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Inventory Management in Hospital Pharmacy: An Integrated Analysis of the ABC Curve and the XYZ Classification

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Abstract

Inventory management in hospital pharmacies is a strategic factor to ensure the availability of medicines and materials essential to health care, contributing to the continuity of services and patient safety. In this context, the present study aimed to analyze the use of the ABC Curve and the XYZ Classification as tools to support inventory management in a hospital pharmacy. Methodologically, this is an exploratory research, with a qualitative approach, developed through bibliographic research, based on books, scientific articles and technical documents related to the management of hospital stocks. The results show that the ABC Curve allows the identification of the items with the greatest financial representativeness, while the XYZ Classification evaluates the criticality of the materials for the continuity of care. The analysis showed that the isolated use of the ABC Curve has limitations because it disregards the importance of care of the medications, while the integration between the methodologies, through the ABC-XYZ Matrix, makes it possible to reconcile economic and operational criteria, establishing different levels of control according to the value and criticality of the items. It is concluded that the joint application of these tools contributes to optimize inventory management, reduce the risk of shortages, rationalize the use of resources and strengthen the decision-making process in hospital pharmacies.

Keywords: *Inventory management, Hospital logistics, Health.*

1. Introduction

Any organization, in order to ensure its continuity, requires efficient management and sufficient inputs and resources to achieve its objectives, related to sustainability, functionality, and, when applicable, profitability, thereby adequately meeting users' needs. In the healthcare sector, units responsible for direct patient care must have logistics and infrastructure capable of ensuring their operation effectively and efficiently, promoting high-quality care through the provision of material and human resources, in addition to ensuring that the population's demand is met [1-2].

Efforts to improve population health do not occur in a linear manner, since diseases have different characteristics and levels of severity. In situations of endemics and pandemics, however, the demand for health services increases significantly, favoring the shortage of essential inputs. In these circumstances, it becomes necessary to use personal protective equipment, support materials, and medicines in volumes higher than expected, directly impacting stock levels. As it is not possible to accurately predict the number of symptomatic patients, the use of these items tends to increase significantly, making it difficult to comply with the previously established planning.

The hospital is one of the main environments for the promotion, recovery and maintenance of the health of the population. According to the Ministry of Health, a hospital is defined as:

> An integral part of a medical and social organization, whose basic function is to provide

> the population with comprehensive, curative and preventive medical care, under any care regime, including home care, and is also a center for education, training of human resources and health research, as well as for patient referral, and it is responsible for supervising and guiding the health establishments technically linked to it (BRASIL, 1977, p. 9) [3].

In hospitals, medicines are one of the main inputs, being indispensable for patient care. Therefore, their control must be rigorous, as the unavailability of these products can compromise the continuity of care and, in extreme situations, put the lives of patients at risk [4-7].

The sector responsible for the storage, control, and distribution of these products is the hospital pharmacy, defined as "a clinical-care, technical, and administrative unit where activities related to pharmaceutical care are carried out, directed exclusively by a pharmacist, forming part of the hospital's organizational structure and functionally integrated with other administrative and patient-care units" [8].

Medicines represent a significant portion of the costs of healthcare institutions, whether private or public. Irrational use, waste and inadequate management of inventories can cause financial losses and compromise the quality of care provided. In this context, it is essential to adopt efficient inventory management practices, capable of ensuring the continuous supply of essential inputs, promoting the rational use of available resources [9-12].

Inventory corresponds to the set of goods held by an organization intended for consumption, the service provision, the production process, or commercialization. From the accounting point of view, it is part of the entity's assets, and its measurement must comply with current standards [13-14].

The Brazilian Accounting Standard NBC TG 16 establishes that inventories must be measured at the lowest of acquisition cost and net realizable value. Likewise, Law 6.404/76, Article 183, item II, determines:

> [...] the rights that have as their object goods and products of the company's trade, as well as raw materials, products in manufacture and goods in warehouse, at the cost of acquisition or production, less a provision to adjust it to the market value, when it is lower (BRASIL, 1976) [15].

Several methods for evaluating and managing inventories. In the tax context, the Brazilian Federal Revenue Service admits the **FIFO** (First In, First Out) method, especially because it more adequately reflects the movement of inventories. In hospital pharmacies, this method is widely adopted because of medication expiration date, allowing the products purchased first to also be the first to be consumed. Inventory write-off occurs due to consumption, expiration, deterioration, obsolescence, discontinued use, losses, or thefts.

Inventory control makes it possible to monitor the inputs and outputs of materials, identify demand, plan resupply, detect deviations, optimize processes, and subsidize resource management. Among the techniques used for this purpose, the **ABC, XYZ, PQR** and **123** classifications stand out.

The **XYZ** Classification evaluates the indispensability or criticality of the items for the functioning of the organization; the **123** classification considers the difficulty of acquisition; the **PQR classification** analyzes the frequency of consumption; and the **ABC Curve** categorizes items according to their financial representativeness in the inventory [16-21].

Among these tools, the ABC Curve and the XYZ Classification stand out as important instruments to support decision-making in hospital pharmacy inventory management, allowing prioritizing items of greater economic value and higher operational criticality, contributing to the balance between availability, the quality of patient care, and costs.

In this context, the present study aims to analyze the application of the ABC Curve and the XYZ Classification in hospital pharmacy inventory management, seeking to demonstrate their contribution to improving medication control and optimizing the use of available resources.

2. Methodology

As for the objectives, this research is characterized as exploratory, as it seeks to expand knowledge about the application of the ABC Curve and the XYZ Classification in hospital pharmacy inventory management, thereby providing a better understanding of the potential and limitations of these tools [22].

As for the approach to the problem, this study is qualitative, as it prioritizes the interpretation of phenomena related to inventory management, using multiple sources of information to provide greater consistency and credibility of the results obtained [22].

Regarding the technical procedures, a bibliographic research was adopted, based on secondary sources of information, consisting of books, scientific articles, academic publications, legislation, and documents available on websites related to inventory management, hospital logistics, material administration, and hospital pharmacy [22].

The bibliographic research made it possible to gather different theoretical contributions to support the analysis of the methodologies studied [22].

The analysis focused on the ABC Curve and XYZ Classification, two tools widely used in inventory management. Initially, the theoretical foundations of each methodology were described, highlighting their classification criteria, advantages, limitations, and applications in materials management. Then, an integrated analysis of these tools was conducted, emphasizing the use of the **ABC-XYZ Matrix** as a decision-support instrument for hospital inventory management.

The ABC Curve was analyzed considering its principle of classification of materials according to the financial representativeness of consumption, allowing the identification of items that require greater managerial attention due to their economic impact. In addition, the XYZ Classification was studied from the perspective of material criticality for the continuity of hospital care, considering the impact that the unavailability of certain drugs and supplies can cause to the functioning of the institution.

Subsequently, an integrated analysis of the two methodologies was conducted to demonstrate how the combination of economic and care criteria contributes to defining priorities for the acquisition, storage, monitoring, and replacement of materials. This integration enables the construction of the ABC-XYZ Matrix, which is considered a strategic tool to supporting inventory planning, reducing the risk of shortages, and optimizing the use of available resources.

The data obtained from the literature were treated through content analysis, allowing the identification of convergences among the authors regarding the contributions of the ABC Curve and the XYZ Classification to hospital inventory management. The interpretation of the results was carried out in light of the selected theoretical frameworks, highlight the implications of these methodologies for logistics planning and decision-making in hospital pharmacies.

3. Theoretical Framework

3.1 PLANNING, LOGISTICS, AND HOSPITAL INVENTORY MANAGEMENT

Planning consists of the formalization of actions intended to be carried out in the future, based on previously established objectives and expectations. Control, in turn, refers to the process of monitoring and correcting the variations that occur during the execution of the planning, enabling the necessary adjustments to achieve the expected outcomes [23-24].

Planning and control activities "provide the systems, procedures, and decisions that bring together different aspects of supply and demand" [23, p. 283]. Therefore, for organizational processes to be conducted effectively and efficiently, supply and demand must be continuously aligned, allowing for the proper operational planning and the control of available resources.

In this context, logistics plays a strategic role in organizations. According to the literature, logistics is defined as:

> The process of planning, implementing, and controlling the flow of materials and information from the point of origin to the final consumer. Key components of logistics include transportation, warehousing, inventory management, order processing, and material handling. [25, p. 15].

In the hospital setting, logistics takes on even greater importance, due to the need to ensure the continuous supply of medicines, materials, and other inputs indispensable to health care. It is estimated that spending on materials represents between 15% and 25% of total hospital costs, involving the regular consumption of approximately 3,000 to 6,000 different items [26].

The efficiency of hospital logistics is indispensable, as failures in planning or implementation may lead to serious consequences, such as shortages or insufficient supply of materials and medicines, thereby compromising both patient safety and the functioning of the healthcare institution [27]. For this reason, hospital logistics is characterized by a high level of complexity, as it involves the planning, acquisition, storage, and distribution of essential supplies, whose main objective is to ensure the continuity of healthcare.

The management of healthcare organizations stands out among the most complex when compared with other organizational sectors, owing to the diversity of resources involved, the multiplicity of processes, and the need to ensure continuous and high-quality services [28].

In this context, inventory management is a strategic element of organizational performance, and inventory is defined as the "sum of materials stored in an organization, which remain reserved for timely use" [29, p. 39]. From an accounting perspective, inventory is classified as an asset, representing goods intended for consumption, service provision, or commercialization, whose valuation and control are carried out through specific procedures, such as physical and accounting inventories. In many organizations, especially healthcare institutions, inventories represent significant financial resources, thereby becoming one of the main points of attention of management.

Historically, inventory control dates back to ancient civilizations. The Egyptians used rudimentary methods to record and control the production of grains and cereals, while shepherds counted their flocks. Over time, these practices have evolved significantly, giving rise to increasingly sophisticated methods for the control, evaluation, measurement and accounting of stocks [30].

Inventory management must seek a balance between availability and costs, maintaining sufficient quantities to meet demand without causing excessive capital immobilization. The maintenance of inventories can be justified by the need to immediately meet the expected demands, the fluctuation of prices over time, and the reduction of risks related to the supply of materials, such as delays in delivery or interruptions in the supply chain.

The lack of stocks can cause: "paralysis of services; risk to the lives of patients; more expensive and urgent purchases; and, the image of the institution harmed" [31, p. 34]. On the other hand, excess inventories can result in "capital immobilization; increased storage cost; increase in loss due to perishability; and, it hides possible deficiencies in the process".

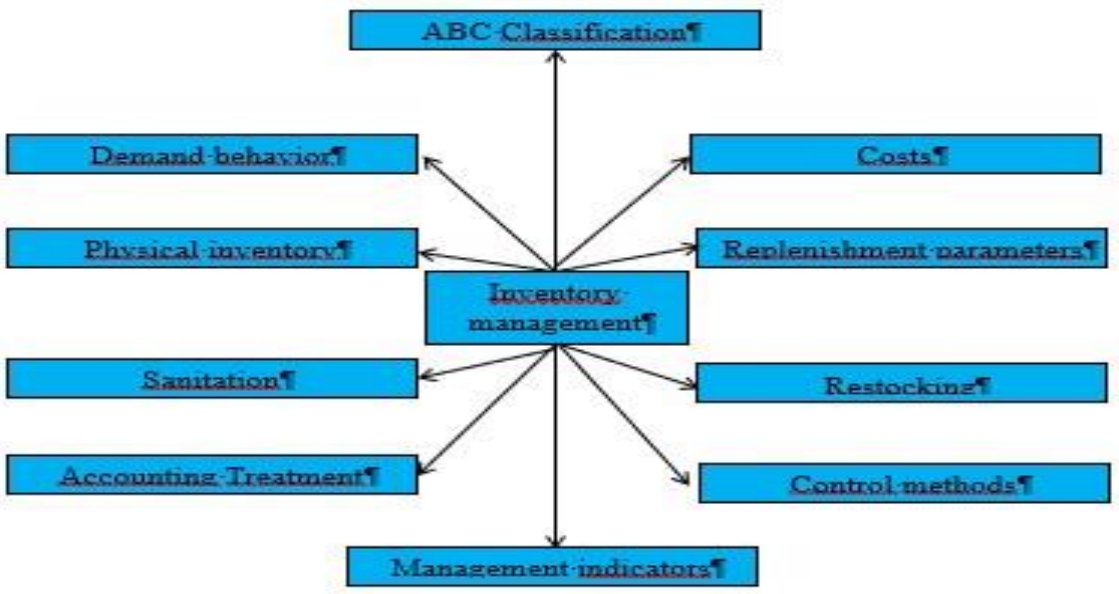
Inventory management comprises the set of activities aimed at managing stored resources that have financial representativeness and are maintained to meet the institution's future needs [32].

The primary purpose of inventory control is to ensure the availability of materials necessary to carry out healthcare activities, avoiding the interruption of services and reducing risks to the safety of both patients and healthcare professionals. At the same time, it seeks to prevent the formation of excessive inventories resulting from unplanned purchases, maintaining inventory levels compatible with demand through the use of appropriate management techniques and tools [32].

In addition, inventory control involves defining the items that must remain stored, determining the appropriate time for replenishment, defining the quantities to be acquired, receiving, storing, and distributing materials, monitoring inventory quantities and values, as well as periodic inventories aimed at identifying and removing obsolete, expired, or damaged items [24].

The main activities related to inventory management are presented in Figure 1.

Figure 1 *- Main activities of inventory management*



Source: Own authorship and based on Reis [31] (2026)

The 1988 Federal Constitution establishes that public administration bodies and entities must maintain internal control systems, including the recording and monitoring of all inventory movements, making this activity one of the responsibilities of public manager [33].

In addition, public organizations are subject to the oversight of the Courts of Auditors, which are responsible for verifying the legality, legitimacy, economy, and correct management of public assets, values, and resources. In this context, the maintenance of efficient inventory management is an important instrument to ensure transparency, accountability, and the proper application of public resources [34].

3.2 CLASSIFICATION OF MATERIALS

Material classification consists of the process of organizing and grouping items according to their characteristics and purposes in order to facilitate their identification, location,

control and use, thereby contributing to greater efficiency in inventory management [31].

Hospital pharmacies store a wide variety of inputs, products, and materials, with emphasis on medicines used for the prevention, treatment, and recovery of patients' health, as well as materials necessary for the care provided by healthcare professionals. These items are classified according to their characteristics, specificities, and inteded purposes, facilitating inventory organization, movement control, supply planning, and the optimization of logistics processes [31, 35].

3.3 INVENTORY CLASSIFICATION METHODS

Inventory planning requires the use of analytical tools that enable the identification of the number of stired items, demand behavior, replenishment levels, and resupply intervals. This information supports decision-making and contributes to efficient inventory management by reducing costs, preventing waste, and minimizing the risk of shortages.

Among the main tools used in inventory management, the XYZ Classification and the ABC Curve stand out, which analyze materials from different perspectives and provide complementary information for the decision-making process. Table 1 presents the concepts of these methodologies and the aspects covered by each one.

Table 1 *- Different classifications and their relationships*

Classification	Concept	Viewpoint contemplated
ABC	Demand or consumption value	Economic (financial resource management)
XYZ	Criticality or indispensability of the item	Care (Continuity of patient care)

Source: Authorship based on [36] (2026)

Table 1 shows that the ABC and XYZ methodologies have distinct but complementary objectives. The ABC Curve prioritizes the economic analysis of inventories by classifying items according to their financial representativeness in the total consumption value. This approach enables managerial efforts to be focused on materials with the greatest impact on institutional costs, contributing to the rationalization of financial resources.

In contrast, the XYZ Classification considers the criticality of the materials for the continuity of the organization's activities. From this perspective, an item may have a low financial impact yet still be indispensable for patient care, justifying stricter controls and differentiated inventory levels. Consequently, this methodology prioritizes the safety of care and the continuity of healthcare services.

Thus, the integrated use of the ABC Curve and the XYZ Classification provides a more comprehensive approach to inventory management, reconciling economic and care aspects. This combination makes it possible to establish priorities for the procurement, storage, monitoring, and replenishment of materials, contributing to cost reduction, improved operational efficiency, and a lower risk of shortages of essential items.

3.3.1 XYZ Classification

The XYZ Classification uses the indispensability or criticality of stored items as its main criterion of analysis. This methodology is especially suitable for healthcare institutions, as the unavailability of certain materials or medications may compromise the continuity of care, put patients' lives at risk, and make it difficult for healthcare professionals to work during care procedures.

The classification of items requires the participation of professionals with technical knowledge about the hospital processes, who assess the degree of criticality of each material by considering aspects such as its importance for care, the complexity of procurement, supplier availability, and the existence of substitute products. Based on these criteria, items are classified into three categories:

- **Class X** (defined as ordinary group): comprises items of low criticality whose unavailability has little impact on the institution's activities, as they can be easily replaced or their absence can be managed without significantly compromising patient care.
- **Class Y** (called critical group): corresponds items of intermediate criticality. The unavailability of these materials may cause operational disruptions and partially compromise the functioning of healthcare services, requiring greater attention in inventory planning and control.
- **Class Z** (vital group): brings together items of high criticality or indispensability. The unavailability of these materials may compromise the continuity of care, interrupt procedures, put patient safety at risk and cause serious damage to the functioning of the healthcare institution. For this reason, these items require permanent monitoring and more stringent replenishment policies.

Although the XYZ Classification is widely used in inventory management, it has some limitations. The main one is related to the subjective character of the criticality assessment, since its classification depends on the perception, experience, and technical expertise of the specialists responsible for the analysis. Thus, different evaluators may assign different levels of criticality to the same item, making it advisable to adopt previously defined criteria and carry out evaluations by multidisciplinary teams, in order to reduce the influence of subjectivity and increase the reliability of the classification.

3.3.2 ABC Classification

The ABC Classification, also known as the ABC Curve, Pareto Analysis, or the 80-20 Rule, is based on the principle formulated by the Italian-Swiss engineer and economist Vilfredo Pareto in the late nineteenth century. This principle was subsequently applied in several areas of administration, especially in inventory management, demonstrating that a small portion of the items is responsible for most of the financial value handled [31, 37].

In inventory management, the ABC Curve is based on the assumption that approximately 20% of the items represent about 80% of the annual consumption value, while the other items have less economic representativeness. This methodology makes it possible to identify the materials that have the greatest financial impact on the organization, allowing managers to direct control, monitoring, and planning efforts to the most relevant items. In addition to inventory management, the ABC Curve can be used to analyze the participation of customers in revenue, identify products with greater economic representativeness, and support administrative and managerial decisions [31, 37].

The ABC Curve is “an important instrument for the administrator; It allows the identification of those items that warrant adequate attention and treatment regarding their administration. The ABC curve is obtained by ordering the items according to their relative importance" [24, P. 69].

The ABC Curve considers the annual consumption value of materials, usually obtained by the period between the quantity consumed and the unit cost of each item. Based on this information, the materials are ordered in descending order of financial representativeness and classified according to their contribution to the total inventory value. Although the economic criterion is predominant, other factors may also be considered in the analysis, such as replenishment lead time, storage volume, perishability, market conditions, and specific characteristics of the materials. The items are then grouped into three classes:

- **Class A**: comprises the materials with the greatest financial representativeness, generally corresponding to approximately 20% of the inventory items responsible for about 80% of the annual consumption value. These items require strict control, continuous monitoring, well-defined replenishment policies, and permanent monitoring by management.
- **Class B**: encompasses items of intermediate financial importance, usually representing about 30% of the inventory items and approximately 15% of the annual consumption value. These items require periodic controls, but less rigorous than those classified in Class A items.
- **Class C**: brings together the materials with the lowest financial impact, corresponding, on average, to about 50% of the inventory items and approximately 5% of the annual consumption value. Due to their low economic representativeness, these items can be managed with more simplified control procedures and longer replenishment intervals.

The boundaries between classes do not constitute rigid rules and may be adjusted according to the characteristics of the organization, common sense, and the convenience of management [24]. In general, it is recommended that Class A represent up to 20% of the inventory items, Class B approximately 30%, and Class C the remaining 50%. However, specific situations may justify the adoption of different classification criteria. In hospitals, for example, materials or medicines with low financial value but high perishability or high criticality for care may receive a level of control similar to that of Class A items.

The limit ranges used to classify the items according to the ABC Curve are shown in Table 2.

Table 2 *- Limit ranges of each class of the ABC Curve*

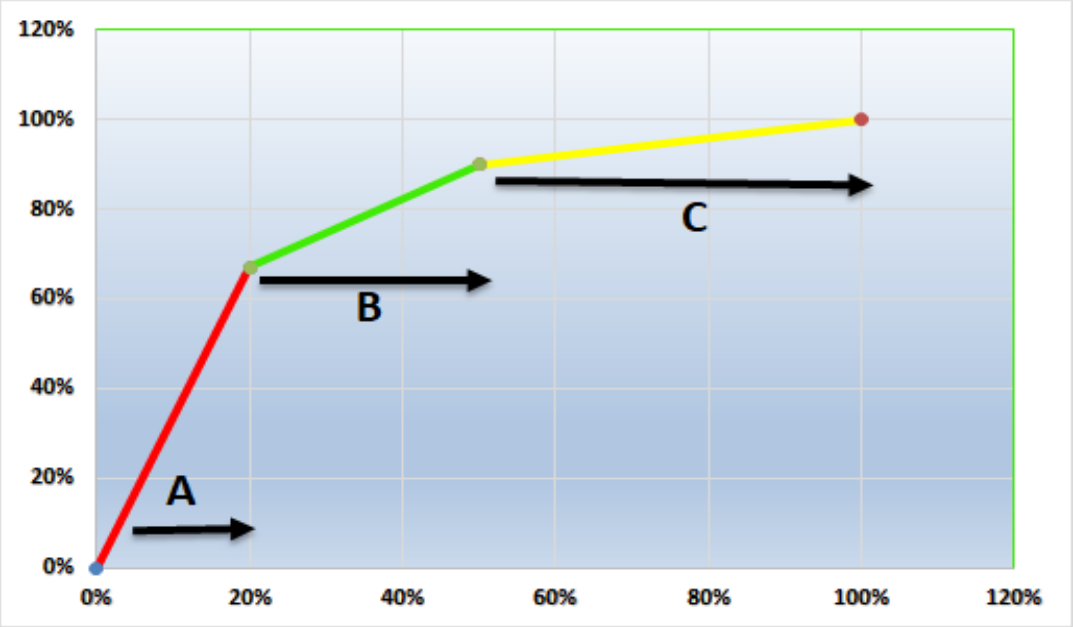
Axle	Class		
	A	B	C
Ordered (cumulative consumption value %)	67 - 75	15 - 30	5 - 10
Abscissas (percentage of inventory items %)	10 - 20	20 - 35	50 - 70

Source: [24, p. 74]

The ranges presented in Table 2 are reference values and not hard limits. In practice, these percentages may vary according to the characteristics of the materials, the consumption patterns, and the organization's objectives. In hospital pharmacies, for example, it is recommended that the ABC Curve be used in conjunction with the XYZ Classification, as medications with low economic value may present high care criticality, requiring a control as rigorous as that applied to Class A items.

Figure 2 shows a graph of the ABC curve based on the limit ranges recommended by Dias (2010).

Figure 2 - ABC curve graph



Source: Own authorship based on [24]

Figure 2 illustrates the graphical representation of the ABC Curve. On the abscissa axis (horizontal axis or x-axis) is the accumulated percentage of inventory items, whereas the ordinate axis (vertical axis or y-axis), the percentage of the total consumption value of these items. The relationship between these two axes allows the identification of Classes A, B and C, according to the following reference intervals:

- Approximately 20% of the inventory items correspond to about 67% to 75% of the accumulated consumption value (Class A);
- Approximately 30% of the inventory items represent about 15% to 30% of the accumulated consumption value (Class B); and,
- Approximately 50% of the inventory items account for only 5% to 10% of the accumulated consumption value (Class C).

These results demonstrate that a small proportion of inventory items accounts for most of the inventory's financial value, thereby justifying the adoption of different levels of management control for each class.

Thus, items classified as Class A require greater managers attention, including continuous monitoring, strict inventory control, frequent reviews, and more precise replenishment policies, as they have high economic representativeness. In contrast, Class C items, as they have a lower financial impact, can be managed through more simplified control procedures and, in many cases, relatively larger safety stocks to minimize the risk of shortages. Class B items are of intermediate financial importance and, consequently, require a level of control consistent with their economic representativeness.

Thus, the ABC Curve is an important tool to support inventory management, allowing resources and management efforts to be prioritized toward the items with the greatest financial impact, without compromising the availability of materials necessary for the organization's operation.

Thus, although the ABC Curve is a tool based on the financial representativeness of inventory items, its use in hospital pharmacies becomes more efficient when integrated with the XYZ Classification, which incorporates the criticality of materials for the continuity of patient care. The combination of these methodologies makes it possible to reconcile economic and care criteria, providing safer, more efficient inventory management, and aligned with the needs of healthcare services.

3.3.3 ABC-XYZ Classification Matrix

The ABC Curve is one of the most widely used tools in hospital inventory management, as it enables the

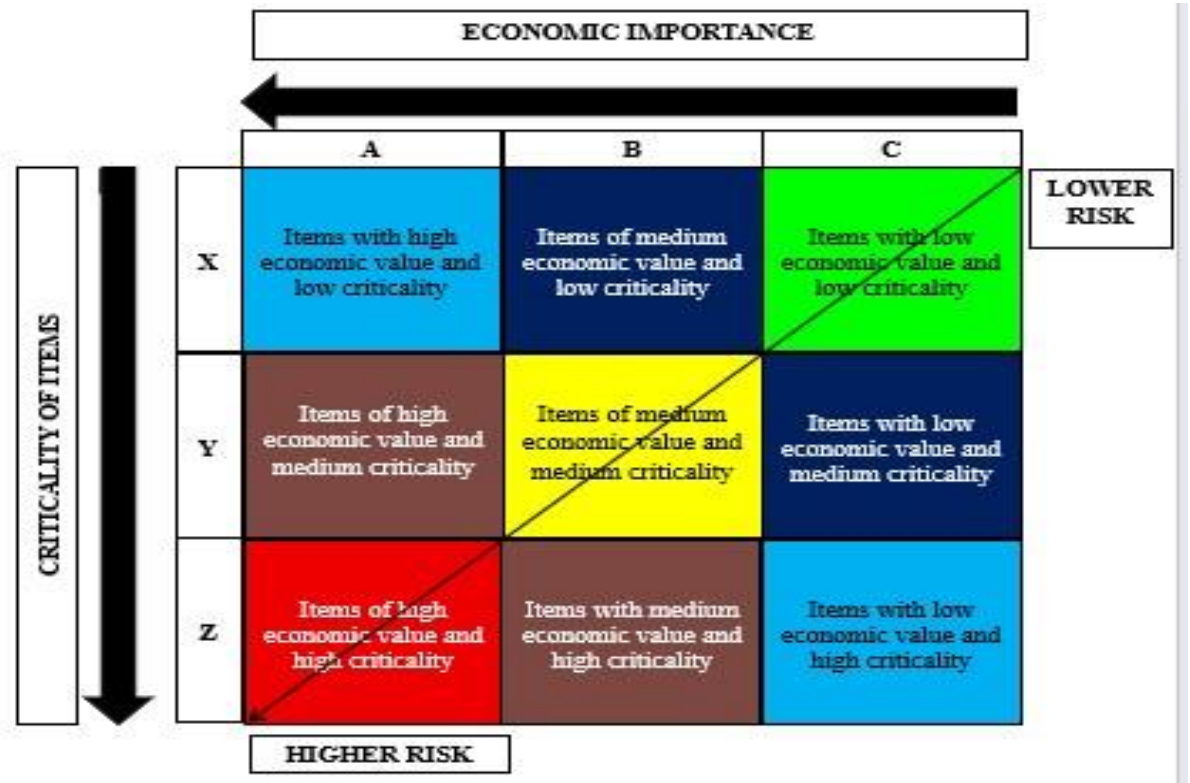
identification of the items most economically representative. However, its application alone may not be sufficient to support decision-making, as it considers only the financial impact of the materials while disregarding their importance for the continuity of healthcare. For this reason, its is often used associated with the XYZ Classification, which evaluates the degree of criticality or indispensability of inventory items.

The integration of these two methodologies allows for a more comprehensive analysis of inventory management, reconciling economic and care criteria. While the ABC Curve prioritizes materials according to their consumption value, the XYZ Classification considers the risks arising from the unavailability of items required for the operation of the healthcare institution. In this way, the joint use of these tools provides greater efficiency of procurement planning, inventory control, definition of replenishment levels, and allocation of available resources.

The combination of the ABC and XYZ classifications results in the ABC-XYZ Matrix, in which each item is framed simultaneously in terms of its financial representativeness and its degree of criticality. This matrix allows for the establishment of differentiated priorities for monitoring, storage, and replenishment of materials, contributing to lower operating costs, the prevention of shortages, and the improvement in the quality of provided to patient care.

The structure of the ABC-XYZ Matrix, formed by the combination of the two classifications methods, is illustrated in Figure 3.

Figure 3 *- ABC-XYZ Matriz*



Source: Authorship (2026)

Figure 3 illustrates that the risk of shortages tends to be higher when an item presents, simultaneously, high financial representativeness and high hospital care criticality. In these situations, inventory management must adopt more rigorous monitoring and control mechanisms, as the unavailability of these materials may significantly compromise the functioning of the healthcare institution and patient safety.

In the ABC-XYZ Matrix, items classified as AZ represent those that combine high consumption value with high criticality, requiring priority in planning, procurement, monitoring, and replenishment actions. In contrast, items classified in the CX category have low financial representativeness and low criticality and can therefore be managed using less rigorous control procedures.

Thus, the probability of occurrence of impacts resulting from shortages is higher in the region of the ABC-XYZ Matrix corresponding to items of greater criticality and greater economic value, while the lowest risks are concentrated in the categories formed by items of low criticality and reduced financial impact. Therefore, the ABC-XYZ Matrix is an important tool to support hospital inventory management, allowing for prioritizing resources,

optimizing inventory planning, and subsidizing decision-making regarding the resupply of materials and medicines.

The main advantages of the integrated use of the ABC and XYZ classifications include more efficient use of capital, reduced shortages of essential medications, and differentiated management according to the characteristics of each inventory item. However, the effective application of these methodologies requires that managers possess adequate technical knowledge [38].

The same authors identify the main limitations of this methodology as the need for periodic reviews of the classification, the use of computerized systems for data processing, the participation of a multidisciplinary technical committee in defining the criticality of inventory items, the difficulty of establishing objective classification criteria, and the possibility of subjectivity during the evaluation process.

4 Analysis and Discussion

Hospitals are institutions responsible for the promotion, prevention, and recovery of health, serving patients who need medical and hospital care of different levels of complexity. To ensure the continuity of patient care, these institutions maintain diversified inventory of medicines, medical and hospital supplies, and other inputs indispensable to healthcare activities. In addition, hospitals have equipment for the diagnosis and treatment of various diseases, which are continuously replaced as a result of technological evolution, requiring constant updating of the hospital infrastructure.

In this context, the hospital pharmacy plays a strategic role by being responsible for the storage, control, conservation, and dispensation of medicines, supplies, and medical-hospital materials intended to meet the institution's internal demands. Its operation occurs uninterruptedly, ensuring the supply of the materials necessary for the healthcare activities 24 hours a day. Inventory management begins with procurement planning based on estimated demand, followed by the storage of items according to their characteristics, category, and specific conservation requirements.

Inventory management in hospitals requires the use of tools capable of supporting decision-making regarding the procurement, storage, monitoring, and replenishment of materials. In this sense, the integrated use of the ABC Curve and the XYZ Classification is an efficient strategy, as it enables the simultaneous analysis of the economic representativeness of the medications and their criticality for the continuity of healthcare. While the ABC Curve prioritizes items with the greatest financial impact, the XYZ Classification identifies those whose unavailability may compromise patient care and the functioning of the healthcare institution.

The application of the ABC Curve begins by determining the annual consumption value of medications, which is obtained by multiplying the quantity consumed by the respective unit cost. Then, the items are organized in descending order of financial representativeness, enabling their classification in Class A, B, and C. Class A medications represent a small portion of the total inventory items stored, but concentrate most of the inventory's financial value, requiring strict control, frequent monitoring, and carefully planned replenishment policies. The items classified as Classes B and C have lower economic representativeness and can be managed with levels of control proportional to their financial importance.

However, when used in isolation, the ABC Curve has limitations because it considers only the economic criterion, disregarding the importance of healthcare of medications. Thus, a medication with low financial value may be indispensable for certain treatments, making its inadequate management solely based on cost.

To overcome this limitation, the XYZ Classification is used to groups medications according to their degree of criticality. Items classified as Class X have low criticality; those belonging to classification as Class Y have intermediate criticality, and those classified as Class Z are considered essential for the continuity of hospital care. The definition of these categories should be carried out by a multidisciplinary team, considering aspects such as clinical importance, possibility of replacement, availability in the market, and time required for replenishment.

The integration between the ABC and XYZ classifications results in the ABC-XYZ Matrix, which enables the establishment of differentiated management priorities. Medicines classified in the AZ category represent those that associate high financial impact and high criticality, and should receive top priority in terms of monitoring, procurement, and replenishment. Next, the AY and BZ groups stand out, which also demand a high level of managerial attention. The AX, BY, and CZ groups have intermediate priority, while BX and CY require moderate levels of controls. Finally, items classified as CX have low financial representativeness and low criticality and can be managed through more simplified control procedures.

In hospital pharmacies, the movement of medicines should preferably occur, according to the FIFO (First In, First Out) method, observing, whenever necessary, priority for products with the earliest expiration date. This practice reduces losses due to expiration, favors inventory turnover and contributes to the rational use of public and private resources.

Another relevant aspect refers to the control system for medication movements. As many products are purchased in packages containing several units but dispensed to patients in fractions, it is essential that each movement is immediately recorded in the management system. The use of technologies, such as barcode readers or automatic identification systems, reduces operational failures, increases the reliability of information, and provides greater accuracy in inventory control.

The integrated management of the ABC Curve and the XYZ Classification also favors the procurement planning and suppliers diversification, especially for medications classified in Categories A and Z. The expansion of the number of suppliers reduces dependence on a single manufacturer, reduces the risks of shortages and can provide better negotiation conditions, contributing to the reduction of acquisition costs.

Despite the use of these tools, hospital inventory planning remains subject to uncertainties arising from demand variability. Situations such as outbreaks, epidemics, and pandemics cause a sudden increase in the consumption of medications and medical-hospital materials, making it difficult to predict consumption and increasing the risk of shortages. In addition, patients with multiple comorbidities often require more complex treatments, increasing the diversity and quantity of medications used.

Thus, it is observed that the efficiency of hospital inventory management depends not only on the application of the ABC Curve and XYZ Classification methodologies but also on the continuous demand monitoring, the periodic updating of classifications, the use of computerized management systems, and the integrated performance of the healthcare and administrative teams. The adoption of these practices contributes to reducing waste, optimizing financial resources, ensuring the availability of essential medicines, and promoting greater quality and safety in the provided to patient care.

5. Final Considerations

Inventory management in hospital pharmacies is a strategic activity for the functioning of healthcare institutions, as these sectors store medicines, materials and supplies essential to patient care. Thus, it is essential to adopt efficient inventory management practices, capable of ensuring the continuous availability of essential items, avoiding shortages that may compromise the continuity of services, the quality of care, and patient safety.

It was found that the ABC Curve represents an important tool for inventory management, as it enables the identification of the items with the greatest financial representativeness. However, its application in isolated has limitations because it considers only the economic value of materials, disregarding their creativity for hospital care. Thus, medication of low financial value may be classified as Class C and still be indispensable for certain treatments. In these situations, the unavailability of these items may compromise the functioning of the hospital unit and put patient care at risk.

In this context, the integrated use of the ABC Curve and the XYZ Classification proved to be more appropriate for the hospital inventory management, as it enables for the reconciliation of economic and care criteria. The ABC-XYZ Matrix makes it possible to identify materials that simultaneously have high financial representativeness and high criticality, subsidizing the definition of priorities for procurement, monitoring, storage, and replenishment. As a result, it contributes to reducing the risk of shortages of essential medicines, optimizing the application of financial resources, and increasing the efficiency of inventory management.

In addition, the ABC-XYZ Matrix is relatively simple to apply, as long as the institution has reliable information on the consumption, costs, and criticality of inventory items. Its use enables the establishment of different levels of control for each category of items, favoring a more rational and efficient inventory management aligned with the operational needs of the hospital pharmacy.

Finally, it is noteworthy that the ABC Curve and XYZ Classifications should not be treated as static tools. Changes in the epidemiological profile of the population, supplier availability, the incorporation of new technologies, and therapeutic protocols require periodic reviews of the classification criteria to ensure that these methodologies remain adequate to the reality of the institution. In this sense, the continuous updating of classifications contributes to the improvement of inventory management, reducing waste, rationalizing available resources, and ensuring the availability of materials essential to the provision of safe, and quality care.

As a limitation of this study, its bibliographic character is highlighted, without the empirical application of the methodologies in a specific hospital pharmacy. Thus, it is recommended that future research carry out case studies, applying the ABC-XYZ Matrix in public and private healthcare institutions, in order to evaluate its impacts on cost reduction, service level, risk of shortages, and efficiency of inventory management.

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