

INVENTORY MANAGEMENT: ASSOCIATED COSTS, FUNCTIONS, FACTORS, AND CONCLUSIONS

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Abstract: One of the healthcare facilities that is most frequently used and where a significant sum of money is spent for acquiring pharmaceuticals. Many medications are kept in pharmacies to aid in patients' treatment. It is challenging to regulate and control the amount of medication because of the wide range of pharmaceutical products. A medication that is consistently supplied at the appropriate time and quantity to maintain a steady supply is necessary for improved and efficient service management in a pharmacy. This can be achieved by effectively managing the pharmacy's inventory, controlling key medications, and setting priorities for distribution and purchases. As a result, inventory management guarantees both optimal resource utilization and a notable improvement in patient care. Three key approaches to inventory management were examined, including ABC (Always, VED (Vital, Essential, Desirable) analysis, ABC-VED matrix analysis, and Better, Control) analysis.

Keywords: Drug Inventory Management, Pharmacy, ABC, VED

INTRODUCTION

Efficient inventory management is a cornerstone of hospital operations, particularly within the pharmacy department, which often consumes a significant portion of a facility's budget. [1] Because medical supplies and medications can account for roughly one-third of total hospital expenditures, maintaining a lean yet robust supply chain is essential for financial stability [2]. By implementing rigorous oversight and prioritizing high-cost items often referred to as "critical medications" hospitals can prevent waste, reduce the risk of theft, and potentially slash pharmacy budgets by up to 20%. This strategic control ensures that capital is not unnecessarily tied up in excess stock, allowing for a more agile and financially healthy organization [3]. Beyond the balance sheet, effective inventory control is directly linked to the quality of patient care and the optimization of clinical resources. [4] In resource-limited environments, such as developing nations like India, the primary duty of a hospital is to maximize the utility of every asset to ensure that life-saving medications are consistently available. Striking the delicate balance between overstocking and stockouts ensures that patients receive uninterrupted, high-value services [5-6]. Ultimately, sophisticated inventory management transforms the pharmacy from a high-cost center into an efficient pillar of the healthcare system, balancing economic concerns with the vital mission of providing high-quality medical care [7].

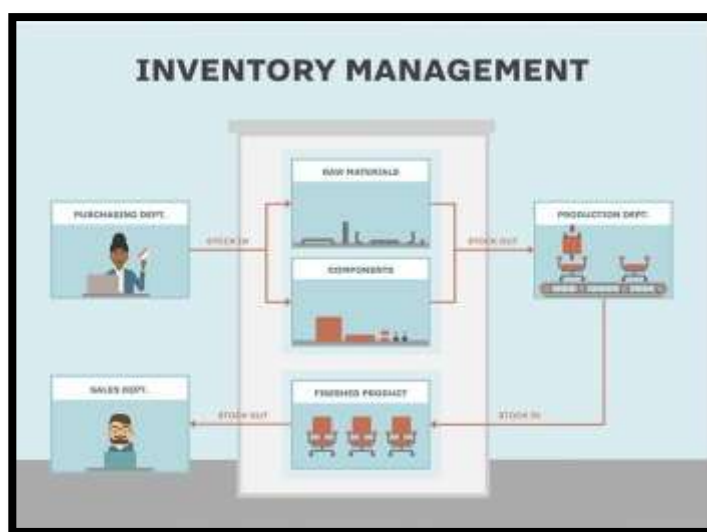


Figure 1: Inventory Management

In the past, inventory management has frequently been associated with either too little inventory and too much management or too much inventory and too little management. Management of inventory is produced. As technology has advanced, businesses are now able to produce goods more quickly, in larger quantities, and with a wider variety of designs. Excessive behavior in either direction can result in harsh consequences. The public's openness to variations and frequent design changes has made the issue worse [8]. The strategic advantages of production planning and scheduling, as well as inventory management, have been clear since the middle of the 1980s [9]. Organization for World Health recommended that no one person should have complete authority over the procurement and purchase of pharmaceuticals. Every purchase will be examined and approved by a designated purchasing committee [10].

Inventory

"Inventory" refers to any stock that a business maintains to satisfy its future production and sales needs. The primary goal of inventory management is to enable uninterrupted production activities. Waiting for the stock to arrive is not feasible from a physical or financial standpoint. when they were genuinely needed to eat. Thus, inventory management is essential to an organization's effective operation [11]. Since inventory is one of an organization's biggest assets, it must be properly controlled. Neither too much nor too little should be kept in stock. While a low level of inventories may lead to frequent production interruptions, a high level of inventories would result in higher interest and storage costs. Timetable resulting in decreased sales and underutilization of capacity. Determining and maintaining the ideal level of investment in inventories that aids in reaching the necessary goal is the primary goal of inventory management. Inventory management reduces operating expenses and improves comprehension [12].

DEFINITION AND CONCEPTS

The stock of pharmaceutical products kept on hand to satisfy future demand is referred to as inventory in pharmacy operations. The biggest current asset and liquid asset in pharmacy is inventory. practice and its worth keep increasing due to the rise in pharmaceutical product variety and price. The definition of inventory management is the ongoing "process of planning, organizing, and controlling inventory" with the goal of balancing supply and demand while minimizing the investment in inventory [13]. Effective inventory management serves as a critical balancing act that oversees the lifecycle of raw materials, work-in-progress, and finished goods to minimize the financial burden of carrying excess stock while avoiding the risks of shortages [14]. Because inventory represents a significant expense for manufacturers and wholesalers tying up capital in labor and materials these carrying costs are ultimately reflected in the final price paid by the consumer. Therefore, the primary goal of any inventory system is to maintain an optimal stock level that ensures operational continuity at the lowest possible cost, transforming what could be a stagnant asset into a streamlined component of the supply chain [15].

Inventory management is fundamentally a strategic tool used to maximize a company's total asset value by maintaining the most cost-effective quantity of goods to meet future demand. By precisely determining when to order, how often to reorder, and the necessary levels of safety stock, managers can minimize the occurrence of stock-outs and ensure operational continuity [16-17]. This process is driven by three primary motives: transactional, which ensures stock is available for daily production and sales; precautionary, which serves as a buffer against uncertainty; and speculative, which capitalizes on potential market fluctuations [18]. Ultimately, inventory functions as a vital bridge between finance, accounting, and marketing, ensuring that the right resources are available at the right time to satisfy consumer needs without overextending the organization's capital [19].

INVENTORY- ASSOCIATED COSTS

Acquisition costs, procurement costs, carrying costs, and shortage costs are the four categories of expenses related to inventory in pharmacy practice [20–21]. The net price the pharmacy pays for the goods is known as the acquisition cost. The expenses related to buying the goods, such as placing and receiving orders, are referred to as procurement costs invoice payment and stocking. Carrying costs are expenses related to product storage, which also include expenses brought on by emergencies, such as theft or harm. Another name for shortage costs is stock-out expenses, specifically the costs associated with not having the product available on the shelves when it is needed.

1. Acquisition Costs



Figure 2: Acquisition Costs

Formula:

The acquisition cost formula is as follows:

$$\text{CAC} = \text{Sales and Marketing Expense} / \text{New Customers Acquired}$$

Here CAC is the customer acquisition cost.

To determine the cost of acquiring property, the following formula is used:

$$\text{Indexed Cost of Acquisition} = \text{Purchase Cost of the property} \times (\text{CII of the year in which the property is sold} / \text{CII of the year in which the property is purchased})$$

2. Procurement Costs

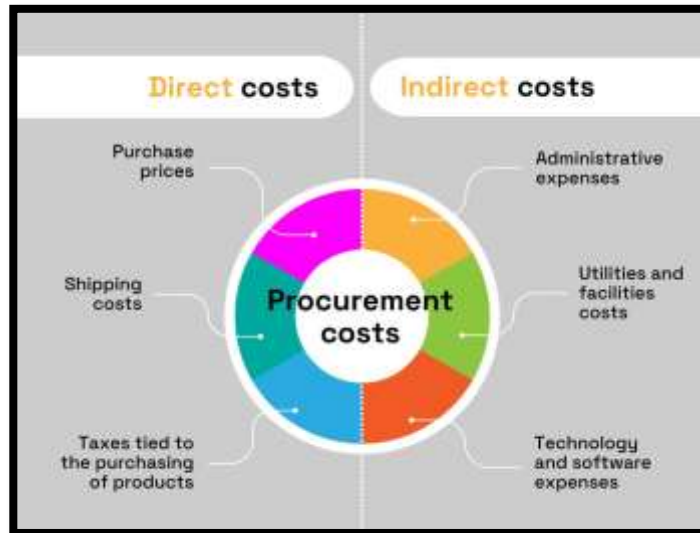


Figure 3: Procurement Costs

procurement cost is the total price for a manufacturing company to purchase raw materials, including the base price of the materials, plus shipping and customs duties.

3. Carrying Costs

Formula:

$$\text{Carrying cost of inventory} = (\text{Total inventory holding costs} / \text{Total inventory value}) \times 100$$

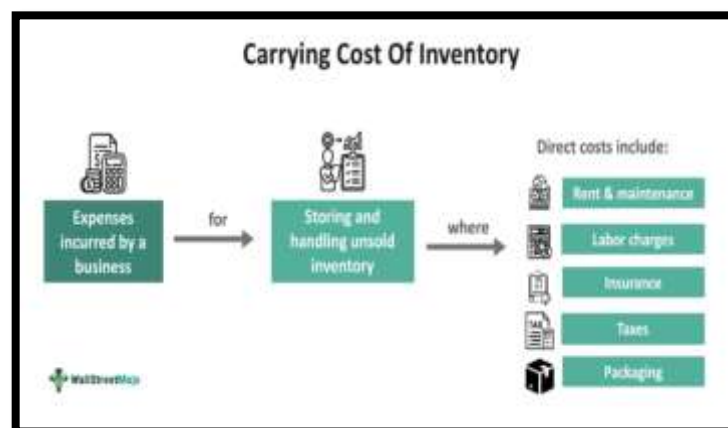


Figure 4: Carrying Costs

4. Shortage Costs

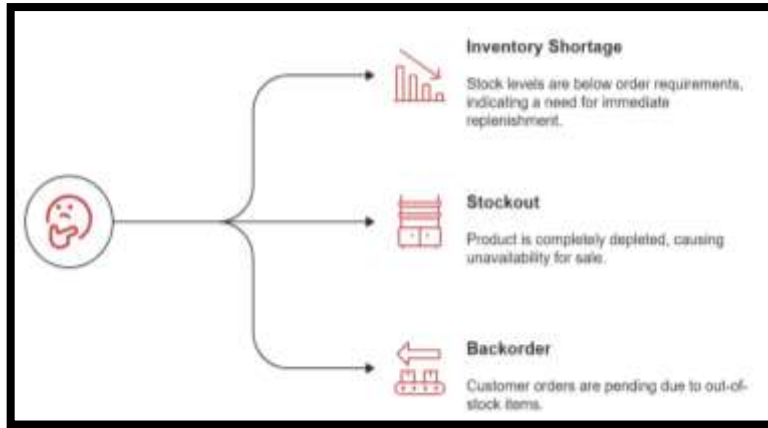


Figure 5: Shortage Costs

TYPES OF INVENTORIES

Raw materials, work-in-progress, and finished goods are the three primary categories of inventories.

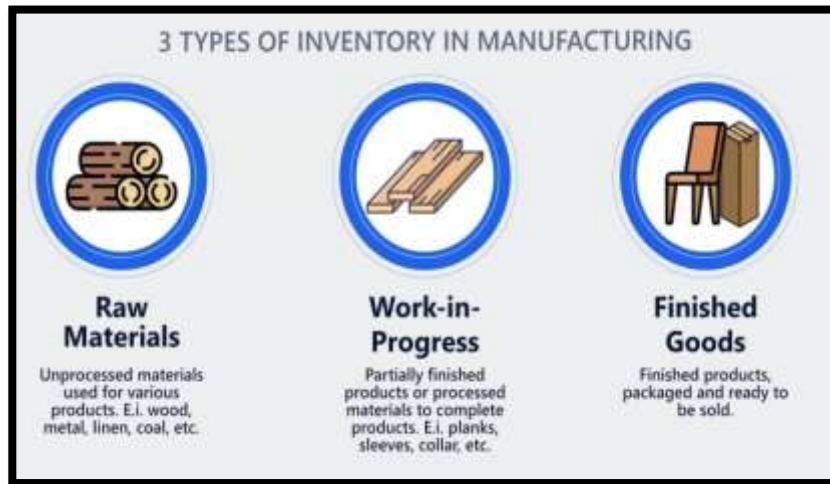


Figure 6: Types of Inventory Management

- **Raw Materials:**

The inputs used in the manufacturing process to create the final product are known as raw materials. The units that have been bought and kept for later use are known as raw material inventories.

- **Work-in-progress:**

Another name for work-in-progress is stock-in-progress. Products in these inventories are semi-manufactured. They stand for goods that require additional development before they are ready for sale.

- **Finished Goods:**

Completed products Finished goods that are prepared for sale are called inventories. Production is facilitated by raw material and work-in-progress inventories. However, a finished goods stock is necessary for efficient marketing operations. As a result, inventories act as a conduit between the manufacturing and consumption of commodities [22].

FUNCTIONS OF INVENTORY:

1. To meet anticipated customer demand. Because they are kept to meet anticipated or planned demand, these inventories are known as anticipation stocks.

2. To meet production requirements. Businesses that see seasonal fluctuations in demand frequently accumulate inventory in the off-season to satisfy excessive demands during specific seasonal intervals. Seasonal inventories are a problem for businesses that process fresh fruits and vegetables.

3. To decouple operations. While the issue is being fixed, the buffers allow for the temporary continuation of other operations. Businesses have employed raw material buffers to shield production from interruptions in supplier deliveries, and inventory of completed goods to protect sales operations due to interruptions in manufacturing.

4. **To protect against stock-outs.** The risk of shortages is increased by delayed deliveries and unforeseen spikes in demand. Keeping safety stocks—stocks that exceed expected demand—can lower the risk of a shortage.
5. **To take advantage of order cycles.** Without having to try to match production or purchases with short-term demand requirements, inventory storage allows a company to buy and produce in economical lot sizes.
6. **To hedge against price increase.** A company can also benefit from price breaks for large orders if it has the capacity to store extra items.
7. **To permit operations.** There will typically be some work-in-process inventory because production operations take a certain amount of time [23].

INVENTORY MANAGEMENT PROCESS

According to the World Health Organization and the International Pharmaceutical Federation, a pharmacist’s eight primary responsibilities include managing resources (cash, supplies, labor, Time, and information) is essential for both individual and organizational success in the workplace [24].



Figure 7: Inventory Management Process

INVENTORY MANAGEMENT TOOLS

The tools of inventory control / inventory management are as follows:

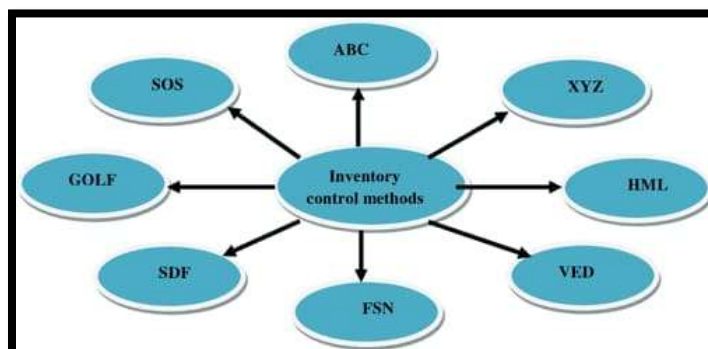


Figure 8: Inventory Control Methods

ABC Analysis

ABC analysis, which stands for "Always Better Control," is a foundational inventory management tool that categorizes items into three classes based on their annual consumption value to help managers prioritize their focus [25-26]. Class A items represent the "vital few," making up only 10% of total inventory but accounting for 70–80% of total value, thus requiring strict oversight by top management. Class B items are intermediate, comprising about 20% of inventory and value, while Class C items represent the

"trivial many," making up 70% of inventory but only 10% of total value. Despite its efficiency in managing capital, a significant limitation of ABC analysis is its sole reliance on monetary value; in a healthcare setting, a low-cost, low-usage item might be life-saving, meaning its criticality or "vitality" is not captured by cost-based categorization alone [27].

VED Analysis

Priority and significance for patients form the basis of VED analysis. Health [28]. Vital (V), Essential (E), and Desirable (D) are the three categories into which it separates the items. Like vaccines, V class medications are life-saving and necessary for life support (e.g., some antibiotics, serums, insulins, digoxin etc.). It needs to always be in stock at the pharmacy. E class medications are less severe and effective in treating serious but less life-threatening illnesses (such as antibiotics, phenytoin, ranitidine, chloroquine, and so forth.) It might be in stock at the pharmacy. The remaining medications in the D class are the least severe and are used to treat minor illnesses. Lack of these medications does not negatively impact the health of the patients, such as sunblock lotions and vitamin E supplements.

ABC-VED Matrix Analysis

Both VED analysis and ABC analysis can be taken into consideration when practicing effective and efficient inventory control on the items. The ABC and VED analyses are combined to create the ABC-VED inventory matrix analysis, which is shown in Table 2. Nine distinct subcategories (AV, AE, AD, BV, BE, BD, CV, CE, and CD) are obtained by cross-tabulating these analyses acquired [29]. More significant control over the material supplies is offered by the ABC-VED matrix establishes three primary categories for the items: Category I, Category II, and Category III. Important and costly items fall under category I. There are six subcategories within it: AV, BV, CV, AE, and AD. Additionally, upper management must exercise control over it. Class II includes inexpensive but necessary items (BE, CE, BD). The most desirable and least expensive items (CD) make up Category III.

Table: 1 ABC-VED inventory decision matrices

ABC-VED Matrix		Criticality of Item							
		High ←			→ Low				
Consumption Value	High ↑ Low	V			E	D			
		A	Continuous Review	High Safety Stock	Low Order Quantity		Continuous Review	Low Safety Stock	Low Order Quantity
		B							
C	Periodic Review	High Safety Stock	High Order Quantity		Periodic Review	Low Safety Stock	High Order Quantity		

The economic order quantity (EOQ), which aims to balance the cost of carrying and the cost of running out of items, is a frequently used inventory control model [30]. It is the quantity of inventory that reduces the overall cost of ordering and keeping inventory. EOQ is only applicable when a product's demand remains steady throughout the year. And when the inventory hits zero, the entire amount of each new order is delivered. No matter how many units are ordered, a fixed fee is applied to each order. When combined with ABC-VED analysis, EOQ is suggested as the most successful and efficient inventory control model. [31] The majority of the ABC-EOQ savings are noted for the low-value items (B and C items) that were also purchased often. [32]

Representation of EOQ: EOQ can be determined with the help of the following formula:

$$E.O.Q.= \sqrt{20cD / Hc}$$

Where, Oc= Cost Of Order, D = Annual Demand, Hc= Holding Cost/Carrying Cost [in Rs. or Unit]

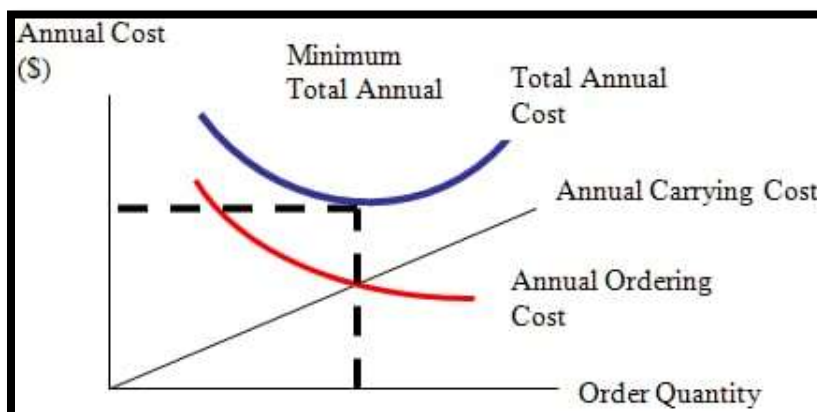


Figure 9: EOQ Model Cost Curves [33]

FACTORS AFFECTING INVENTORY MANAGEMENT

Pharmacy inventory management relies on several critical variables, ranging from product selection to the handling of unclaimed orders. Utilizing generic medications significantly lowers acquisition costs compared to brand-name counterparts, thereby reducing the total capital tied up in stock. Additionally, pharmacies must actively manage unclaimed prescriptions, which typically constitute about 1.5% of filled orders; establishing a clear "return-to-stock" deadline, such as a two-week cutoff, ensures these products remain available for other patients rather than expiring on the pickup shelf. Understanding supplier return policies is also vital, as these rules determine how pharmacies can recover value through credits or replacements for products that remain unsold or reach their expiration dates [34].

Operational losses, particularly inventory shrinkage and formulary constraints, represent major challenges to a pharmacy's financial health. Shrinkage largely driven by employee theft and shoplifting can drain up to 4.5% of sales, necessitating rigorous security training and the close monitoring of controlled substances. While hospital pharmacies often use strict formularies to limit stock to a single therapeutic equivalent per drug class, community pharmacies often lack such lists, making it harder to balance supply with unpredictable demand. By combining honest staffing with strategic observation techniques and formulary-like consistency where possible, pharmacies can better protect their assets and ensure resources are used efficiently [35].

THE ROLE OF INFORMATION TECHNOLOGY IN INVENTORY MANAGEMENT

In modern pharmacy practice, information technology is a transformative force that enhances the accuracy and efficiency of inventory cycles. By integrating computerized systems—such as handheld barcode scanners and e-procurement platforms pharmacists can streamline the ordering, purchasing, and payment processes [36]. These tools allow for the electronic submission of orders by simply scanning shelf labels, which minimizes human error and ensures that stock levels are replenished precisely when needed. Furthermore, the adoption of Radiofrequency Identification (RFID) tags provides a sophisticated tracking mechanism, allowing products to be monitored from the point of manufacture all the way to the pharmacy shelf [37].

Beyond mere logistics, technology serves as a vital safeguard for both financial health and patient safety. Automated inventory management significantly reduces procurement costs and mitigates inventory shrinkage by providing real-time oversight that discourages theft. In hospital settings, barcode scanning acts as a critical fail-safe, drastically reducing the possibility of medication errors by ensuring the right drug reaches the right patient. By automating these labor-intensive tasks, pharmacists are liberated from manual stock-taking, allowing them to dedicate more time to direct pharmaceutical care and high-value patient services [38].

RECOMMENDATION

From an operational and financial standpoint, Effective inventory control is crucial to pharmacy practice. Therefore, in addition to being covered in continuing education courses for registered pharmacists, inventory management techniques and inventory management evaluation techniques ought to be incorporated into pharmacy program curricula. Considering the substantial amount of money spent on inventory control, the pharmacist ought to assess how effectively a pharmacy is managing its inventory, compute the ITOR on a regular basis. Information technology improves the efficiency, accuracy, and precision of inventory management techniques as well as methods for assessing inventory management. Consequently, pertinent Pharmacies ought to use software, and Pharmacists ought to receive training on how to use these inventory management systems.

CONCLUSION

This study demonstrates how crucial demand forecasts are to inventory management because they allow for accurate order quantity calculations, which lowers the risk of overstock and stock outs. Depending on monthly variations in demand, the forecasting method may produce a different error value for each item. To gain a better understanding of future planning, it is crucial for the business to record monthly demand. This study's recommended approach can be applied to demand situations that are unstable without seasonal trend. Class A items are used as representatives in simulation and computation, but the formulas and sequence of steps Carried out is also applicable to class B and class C items. Both the inventory management model and the forecasting method used in this study do not take the expiration date into account when making calculations because of insufficient data resources. It is anticipated that future health-related research will be able to examine the expiration date for every item for better planning when making purchases.

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