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Supply Chain Optimization in a Pharmaceutical Distribution Center

Supply Chain Optimization in a Pharmaceutical Product Distribution Center

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Summary

The field of pharmaceutical logistics has existed since antiquity, but not at the speed we know today! This is due to the execution of the supply chain, which is a set of functional activities carried out in a distribution center. Given the above, this work aims to present and understand the logistics process in the pharmaceutical sector, which consists of: receiving, moving, storing, separating, shipping, transporting, and delivering the product in the right quantity to pharmacies with the best possible efficiency. The supply chain allows us to identify opportunities for improvement and thus make the best decisions, since it is a synchronized process and when a task is not completed it has a great impact on the company's activities. The methodology applied to develop this study was a bibliographic review of scientific articles already published on the internet in reliable databases, considering a publication time of the last 20 years. It is worth noting that a visit was made to a distribution center in order to make this study as close to reality as possible.

Therefore, based on the articles analyzed, this work poses the following question: is the supply chain practiced in the distribution center actually efficient? The choice of the topic is justified after a visit to the distribution center of company y (fictitiously named), where the importance of correct execution across all stages of the supply chain was observed.

Keywords: Supply Chain. Distribution Center. Logistics. Pharmaceutical.

Abstract: The field of pharmaceutical logistics has existed since antiquity, but not at the speed we know today! This is due to the execution of the supply chain, which is a set of functional activities carried out in a distribution center. Given this, the present work aims to present and understand the logistics process in the pharmaceutical sector, which consists of receiving, moving, storing, separating, shipping, transporting, and delivering the product in the right quantity to pharmacies with the best possible efficiency. The supply chain allows us to identify opportunities for improvement and thus make the best decisions, since it is a synchronized process and when a task is not completed it has a great impact on the company's activities. The methodology applied to develop this study was a bibliographic review of scientific articles already published on the internet in reliable databases, considering the publication time of the last 20 years. It is worth noting that a visit was made to a distribution center to make this study as close to reality as possible. Therefore, based on the articles analyzed, this work raises the following question: is the supply chain practiced in the distribution center efficient? The choice of the topic is justified after a visit to the distribution center of company y (fictitiously named), where the importance of correct execution across all stages of the supply chain was observed.

Keywords: Supply Chain. Distribution Center. Logistics. Pharmaceuticals.

1. Introduction

Over the years, it has been possible to observe the advancement of the logistics sector in various segments.

However, a practical example of this increase was the post-pandemic period, which led to a...

The great speed involved in logistics has given rise to various new concepts.

about management and supply chain with the aim of ensuring efficiency in all processes of

a distribution center.

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According to the authors Bowersox & Closs (2001), a definition did not exist until the 1950s. The term logistics is formal, and therefore it has acquired several names, the most common being: Distribution, physical distribution, materials management, distribution logistics, among others. However, Schroeder et al. (2006) is direct in its definition and says that logistics can be defined how to move resources over a period of time at a cost-efficient rate.

According to Pires (2007), if the Supply Chain were so widely explored and applied, Several factors contributed to the evolutionary process of efficient management in a center of distribution. The author highlights the changes caused by the industrial revolution which, with the emergence due to the need for more expensive and heavy machinery, the company ended up centralizing the purchase of these products in one place. A minority, since the businessmen, who held the capital, and the artisans became only owners. of the workforce, thus giving rise to two classes in the industrial sector that established a new order in the production chain. With this new order and with the growth of the market and demand, The need then arose to produce and interact with the market more efficiently, and sequentially seeking to increase productivity in various logistics sectors.

According to EEEP (2012), supply chain management seeks to create links and coordination between the processes of other organizations existing in the channel, that is, suppliers and customers, and the organization itself. According to the author, the focus of management is... The objective of supply chain management is to achieve a more profitable outcome. for all parts of the chain. This results in some important challenges, as there may be situations in which the limited self-interest of one of the parties must be subordinated to the benefit of the chain as a whole.

Logistics/Supply Chain is a set of functional activities, including (receiving, move, store, separate, ship and transport.) which are repeated numerous times in a Distribution Center (DC). Since, to the sources of raw materials, factories and points of sale. They generally do not have the same location, and the channel represents a sequence of production steps. Logistics activities can be repeated several times until a product reaches a pharmacy. For example, logistical activities are repeated as used products are transformed. upstream in the logistics channel (BALLOU, 2006).

Based on the analyses presented, it is expected that the objectives proposed in this topic will be achieved. Because, We will work on logistical concepts applied to the pharmaceutical sector, a topic that presents... a great responsibility towards civil society. Since, in many cases, medicines Cases save lives, and therefore one cannot imagine their absence for the consumer (pharmacies). due to a lack of efficient management.

Given the above, the general objective of this work is to present and Understanding the logistics process within a distribution center. This consists of purchasing,

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to receive, move, store, separate, ship, transport and deliver the right product or service, in the right quantity, in the right place, at the right time, and at the lowest possible cost in order to meet the... Customer expectations, in this project the expectations of customers of a pharmaceutical distribution center. They are the pharmacies themselves.

To complement the research, a visit was made to a distribution center, with The intention is to make this study as close to reality as possible. Therefore, based on the articles analyzed, The work raises the following question: is the supply chain practiced in the center... Is the distribution system truly efficient? The choice of this topic is justified after a visit to the center. distribution center of company Y, where the importance of correct execution among all the stages of the supply chain.

The project in question focuses on the supply chain, which allows us to identify Opportunities for improvements in management and decision-making in distribution operations within the sector. Pharmaceuticals, from purchasing to the end consumer.

2 Literature Review

This section will present important topics for understanding the concept of logistics and to ensure the optimization of the supply chain in pharmaceutical distribution centers with emphasis in the field research at company Y.

2.1 Definition of Logistics and Applications in the Pharmaceutical Area

The authors Bowersox & Closs (2001), in works written in the 1950s, state that no There was no formal definition of logistics; the authors referred to it as: physical distribution, materials management, distribution logistics, among others. At this time, in turn, the Companies weren't entirely sure what the term meant, and that's why this area existed for a long time. It became fragile.

However, Ballou (2001) argues that despite the existence of management of Logistics activities, respecting the pharmaceutical supply chain, until a few decades ago the concept of Logistics optimization was tied to replacing one cost with another, not to the use of tools. However, according to Freitas (2001), the concept of logistics is totally linked to two Fundamental lines of transformation: the economic and the technological, these being essential items. to ensure the proper functioning of a distribution center.

Ballou's (2001) definition of logistics adds some terms related to Supply Chain, since logistics is involved with the concept of "marketing mix" (product, location,

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time and conditions), when they say that the mission of logistics is to make the product or service available. Right, in the right place, at the right time and with the right conditions, it is clear that it is not enough to just... Upon delivery, you must ensure that the delivery time has been respected and that the product is in good condition.

When we refer to optimization through simulation applied to the logistics area, we cannot... Not to mention how important the supply chain is, including in transport of medicines, as it is responsible for (planning; implementation; control) of efficiency; effectiveness of outflow; of inventory; reverse flow of goods and services and information related to the point of origin and the point of consumption) with the objective of meeting service restrictions (CSCMP, 2007).

Economic transformations in the globalized world create an environment of demands. Competitive trends and technological transformations allow for increased efficiency in management. operations are becoming increasingly complex and have unique characteristics, as is the case with the transportation of medicines. In this way, logistics ceases to be seen as a simple operational activity, and it comes to be treated as a function of strategic importance that requires investment. in simulations to ensure effectiveness in the process (FLEURY et al., 2000).

According to Lambert (1998), the focus of the logistics area has always been solely on physical control. of the flow of materials, from the point of origin to the point of consumption, in the case of this article the point from the distribution center to the pharmacies. However, the transformation of this vision to the Understanding of its importance and scope has been shaped in recent years. Ballou (2001), agrees with the above position, and believes that it was within the business environment that... initiated the process of improving the managerial functions of logistics through grouping. of these activities and consequently optimization through simulation.

According to Ballou (200l), logistics must provide products and services in the form as previously mentioned, adding the largest contribution to the company. In general terms, we can

Pharmaceutical logistics encompasses the handling, transportation, distribution, and supply chain management of pharmaceutical products.

multiple and varied. In this respect, the vast majority require specific conditions in their logistical handling, respecting the parameters established by the National Health Surveillance Agency.

Sanitary authority (ANVISA).

For example, consider temperature control, which is a feature of most pharmaceutical products. requires storage and transport at temperatures ranging from -150 °C to 25 °C to preserve it. its effectiveness. Therefore, logistics must be perfect, also considering points such as storage and transportation, which must adhere to strict cleaning and quality control procedures. Pests and moisture (ANS, 2020).

In this sense, distribution centers store, transport, and market... Pharmacies are committed to removing expired items from the shelves, and in this way,

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To carry out the reverse logistics of these items, which is nothing more than ensuring their proper final disposal.

In Brazil, reverse logistics for medicines is still quite recent. It was only in 2020 that it was implemented.

As regulated by the decree, each consumer must take expired or unused products to a

The pharmacy will be responsible for the final disposal (Decree 10.388, of July 5, 2020).

Producing a medicine is only the first step in getting it to the consumer who needs it.

It is necessary. To protect patients from unsafe medical products, the WHO says it is essential.

that “there are no weak links in the supply chain” and that transportation, distribution and

Storage systems need to demonstrate an uninterrupted series of steps. Although logistics is

just one step in the pharmaceutical supply chain, these shipping processes can

represent almost 40% of total operating expenses.

Modern pharmaceutical products follow two key control processes. Good Manufacturing Practices (GMP)

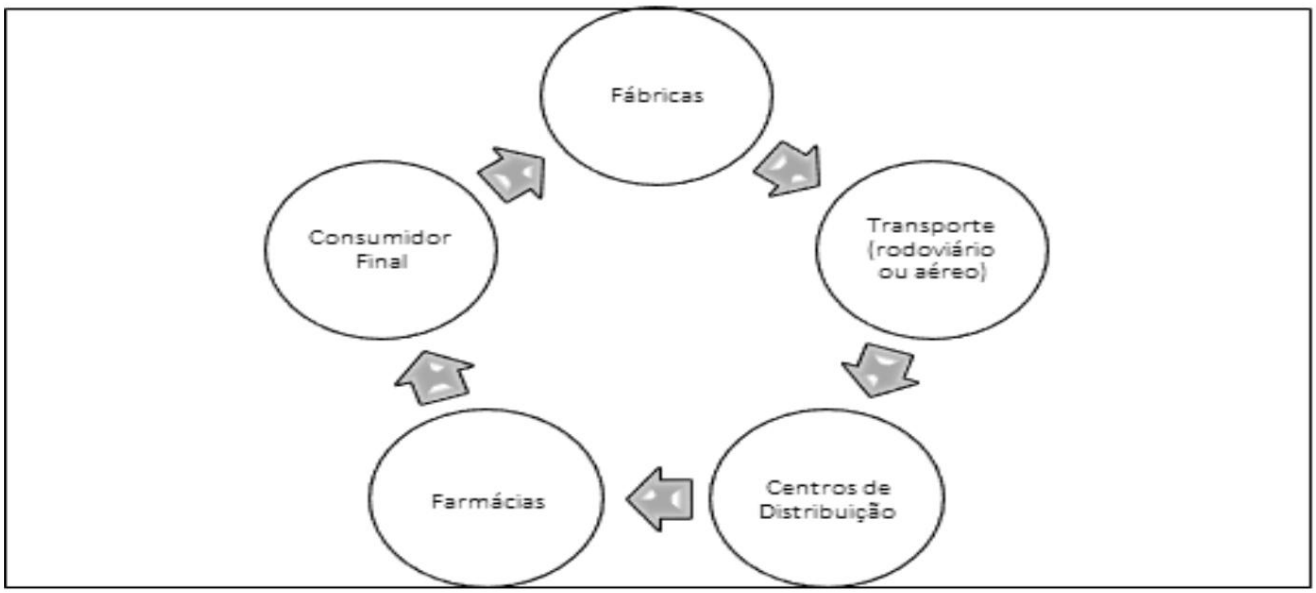
Good Manufacturing Practices (GMP), regulated by Resolution RDC 301/2019, help to ensure the

Product quality, with a defined process for each medication. These practices also

They aim to ensure that a product is of the highest quality when it leaves the warehouse and enters the supply chain.

Supply chain. In general, pharmaceutical logistics includes the following steps (Figure 1).

Figure 1 – Drug Logistics



Source: Authors' own work (2025).

The flow described above regarding the logistics of medicines appears to be simple, in

However, the distribution and logistics of medicines require care at each stage. Furthermore...

Furthermore, the entire overall pharmaceutical supply chain has a number of opportunities to reduce costs.

costs. For example, technology is offering new ways to coordinate tasks. There are only

Five years ago, there was a temperature sensor and another that tracked the location of the medications.

stability and so on, this would optimize and reduce the possibility of losses. However, it must

What matters in Brazil is its territorial size and the logistical challenges of each region.

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(BATEMAN, 1997).

2.2 Distribution Centers

Distribution centers (DCs) are locations where goods belonging to various owners or to one person can be received. The sole owner, these are called suppliers. Therefore, one of the main activities Developed in a distribution center, key areas include inventory control, receiving, material storage, warehouse addressing, replenishment control, control of the product respecting the expiration date for shipment of goods, the allocation of resources in efficient processes, the control of material batches, inventory, and shipping of goods, management reports, item and pallet coding, and order assembly. for supplying pharmacies (DECREE No. 1,102, OF NOVEMBER 21, 1903).

In this sense, distribution centers store, transport, and market... items from the pharmaceutical sector (medicines), for example, have a commitment to remove from The expired items are removed from the shelves, and in this way, reverse logistics is implemented for them. This process It ensures that these products are properly disposed of and do not end up in the hands of customers. In Brazil, Reverse logistics for medicines is still quite recent, regulated in 2020 by... (Decree 10.388, of July 5, 2020).

Producing a medicine is only the first step in getting it to the consumer who needs it. It's necessary! To protect patients from unsafe products, the World Health Organization (WHO) says it is crucial that “there are no weak links in the supply chain” and that the Transportation, distribution, and storage must demonstrate an uninterrupted series of steps. in a logistics center. However, although logistics is only one step in the supply chain of In the pharmaceutical supply chain, these shipping processes can account for almost 40% of... Total operating expenses of a distribution center.

Modern pharmaceutical products follow two key control processes: Good Manufacturing Practices (GMP) Good Manufacturing Practices (GMP) regulated by Resolution RDC 301/2019, whose objective is to To guarantee product quality, a process is defined for each medication. These practices They also aim to ensure that a product is of the highest quality when it leaves the warehouse and enters the warehouse. in the supply chain.

According to Rara's concept (2010, p. 127), the distribution center is merely the layout. where the products are stored, but distribution is one of the processes within logistics, which is... responsible for managing materials, from the moment the product leaves the production line until... This will arrive for delivery to the end consumer; in the case of this work, it is expected that the medications... Distributed by the company R's distribution center, the products reach the pharmacies that are its clients efficiently.

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Ballou (2006) agrees with the statement above and reinforces it: the distribution center is a
A strategically constructed space for receiving and storing goods coming directly from...
Suppliers will then send the goods in an organized manner to branches or directly to customers.
Another author adds that the layout of a CD is the way it is structured according to...
With their operational needs, they are adopted according to the requirements of each operation.
companies, considering the characteristics of physical facilities, which may include: space of the areas
and sectors, floors, shelves, pallet racks, conveyors, etc. It also includes product characteristics and
Services such as: product type, weight, volume and packaging method, also considers the
equipment to be used throughout the operation (BOWERSOX, CLOSS, 2001).

According to Calazans (2001), the main objective of CD is due to the high level of competition from
In the market, maintaining a distribution center is a way to optimize logistics operations and
to develop a competitive advantage, considering that even small additional gains already
They signify an advantage. With the implementation of high technology, this allows for optimization.
of the operations. Choi & Kang (2013) disagree with the author's assertion, stating that it is only possible
Optimizing processes through the use of simulation is why technology has been helping the field of...
Logistics involves the intensive development of hardware and software, using simulation techniques.

3. Materials and Methods

The methodology used was a literature review with the application of a case study.
A punctual consultation at company Y, which operates in the field of the subject matter in question. The objective was to understand the set of...
approaches, techniques and processes used by science to formulate and solve problems of
The objective acquisition of knowledge in a systematic way. Therefore, this topic should...
to help explain not only the products of scientific research, but especially its own
process, since its requirements are not for strict adherence to rigid procedures, but rather for
fertility in the production of the results to be presented in the following topic (BRUYNE, 1991)
p. 29).

Bibliographic research is understood as a review of the literature on the main theories that
These guidelines guide scientific work. This review is what is called a literature review or
A literature review, which can be conducted using books, periodicals, newspaper articles, websites, etc.
The Internet, among other sources, as Boccato (2006, p. 266) clarifies.

The literature review is responsible for generalizing the concepts and broadening the scope of the...
themes, that is, we start from something particular to a broader, more general issue, and that in turn
In turn, it plays a fundamental role in society" (LAKATOS and MARCONI, 2007, p. 86).

It is possible to state that bibliographic research seeks to resolve a problem (hypothesis).

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through published theoretical frameworks, analyzing and discussing the various contributions.
scientific. This type of research will provide valuable insights into the subject matter being researched.
How, and from what perspective and/or approach, was the subject presented in the scientific literature addressed?
Therefore, it is of utmost importance that the researcher carry out a systematic planning of the
research process, encompassing everything from defining the topic to logical construction
from the work itself to the decision regarding its form of communication and dissemination (BOCCATO, 2006 p. 266).

In this sense, the methodology used was an exploratory literature review.
through scientific articles already published on the internet during a minimum publication period of
20 years. For the construction of the theoretical framework and results of the aforementioned project, the following was used:
A survey of 15 scientific articles published in reliable databases. The data collection was...
carried out using data from books, articles, magazines, and websites on the respective topic. The articles
They were separated into: 12 in Portuguese and 3 in a foreign language (English). The method of
Articles that did not contain any information on the proposed topic were excluded.

The criteria used included articles, monographs, and dissertations, whether master's or master's level.
(doctoral) in Portuguese and foreign languages as mentioned above. The databases used
The sources used were: Medline, Scielo, and internet publications, in addition to decrees and resolutions.
The application of word clouds was assumed in order to search for materials that had references.
to the project title, for example, using keywords such as: supply chain; management of
supply chain; logistics in distribution centers; pharmaceutical distribution centers;
Logistics in the pharmaceutical industry were some of these examples.

3. Results and Discussion

This section will present and discuss the results of the study on efficient management.
of the supply chain in pharmaceutical distribution centers with an emphasis on field research
at company Y.

Some authors claim that the pharmaceutical supply chain has
Specificities due to the high sensitivity of the products and regulatory complexity, which requires
optimized and integrated approaches (SIMCHI & LEVI et al., 2020).

Therefore, the research focused on operational efficiency practices and best practices in
storage and transportation beyond the existing steps in a distribution center that guarantees
efficiency, considering the studies by Moura and Vieira (2021) on the relevance of controlling
Quality and compliance in the sector.

To measure supply chain efficiency, it is necessary to use key performance indicators (KPIs).
performance (KPIs), including operational efficiency, inventory management, regulatory compliance,

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Order cycle time, customer service level, and logistics cost as directed.

(CHRISTOPHER, 2016). Each of these indicators represents a critical aspect of the chain of pharmaceutical supplies, whose practices and innovations can significantly affect quality. and the availability of the products, up to their delivery to the end consumer.

Inventory management practices, for example, are fundamental to reducing the risk of... Loss of products due to expiration or excessive storage. Studies such as those highlighted by Santos et al. (2022) point out that automation and real-time inventory control are essential strategies. for distribution centers, allowing for better traceability and minimization.

Furthermore, regulatory compliance is another crucial point for the operation of centers. pharmaceutical distribution. Moura and Vieira (2021) highlight that compliance with the standards of The National Health Surveillance Agency (ANVISA) and international bodies face a challenge. continuous factor that impacts operational efficiency. This research analyzes compliance with These regulations revealed the importance of rigorous quality control processes for to guarantee the safety of medicines.

The results obtained show that, although there are challenges and bottlenecks Specific to the management of a pharmaceutical distribution center, the implementation of best practices Management practices and the use of logistics technologies ensure operational efficiency and help reduce costs. of costs. These results corroborate recent findings by authors such as Oliveira and Ramos (2023), who They reinforce the importance of digitization and automation studies in the logistics sector.

Therefore, this section will discuss in detail how the indicators of a distribution center, They favor results and align with existing literature, offering suggestions for improvement. This further improves the efficiency of the supply chain in the pharmaceutical sector, especially in terms of... Regarding innovation and best compliance practices, it is necessary to read the paragraphs. below.

• Operational Efficiency

The goal of operational efficiency is to assess whether the results are achievable. According to Silva & Severino (2018), operational efficiency can only be analyzed in a way that... technical and detailed analysis, using tools such as PDCA, fishbone diagram, check sheet, charts. (of trends, among others) that will provide a complete data stratification and a targeting the main sources of waste, whether they are: processes, Equipment, operational flows, procedures, manpower, and information systems.

• Inventory Management

The goal of inventory management is to ensure that there are no shortages of supplies for the center. distribution operation. Secondly, Chopra and Meindl (2016) highlight that effective inventory management It allows for cost reduction throughout the supply chain, while simultaneously increasing the level of

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service to the end customer.

In pharmaceutical contexts, this practice is even more critical due to the possibility of expiration and the need for strict quality control to meet the requirements of health authorities.

• Compliance and Regulation

Compliance is a new term, and it shouldn't be the primary indicator to monitor when... The goal is to ensure efficiency. However, its objective is to guarantee that all processes are in order. compliance with safety and quality standards, especially regulations such as ANVISA, which rigorously oversees the pharmaceutical sector. The goal is to ensure that... Medicines should not only be safe, but also reach the consumer in ideal conditions. end.

• Order Cycle Time

The goal of the order cycle timeframe is the total time it takes for a picking (order request) to be completed. (The request remains open), which requires evaluating the total processing time, from the request to the final delivery. This indicator is fundamental to understanding the speed of the supply chain and Identify areas where time can be reduced without compromising quality. Because according to According to Simchi-Levi, Kaminsky, and Simchi-Levi (2008), order cycle time is an indicator... important for supply chain performance, as it directly impacts the level of Customer satisfaction and the efficiency of internal processes.

• Customer Service Level

Its objective is to evaluate the quality with which customer demands are met. including responsiveness and order fulfillment rate. In the pharmaceutical sector, A good level of service is crucial to maintaining trust and ensuring continued customer service. patients and health units. As Ballou (2006) mentions, the level of customer service is One of the main indicators of success in logistics, as it influences customer satisfaction and loyalty. customer. In the pharmaceutical sector, where timely delivery can be critical to health, this indicator It carries even more weight.

• Logistics Cost

Costs are one of the indicators that are most closely monitored, as the objective of any company is... monitor in order to reduce the costs associated with logistics operations, including procurement, Storage, delivery, and transportation. The goal is to achieve the best balance between cost and... Efficiency, ensuring that the final price of the product is not inflated by excessive costs. According to Bowersox, Closs, and Cooper (2014), reducing logistics costs is a priority in Modern supply chains are fundamental to increasing competitiveness and maintaining... financial sustainability of the operation.

This section will present the results obtained using the company's data.

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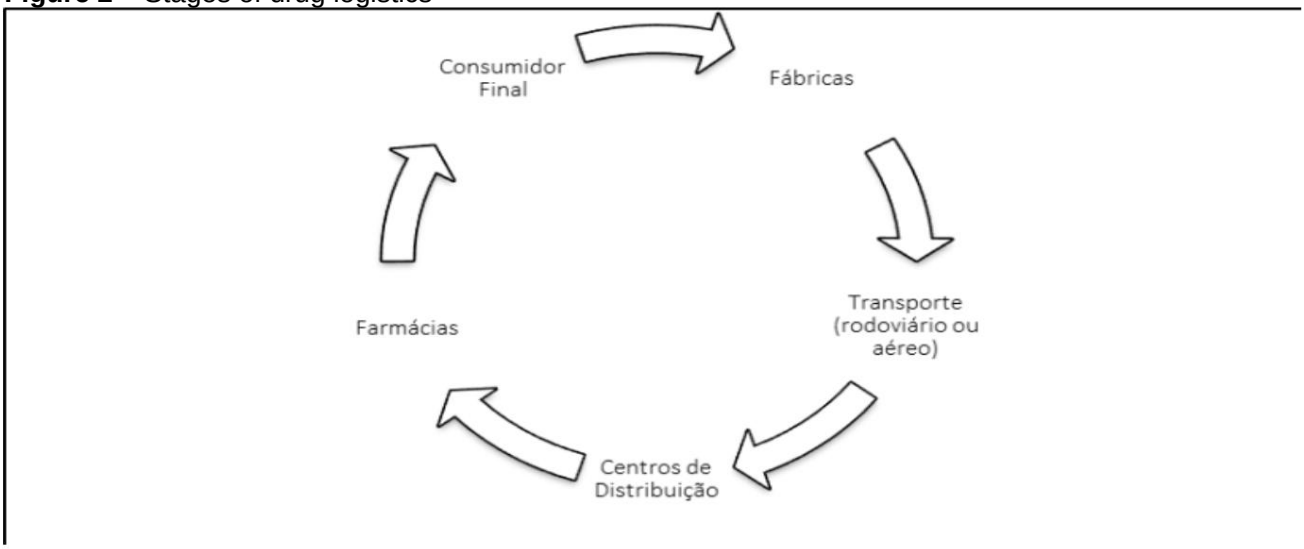
fictitiously named company Y, carried out with the objective of describing and explaining the processes Supply chain practices in a distribution and logistics center in the pharmaceutical sector.

During the visit, relevant verbal information was collected regarding the operation of the areas. strategic factors, such as product flow, inventory control, storage practices and distribution, as well as aspects of compliance with specific regulatory standards of sector.

Figure 2 – Stages of drug logistics



Source: Authors' own work (2025).

Figure 2 presents a flow chart about the logistics of medicines, which appears to be... While simple, the distribution and logistics of medicines require careful attention at every stage. steps. In addition, the entire pharmaceutical supply chain has a number of opportunities for to reduce costs. However, Bateman (1997) states in one of his studies that technology is offering new ways to coordinate tasks:

"Just five years ago, there was one temperature sensor and another that tracked the location of..." Regarding medications, stability, and so on, this would optimize and reduce the possibility of losses. However, what must be considered in Brazil is its territorial extension and the logistical difficulties of each country. region (BATEMAN, 1997).

Distribution channels can be viewed as a set of organizations. interdependent, involved in the process, and that make a product or service available for use. or consumption. At Company R's Distribution Center, the distribution chain is designed to facilitate the The arrival of products to their respective consumers is only possible because there are... suppliers, where they operate in the supply of these products, helping in the supply and Replenishment of its Distribution Center.

On-site observations allowed for a detailed analysis of the application of the methodologies and planned indicators as described in the topic above, identifying strengths and potential weaknesses.

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Areas for improvement in the observed processes for later application in similar companies.

Following this, the main results will be discussed based on the data and insights gathered.

obtained, which provide a practical view of the workings and daily challenges faced in

pharmaceutical logistics environment. These results will serve as a basis for explaining the steps of

distribution center of company y (figure 2).

Through this partnership with suppliers, the products are checked, received and

stored, then the order is generated and again separated, checked and dispatched to the

pharmacies. This entire process relies on logistical support, overseen by the logistics manager.

And with this procedure, the product arrives quickly and with quality at the pharmacy chains of the brand.

y. The efficiency of this entire distribution chain process involves planning and work.

With the entire team engaged, we will present the steps below in Figure 3: (1. Purchases from the supplier; 2.

Receiving; 3 Checking; 4 Moving; 5 Storage; 6 Replenishment; 7 Picking; 8

dispatch; 9 transport; 10 final destination).

Figure 2 – Stages of the distribution center of company Y

Source: Authors' own work (2025).

Final Considerations

The analyses carried out in this work made it possible to understand the importance of a chain.

Effective supply chain management in the pharmaceutical sector to optimize the supply chain, where there should be

Synchronization between the stages from receiving to transport is essential. Compliance with this is crucial.

A workflow to ensure the correct delivery of health products to pharmacies. This study highlighted that

Each phase of logistics, from collection to delivery, plays a vital role in success.

Operational control of the distribution center of company Y.

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Through literature review and practical observation in a distribution center.

Designated Y, it was possible to identify monitoring indicators that assist in management.

efficient supply chain. However, despite advances in the area, there are still...

Opportunities for improvement.

In conclusion, pharmaceutical logistics demands precision and agility, especially

due to the nature of the products involved, they pose a significant risk to human health when transported improperly.

and/or controlled. For future research in a distribution center, it is suggested that a survey be conducted.

quantitative (time) between each stage of the CD, until the first transport route reaches the

final recipient.

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