An Excel-Based Inventory Control System Based on ABC and VED Analyses for Pharmacy: A Case Study

Hacer GünerGören¹, Özge Dağdeviren¹

¹Asst. Prof. Department of Industrial Engineering, Pamukkale University, Kınıklı Campus, 20070, Denizli, Turkey

Corresponding author: Hacer GünerGören

ABSTRACT

In today’s competitive environment, businesses that can offer products or services to users at any time, in any quantity and quality, have great advantages. Especially when these businesses are vital for human health, they need to keep staples of medicines, medical supplies and other support materials in sufficient quantity so that the service can continue without any interruption. Hospitals must keep drugs according to their cost and importance in order to minimize inventory and holding costs. For this purpose, inventory control techniques are needed in order to cut total expenses. The aim of this study was to determine the importance of drugs in a hospital’s pharmacy via ABC, VED and ABC-VED Matrix Analyses. Based on the results, order quantities were determined using Economic Order Quantity model. In order to cope with numerous drugs, an Excel-based inventory system was built to do the analyses quickly and efficiently.

Key words: Inventory management, ABC analysis, VED analysis, ABC-VED matrix, economic order quantity, pharmacy.

INTRODUCTION

One of the most important institutions that provide community healthcare is hospitals. Hospitals should keep their services at the highest level in order to meet expectations of patients. Like every sector, there is a competitive environment in health sector and this competition is further enhanced by legal regulations allowing the private sectors operate. Therefore, inputs, processes and outputs should be checked regularly and resources should be used efficiently at hospitals.

Inventory at hospitals have a significant share in total cost. As stated in Kant et al. [¹], about one-third of the annual hospital budget is spent on buying materials and supplies, including medicines. Therefore, hospitals need to adapt efficient techniques for inventory control in order to cut their expenses. A savings of 1% or 2% from these costs can lead to a significant increase in hospital productivity, profitability, financial performance and increase competitive advantage. Yiğit [²] stated that inventory control analyzes and precautions were taken in a study conducted in a 1500-bed hospital, resulted in saving 20% of the cost of expensive drugs. The ability to provide the financial sustainability of hospital enterprises with today’s highly complex, technological and competitive structure can only be possible by the availability of medical supplies and medicines at the right location, time, quantity, quality and price. [³] In order to achieve this, an efficient material management and inventory control system must be adapted at hospitals. In case of ineffective inventory control, lack of necessary medicines and medical supplies may not be detected. This can lead to consequences such as death, disability and inability to compensate and avoid damage which might have a negative effect on hospital’s image and lead to loss of income in the long term. Therefore, inventory control techniques should be applied.
ABC analysis is one of the most widely used inventory control technique. In order to classify drugs, researches 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. [4] In order to overcome this disadvantage, VED analyses depending on the criticality of drugs have also been utilized in classification at hospitals. Combining these two techniques, ABC-VED Matrix has been emerged and this matrix is the most suitable method for hospital medical materials. [5] Antonoglou et al. [6] analyzed the annual consumption and expenditure incurred on each product at a general military hospital of Athens for the year 2012 via ABC and VED analyses. Another study of ABC and VED analyses was presented by Yiğit. [7] The author analyzed the annual medical materials expenditure and consumption using inventory control techniques. Different classifications were presented by various authors using ABC and VED analyses. [8, 9, 10, 11]

All these aforementioned studies focused only on classifying drugs via ABC and VED analyses. In this study, an Excel-based program was built to classify drugs using ABC, VED, ABC-VED analyses and determine the order sizes. By using this program, hospital staff can easily classify drugs and determine order sizes quickly and correctly. This would help in reducing stock-out problems and total costs.

The rest of the study is organized as follows. Section two presents the material and methods used in this study where the case study is explained in the third section. The last section summarizes the findings of this study.

**MATERIALS AND METHODS**

This case study was conducted at a hospital’s pharmacy. Using the data of year 2015, drugs were classified. For ease of use, an Excel-based inventory control system was built. This section gives some background information regarding ABC and VED analyses.

**ABC Analysis**

ABC analysis is one of the most widely used tools in inventory control. It is based on Pareto’s Law or “80-20 Rule”. [12] This rule, developed by Vilfredo Pareto, states that 80% of total value is accounted by 20% of items. Motivated by this rule, ABC analysis classifies the items in inventory in three groups as in the following.

- Class A represents 20% of inventory items and 80% of inventory value.
- Class B represents 30% of inventory items and 15% of inventory value.
- Class C represents 50% of inventory items and 5% of inventory value.

According to ABC analysis, inventory items in Class A will be handled extensively since the most of the inventory value belongs to this group. Shortage of these items will result in high costs therefore; the inventory control of these items should be done carefully. Continuous review inventory control policies might be more appropriate for this group and safety stocks should be determined strictly. On the other hand, no strict rules should be applied for class B and C items. Low safety stock policy might be appropriate for class B items whereas class C items do not need to be controlled carefully. However, these items should not be overlooked. Especially in hospital pharmacy, shortage of these items may lead to a failure in medical treatment which is very important for the illness. [10]

**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. [4]

- **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.

### ABC-VED matrix analysis

The ABC-VED matrix is formed by cross-tabulating the ABC and VED analysis. [10] 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.

### RESULT AND DISCUSSION

For ABC analysis, annual consumption amount and expenditures of 157 items used in 2015 were analyzed. For VED analysis, these items were grouped by an expert in terms of their importance to a patient’s life. These data then were used in forming the Excel-based inventory control system. The unit purchasing cost, annual consumption amount and groups of V, E and D were transferred to the program. The screenshots of the program are given in the following.
Table 1: Results of ABC Analysis

<table>
<thead>
<tr>
<th>Category</th>
<th>No of Items</th>
<th>Annual Expenditure (TL)</th>
<th>% of Items</th>
<th>% Expenditure</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>16</td>
<td>48,167.48</td>
<td>10%</td>
<td>80%</td>
</tr>
<tr>
<td>B</td>
<td>36</td>
<td>10,203.04</td>
<td>23%</td>
<td>17%</td>
</tr>
<tr>
<td>C</td>
<td>105</td>
<td>1,796.86</td>
<td>67%</td>
<td>3%</td>
</tr>
<tr>
<td>Total</td>
<td>157</td>
<td>60,167.38</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table 1 presents the results of ABC analysis regarding number and percentage of items, annual consumption amount and expenditures. Figure 2 presents the results obtained by the Excel-based inventory control program. In the program, the cumulative percentages were calculated based on the unit price and annual consumption (referred as quantity in the program). Regarding the cumulative percentages, drugs were classified as seen ABC groups in the program.

On ABC analysis, 10 % (16), 23 % (36) and 67 % (105) items were found to be A, B and C category items, respectively, amounting for 80 % (48,167.48 TL), 17 % (10,203.04 TL) and 3 % (1,796.86 TL) (Please see Table 1 and Figure 2).

The findings of VED Analysis of this study are shown in Table 2 and Figure 4.

<table>
<thead>
<tr>
<th>Category</th>
<th>No of Items</th>
<th>Annual Expenditure (TL)</th>
<th>% of Items</th>
<th>% Expenditure</th>
</tr>
</thead>
<tbody>
<tr>
<td>V</td>
<td>38</td>
<td>25,921.29</td>
<td>24.20%</td>
<td>43.08%</td>
</tr>
<tr>
<td>E</td>
<td>22</td>
<td>11,563.71</td>
<td>14.01%</td>
<td>19.22%</td>
</tr>
<tr>
<td>D</td>
<td>97</td>
<td>22,682.38</td>
<td>61.78%</td>
<td>37.70%</td>
</tr>
<tr>
<td>Total</td>
<td>157</td>
<td>60,167.38</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

About 24.20 % (38), 14.01 % (22) and 61.78 % (97) items were found to be V, E and D category items, respectively amounting for 43.08% (25,921.29 TL), 19.22% (11,563.71),37.70% (22,682.38) of hospital pharmacy.
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There were 47 (29.94%) items in category I, 39 (24.84%) items in category II and 71 (45.22%) items in category III, amounting for 84.81% (51,028.38 TL), 13.39% (8,054.69 TL) and 1.80% (1,084.31 TL) of the annual expenditure of the pharmacy, respectively (Table 3 and Figure 6).

Table 3. ABC-VED Matrix Analysis

<table>
<thead>
<tr>
<th>Category</th>
<th>No of Items</th>
<th>Annual Expenditure (TL)</th>
<th>% of Items</th>
<th>% Expenditure</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&lt;sup&gt;st&lt;/sup&gt; Category (AV+BV+CV+AE+AD)</td>
<td>47</td>
<td>51,028.38</td>
<td>29.94%</td>
<td>84.81%</td>
</tr>
<tr>
<td>2&lt;sup&gt;nd&lt;/sup&gt; Category (BE+CE+BD)</td>
<td>39</td>
<td>8,054.69</td>
<td>24.84%</td>
<td>13.39%</td>
</tr>
<tr>
<td>3&lt;sup&gt;rd&lt;/sup&gt; Category (CD)</td>
<td>71</td>
<td>1,084.31</td>
<td>45.22%</td>
<td>1.80%</td>
</tr>
<tr>
<td>Total</td>
<td>157</td>
<td>60,167.38</td>
<td>100%</td>
<td>100%</td>
</tr>
</tbody>
</table>

The items in the first category (47 items) were found to be vital or expensive. Their inventory level had an important effect on the total cost therefore they needed to be monitored continuously. The second category (39 items) consists of essential items. These drugs were not as important as the drugs in the first category but they needed to be control moderately. Category III (71 items) consists of drugs which are

Figure 4. Results of VED Analysis

Figure 5. VED Analysis cumulative curve (2015)

Figure 6. ABC-VED matrix cumulative curve (2015)
cheap and desirable. These drugs should be given the least priority and purchased periodically.

In the last step, the Excel-based inventory program was used to determine the order sizes of the drugs. The Economic Order Quantity (EOQ) model was used to determine the order sizes since the annual demands were found to be constant. EOQ is the order quantity that minimizes the total costs including inventory holding and ordering costs. It is the most widely used approach in determining the order sizes when the annual demand is constant. For further information regarding the EOQ, the reader can refer to Harris. [13] The quantities determined using the Excel-based program were given in Figure 8.

Figure 7. Results of ABC-VED matrix

Figure 8. Order quantities determined.
In Figure 8, the results of ABC, VED and ABC-VED Matrix can be seen. Moreover, economic order quantities of these items were given. This Excel-based program will help hospital staff in doing these analyses easily and correctly. Furthermore, no shortage problems would occur since which drugs would be given more priority, had already been determined.

CONCLUSION

In health institutions, effective and planned inventory control is essential in order to determine demand definitively, optimize the use of financial resources, make the best use of the opportunities offered by renewable and developing technologies, and provide timely and necessary supplies. It is possible to follow the movements and control of drugs within the hospital using inventory management.

Inventory management includes all processes from procurement of materials to the consumption of end user. The workflows in these processes should be specified and material must be recorded in every physical environment.

In this 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 have been standardized by ABC-VED analysis. Thus, drugs with higher importance will be controlled more frequently; drugs with lesser importance and counterparts will be controlled with longer intervals. Therefore, the work force will be shaped according to this analysis and the negativities experienced in the past will be prevented.

REFERENCES


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