

System of Intelligent Marketing for Healthcare Goods to Hospital

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Abstract—A comprehensive Supply Chain Management (SCM) solution is designed to improve the inventory management system and lower the material management costs of medical items in the healthcare industry. Hospitals, a wholesaler, and medical supply firms make up the supply chain in this study. First, the system requirements for effective SCM hospitals and their business activities to increase the effectiveness of material handling, Vendor Managed Inventory (VMI) is the key application of SCM embraced and put into practice. For the departments of pharmaceuticals and place orders, an online procurement system has also been built. Additionally, real-time information exchange capabilities are offered to improve the management of medical inventories. This created SCM system helps hospitals to enhance the purchasing procedures including inventory management of medical supplies, which results in a more than 30% reduction in total inventories. By information exchange with clinics, the wholesaler may get more precise and up-to-date data on the inventory levels including drug usage rates of hospitals, allowing it to estimate demand more correctly. This allows for the timely and efficient supply of necessary goods. The proposed method has greatly reduced the overall distribution network cost of medical items.

Keywords—Healthcare, Supply Chain Management, Material Handling, Medicals, Intelligent Marketing

I. INTRODUCTION

Patients are becoming increasingly inquisitive and worried about the availability of healthcare services as a result of the emergence of global competition in the healthcare sector [1-2]. The increase of the senior citizen population and the growing emphasis on health have significantly enhanced general population health requirements and the spread of better lifestyles [3]. The residential industry, particularly healthcare services, has been impacted by the recent expansion in the worldwide competitive service environment. As a result of the rising rivalry between hospitals daily encouraging patients to make the best decision when choosing any hospital, healthcare associations have started to emphasize the better quality of healthcare services [4-6]. Since it is the most important factor for service providers to succeed, service quality needs to be greatly improved and accurately monitored.

Among the few issues in the research on a marketing strategy that has garnered extensive academic attention over the past three decades is the quality of services and its results [7]. It has become increasingly difficult for researchers, hospital administrators, government policymakers, and therapeutic professionals to meet patient needs, which also contributes to satisfaction and retention. Even so, it necessitates higher expenditures to attract new patients rather than to keep hold of current patients [8–10]. As a result, there is increased pressure on the supply side of the healthcare system. One of the key components of a successful business is customer loyalty, which can only be created and maintained by offering higher-quality services that increase customer pleasure. Such enhanced capabilities are all needed for efficient distribution and management practices [11].

Private providers that are not supported by the government are more focused on making a profit than providing high-quality treatment, which causes patients to seek out private care only when they believe it would be more effective and have superior facilities [12]. The current study fills this vacuum by investigating whether variables if any, influence patients to select private healthcare over public ones if they prefer to go to private clinics [13]. Studies have also shown that people only choose private hospitals when they are dissatisfied with the quality of care they receive from public healthcare providers. They force clients to spend more dollars to receive the required level of service [14]. Paying more on treatment options, clients are becoming more inquisitive & expecting supplemental facilities to receive the quality of services above their anticipations, as well as purely any instance of discontentment manages to pressure them to continue moving towards other competing companies, clients now request accurate and complete data before actually utilizing any type of service by a specific healthcare association [15]

As a result, the management of all service organizations places considerable importance on the service quality arrangement, and hospitals should pay particular attention to providing excellent medical care as well as quality support to their customers [16]. From the discussions preceding, it is clear that it has always been essential—and it still is—for

vendors to create and sustain satisfaction among customers by providing high-quality products and extensive medical therapies through a better knowledge of service quality as defined by the consumers [17]. This would only be feasible if service providers learned about and understood the perceptions and views of their clients. The current study thus tends to concentrate on patients' perceptions of the healthcare services provided [18]. The links between quality of service, shopping enjoyment, and commitment in various service industries have been the subject of numerous empirical research. However, the present study focuses on the need to improve the circumstances of the medical quality of services provided by clinics in the private industry.

A supply chain is an organization of producers, transporters, merchants, and users made up of raw material suppliers, as shown in Figure 1.

II. RELATED WORKS

Data transmission is a crucial component of SCM. Programmes like JIT, CRP, & QR in retail rely on the supply chain being informed about production, scheduling, and shipments [19–22]. Releasing intelligence enhances supply chain coordination, enables more effective material flow management, and lowers production costs [23]. By enabling the integration of disparate information management, component-based software technologies and XML technologies enhance information sharing. An effective medical SCM system has been created and improved in this study to improve inventory tracking and save material processing expenses [24-25]. Clinics, wholesalers, and leading healthcare firms make up the system in this study. The cooperation between a medical distributor as well as several medical centers of a medical center is the main subject of this study.

First, we looked at the requirement specification for efficient circulation management and inventory monitoring in clinics and examined their internal operations [26-27]. VMI, one of the key SCM systems, has been implemented for managing hospital medication warehouses to satisfy those criteria [28]. Additionally, a CAO system, or electronic procurement framework, is created for the departments that make purchases and utilize pharmaceuticals. Researchers have determined that a vital element in completely attaining the intended aim is information exchange through solid cooperation involving clinics as well as wholesalers [29-30]. Clinics may enhance their pharmaceutical product stock management and purchasing procedures thanks to the established SCM system. To more correctly estimate demand and ensure that necessary items are delivered on time and under budget, the wholesaler can estimate the future by exchanging information with hospitals to obtain precise and up-to-date data regarding inventory conditions and consumption of drug volumes

III. PROPOSED METHOD

A. SCM in Healthcare

A supply chain is an organization of producertransporters, merchants, and users made up of raw materialsuppliers,

as shown in Fig.1.

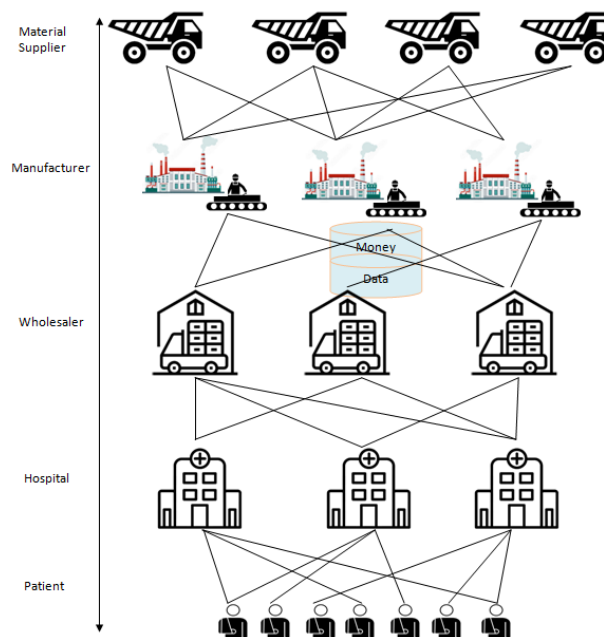


Fig. 1. Composition of healthcare SCM

As seen in Fig.1, a distribution network is a group of manufacturers, carriers, retailers, and consumers made up of raw material suppliers. Commodity management processes may be enhanced by connecting supply chain elements and regulating the movements of commodities, data, and financing in an integrative manner with the use of an SCM system.

B. System requirements

Particularly, medical therapy is crucial to patient care in hospital settings. Following a doctor's precise diagnosis, the patient should receive the best medications at the right time. Based on medical expertise and a fundamental understanding of material management, medicinal items should be maintained well. As circumstances for drug preservation and usage patterns evolved, the legitimacy and safety of medications became increasingly crucial. There are an increasing variety of expensive medicine kinds being employed in medical settings. More specialized physical distribution and effective supply chain connectivity are needed as a consequence of the shifts in the healthcare environments.

Due to hospitals lacking an adequate inventory management system, we had several issues. Before implementing the SCM system, the medical center's ability to share information with the wholesaler was highly limited, which resulted in a high number of emergency orders and average inventory levels. Hospital ordering procedures were also carried out according to general principles. We have examined the following system requirements to design an integrated SCM system that would optimize the material handling of medical items and address these issues.

C. Effective Inventory Control

Hospital inventory control can be enhanced with the use of a suitable classification scheme. Without a categorization system and uniform product control, managing all the

medicinal items in hospitals is exceedingly inefficient. The ABC inventory control system may be used to classify the items according to their attributes and importance. Because there are several product categories and they vary in importance, discriminating inventory control and ordering strategies should be used. The SCM system decreases user involvement and order processing time through intelligent order management. To improve material handling in warehouses, barcode technology should be used. Although RFID technology may be used to identify items, we have not adopted it because of the technology's infancy. To increase the effectiveness of material handling, hospital warehouse layout planning must be optimized, and the FCFS method for distributing medications is also necessary.

D. SCM System Architecture

Fig.2 displays the general design of the created system. Wards, clinical departments, special dispensaries, inpatient pharmacies, and outpatient pharmacies are just a few examples of departments that request the materials they need, which are subsequently transported from the central warehouse to the departments that requested them. Information about orders, shipping document verification, and daily medication consumption is sent from HIS to the wholesaler's ERP system. Documents about invoices, tax statements, and medicine prices are moved in the reverse direction.

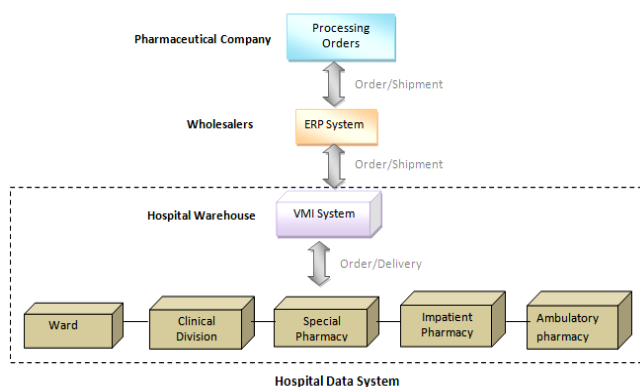


Fig. 2. Architecture SCM system

IV. IMPLEMENTATION

The SCM system had several issues at the time of deployment, including functional and data mistakes, which necessitated ongoing system improvement and modification. Using the Microsoft.NET framework and the C# programming language, we created the SCM applications. C# is a straightforward, contemporary, object-oriented, and type-safe programming language that blends the raw power of C and C++ with the high productivity of rapid application development languages. Two significant application programmes created to integrate the supply chain are described in this section. Each department that uses medications uses the first software, which includes features like "Environment configuration," "Sending document," "Receiving document," and "Receiving delivery order document." With the help of this application, orders may be processed online, and information about hospital warehouse

inventory levels and code lists for medical supplies can be shared.

The application displays a list of prepared order papers under the "Sending document" menu. The application offers suggested order quantities for each item when creating an electronic order document, allowing for a quick compilation of the order document. A variety of code lists for medical items, including medication codes, EDI code lists, manufacturer's code lists, barcode lists, and ingredient code lists, are provided under the 'Receiving document' page for hospital users to use. With double the chosen line or using the "Receive" button, one may choose a part of the budget to receive and get the data.

The wholesalers create the delivery document after receiving the hospital's order and completing the delivery. Delivery order papers created by the wholesaler are displayed on the "Receiving delivery order document" page. By double-clicking the chosen line in the data list or depressing the "Receive" button, one can choose a line to receive and obtain the delivery order document. The VMI application software is the second crucial SCM system application programme. Using the VMI application as detailed in Table 1, domain experts delegated from the wholesaler administer the hospital warehouse

TABLE 1. FUNCTIONS OF THE VMI APPLICATION

VMI Function	Major Roles
Management of product delivery and receipt	*Every department's control over delivery and reception *Management over the delivery & receipt of goods shipped from the wholesaler
Management of item receipt & delivery information	*Management of item receipt & delivery history information *Inventory management such as physical review of inventory and closing
Management of the delivery request's status	*Tracking the progress of the delivery requests from each department
Base data Management	*Setting up base information needed for warehouse management
Configuration	* Configuring the environmental parameters

A. Benefits of the System

A hospital system made up of eight university institutions has adopted the medical SCM system described in this study. Due to a significant shift in the workers' work processes and a little amount of system instability, there was initially tremendous opposition to the new SCM system. Given that an SCM system comprises several players from numerous companies, collaboration/partnership across organizations is a crucial component of putting the system into place. They have accomplished the intended goals through ongoing system improvement and training. Following the requirement analysis of the SCM system. Following is a summary of some of the main advantages of the SCM system, which come from the effective application of the system criteria. Second, the sharing of information systems built on a solid collaboration has enabled semantic interoperability and improved supply chain monitoring.

Online ordering with electronic documents provide quick order processing and mistake reduction as opposed to exchanging paper papers via mail or fax. Additionally, the wholesaler has access to data on medicine consumption in hospitals, enabling them to maintain the hospital warehouse's stock. Additionally, institutions have access to data supplied by the wholesalers, such as a listing of contractual items, pricing history, details on prescription treatments, and health codes, as needed.

Third, the use of numerous SCM solutions has substantially enhanced the material handling of hospitals. Based on the categories of things, discriminating management strategies are used to control the inventory of the products. Although it frequently happens that the inventory quantity of goods in hospital information systems does not match the actual number of objects, the discrepancy should be kept to a minimum and the information system's dependability should be increased. The SCM is being implemented at the medical facility with much effort, which has greatly increased the information system's dependability. Hospital ordering procedures are made simpler by providing each department using pharmaceuticals with calculated order quantities to restock products. Figure 6 summarizes the output. Consecutive reading, together with writing operations, produces rapid condensed versions of three peaks. Therefore, the storage requires only a few dozen peaks at one time. On cloud storage, spontaneous read/write operations were incredibly intensive. Cloud drivers appear to be the bottleneck as almost all activities have been researched in Fig.3, Fig.4, Fig.5 and Fig.6.

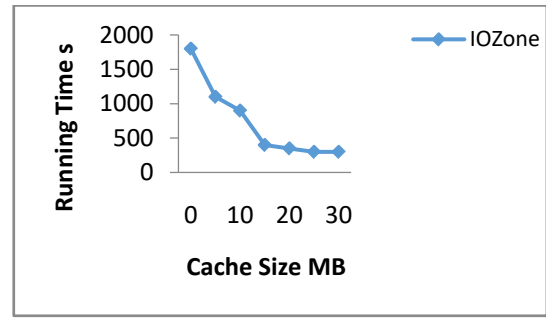


Fig. 5. IOZone

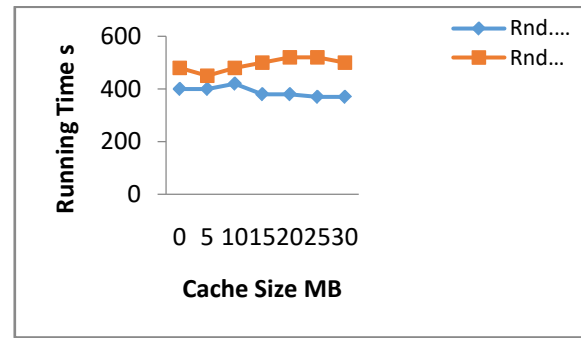


Fig. 6. Cache size workload performance measure

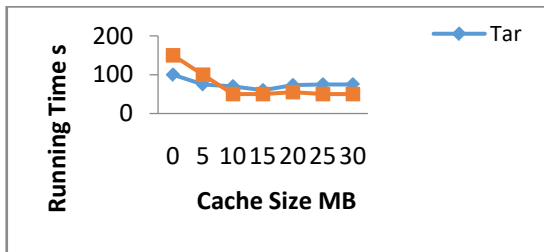


Fig. 3. Target

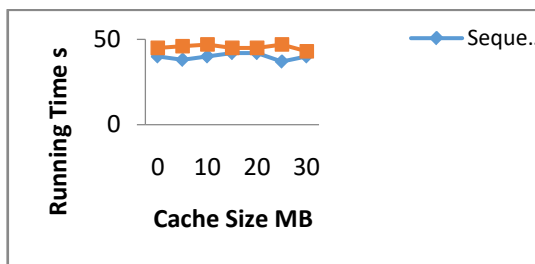


Fig. 4. Sequence

The established system must be regularly evaluated and improved to maintain and optimize the main benefits mentioned above. Collaboration between partners and information exchange in the supply chain are the most important components of a successfully integrated supply chain management system installation. As a result, the wholesaler and the hospitals should promptly submit the information required for supply chain planning. In particular, ongoing information from hospitals, where medical supplies are used and associated data are generated, including drug consumption volume and inventory status, is required.

III. CONCLUSION

We have created a computer-aided electronic ordering system, effective and efficient information exchange systems, and specialized inventory management, known as VMI. The created SCM system enhances hospital material handling while lowering inventory management expenses and, eventually, raising patient care standards. To increase the overall supply chain's efficiency, several measures are still needed. Medical producers should take part in this sort of cooperative activity to integrate the complete medical supply chain. The manufacturers' assistance was crucial throughout the implementation of the SCM suggested in this study. To fully enjoy the advantages of supply chain integration, all parties in the chain should exchange information. Guidelines for information transmission wirelessly must be defined and approved to expand the advantages discussed in this work.

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