Clinical and Experimental Health Sciences

Improvement of Drug Stock Management Using ABC-VED Analysis in a University Hospital

Murat Taşer[1], Murat Özban[2]

[1] Pamukkale University, Faculty of Medicine, Department of Performance, Denizli, Türkiye.
[2] Pamukkale University, Faculty of Medicine, Department of General Surgery, Denizli, Türkiye.

Correspondence Author: Murat Taşer
E-mail: mtaser@pau.edu.tr

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ABSTRACT

Objective: Hospitals allocate approximately 35% of their budgets to pharmaceutical and material stocks in order to provide uninterrupted health services. For this reason, hospital managers spend a lot of time and effort in order to keep a minimum level of stock so as not to disrupt health service production and thus to better manage the limited resources of the enterprise. The aim of this study is to group the drugs according to their financial value and vital importance. In this way, it is aimed to perform stock management in the least costly, error-free and effective way.

Method: In the study, data corresponding to one-year (2021) consumption of a total of 1327 items of drugs were analyzed. The total cost is approximately 83 million ₺. In this study, an ABC-VED cross-analysis was performed on the one-year drug consumption data of a university hospital with 853 beds in order to provide an example of a more controlled inventory structure.

Results: According to the results, it is seen that the ratio of drugs in the first category, that is, drugs that are both high cost and vital for the patient, to the total drug item is 38%. The cost of these drugs constitutes 87% of the total cost.

Conclusion: Taking into account the classifications put forward in the study, strict monitoring of a small number of drugs and regular weekly counts will make drug stock management much easier for managers.

Keywords: Drug stock management, university hospital, pharmacy, ABC analysis, VED analysis.

1. INTRODUCTION

Hospitals are complex organizations consisting of units with many different functions such as pharmacy, laboratory, operating room, laundry, and human resources. Each department has its own products with different conditions in terms of high/low cost, high turnover/rare use, durability/perishability, storage conditions and vitality. This diversity challenges hospital managers to procure before the time of need, to use them in place and on time, to invoice correctly, and to prevent loss and waste. Therefore, the inventory management system should be well organized (1).

Successful inventory management is the key to improving service quality, preventing waste and increasing efficiency in hospitals. Health is a sector where the slightest mistake can cause irreversible situations for human health. Therefore, it is very important to store medical supplies and drugs continuously and in sufficient quantity and to monitor stocks. The obligation of hospitals to have the necessary materials ready for use at any time creates the need for stocking (2). However, this need should be adjusted in appropriate quantities. Keeping more than the needed adversely affects the financial structure of hospitals due to the capital tied to stocks. Insufficient stock is not recognized in time and increases the risk of exhaustion and may cause irreparable consequences such as death and disability. Compensations to be paid in such cases damage both the budget and the image of the hospital (3). As a result, in order for the hospital to survive and prevent financial losses, it is vital to monitor the warehouse stocks accurately.

When it comes to inventory management, drugs are the first thing that comes to mind in hospitals. Effective management of pharmaceuticals, which brings a burden of 10-20% to the budget, has a significant impact on the financial structure and efficiency of the hospital. However, it is often difficult to determine the correct consumption amount of medicines. In order to avoid the uncertainty arising from the use of drugs that may vary according to patient profile, reimbursement conditions, treatment protocols and physician preferences, it is necessary to keep some safety stock. This leads to stocking costs. Therefore, drugs should be strictly monitored,

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especially at the item level, and subjected to continuous control (3).

Health service production costs in Türkiye have increased significantly in recent years. Increases in the cost of medical supplies and pharmaceuticals, rising labor wages, and limited availability of outpatient and surgical services during the pandemic have exacerbated financial challenges. Public hospitals could not make payments to the companies from which they receive services. For this reason, drug inventory tracking has become even more important in order to manage limited financial resources well, prevent waste and ensure efficiency in service delivery (4).

When the literature is examined, different analyses are used in the literature for drug inventory management. ABC (Always, Better, Control), VED (Vital, Essential, Desirable), SDE (Scarce, Difficult, Easy), SOS (Season-Off Season), HML (High, Medium, Low), FSN (Fast-moving, Slow-moving, On-moving) are some examples (5, 6). The ABC-VED cross-analysis, which utilizes the advantages of both analyses, is the most widely used among them.

ABC analysis is an easy, low-cost and fast way to identify products. The aim is to classify and control materials with different prices and frequency of use according to their amounts (7). It is one of the most commonly used analysis methods in hospitals for the procurement of drugs and medical supplies.

In short, since the cost of group A drugs is high, the stock level should be kept low and monitored carefully. They constitute 15-20% of the annual stock amount and 70-80% of the stock value. Group B drugs do not require continuous control because they have a medium cost. They constitute 30-40% of the stock amount and 15-20% of the stock value. Group C drugs have low costs and require a low level of control. They constitute 40-50% of the stock amount and 5-10% of the stock value (8, 9). The characteristics of ABC groups are detailed in Table 1 (10).

Table 1. *ABC classification system features*

Group	Numbers (%)	Cost (%)	Features
A	% 10-20	% 70-80	Strict control No safety stock / very low Frequently ordering Follow-up by senior officials Individual submission
B	%30-40	% 15-20	Monthly check Safety stock low level One order every three months Moderate follow-up authorization Submission in small groups
C	% 40-50	% 5-10	Quarterly controls Security stock level high Batch order every six months Lower level employees authorization Bulk shipping

In VED analysis, products/drugs are classified into three main groups according to their vital importance: Vital, Essential and Desirable. V group drugs are of urgent and vital importance for patients and must be available in hospitals. E group drugs are drugs of moderate importance for patients, which are desirable to have in the hospital but for which there are alternatives. Group D drugs are not vital for patients and may be preferably necessary. These drugs do not directly affect service quality (11, 12).

While the price of the drug is important in ABC analysis, drugs with high vital importance are at the forefront in VED analysis, even though they are cheap. For example, drugs such as potassium ampoules and adrenaline may rank high in the VED analysis because they are of vital importance although their cost is very low (13, 14). In recent pharmaceutical inventory management practices, these two analysis methods alone are not considered reliable. Especially in university hospitals where drug variability is high, using the ABC-VED matrix instead of applying these methods alone is considered a more accurate method for purchasing (10).

In the ABC and VED Matrix, both analyses were divided into three main categories by combining the crossover. Drugs in the first category were categorized as AV, AE, AD, BV, CV (Vital-expensive), drugs in the second category were categorized as BE, CE, BD, (Moderately vital and costly) and drugs in the third category were categorized as CD (Non-vital-low costly) (15, 16).

Recently, due to reasons such as the pandemic and exchange rate variability, drug supplies of drug suppliers in Türkiye may be interrupted (17). In this case, it has become much more important for managers and pharmacists of university hospitals with a wide patient profile and drug variety to categorize stock management according to cost and vitality. Starting from this point, the study aims to classify and stock drugs according to their financial value and vitality in a university hospital with a capacity of 853 beds. A review of the literature shows that many studies in Türkiye and around the world have classified pharmaceuticals with the help of ABC and VED analyses. In this way, it is stated that stock management can be done more flexibly and effectively with fewer personnel (2, 3, 7, 8, 10, 18-21).

2. METHODS

In the study, ABC-VED matrix analysis was used for more efficient inventory management. Drugs classified according to their material and vital importance are controlled more regularly and losses, leakages and deficiencies are minimized. It has been reported that the analysis benefits the hospital budget in the long term (22). The procedure to be followed during the study is given below:

- Drugs in the hospital pharmacy will be categorized according to their costs (ABC).
- Drugs in the hospital pharmacy will be classified according to their vital importance (VED).
- Drugs will be cross-grouped according to the ABC-VED matrix.
- According to the ABC-VED matrix obtained, the rates of drugs will be compared with other existing drug order rates in the literature and the reliability of the analysis will be questioned.

Data on the drugs of Pamukkale University Hospitals for 2021 were used for the analysis. We aimed to reach the most accurate result in ABC and VED analysis by including all drugs used in the pharmacy for this study. Data were extracted from Probel Hospital automation system databases using Structured Query Language. The data extracted from the database were transferred to the Excel program and analyses were performed.

In the verification, examination, cleaning and classification stages of these data, expert opinions of the staff of pharmacy, purchasing, nursing services and drug planning units were consulted and joint studies were carried out on the tables. First of all, drugs were transformed into a unique table and submitted to the control of the pharmacist responsible for medication planning. Here, some blood products that should not be included in the table were identified and excluded. Subsequently, the drugs were grouped by the researchers as A, B and C. For this process, the costs derived from annual usage and purchase prices were used. The list with A, B, and C groups was submitted to the opinion of the procurement officer and necessary corrections were made. In the VED analysis, both the chief pharmacist and the assistant chief nurse were consulted, as vital importance information is a more subjective assessment than cost. The list was evaluated separately by both managers. The researchers finalized the medication table by resolving the differences in lists in a meeting with both managers present.

3. RESULTS

In the study, firstly ABC analysis was performed on 1327 items of drugs obtained by compiling one-year consumption data. According to the results, the value of drugs consumed for a year is over 83 million ₺. In accordance with the literature, these drugs are divided into the A group approximately 70%, B group approximately 20% and C group approximately 10%. In terms of quantity, group A is approximately 5.5%, group B is approximately 11% and group C is 83.5%. Detailed data are given in Table 2. From this point of view, it is concluded that 72 drugs among 1327 drugs should be strictly controlled in terms of cost.

Table 2. *ABC analysis results*

Group	Numbers (n)	Numbers (%)	Cost (₺)	Cost (%)
A	72	5.43%	58,916,145	70.26%
B	148	11.15%	16,586,168	19.78%
C	1107	83.42%	8,350,645	9.96%
Total	1327	100%	83,852,958	100%

As a result of the analysis, the ratio of group V drugs in terms of quantity was found to be approximately 37%, group E approximately 43.5% and group D approximately 19.5%. In terms of cost, group V was calculated as 79%, group E as 17% and group D as 4%. Detailed data are given in Table 3. From this point, it is seen that the number of drugs (group V) for which stock follow-up should be carried out at a high level in order to prevent interruption of vital health services is 494.

ABC-VED cross-analysis was performed in the rest of the study. As explained in the method section, three categories are formed as a result of crossing two analyses. According to the results of the analysis, there are a total of 513 drugs in Category I, which includes drugs of great importance in terms of both cost and vital. These drugs account for 87.5% of the total cost of drugs for a year. The ratio of the number of drugs that the pharmacy should keep control and follow-up at a high level to the total number of drugs is approximately 38%. The number of category II drugs, drugs of medium cost and vital importance, is 566. Their ratio to the total number is approximately 43%. The ratio of drugs in this category to total cost is approximately 12%. The number of Category III drugs, which are non-essential and low-cost drugs, is 248. The cost of these drugs, which constitute 19% of the total number, is below 1%. Detailed data are given in Table 4.

Table 3. *VED analysis results*

Group	Number (n)	Number (%)	Cost (₺)	Cost (%)
V	494	37.23%	66,242,621	79.00%
E	575	43.33%	14,173,616	16.90%
D	258	19.44%	3,436,720	4.10%
Total	1327	100%	83,852,958	100%

Table 4. *ABC-VED analysis results*

Group	Number (n)	Number (%)	Cost (₺)	Cost (%)
Category I	513	38.66%	73,382,231	87.51%
Category II	566	42.65%	9,934,903	11.85%
Category III	248	18.69%	535,824	0.64%
Total	1327	100%	83,852,958	100%

Table 5. *Comparison of the results with the literature*

	Current Study		Yılmaz, 2018		Khurana, Chhillar & Gautam, 2013		Wandalkar, Pandit & Zite, 2013	
	Number	Cost	Number	Cost	Number	Cost	Number	Cost
A	5.43%	70.26%	5.05%	70.08%	3.45%	70.50%	13.40%	69.10%
B	11.15%	19.78%	10.11%	19.88%	6.90%	19.68%	16.50%	19.20%
C	83.42%	9.96%	84.84%	10.04%	89.65%	9.83%	70.10%	11.70%
V	37.23%	79.00%	29.12%	44.42%	32.41%	70.90%	50.90%	55.20%
E	43.33%	16.90%	51.32%	47.06%	61.38%	28.72%	40.20%	41.50%
D	19.14%	4.10%	19.56%	8.52%	6.20%	0.38%	8.90%	3.30%
I	38.66%	87.51%	32.75%	82.55%	33.80%	92.33%	57.00%	85.30%
II	42.65%	11.85%	49.01%	15.66%	60.00%	7.29%	35.00%	14.20%
III	18.69%	0.64%	18.24%	1.79%	6.20%	0.38%	8.00%	0.50%
	Vaz et al., 2008		**Yeşilyurt, Sulak & Bayhan, 2015**		**Devnani, Gupta & Nigah, 2010**		**Uygun & Yiğit, 2016**	
	Number	Cost	Number	Cost	Number	Cost	Number	Cost
A	12.93%	69.45%	8.26%	70.38%	13.78%	69.97%	4.78%	69.61%
B	19.54%	20.48%	14.13%	20.02%	21.85%	19.95%	11.29%	20.28%
C	67.53%	10.07%	77.61%	9.60%	64.37%	10.08%	83.93%	10.11%
V	12.36%	15.67%	28.26%	52.91%	12.11%	17.14%	40.77%	80.90%
E	47.12%	70.02%	58.48%	29.18%	59.38%	72.38%	54.71%	16.52%
D	40.52%	14.31%	13.26%	17.91%	28.51%	10.48%	4.52%	2.59%
I	22.99%	74.80%	31.74%	85.93%	22.09%	74.21%	41.96%	85.97%
II	41.67%	21.68%	57.39%	12.92%	54.63%	22.23%	54.58%	13.95%
III	35.34%	3.52%	10.87%	1.15%	23.28%	3.56%	3.45%	0.08%

Table 6. *Distribution of expenditure items for 2021*

Budget Account Name	Percentage (%)
Personnel Expenses	39.66%
Energy Purchases	3.75%
Laboratory Material Purchases	**34.53%**
Medical Equipment Purchases	
Medical Drug Purchases	
Other Material Purchases (Clothing, Cleaning, Stationery, etc.)	1.58%
Service Purchases	11.03%
Maintenance and Repair Expenses	4.11%
Current Transfers	4.44%
Capital Expenditure	0.90%

4. DISCUSSION

The results obtained at the end of the study were compared with examples in the literature. According to the results of a study conducted in a university hospital in India using 348 drug data, the share of drugs in group A was found to be 12.93% in quantity and 69.45% in expenditures. Drugs in group V were found to be approximately 12% of the total amount and 15.67% of the annual drug expenditure (23). Again, in a study conducted in a tertiary care teaching hospital in India, the share of group A drugs was found to be 13.78% in quantity and 69.97% in drug expenditures in an analysis using 421 drug data. Group V was found to be 12.11% in quantity and 17.14% in cost (8).

Another research was conducted in a university hospital in Türkiye using 753 drug data and according to the results of the analysis, the share of group A drugs in the total number was 4.78% and their share in the annual drug expenditures was 69.61%. The share of group V drugs in the total number was found to be 40.77% and the share in the annual drug expenditures of the hospital was found to be 80.90%. In the ABC-VED matrix, 41.96% of the total amount of Category I and 85.97% of the hospital's annual pharmaceutical expenditure (19).

In a study conducted at the Post Graduate Institute of Medical Education and Research in Chandigarh, India, the percentage of drugs in group A in terms of quantity was found to be 13.4% and the percentage of drugs in terms of cost was found to be 69.1%. In the VED analysis, the percentage of

drugs in group V was found to be 50.9% in terms of quantity, and 55.2% of their share within the annual drug expenditures of the hospital. Category I was found to be 57% total quantity and 85.3% of the annual drug expenditures of the hospital (20).

In a study conducted on 145 drug data in a neuropsychiatric hospital in Delhi, group A drugs were found to be 3.45% of the total quantity and 70.5% of the total cost. Group V drugs were found to be 32.41% of the total quantity and 70.90% of the total cost. Category I drugs were found to be 33.8% of the total quantity and 92.33% of the total cost (24). Furthermore, a study conducted in 2013 in a public hospital in Türkiye using data on 460 medicines found that group V medicines accounted for 28.26% and 52.91% of the cost (25). Details of the comparisons between the present study and the literature are given in Table 5.

When compared with other previous studies in the literature, it is seen that the results are very similar to some studies (19, 24). Differences were observed in the VED analysis with other studies examined. This is thought to be the result of the differentiation of the patient profile served by the hospitals in the region. However, the results of category I, II, and III are similar in all examples. Category I provides tracking of a large cost with few items. It is seen that the first category, which stands out in terms of both cost and vitality, accounts for approximately one-third of the pharmaceutical items and more than 85 percent of the total cost. Therefore, according to the results of the analyses presented in the study, strict monitoring of a small number of drugs and regular weekly counts will make drug inventory management much easier for managers. The second category of medicines accounts for about half of the total pharmaceutical items and a small part in terms of cost. The results show that the organization of these drugs is in accordance with the conditions stated in the literature. In other words, the level of monitoring and delegation can be kept at a moderate level. Purchases can be made on quarterly orders and sent to the units.

Hospital managers try to find the most appropriate solution between spending as little as possible of the already limited financial resources on stocks and the disruption of health service production as a result of not having sufficient stocks. Studies indicate that giving equal importance to all drugs in the hospital inventory in planning is an inefficient approach (5, 26). As in our study, multidimensional analyses should be performed by considering the methods that are important for the hospital. Thus, more time can be allocated to the follow-up and control of a small number of drugs that should be given more importance.

In this study, ABC-VED cross-analysis was used both because it is frequently used in the literature and because it is thought to best fit the planning structure of the existing hospital. The data for the analysis to be applied should be easily identifiable or extractable from the database. At the same time, it is easy to understand and easy to use, which will be preferred by hospital administrators. Some methods suggested by academics in the literature may not be practically suitable for the hospital supply chain. Of course, this may vary depending on many variables such as the size of the institution, financial situation, and patient profile (10, 26).

Another point to be mentioned is the financial importance of well-organized inventory management. As seen in many examples in the literature, 35% of total expenditures are due to drug and material purchases (14, 21, 22). The annual expenditures of the analyzed hospital also support this conclusion (Table 6). In a study conducted with the ABC-VED method for inventory control of high-cost drugs in two different hospitals in Ethiopia, it was reported that nearly 20% savings were achieved. The rate of expired drugs was reduced from 4.5% to 0.27% in the first hospital and from 10% to 2% in the second hospital (27). At this point, it is clear that the study will benefit the relevant hospital. The majority of the pharmaceutical procurement of public hospitals in Türkiye is provided through the State Supply Office. A similar study can be applied on this platform on a hospital basis. By creating special order suggestions for hospitals, a high amount of benefit can be achieved at the national level.

The analysis was conducted on more than 4 million consumption data of 1327 medicines with an annual cost of approximately 85 million ₺. Therefore, it is exemplary in terms of having more comprehensive data than similar studies in the literature. The study data examined in the literature is not at a level to serve as an example of a full-fledged hospital. In addition, while performing ABC and VED analyses in the study, experts were consulted to the extent not seen or specified in the literature (8, 13, 19, 20, 23-25) and the method followed was specified. The aim is to present the correct results more clearly.

5. CONCLUSION

This study has provided guidance to hospital managers by categorizing medicines according to their cost and vital importance. However, this analysis may need to be improved according to changing policies and patient profiles. Multidimensional analyses can be developed according to variables such as supply requirement, ease of availability, fast-slow stock movement and seasonal usage changes. For example, chemotherapy drugs constitute a significant portion of Group A drugs. The reason for this is the Health Implementation Communiqué rule for the procurement of inpatient medicines in Türkiye. Inpatient medicines must be supplied by the hospital where the patient is hospitalized. If the medication is obtained from outside with a prescription, the amount of the medication will be deducted from the patient's package bill. In another country where this practice does not apply, the drug item in group A may be higher. This may require prioritizing other criteria in the analysis.

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