Study on Optimizing Inventory in Laboratory by Finding Inventory Consumption and Application of ABC-VED Analysis at The Mission Neighbourhood-Advanced Diagnostic & Patient Care, Asansol.

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in

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by

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Under the Supervision and Guidance of

Dr. Arindam Das

2021

DECLARATION BY STUDENT

I hereby declare that this dissertation titled Study on Optimizing Inventory in Laboratory by Finding Inventory Consumption and Application of ABC Analysis at The Mission Neighbourhood- Advanced Diagnostic & Patient Care, Asansol is a Bonafede record of my original research work. I declare that it has not been submitted to any other university or institution for the award of any degree or diploma. Information derived from the published or unpublished work of others has been duly acknowledged in the text.

Amit Kumar Thakur
Date- 25th June'2021

THE MISSION HOSPITAL DURGAPUR | FUTURISTIC TECHNOLOGY. BRILLIANT MINDS.

Ref: TMH/HRD/OG/June -21/26

Date: 21.06.2021

To Whom It May Concern

This is to certify that **Mr. Amit Kumar Thakur** has done his three months dissertation on "A Study on Optimizing Inventory in Laboratory by finding inventory consumption and application of ABC Analysis at The Mission Neighbourhood – Advanced Diagnostics & Patient Care, Asansol" from 22.03.2021 to 21.06.2021.

During the period of dissertation he has been found sincere.

We wish him a successful future and career ahead.

Lalita Sen Ghosh
Senior Manager – HR

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CERTIFICATE

This is to certify that dissertation titled "Identifying Business War-Gaming Applications and Utility in Product Launch Strategy" is a record of the research work undertaken by Akansha Singh in partial fulfillment of the requirements for the award of the degree of MBA (Hospital and Health Management) from the IIHMR University, Jaipur under my guidance and supervision and her approach to the research study has been sincere, scientific, and analytical.

Faculty Guide	School Dean
IIHMR University, Jaipur	IIHMR University, Jaipur
Date	Date

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I recognize this opportunity as a big milestone in the development of my career, I will strive to use the knowledge and skills gained in the best possible way.

Lastly, I want to express my respects and love to my parents, my siblings and my friends for constant encouragement and motivation in my higher studies.

Sincerely,

Amit Kumar Thakur

Abstract

Basic objective of material department is to get right goods/products, at right cost, and at right time to maintain desired services level at minimum cost. This study is done at The Mission Neighbourhood- Advanced Diagnostic Center. The role of the material warehouse is to provide the right quintiles of the right item at right price at right time. The key performance indicators for materials department are no stock outs, zero errors in maintenance of accounts, zero error in billing processing, maintain minimum inventory maximum efficiency.

Introduction:-

Inventory is defined as the goods and materials that any business firm holds for the purpose of utilization, resale, or production. Planning and managing these inventories are also called inventory management. Since the valid inventory is essential to achieve the possibility of the supply chain, it is a major concern for The Mission Neighbourhood-Advanced Diagnostic Center.

The inventory management system is the center of the business for tracking and managing inventory. The ability to accurately measure inventory in a timely manner is very important to ongoing business operations in The Mission Neighbourhood-Advanced Diagnostic Center, because these activities are one of the largest current assets on the center's balance sheet. Organizations need to pay great attention to managing their inventory. Inventory investment cannot be excessive or inappropriate, it should be just optimum. Keeping the stock in optimal level is the primary goal of stock management in The Mission Neighbourhood-Advanced Diagnostic Center. An excessive investment in inventory results in the occupation of more capital costs, which reduces profitability, misuse of inventory, loss, increased damage and holding costs in terms of large space. At the same time, low or insufficient inventory investment causes stock-outs, sales and production and operation interruptions. Therefore, there is a high possibility that The Mission Neighbourhood-Advanced Diagnostic Center can lose customers because they turn to the competition. The supply chain manager, due to his involvement in supply chain management, should always try not to over-or under-invest in inventory. The importance of inventory management can be explained in many ways. For example, inventory management helps maintain a balance between maintenance

costs and order costs, thereby minimizing inventory costs, it is conducive to maintaining sufficient inventory, ensuring the smooth progress of production and sales, and avoiding the problem of out of stock in the enterprise, Otherwise, you will face a lack of proper inventory management.

It is recommended that the The Mission Neighbourhood-Advanced Diagnostic Center implement a proper inventory control system to avoid loss, damage, and misuse. Approximately one-third of the annual budget is used to purchase stocks that also include medicines in The Mission Neighbourhood-Advanced Diagnostic Center. Pharmacy is one of the departments in hospitals where a lot of money is often spent. The inventory supply chain must be efficient to maintain sufficient inventory. Since stock management has a major contribution in revenue generation as well, therefore there is a need of proper planning, designing/structuring, and organizing proper flow of inventory supply chain effectively. The aim of inventory management in hospital is to ensure sufficient inventory is present at right time, right place, and at right number when required. There should be uninterrupted supply of essential inventory and it should be maintained properly so that hospital can function uninterruptedly.

ABC analysis is a method of classifying inventory in accordance with their relative importance which is based on consumption and cost of inventory. It can be said that it is based on Pareto's principle that 80% of all problems can be attributed to 20% of the causes. It is also known as 80/20 principle, or Pareto principal, and known as the rule of the vital few and the trivial many. The analysis done at The Mission Neighbourhood-Advanced Diagnostic Center classifies items into three categories; the first category (Category A) is that 10-20% of the inventory items are representative for approximately 80% of the cumulative cost, 20-25% of the inventory accounts for approximately 15% of the cumulative cost, which is Category B, and remaining items which costs for approximately 5% of the cumulative cost, which is Category C.

Review of Literature

S. No.	Author	Year of Publication	Study Design	Sample Plan	Objectives	Key findings
1	Mahatme MS, Dakhale GN, Salve AM, Shinde AT	2012	Observational study	Drug formulary of a hospital consisting of 210 items	• To apply Economic order quantity (EOQ) along with ABC-VED analysis. • Compare exponential costs with the actual costs. • Find the spending in next few years	EOQ along with ABC-VED analysis optimizes health service costs. This also ensures that patients have access to materials at any time. Improve the quality of health services provided.
2	Sukhbir Singh, Mahesh Devnani, Anil Kumar Gupta, Latika	2015	Observational study	Drug formulary consisting of 416 drugs.	• Application of ABC-VED analysis in hospital pharmacies of tertiary medical institutions. • To identify drugs	• The total hospital pharmacy expenditure in 2008-09 was Rs 6.04 million. • Therefore, prioritize inventory optimization and determine the need for tight inventory

					requiring strict management control.	management control.
3	Dr. Babu Krishmaraj Meenashkshi PK	2011	Observational study	Drug Inventory of hospital with 124 items.	• Ensure that the load of required items is satisfactory.	• 30.3% (40) projects are classified as A-grade projects, 25% (33) projects are classified as B-grade projects and 44.7% (59) projects are classified as C-grade projects.
4	PITTAYACHAIC HOOPARA, ITTRARUKIJKANPANICH	2019	Analytical study	862 inventory items	• To improve Inventory management for medical supplies in the Surgery department at a hospital.	The result of improvement that show the variation, turnover rate and unnecessary were improved 21.97%,5.00%. And 50.34% respectively Cost.
5	P. O.Agada* and E.H. Ogwuche	2019	Quantitative study	786 medical consumables	• To implement a probability EOQ model for inventory	• The EOQ and reorder levels are 11 and 864, 24 and 810, and 34 and 786 units, and the ordering costs are 2.5%,

					management of drugs and medical consumables.	12.5%, and 25% of the actual cost per drug unit, respectively. Considering the related ordering costs. This will help hospital in making an informed decision about the quantity of drugs or hospital consumables to order.
6	Sushanta Sengupta, Ruma Dutta	2014	Quantitative research		• Analyze demand forecasts using linear regression functions.	• It has been suggested that a good forecast depends on the forecasting technique used in conjunction with demand function identification.
7	Carlos Miguel Ferreira Alves	2018	Exploratory study		• Try to determine which predictive algorithms will provide the best results when applied in a	• • In an inventory management environment, it may be more useful to use RMSE instead of MAAPE, because larger errors are not advisable. When

					hospital setting.	analyzing the MAAPE indicator, machine algorithms perform better only for soft and unstable categories. • When interpreting the aggregated results, we are clearly aware that classification helps to draw conclusions that certain categories are easier to predict than others due to their characteristics. • Another important aspect of algorithmic decision making is computational complexity. Machine learning algorithms have a longer execution time than statistical

						methods, which can be a negative factor when choosing a method, even if it means reduced precision.

Table- 1

Problem Statement:

Hospital or any other organization dealing with inventory are concerned with the cost associated with it. A large percentage of total money are invested in stock/inventory and effective management of inventory can save a lot of money for Hospital.

Research Question:

1. What should be the sufficient inventory level?
2. How to maintain sufficient inventory level ?

Aim

To make inventory management cost effective and minimize stock out.

Objectives

1. To analyze the stock movements in stores.
2. To analyze the consumption trend of inventory and to rank them based on their consumption.
3. Classify the inventory based on their importance.

Materials and Methods

- **Study Design**: This is an observational descriptive study. The location of study is The Mission Neighborhood, Asansol, West Bengal. The Study is done between 1st April'2021 to 30th May'2021 and covered all the consumables consumed during the study period.

Important terms & concepts used in the study.

When there are tens of thousands of products in different locations, inventory management can be a daunting task for companies. The challenge is even greater when these locations are close to each other and in the same complex. In such a network, new products are initially stored in a central facility. These central facilities are internal suppliers at customer-oriented locations, in this case secondary specialized stores. There are major drawbacks to managing inventory in a network with multiple replenishment cycles and a network with a single replenishment cycle. First, true network inventory optimization is impossible because the replenishment strategy is applied to one cycle without considering the impact on other cycles. These traps can have serious negative consequences, including carrying excess inventory in the form of redundant stockpiles. (Lee, 2003).

The goal of having multiple replenishment cycles is to provide at least the required level of service to the end customer by dividing inventory into multiple replenishment stages. Before continuing, for clarity, I would like to discuss some terms used in this report.

Buffer Stock: Buffer Stock is the amount of inventory reserved to prevent changes in demand and supply shortages or delays. It is also called safety stock or reserve stock. (SV, 2012) It is calculated by multiplying the difference between the daily maximum and average consumption rate by the delivery time of the item. (Kumar, 2013)

Buffer Stock=(Maximum (Max.) Consumption- Average (Avg) Consumption) Lead Time (in days)

There are several factors that affect the required safety stock or reserve stock level. (Walter Ramsey Crowe, 1977) (Kumar, 2013)

1) Uncertainty of Demand.

2) Replenishment period,

3) Delivery time variability, and

4) Required product availability.

5) Continuous review policies vs. Periodic review policies.

Lead Time: It is the average number of days between placing an order and receiving materials. In addition, it is divided into internal delivery time (ILT) and external delivery time (ELT). (SV, 2012)

Internal lead time- The time required to complete the organizational process.

External lead time- The time required to place an order and receive the product.

The addition time and lead time change are negligible and therefore insignificant in this case. Product availability is the company's ability to fill customer orders with available inventory (Kumar, 2013).

There are many ways to measure the availability of product, some of the important methods are:

- Product Rill Rate
- Order Fill Rate
- Cycle Service Level (CSL)

Product fill rate: The proportion of demand that is met by the products in inventory. The execution rate corresponds to the probability that the product will be delivered from existing inventory. If the hospital sells Tab Crocin to 90% of its inventory customers, the remaining 10% will be lost to neighboring competitors due to lack of available inventory. The filling rate is 90%. If you increase the safety stock, the fill rate will increase. This also improves the service level of the cycle.

Order fill rate: It is part of an order that is filled with inventory, and order fulfillment rates are also measured against specific orders, not time. In a multi-product situation (as is the case with most orders) the order will only be filled from stock when all products in the order / order can be supplied from on-site inventory.

Cycle Service Level (CSL): Meeting all customer needs is part of the replenishment cycle (D/Q) that ends. Probability of CSL is equal to of being out of stock during a replenishment cycle. CSL is measured during the replenishment cycle of the specified quantity. Example If a hospital orders a replenishment batch of 600 boxes of Crocin, the interval between two consecutive replenishment batches is a

replenishment cycle. If the hospital pharmacist manages the inventory so that the store will not run out of inventory 6 out of 10 replenishment cycles, the store can achieve a CSL of 60%.

Desired product availability is also not an issue as a lot of stock is maintained just to enable that and the OT main store takes care of that during their continuous review process and ensures at least 90% CSL.

Reorder Level: Indicates the inventory level at which a new order must be placed. It is calculated by multiplying the average daily consumption by the delivery time and adding the reserve inventory. If there is no variation in lead time and average consumption during lead time then this formula holds true for the re-order level (ROL) (Kumar, 2013)

ROL- Average consumption/day * Lead time Buffer stock

Stockout: When the product is not available, the customer's order arrives. (Kumar, 2013)

Inventory in this case can be controlled by setting various stock levels for each item. It also depends on the timing of inventory replenishments which in this case is daily. Economic order quantity (EOQ) is another effective method of inventory management but cannot be used in this case.

Economic order quantity (EOQ) It is the amount of quantity that minimizes the total cost of inventory (such as inventory holding cost, ordering cost, and out-of-stock cost). (SV, 2012) Therefore, EOQ is the optimum size of order which minimizes the cost of ordering as well as the cost of carrying the inventory. It is beneficial only when the following conditions are there:

a. When the demand and lead time are relatively constant.

b. Its maintenance costs and installation or ordering costs are well known and relatively stable.

c. When you use make to stock strategy.

Economic Order Quantity (EOQ) is the ideal amount of inventory a business should purchase to reduce costs such as maintenance and ordering cost.

Economic Order Quantity (EOQ) is calculated by using the formula:-

$Q = \sqrt{2DS/H}$

Where,

Q= Economic Order Quantity

D= Demand of Inventory

S= Ordering Cost of Inventory

H= Holding Cost of Inventory

Even then if we just compare the costs of carrying (which includes blocked capital and interest payments, cost of space and storage facilities, cost of labor, cost of salaries to staff. cost of obsolescence, pilferage, damages) and the costs of not carrying (which includes direct stock out, cost, expensive emergency purchase ,indirect stock out cost ,criticism, patient dissatisfaction, illness, death) in this case, the costs of not carrying seems to outweigh the costs of carrying just for a simple reason that the area that we are discussing here is the OT complex and any stockout here can lead to grave outcomes, even death. Although the costs of carrying are also not less since the nursing staff must spend a lot of time in just maintaining inventory, which otherwise could have been spent on patient care and not to forget the other ills of carrying stock as mentioned earlier. Therefore, a balance between the two is required and some amount of buffer stock must be maintained in the specialty wise sub stores (in this case the three CTVS sub stores) even though replenishments happen daily.

Inventory control is a management tool which tries to ensure that optimal quantity of items is present at the facilities in accordance with the need at the most economical cost possible. It also ensures that there are no stock outs or overstocking. (SV, 2012) **Tools used for inventory control here include maintaining a buffer stock and daily replenishments by following a cyclic ordering system.** The **cyclic ordering system** is one in which the stock position is reviewed at definite intervals (which is daily). Availability and consumption are assessed for placing orders. The review is physical check, a visual review of the inventory documents and a computer-based system. The quantity ordered each time varies according to the stock position. The projected requirements are based on previous year's trends of consumption but in the method followed in this hospital they are just replenishments of previous day's consumption. This system may work well for materials which show irregular or seasonal variation.

The main limitation of this system is that it does not permit ordering based on EOQ method.

ABC Analysis (Always better control)

In supply chain management, ABC analysis is classification of inventory This divides the items into three categories; A, B, and C. A is the most valuable item while C is the least valuable item. This approach aims to focus on the critical few (A-items) rather than the trivial majority (C-items).

Steps involved in ABC analysis:-

1. List of total consumables was prepared.

2. Their per unit price and annual consumption was determined.

3. Per unit price was multiplied with annual consumption to get their annual usage.

4. It was arranged in decreasing order of annual usage.

5. It was expressed as cumulative usage percentage.

6. Cumulative usage percentage up to 80% was taken as Category A .

7. 81-95% was taken as Category B.

8. 95- 100% was taken as Category C.

- **ABC analysis sometimes called as the selective inventory control.**
- **Need of the ABC analysis**:

1. To identify items which has a significant impact on the total cost of inventory.
2. It helps in categorizing important items to control different levels of items based on relative importance.

3. It helps in bringing down the cost of working capital and carrying cost.

4. It helps in maintaining the stock better and control over the high-value goods and track the value of assets held at the same time.

VED- Analysis

The VED analysis of the inventory is carried out by dividing the inventory into Vital(V), essential (E), and desirable (D) categories according to the criticality of the inventory.Vital (V) are the Items urgently needed because it is proportional to survival of patients, and these stocks must be readily available at the center. Using VED analysis, we made a priority list, where the list is categorized according to the impact on health. Vitals inventories are those which are very critical for the operations and do not provide any corrective time i.e., they cannot be procured off the shelves if they are not available. Essential inventories are less critical compared to vital and essential inventories, and we can work without these inventories for few days. Rest all other inventories comes under the category of desirable inventories.

Clinicians and Medical Laboratory Technologist classified the inventories into Vital(V), Essential (E) and desirable (D).

ABC-VED Matrix

CLASSIFICATION	A	B	C
V	AV	BV	CV
E	AE	BE	CE
D	AD	BD	CD

Table- 2

The ABC-VED matrix is developed by ABC crosstabulation and VED analysis. On the basis combination of results obtained after cross-tabulation, three types of lists (I, II and III) were compiled. Category I consists of elements belonging to the subcategories of AV, AE, AD, BV, and CV. The second category consists of items belonging to the BE, CE, and BD subcategories, and the remaining items in the subcategory CD constitute the third category. In these subcategories, the first letter indicates your position in the ABC analysis and the second letter indicates your position in the VED analysis.

Treating items according to their value and consumption importance can improve customer service and we can control inventory. We can design the inventory level in such a way that:

- We Provide maximum service for Class I category.
- For class III category, services can be minimum desirable.
- For Class II items, the service level can be between these two levels, and the average inventory can be adjusted accordingly.

- **Data Collection:**

  Primary Data: Primary data was collected/obtained for this study. Interaction with personnel of the hospital supply chain department was carried out.

  Secondary Data: Inventory data statements obtained from HIS.

- **Data Analysis Tool:** Microsoft Excel, Version Microsoft 365.

Data Analysis Plan: Descriptive analysis is used as per objectives.

Results:-

Findings of ABC-Analysis

Category	Number of Items	Percentage Consumption	Type of Control Required
A	32	79.31	Strict
B	27	15.82	Moderate
C	150	4.87	Loose

Table- 3

ABC Categorization of Medical Consumables

Category-A : It includes 32 inventories which need strict control. These are the inventories having highest percentage of consumption.

Category-B : It includes 27 inventories and needs moderate type of control. It is having second highest percentage of consumption.

Category-C : It includes the remaining 150 inventories which needs least/loose control. These inventories also have the least percentage of consumption.

Table-3 indicates that 14.83% medical consumables accounts for approximately 80% of the total cost, while 13% accounts for 16% of the total cost and rest of the items constitute for approx. 5% of the total cost.

ABC-VED analysis

DRUG ANALYSIS	NUMBER OF INVENTORIES	PERCENTAGE OF INVENTORIES
V	**39**	**18.66**
E	**114**	**54.55**
D	**56**	**26.79**

Table-4

VED analysis of the inventory was done .

Out of 209 inventories, 39 inventories fall in “Vital” class i.e., 18.66% of total inventories.

114 inventories fall under “Essential” class i.e., 54.55% of the total inventories.

Remaining 56 inventories fall under “desirable” class i.e., 26.79% of the total inventories.

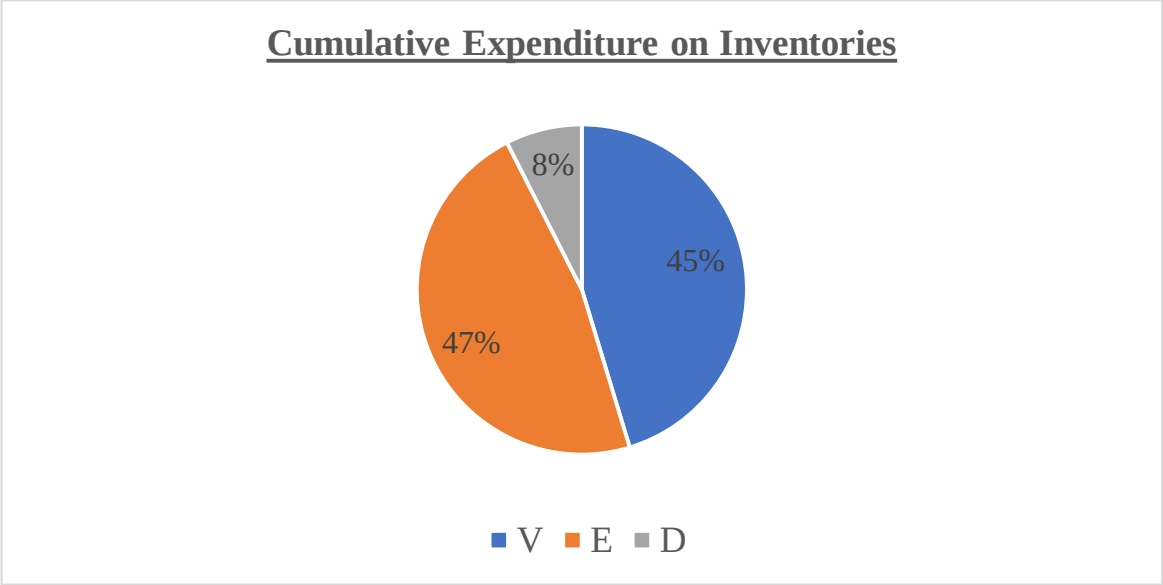

Chart- 1

ABC - VED	V		E		D		Total Inventory	Percentage of Inventory
	Combined category	Number of Inventory	Combined category	Number of Inventory	Combined category	Number of Inventory		
A	AV	12	AE	17	AD	2	31	14.83
B	BV	3	BE	19	BD	6	28	13.40
C	CV	24	CE	78	CD	48	150	71.77
		39		114		56	209	100

Table-5

ABC-VED			
Classes	Combined Category	Number of Inventories	Percentage of Inventories
Class I	AV+AE+AD+BV+CV	58	27.75
Class II	BE+CE+BD	103	49.28
Class III	CD	48	22.97
Total		209	100

Table-6

The combined matrix of ABC and VED analysis results into nine combined categories which are: AV,AE,AD,BV,CV,BE,CE,BD and CD.

The total number of inventories falling under AV is 12, AE category is 17, AD category is 2, BV category is 3, CV category is 24, BE category is 19, CE category is 78, BD category is 6 and CD category is 48.

The items are classified into three classes i.e., Class I, II and III.

Class I items

These items are sum of AV,AE,AD,BV and CV

i.e., 12+17+2+3+24=58

Class II items

These items are sum of BE,CE,BD

i.e., 19+78+6=103

Class III items

These items are CD items.

CD= 48

The ABC-VED matrix above shows that category I (58 items) will help to verify the annual budget and its availability. The pharmacy supervisor manages the inventory of second-level (103 items) and lower-level management of the inventory of third level (48 items) is desirable.

Conclusion

There are only 32 inventories which accounts for the highest costing and requires strict attention on its availability. Rest other inventories accounts for 15% of the total cost, therefore, there should not be any stockout of the items which belong to category-A to prevent loss for the organization.

Discussion

After analyzing the results, the current ABC analysis showed that the cost of only 32 inventory items comprises 80% of the total cost. Since the data collected had many inventories which free of cost during the purchase of machinery/diagnostic equipment, therefore, all the free inventories will have their costing from next purchase and hence ABC analysis of inventories will change accordingly.

Suggestions and Recommendation

- For Group- A : Order should be placed frequently, and lead time should be as less as possible to prevent damage by overstocking and not utilizing items.
- For Group- B: There should be sufficient stock which should be maintained, and orders should be placed less frequently.
- For Group- C: Orders can be placed very less frequently.

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