

# APPLICATION OF SELECTIVE INVENTORY CONTROL MODELS IN THE PHARMACEUTICAL INDUSTRY: A LITERATURE REVIEW

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## ABSTRACT

*The purpose of this paper is to demonstrate the use of different selective inventory models in pharmaceutical centers and medical facilities. The paper delineates the various inventory models and their applications in the aforementioned industry. The objective of the study is to give a clear idea of how the logistics and supply chain for different drugs are managed in the healthcare industry. Hospitals need to stock medicines depending upon the requirement, availability and costs so that the inventory holding costs can be curtailed and the allocated budget can be utilized coherently. Based on the literature, the most common inventory control models used for the effective management of the medicines are ABC, VED and a combination of the two followed by FSN, XYZ and MRP models used in integration with one another. The paper also focuses on the inventory analysis and considerations viz. the basis and the variables to be considered followed by a review of literature. Furthermore, the data collection tools are enlisted and the importance and benefits of an efficient selective inventory control model in a pharmaceutical industry is concluded.*

**Keyword:** - selective inventory control models, pharmaceutical centers, applications. ABC, VED, FSN, XYZ, MRP, data collection tools

## 1. INTRODUCTION

At present, healthcare industries have been incurring striking amounts of capital in drugs and other health care technology as compared to any other industry (Gupta et al, 2017), along with which there are a series of difficulties and a huge pressure on the industry to meet the demand and expectations of the customers, while maintaining the fair level of service and financial stability alongside. Administrating the inventory management sector is one of the most important aspect in any health industry. This is because, around 33.33% of the total annual budget of hospitals, goes into purchasing and stocking of medicines and other medical supplies. (Kant et al, 1997) Hence, it is essential, that a methodical and structured technique is adopted for the inventory control. With an efficient supply chain system, there can be significant cost savings and challenges such as understocking, over-stocking and expiry can be eliminated.

Over stocking and shortages are the two most important problems with an ineffective inventory control system. These two purposes are often conflicting. For example, keeping the inventory level high to avoid stock-outs leads to more storage space requirements, higher management costs, deterioration of products and financial loss (Gandhi et al, 2000). In order to keep the cost of inventories low, the status of stock-outs in terms of health facilities in particular will cause negative consequences such as delay in the production of health care services, possible loss of income caused by delay, disability or death and related penal practices (Agirbas, 2014). Consequently, it is necessary to use inventory control models such as ABC, XYZ, VED, HML, SDE, SOS, FSN and GOLF. Now, there are different criteria for a medical facility, to decide which inventory control model should be used. A few of them are, the size of the facility, the quantity of drugs required, the demand, rate of consumption, budget allocated, availability of the drugs and the inventory holding costs.

## 2. TYPES OF SELECTIVE INVENTORY CONTROL MODELS:

Out of the eight aforementioned inventory control techniques, the most widely used techniques are ABC Analysis, VED Analysis and an ABCVED Matrix Analysis. The eight techniques are seldom used individually as an integration of more one technique, bears more efficient results. For the ease of understanding, this section focuses on the background information on each of the technique:



Figure 1: Types of Inventory Control Techniques

### 2.1 ABC Analysis:

ABC analysis is one of the most widely used inventory control technique. In order to classify drugs, researchers in healthcare systems have mostly preferred this analysis. ABC analysis focuses on the annual consumption amount and cost in classifying drugs. This analysis puts strict control on the drugs in class A which are the most expensive among all. But importance of class B and C however should not be overlooked. In some cases, there might be medicines from A, B and C in one prescription. Short of class C drug can lead to a failure in medical treatment if it is vital for the illness. (GünerGören et al, 2017)

### 2.2 VED Analysis:

VED analysis is a method that is used in control of drugs and medical materials. As ABC analysis classifies items based on purchasing costs, VED analysis classifies them based on the critically of stock items. There are three groups in VED analysis based on the basis of priority and importance to patients' health.

- V (Vital): These are drugs that potentially involve lifesaving which should be available all times.
- E (Essential): They are significant for illnesses but less severe compared to vital drugs which may be available in the hospital.
- D (Desirable): These items are lowest critically and shortages of these items are not detrimental to the health of patients. [10] The critically of each item is identified by a group of doctors with different specializations and pharmacists. (GünerGören et al, 2017)

### 2.3 ABC-VED Matrix Analysis:

The ABC-VED matrix is formed by cross-tabulating the ABC and VED analysis. Three combinations are formed from the resultant combination. It should be noted that the first letter in this category denotes the place of the item in ABC analysis where the second letter shows the place of the item in VED analysis.

- 1st Category: These items are both expensive and critically vital for patient's life. They need to be monitored and controlled continuously. These items might be in sub-categories namely, AV, AE, AD, BV and CV.
- 2nd Category: The items in this group are not as expensive as the first group or not as critically vital for patient's life. These need to be controlled periodically. These items might be in sub-categories namely, BE, CE, BD.
- 3rd Category: These items in this group are the least expensive and vital. They do not need to be controlled periodically. These items might be in sub-category namely, CD. (GünerGören et al, 2017)

### 2.4 XYZ Analysis:

The XYZ analysis gives an immediate view of the items that are expensive to hold. Through this analysis, firm can reduce its money locked up by keeping as little as possible of these expensive items. In the XYZ analysis there are three groups of materials that can be described as X material group has a fixed size of demand/ need, and it is characterized by small periodic fluctuations, which provides high accuracy of forecasting, Y material group has moderate fluctuations in demand / need, which allows an average accuracy of forecasting, Z material group has irregular demand/ need, which allows a low accuracy of forecasting. (Krishnaraj et al, 2016)

### 2.5 ABC-XYZ Matrix Analysis:

The ABC-XYZ matrix is formulated by cross tabulating ABC and XYZ analysis. From the resultant combination, three categories (I, II and III) were deduced. Category I is constituted by items belonging to AX as sub category. The BX, CX, AY, BY, CY, AZ and BZ subcategories constituted by category II and remaining items in the CZ subcategory constituted category III. In these subcategories constituted category III. The first alphabet denotes its place in ABC analysis, while the second alphabet stands for its place in the XYZ analysis. (Krishnaraj et al, 2016)

### 2.6 FSN Analysis:

This classification is based on the consumption pattern of the materials i.e. movement analysis forms the basis. Here the items are classified into fast moving, slow moving and non-moving on the basis of frequency of transaction FSN analysis is especially useful to combat obsolete items whether spare parts are raw materials or components. It helps in arrangement of stocks in stores and their distribution and handling methods.

The main aim of this analysis is to control obsolescence of the inventories. If there is a rapid change in technology then this classification will have to be updated more often. FSN analysis is stock turnover ratio-based analysis. Stock turnover ratio is defined as the ratio of annual consumption of a material divided by its average inventory i.e. The items can be classified into three categories viz.

- Fast moving (F) those items whose stock turnover ratio is greater than 3.
- Slow moving (S) those items whose stock turnover ratio is between 1 and 3.
- Non moving (N) those items whose stock turnover ratio is below 1.

Sr.no.	Title	Basis	Variables to be considered
1.	ABC	Value of Consumption	To identify inventory hotspot
2.	FSN	Consumption pattern of the drug	To control obsolescence
3.	HML	Unit price of the drug	Mainly to control purchases
4.	XYZ	Value of drugs in storage	To receive inventory in scheduled intervals
5.	VED	Criticality of the drug	To determine the stocking level of drugs
6	SDE	Problem faced in procurement	Lead time analysis and purchasing strategy
7.	GOLF	Source of the drug	Procurement strategy
8.	SOS	Nature of supply	Holding strategy for seasonal items

Table 1: Inventory analysis and their considerations

### 3. A REVIEW OF LITERATURE

According to GünerGören et al (2017), inventory management includes all processes from procurement of materials to the consumption of end user. In their study, drugs were grouped according to their cost and vital importance in order to make decisions related to inventory control and to keep the costs related at minimum level. Drugs were standardized by ABC-VED analysis. Thus, drugs with higher importance would be controlled more frequently; drugs with lesser importance and counterparts would be controlled with longer intervals. Therefore, the work force would then be shaped according to this analysis and the negativities experienced in the past could be prevented. Seema Ahlawat (2016), states that in case of drugs, besides the criticality factor, the cost factor must also be taken into consideration, it can be seen in her study that about 25% of the drugs consumed about 70% of the budget of the pharmacy. This is the group requiring greater monitoring as it has fewer drugs consuming most of the money.

In the study proposed by Manivel et al (2016), the pharmacy purchasing and the stock maintenance procedure was observed through a questionnaire and a discussion was conducted with the pharmacy personnel to identify the existing issues with the inventory management that were caused because the personnel involved in the supply management process lacked logistic skills. As a step towards achieving effective inventory control, an ABC-FSN inventory matrix was formed and drugs were narrowed down for monitoring and control strategies of pharmacy drugs. According to a study by Vahit Yigit (2017), ABC, VED and VED matrix analysis provides an important management tool for the effective management of the medical store department in hospital. Owing to this analysis, inventory costs could be reducing in university hospital. As a result, the management of class I (301 items) vital medical materials requires top managerial control and these materials must be constantly keep in stock for uninterrupted health care service. Category 2 and category 3 medical materials should middle and lower managerial control respectively.

Nag et al (2016) says furthermore, the ABC-VED was significantly useful for identifying the drugs requiring stringent control for optimal use of financial resources and elimination of out-of stock situations. In their study, it was revealed that only 27% of items can be considered as vital and costly, accounting for a high 71% of the Annual Drug Expenditure. According to an analysis by Keerthana S. et al (2018), regular reviewing of data from past six months can be used to lead the order-set changes in the hospital's computerized order entry system for frequently intervened drugs. The calculated minimum safety stock level is given as a "Alert Level" and "Alert Codes" for the enhancement and betterment using Track care software. The red code indicates stocks below safety level followed by blue for unavailability of drugs and green indicating the stocks above safety level. The second phase of the study

aims at implementation of effective (Economic Order Quantity - EOQ) cost control management technique. The implementation of a robotic dispensing system substantially decreases the rate of dispensing errors and optimizes stock management.

Taddele et al (2019), states that the general hospital mentioned in their research called for an effective inventory control technique i.e. the ABC-VEN matrix analysis that could make right utilization of budget by concentrating on vital or essential medicines. This analysis should be done before and after the procurement of medicine. They also concurred that ABC-VEN matrix analysis was the best inventory control method at a secondary level health care facility. The classification and results of the research were informed to the procurement and drug store staffs and were then being integrated into the decision-making on procurement, storage and controlling of drugs. In his study, Faruk Yilmaz (2018), affirmed that ABC-VED matrix methods provides considerable benefits for hospitals because of the evaluations are made both economically and in terms of vital importance. The analysis helped the managers to determine the safety stock level of medicines that constitute a significant portion of total expenditure and to effectively and efficiently manage scarce financial resources.

#### 4. DATA COLLECTION TOOLS

Data was collected mainly through Document Review like:

- Stock registers of the concerned financial year,
- detailed report of annual consumption of medicines,
- purchase orders,
- final rate contract lists (Seema Alhawati, 2016)

#### 5. CONCLUSION

From the numerous studies conducted in the present scenario it is quite evident that the selective inventory control techniques are lucrative for the healthcare industry. They not only provide a clear understanding of the healthcare supplies required but also help in cutting costs by a large margin. The various studies included in the paper represent ABC analysis, VED analysis, ABC-VED matrix and FSN analysis for optimization of stock management.

There are also studies focused on secondary level healthcare organizations where handling of the budget using the aforementioned techniques have made the operation of the organization much efficient. Some stores have also made an attempt to link the analysis to a computerized order entry system of the hospital. All this data highlights the effectiveness of inventory control techniques and leaves a promising area for future research.

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