Drug Inventory Management of a Pharmacy using ABC and VED Analysis

Zeynep CEYLAN*,**[‡], Serol BULKAN**

* Department of Industrial Engineering, Faculty of Engineering, Ondokuz Mayıs University, Kurupelit-Samsun, Turkey
** Department of Industrial Engineering, Faculty of Engineering, Marmara University, Kadıköy-Istanbul, Turkey

[‡]Corresponding Author; Address: Department of Industrial Engineering, Faculty of Engineering, Ondokuz Mayıs University, Samsun, Turkey   Tel: +90 362 3121919 - 1098, e-mail: zeynep.dokumaci@omu.edu.tr

Abstract- The pharmacy is one of the most extensively used facility in healthcare where a large amount of money is spent for purchasing medicinal items. In pharmacies, various drugs are being stored for supporting the therapy of patients. Due to the variety of pharmaceutical items, it is a difficult task to control and manage the quantity of drug. However, for a better and effective service management in a pharmacy, required drug must be provided continually at correct time and quantity to sustain steady in supply. This can be accomplished by efficient inventory management of pharmacy by providing control on important drugs, and deciding on priorities in purchase and distribution. Therefore, the inventory management ensures significant improvement for both patient care and optimal use of resources. In this study, annual drug sale data of a pharmacy was analyzed to identify the categories of drugs needing strict management control. Three important methods regarding inventory management practice were studied such as ABC (Always, Better, Control) analysis, VED (Vital, Essential, Desirable) analysis, and ABC-VED matrix analysis. The aim of this study was to properly manage the drug inventory in the pharmacy to balance drug levels to provide patients' needs and customer satisfaction.

Keywords- Drug Inventory Management; Pharmacy; ABC; VED

1. Introduction

Pharmacies are important part of health care systems. Depending on the illness type and level, the characteristics of the drugs widely varies, from the common and cheap ones, such as antipyretics, to highly specific and expensive ones, such as chemotherapy drugs. There must be enough amount of drug always present in pharmacy stock to prevent any trouble. Because, the unavailability of any drug can negatively affect pharmacies image and results in fewer patient visits, conveyance of dissatisfaction with the pharmacy to other people. Furthermore, for a quality service management in a pharmacy, required drug must be supplied continually at correct time. Therefore, the inventory management ensures significant improvement for both patient care and optimal use of resources. It improves workflow and enhances

customer satisfaction which is ultimately the breaking point of the business. Moreover, "Essential Inventory Management (EIM) is vital for the profitability of the pharmacy, EIM results in better cash flow, good customer service, good relationship with suppliers, good return on investment and accurate prediction of future needs of inventory" (NCPA). There are two different types of inventory control methods which are related with cost and criticality of the drugs respectively: ABC and VED analysis. ABC-VED Matrix analysis is a combination of both of them and gives result based on cost as well as critical value of drugs. It also classifies drugs into categories according to the priority of their control. In this study, we have performed ABC, VED, and ABC-VED Matrix analysis of a pharmacy. The objective of the study is to classify the drugs based on economic and criticality and decide those which require stringent managerial control.

2. Material and Methods

In this study, we have performed ABC, VED, and ABC-VED matrix analysis of a pharmacy in Istanbul, Turkey. The annual drug consumption and expenditure on each drug were derived from the pharmacy database. The taken dataset included 1552 prescribed drugs, and it was stored in MS Excel spreadsheet format for quantitative calculations. Database provided 5 features (attributes) which are prescription number, date of prescription, commercial name of prescribed drug, quantity of prescribed drug and price.

2.1. ABC Analysis

ABC (Always, Better, Control) analysis is a significant and well-known analytical tool in inventory management (Yu, 2010; Khurana, et al., 2013; Kumar and Chakravarty, 2014). It was first developed in the 1950s and aims to gain managers' interest on the critical few (A-items) and not on the insignificant many (C-items). It divides items into three classes as A, B and C that can be managed and controlled separately. *A-items* constitute only 10% of all inventory items. They have to be under strict control of higher management as they consume the top 70%‐80% of the total inventory consumption value of the company. *B-items* are the interclass items which include 20% of total inventory items. They require moderate control by middle management since they consume 20% of annual consumption value, on the contrary, *C-items* need control by lower management, account for 70% of total inventory items and consume 10% of the annual consumption value. The main restriction of ABC analysis is that it depends on price and the percentage of usage of the products. Thus, importance of items cannot be considered entirely. Therefore, it is not enough for inventory management since an item which has low capital investment and consumption may be staminal or life-saving. The criticality (vitality) of an item should also be considered for development of management tool for inventory control.

2.2. VED Analysis

VED analysis is based on priority and importance to patients' health (Gupta, et al., 2007; Devnani, et al., 2010; Yeşilyurt, et al., 2015; Antonoglou, et al, 2017). It divides the items into three categories as Vital (V), Essential (E) and Desirable (D). V class drugs that are life-saving like vaccines, and needed for life support (e.g., some antibiotics, serums, insulins, digoxin, and etc.) must be available in the pharmacy stocks at all times. E class drugs, which have lower severity, are efficient for therapy of less life threatening, but still serious diseases (e.g. antibiotics, ranitidine, chloroquine, phenytoin and etc.) may be available in the pharmacy stocks. The remaining drugs with lowest severity, which are used for therapy of slight diseases, are included in D class drugs. The absence of these drugs isn't fatal to the health of the patients e.g., Vitamin E capsules, sun screen lotions (Thawani, et al., 2004).

2.3. ABC-VED Matrix Analysis

Effective and efficient inventory control can be accomplished on the items by considering both VED analysis and ABC analysis. As seen on Table 1, ABC-VED inventory matrix analysis is created, by combining the ABC and VED analysis. By cross-tabulating of these analysis nine different subcategories (AV, AE, AD, BV, BE, BD, CV, CE, and CD) are obtained (Vaz, et al., 2008; Singh, et al., 2015; Pund, et al., 2016; Uygun and Yiğit, 2017).

ABC-VED matrix provides more meaningful control over the material supplies and divides items into three main categories: Category I, Category II, and Category III. Category I items are vital and expensive, consist of six subcategories (AV, BV, CV, AE, and AD), and need control by top of management. Category II includes essential with low cost items (BE, CE, BD). Category III consists of the desirable with least cost items (CD).

Table 1. ABC-VED inventory decision matrix

ABC-VED Matrix			Criticality of item						
			High ⟵ ——————————————————————— **Low**						
			V			**E**	**D**		
Consumption Value (**High** ↑ **Low**)	**High**	**A**	Continuous Review	High Safety Stock	Low Order Quantity		Continuous Review	Low Safety Stock	Low Order Quantity
		B							
		C	Periodic Review	High Safety Stock	High Order Quantity		Periodic Review	Low Safety Stock	High Order Quantity

3. Results and Discussion

In the initial stage, the annual drug expenditure (ADE) for all the drugs was calculated by multiplying the price of each package by the total number of packages consumed. The total cost of all the drugs, cumulative percentage of expenditure and the cumulative percentage of drugs were also calculated. The drugs were assigned to a class (A, B and C) according to total cost consumed 70%, 20% and 10%, respectively.

As seen on Table 2, total ADE of the pharmacy on drugs was calculated about 589917.17 TL. ABC analysis results revealed that, 10.31% (160) of drugs in A class and 21.78% (338) of drugs in B class constituted 89.98% of the total pharmacy expenditure. The remaining 67.91% (1054) of drugs which are in category C, constituted only 10.01% of the ADE.

Table 2. ABC analysis results

Analysis Parameter	Category			TOTAL
	A	**B**	**C**	
Total Annual Consumption (%)	69.96	20.02	10.01	100
Value of Annual Consumption (TL)	412728.29	118119.63	59069.25	589917.17
Quantity of drugs	160	338	1054	1552
Cumulative % of drugs	10.31	21.78	67.91	100

The percentage of drugs in the increasing order against the ADE was also calculated. As seen Table 3, the ADE for first 10 % of drugs is 409513.46 TL (69.42 %) while only 924.11 TL (0.157 %) for last 10 % of the drugs.

Table 3. Percentage of drugs versus ADE

Percentage of Drugs	Quantity	ADE (TL)	ADE (%)
10	155	409513.46	69.42
20	310	72795.88	12.34
30	466	42078.30	7.133
40	621	25510.82	4.324
50	776	16067.73	2.724
60	931	10427.70	1.768
70	1086	6481.37	1.099
80	1242	3916.61	0.664
90	1397	2201.19	0.373
100	1552	924.110	0.157

The ABC analysis depends on cost (annual drug expenditure) and is not enough for inventory management. Therefore, the criticality of a drug (Vital, Essential and Desirable analysis) should also be considered for improvement of management. Thus, criticality analysis of all the drugs in the pharmacy store was conducted and then these drugs were classified based into three groups (V, E, and D).

VED analysis results revealed that, 10.67% (167) of drugs in V class and 45.49% (706) of drugs in E class constituted 79.16% of the total pharmacy expenditure. The remaining 43.75% (679) of drugs which are in category D, constituted 20.84% of the ADE, as seen on Table 4. The categorization of each drug was arranged by using information from Turkish Medicines and Medical Devices Agency and group of pharmacist (TMMDA).

Table 4. VED analysis results

Drug Category	Quantity of Drugs	% of Drugs	Value of Annual Consumption (TL)	Total Annual Consumption (%)
Vital (V)	167	10.76	137529.70	23.31
Essential (E)	706	45.49	329451.16	55.85
Desirable (D)	679	43.75	122936.31	20.84
Total	1552	100.00	589917.17	100.00

Table 4. ABC- VED matrix analysis results

		VED Analysis					
		V		E		D	
		No	% of Drugs	No	% of Drugs	No	% of Drugs
ABC Analysis	A	AV (57)	3.67	AE (63)	4.06	AD (40)	2.58
	B	BV (58)	3.73	BE (167)	10.76	BD (113)	7.28
	C	CV (52)	3.35	CE (476)	30.67	CD (526)	33.89

Table 4 shows combination of ABC and VED analysis (ABC-VED matrix analysis). Nine different subclasses were studied using this analysis. These nine were then grouped into three main categories (I, II and III).

Table 5 showed that 17.04% (270) drugs belong to category I and constituted about 79% of the ADE of the pharmacy. Category II consisted 33.9% (526) of drugs, which accounts for 17.3% of the ADE of the pharmacy. The remaining 33.9% (526) drugs are in category III, accounts for only 2.57% of the total drug expenditure.

Table 5. Distribution of drugs according to categories

Category No	No of Drugs	% of Drugs	Value of Annual Consumption (TL)	Total Annual Consumption (%)
Category I	270	17.40	443924.4	75.25%
Category II	756	48.70	130820.15	22.18%
Category III	526	33.90	15172.62	2.57%
TOTAL	1552	100.00	589917.17	100.00%

Drugs in Category I (AV, AE, AD, BV and CV) should be seriously managed. The consumption and stock level should be monitored continuously by the top management.

AV, AE and BV subgroups of *Category I* consist of 178 expensive drugs which consists 11.46% of total drugs and 62.41% of ADE. Since, they are either vital or essential and their being out of stock inadmissible. CV subgroup (52, 3.35%) consists of low cost but high criticality drugs and consumes only 0.81% of ADE of the pharmacy. These drugs can be supplied once a year as ADE is negligible.

Drugs in *Category II* (BE, CE, BD) are essential and have average cost. They should be managed with moderate control by the middle level management, but their consumption should also be controlled.

Category III (CD) consists of drugs that are desirable and inexpensive. They should be ordered periodically and controlled by lower level of management. The results obtained in this study were compared with the other study results in the literature and presented in Table 6.

Table 6. Comparison of analysis results with different studies in literature

Analysis	Category	Several Studies in Literature						
		Thawani, et. al., 2004	Gupta, et al., 2007	Vaz, et al., 2008	Devnani, et al., 2010	Singh, et. al., 2015	Pund, et. al., 2016	Present Study
ABC analysis	A	10.76	14.46	12.93	13.78	11.08	16.8	10.31
	B	20.63	22.46	19.54	21.85	22.16	21.8	21.78
	C	68.61	63.08	67.53	64.37	66.75	61.4	67.91
VED analysis	V	23.76	7.39	12.36	12.11	12.40	35.3	10.76
	E	38.12	49.23	47.12	59.38	60.16	50.4	45.49
	D	38.12	43.38	40.52	28.51	27.44	14.3	43.75
ABC-VED analysis	I	29.15	20.92	22.99	22.09	19.80	47.9	17.40
	II	41.26	48.92	41.67	54.63	57.54	43.7	48.70
	III	29.59	30.16	35.34	23.28	22.7	8.4	33.90

4. Conclusion

Inventory analysis plays important role in the management of pharmacies. The usage of inventory control techniques in the healthcare provides significant improvement in patient care, customer relationships and optimal use of resources. Pharmacy spends a large amount of money for buying pharmaceutical items. Therefore, pharmacy management requires planning, designing and organizing of the medical stores. However, effective inventory management by keeping a close supervision may sometimes be challenging, due to huge variety items and traffics in the pharmacy. To address this issue, this study aims to examine inventory management practices in a pharmacy. The study analyzed drugs inventory of pharmacy according to their cost and criticality properties.

ABC analysis is an important and widespread tool used for ensuring decrease in expenditures and increase in effectiveness of drug utilization. However, it is not enough for efficient inventory management as ABC analysis is that it is depends on price and the rate of consumption of the item. A drug can be inexpensive and vital or life-saving. Thus, to overcome the limitation of ABC analysis, VED analysis was applied. VED analysis classifies drugs according to criticality and importance on patient's heath. However if we only consider VED analysis or ABC analysis alone, effective control cannot be accomplished on the items inventory. Therefore, the ABC-VED matrix was obtained with combination of ABC and VED analysis. ABC-VED matrix analysis provides strict controlling the drugs for optimal usage of budget and preventing out-of-stock conditions in the medical stores.

Acknowledgements

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