the trend of drug usage, it is crucial to collect correct data. Due

Figure 2. Flowchart of the Hospital Information System.
to the lack of expertise in supply chain management among today’s hospital storekeepers, the supply chain is sometimes plagued by situations of “High Demand and Low Availability” or “Reverse, with Low Demand and High Availability” for some medicines, thereby increasing the likelihood of medication expiration and extending shelf life.

D. Blood Bank Supply Chain
The crucial issue in healthcare is the control of the blood supply. Dynamically managing the blood supply chain is the hospital’s aim. According to a study, donor blood supply is erratic; hence the places chosen for blood collecting sites need to be considered. This study stated that dynamically managing the blood supply chain is a crucial issue in healthcare, and hospitals aim to balance the demand and supply of blood to achieve the goal of providing blood as needed. This study further demonstrated that the number and location of blood banks should be chosen carefully to ensure a balanced supply and demand for blood, and delivery systems should be tightly coupled to satisfy runtime requirements. The authors also suggest that blood banks should be opened around the clock to ensure a timely response to emergencies in hospitals or nearby hospitals. Depending on the transfusion services supply that is needed, the number of local blood banks, that demand and supply should be balanced to achieve the goal, transporting blood as needed. Delivery systems must be coupled tightly to satisfy runtime requirements. For any emergency in hospitals or nearby hospitals, blood banks should be open around-the-clock.

E. Patient Safety Supply Chain
According to research, 440,000 patients each year pass away due to medical mistakes that could have been avoided and unsafe work environments.

Figure 3 depicts the drug flow supply chain. The vital life and smooth operation of the company are crucially dependent on the healthcare supply chain. Better healthcare supply chains increase patient safety and improve the standard of

![Figure 3. Drug flow supply chain.](image-url)
The management of expired medications by automating the monitoring and identification of medications and products, as well as taking appropriate action, has been connected by many hospitals to patient safety and other operations in the correct manner.

Reducing drug-search times, human error, and unnecessary processes can be achieved by streamlining the whole supply chain. To cut down on repetition and human error, the whole data sheet filled out by the doctor needs to be electronically input utilizing RFID technology. To increase patient satisfaction and take into account the value of human life, all procedures must adhere to supply chain transparency. A supply chain function and patient safety practices can be found in Figure 4.

V. Conclusion
Healthcare supply chain management was the primary focus of this literature survey. The healthcare sector is under a lot of strain right now because of factors such as heightened competition, governmental limitations, rising costs, and consumer expectations for higher-quality services. Due to the industry’s expanding worldwide reach, evolving organizational structures, mergers, workforce, and growth of information technology, managing healthcare as a business becomes exceedingly difficult. It is solely used to distribute medicines and vaccines, and our review does not include the delivery of devices that support life. SC implementation in healthcare requires a highly specialized, nation-specific methodology. Healthcare organizations should monitor the performance of their supply chains to make sure they are adding value at each level. Modern RFID technology, SUM, and centralized virtual supply chain management lay the groundwork for the future of supply chain management. Radio Frequency Identification (RFID) technology, Self-organizing Maps (SUM), and centralized virtual supply chain management are three key technologies that are paving the way for future supply chain management. RFID technology provides superior visibility to supply chain data, making it easier to track and monitor inventory. SUM provides an intuitive way to visualize and analyze data, allowing for better decision making. Centralized virtual supply chain management systems enable greater collaboration between suppliers and customers, helping streamline processes and reduce costs.

Data availability
No data are associated with this article.

Figure 4. Patient safety practices supply functions.
References


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