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Investigation Consumables in Operating Room with ABC & VED Analysis: Adana, Turkey Case

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Abstract

Stock control methods are the proceedings that help many institutions and organizations to increase their profitability and use of resources / materials more efficiently and rationally. The results of the effective inventory control methods differ for each institution in terms of the expected benefit, necessity and the cost of materials. In the literature, various stock control methods have been implemented in various institutions and organizations and are still being implemented. In this study, ABC and VED analysis methods, which are widely used in the hospitals and other sectors where uncertainty and dynamism are relatively high, were applied for the surgery room of Çukurova University Hospital in Adana. The analysis was applied by taking into consideration of number of 806 consumables and evaluated based the month of January. ABC and VED analysis was performed for the consumables in the surgery room, and the ABC-VED matrix table was created by crossing the two tables of ABC and VED analysis. The materials purchased for January were divided into 3 main categories based on the ABC-VED matrix table, and the ratio of Category I with the highest cost and importance to the total cost was found to be 82.36%. The ratio of the materials in Category II and Category III to the total material costs is 16.99% and 0.64%, respectively. Based on the results, suggestions were made for the surgery room's consumables of the Çukurova University Hospital.

Keywords: ABC Analysis, VED Analysis, Stock Control, ABC-VED Matrix

1. Introduction

Stock is raw material, semi-finished product, finished product, scrap, waste or assets that have an economic value that a company holds in order to produce and / or provide services. In today's conditions, inventory control is of great importance for institutions, companies and businesses operating in the service and production sector. There is a cost of stock keeping as well as a cost of stocking. The consequences of holding and not stocking may differ for each company / institution, and it may be possible to balance these two situations by using various inventory management techniques.

The concepts of cost and satisfaction come to the fore in the effective control of stocks. Effectively managed inventory not only increases the profitability of the company, but also reduces product losses to a minimum, prevents excess stocks, provides advantages related to demand fluctuations, seasonality and cost. At the same time, meeting the product / service demands of the customers that the organizations serve is among the primary goals of the institutions.

When the previous studies are examined, the studies on inventory management are mainly on hospital stocks where uncertainty and dynamism are high. It is important for hospitals to have enough supplies to intervene in patients in a timely manner and to protect public health.

In order to increase the efficiency of medical equipment in hospitals, stocks must be effectively planned, purchased, stocked and controlled with modern stock control methods. In the management of medical supplies in hospitals, the demand for healthcare services cannot be predicted precisely, especially in materials that may vary according to the type of disease. In this case, the medical stock level should not be allowed to fall below zero by applying patient-based purchasing methods.

The aim of this study is to propose a system that minimizes stock keeping costs, and does not cause stock shortages, since stock management is an important and costly activity in hospitals. In the study, 2019 consumables of the operating room in Çukurova University Hospital in Adana were examined. ABC and VED analysis, which are among inventory management techniques and used in case of large number of stocks, were applied on these data and

ABC & VED Matrix was created. The analysed data were analysed monthly and the results were interpreted based on the month of January, when all materials were ordered. With ABC, VED and ABC & VED matrix analysis, suggestions were made about the most appropriate stock control level by classifying them according to the number, amount and vital importance of the materials used in the surgery.

2. Literature Review

Stock management is one of the subjects that has been frequently discussed and studied in the literature for years. One of the most important factors in ensuring the continuity of production and service in the production and service sector has been stock.

Studies have been carried out on various methods used in inventory control in the service and production sector. One of the general purposes of using inventory control methods used in institutions and / or organizations such as factories, hospitals and hotels where various industries produce, is the cost factor. ABC and VED analysis in the manufacturing sector (Ravichandran, 2014; Mitra et al., 2013; Felice et al., 2014; Fathoni et al., 2019) is one of the frequently used stock control methods. For example, Bagal and Memane (2020) aimed to analyse and apply inventory classification techniques using HML and VED analysis in a factory. In addition, they stated that it is among their aims to ensure that the materials are available in sufficient quantity and also to minimize the stock cost. Ertuğrul and Tanrıverdi (2013) aimed to create a more effective stock management of the company as a result of comparing the results by applying ABC analysis and Analytical Hierarchy Process in the classification of stocks with the information obtained from the supplier business. In the light of the data obtained, he stated the differences between AHP and ABC analysis in the classification of stocks, and by calculating the total inventory costs of the enterprise, it was revealed which method is advantageous. As an example to the hospitality industry from the service sector, the study of Kumar and Soni (2017) to reduce the stock costs of a hotel using ABC analysis and to find the appropriate stock levels to determine the required stocks can be given.

In hospitals, which are an institution of the service sector, the concept of "stock"; maintenance, medical examinations and treatments to be carried out without interruption and to keep all kinds of consumables ready in order to meet the demand in emergency situations. Stock control is the process of ensuring that sufficient and necessary basic materials are available to ensure uninterrupted maintenance. The purpose of stock control in hospitals is to ensure that the material is constantly available in the warehouse, to minimize investments in stocks, to use the workforce effectively, to reduce transportation costs and to improve the quality of care with less stock (Tisinli & Savaş, 2019). In the literature, ABC, VED, XYZ, FSN, SOS, SDE analysis, fixed order period, economic order quantity, visual control, double box, fixed order quantity, maximum-minimum etc. are the most frequently used stock control methods in hospitals. Methods have been applied (Yiğit & Yiğit, 2019).

Studies applying ABC and VED analysis (Yiğit & Yiğit, 2019), medical equipment stocks in hospitals affiliated to the General Directorate of Public Hospitals (KHGM), (Tisinli & Savaş, 2019), disposable materials in the operating room of a private hospital, (Işıkçelik et al., 2019), the annual drug stocks of a hospital affiliated with the Ministry of Health, (Yeşilyurt et al., 2015) conducted studies where they analysed the medical equipment and drug stocks in a hospital operating in Isparta.

With stock control, sufficient stock of the required items and uninterrupted production are ensured with these products (Wandalkar et al., 2013; Khurana et al., 2013; Devnani et al., 2010). It helps with what, when and in what quantity can be ordered and how much stock should be available based on purchasing costs and storage of costs (Dudhgaonkar et al., 2017). There are many methods of inventory control that are widely used to manage stocks effectively (Kumar et al., 2017; Işıkçelik et al., 2019).

Especially ABC and VED analyses are preferred in stock management in health institutions, and there are many studies related to these analyses at home and abroad. However, these studies are generally related to drugs. There is a study on medical consumables in Sakarya University Training and Research Hospital, which is analysed only with the ABC technique, "The Importance of Material Management in Health Management Systems and an Application Example with ABC Analysis" (Yalçıner, et al., 2015). ABC and VED related to drugs, analysed using ABC VED Matrix analysis, “Inventory Control Analysis in Hospitals: An Application in Akdeniz University Hospital” and Effective Stock Management in Hospital Businesses: An Application for Pharmaceutical Stocks” (Yiğit, 2014; Uygun & Yiğit, 2017). The analysis of medical consumables used in hospitals with ABC, VED, ABC-VED Matrix methods is included in the “Stock Management with ABC and VED Analysis in Hospitals” study (Çabuk et al., 2018).

3. Material and Method

3.1. ABC Analysis

While performing the purchasing function, whether the demand is less or more valuable, the frequency and amount of use of the material for the enterprise are taken into consideration. For this, a method called the ABC method is used. The ABC classification method is to indicate the relative importance of the various materials that are needed by

the business and kept in stock. In other words, it is to indicate the relative importance of stock items with respect to each other. In terms of stock control, stocks should be classified according to their importance and control should be applied in proportion to the stocks' importance. It is both unnecessary and uneconomic since it will cause excessive expense to control inventory items with different degrees of importance. For this reason, inventory items are divided into groups according to criteria that indicate their relative importance, and the control process is differentiated. This method is also used successfully in stock control, sales or distribution, quality control, material supply and production planning problems.

The ABC method in inventory control consists of classifying inventory items according to their accumulated percentages in total. In the classification, stocks are generally divided into 3 groups:

- **Most important (group A):** It constitutes 15-20% of the total amount, 75-80% of the total value.
- **Medium important (B group):** 30-40% of the total amount, 10-15% of the total value.
- **Least important (C group):** It constitutes 40-50% of the total amount, 5-10% of the total value.

Since stock investments are at a high level in A group items, demand forecasts should be made for each A group item by conducting strict management control for A group items. In addition, efforts should be made to shorten the lead time required for order purchases or the production of items. Forecasting and recording systems of Group A items, detailed analysis of safety stock and order quantity should form the bulk of control efforts. The inventory policies of the B group items should be reviewed less frequently than the A group items under computer control. For group B items, easy forecasting methods, less detailed transactions and economical order quantity model are sufficient. It is sufficient to review the C group items once or twice a year. Briefly, in this system, stock items are grouped in terms of their values, important items are determined, and information is provided on stock items to be given priority to the control process, the importance of the control process and similar issues. Thus, excessive and deficient stock control is prevented (Ertaş, 2016).

3.2. VED Analysis

This method which is used in the control of medicines and medical supplies in hospitals is called the VED method because it consists of the initials of the English words Vital, Essential, and Desirable (VED). In the VED method, drugs and materials are divided into three groups according to their value to human life.

- **Group V:** Materials and medicines are vital, urgent and must-have items.
- **Group E:** Although materials and drugs are important, they are materials that can be found alternatives.
- **Group D:** The materials are optional, not mandatory. These materials do not have a direct effect on the services offered by the hospital.

V and E group materials should be kept in stock as they are available at all times and the safety stock should be kept high. Group D materials are not required to be kept in stock (Tengilimoğlu, 1996).

3.3. ABC-VED Matrix

The ABC & VED matrix is obtained by crossing ABC and VED analyses and tabulating them as a 3x3 matrix. There are 9 groups of crossed tables. These; They are called AV, BV, CV, AE, BE, CE, AD, BD, CD. These 9 groups are categorized as I, II and III.

I. **Category (AV, AE, AD, BV, CV):** Medical materials in this group are both vital and costly materials. For this reason, it was assumed that it was affordable and that tight stock levels should be continuously and tightly monitored and controlled.

II. **Category (BE, CE, BD):** Medical supplies required to provide healthcare services in hospitals. Since the cost of this material group is at a medium level, inventory control audit is done at a medium level.

III. **Category (CD):** In the CD group, materials are materials that are low in terms of both cost and vital importance, and medical supplies that are optional for a special case, patient and special services are included in this group (Yiğit & Yiğit, 2019).

4. Research Findings and Discussion

According to the data obtained from Balcalı Hospital, a total of 806 medical supplies were ordered for the operating room in 2019 and Figure 1 shows the amount of materials by month. When analyzed on a monthly basis, it can be said that an average of 67 different medical consumables are purchased monthly. The cost of the materials per month is calculated according to the unit prices and quantities supplied. Since there is a large variety of materials in the operating rooms, January was chosen as the reference month, and ABC and VED analysis was made for January.

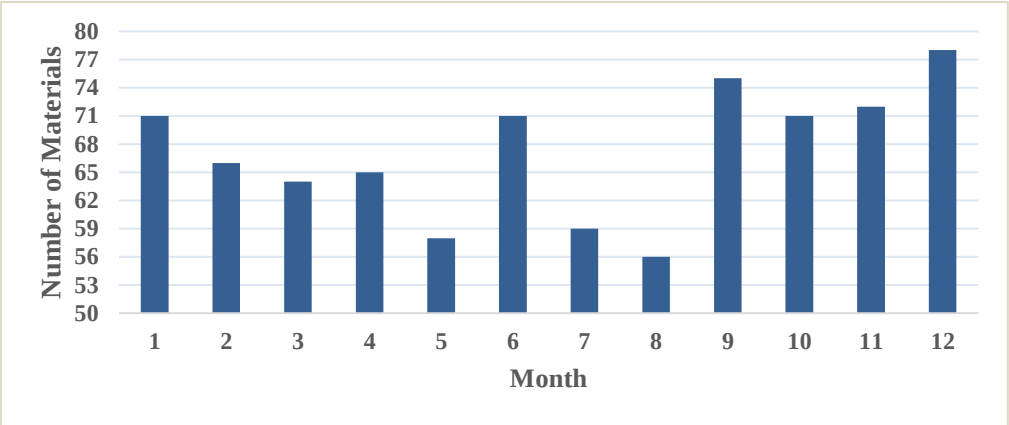

Figure 1. Table of Materials by Month

While the annual cost of the materials used in the operating room of the hospital is 2,616,159.50 TL, it has been calculated that the monthly average amount of the materials in the operating room is 219,609.60 TL. According to the findings, among the 67 items of materials that make up the sample, the most demanded materials for the operating room are examination gloves and surgical masks. While the material with the highest unit cost among the materials in the operating room was "Fiber Optic Light Cable-Medium" with 1000 TL, the material with the lowest unit cost was observed as "Galosh" with 0.20 TL. Some of the 71 materials purchased for January are shown in Table 1.

Material Order No	Stock Code	Stock Name
341	STK-12790008	BIOLOGICAL INDICATOR
74	STK-11010016	TRANSPARENT MEDICAL FLASTER
577	1.5003E+15	KIRSCHNER WIRE WITH DOUBLE TROCAR POINT 0,75X280MM
104	STK-11011002	INJECTOR 2 CC
452	1.5003E+15	PATHOLOGICAL CONTAINER 5000
391	1.5003E+13	PATHOLOGICAL WASTE BOX 30 L

Table 1. Material Sampling Table

According to the results obtained by ABC analysis, there are 13 items in Group A, 25 items in Group B and 33 items in Group C. The materials in the A group constitute 18.3% of the total 71 materials, while the B group constitutes 35.2% and the materials in the C group constitute 46.5%. As a percentage of the expenditure, Group A with 80.44%, B group with 14.53% and C group with 5.3% constitute the largest portion of the total amount. Findings of ABC analysis are shown in Table 2. The ABC chart for January obtained with these findings is as in Figure 2. The reason why January was included in the study is that all stock materials were purchased.

ABC	Number of Materials	Material Percentage	Price (TL)	Price Percentage
A	13	18.30%	161.248,64	80.44%
B	25	35.20%	29.125,98	14.53%
C	33	46.50%	10.079,24	5.03%
Total	71	100%	200.453,86	100%

Table 2. Material Numbers, Expenses and Percentage Rates According to ABC Analysis

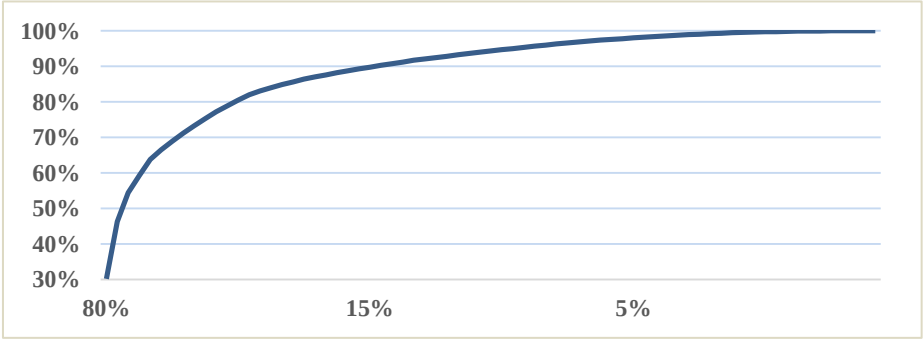

Figure 2. ABC Analysis Graph for January

According to the findings obtained by VED analysis, 4 of 71 materials belong to V group, 44 of them belong to E group and 23 of them belong to D group. In other words, V, E and D groups constitute 6%, 62% and 32% of all materials, respectively. According to the total cost belonging to these groups, the amount of materials in the V group constitutes 4.3% of the total amount, while the materials in the B group constitute 23.6% and the materials in the C group constitute 72.1%. Table 3 shows the values found according to the VED analysis.

VED	Number of Materials	Material Percentage	Price (TL)	Price Percentage
V	4	6%	8.652,00	4.30%
E	44	62%	47.253,93	23.60%
D	23	32%	144.547,93	72.10%
Total	71	100%	200.453,86	100%

Table 3. Numbers, Costs and Percentage Costs of Materials According to VED Analysis

The categorization of materials belonging to groups A, B, C and V, E, D is shown in Table 4. In addition, Table 4 contains information on the total costs of the categories and the number of materials.

ABC - VED	V			E			D			Total	
	Category	No of Materials	Price (TL)	Category	No of Materials	Price (TL)	Category	No of Materials	Price (TL)	Amt	%
A	AV	1	4.8	AE	5	23.744,64	AD	7	132.704	13	80.44 %
B	BV	2	3.45	BE	13	15.118,85	BD	10	10.557,13	25	14.53 %
C	CV	1	402	CE	26	8.390,44	CD	6	1.286,80	33	5.03%
	Total	4	8652	**Total**	44	47.253,93	**Total**	23	144.547,93	71	100%

Table 4. Number of Materials, Price and Percentage Costs According to ABC-VED Matrix Analysis

In order to create the ABC-VED matrix table, the data in Table 4 were organized on a category basis, and as seen in Table 5, the ABC-VED matrix table was obtained. According to Table 5, 22.53% of the total number of operating room materials in Category I AV, AE, AD, BV, CV class, and the total number of consumables in Category II, BE, CE, BD class. It can be said that their ratio in the material is 69.01% and the CD class in Category III constitutes 8.45% compared to the total material. Materials in Category I constitute the highest cost category with 82.19% of the total amount. In Category II, the number of materials constitutes 16.99% of the total cost amount, while the materials in Category III constitute the lowest cost class with only 0.64% of the cost amount of the materials.

Category	Number of Materials	Material Percentage	Price (TL)	Price Percentage
I (AV+AE+AD+BV+CV)	16	22.53%	165.100,64	%82,36
II (BE+CE+BD)	49	69.01%	34.066,42	%16,99
III (CD)	6	8.45%	1.286,80	%0,64
TOTAL	71	100%	200.453,86	100%

Table 5. ABC-VED Matrix

5. Conclusion

Stock management policies are the methods that are used to physically manage and analyse stocks that help to improve profitability for businesses and institutions. Especially in institutions and organizations such as hospitals where uncertainty and vital risks are high, materials should be evaluated not only in terms of cost but also in terms of vital importance. In addition, the more important it is to avoid over stock in health institutions, the less stocks will create a problem for public health. While ABC analysis is made according to the costs of the materials, VED analysis is analysed according to the importance of the materials according to the customer, patient or buyer in the relevant institution. The combination of these two methods, enables rational decisions to be taken in the institutions that are vital in terms of evaluating both the cost and the importance of the materials.

In the study, materials used in the operating room of Çukurova University Hospital were examined and ABC and VED analysis were performed. The 1-year data obtained were examined separately for each month and January was chosen as the reference month. Due to the high cost and vital importance of the materials considered as Category I, they are essential and important materials that must be kept in the hospital continuously. According to the material list in the operating room examined, 82.36% of the January expenditure and 16 of the total material are materials in Category I. Considering that the materials in this category have the largest share in terms of cost, strict controls should be made. On the other hand, the materials required to provide health services in health institutions are the materials in Category II and according to the findings, 69.01% of the materials in the operating room and 17% of the total cost. Since the cost of the materials in Category II is relatively low compared to Category I, it will be sufficient to make inventory control at a medium level, not often as in Category I. Materials included in Category III, which constitutes the lowest cost items, can be kept in the hospital on request and / or for specific cases. So levels of control need not be frequent or moderate. Different levels of ordering techniques can be applied for these 3 different categories.

The stock control analyses helped to determine the required stock control levels by classifying the operating room materials in Çukurova University Hospital. In order to use materials more efficiently and rationally, ABC-VED analysis can be applied within a period of 3-4 months throughout the year.

With the periodic order policy at the hospital, it is seen that regular orders are placed every month, regardless of the stock on hand. We recommend the just-in-time order policy (JIT), which is the stock policy of the lean philosophy, instead of the periodic order policy, as it involves both large material purchases and large amounts of cost. By establishing the Kanban system, when the materials are reduced to the buffer stock amount, both the material stock cost will be reduced and the material cost will be limited to only the necessary materials.

The Kanban stock management system is based on the principle of "pull system" between units and it is to make available as many materials as the next process needs. In the Kanban system, the empty box is seen as the type of material that needs to be ordered, and the system continuity is ensured by sending a full one instead of the empty box. In this way, organizations simplify their order processes and do not suffer from increases / decreases in demand. This study recommends applying the Kanban system to the hospital stock by digitizing it and ordering the materials when the stock level decreases to the buffer stock level. The recommendation of a buffer stock level instead of a zero stock level is due to the fact that the stock materials are of vital importance and cannot afford the zero stock risk. Thanks to Kanban stock management, inventory costs will be minimized and only the necessary materials will be purchased at the required time, thus a stock policy will be followed free from waste.

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