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

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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 year2012 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.

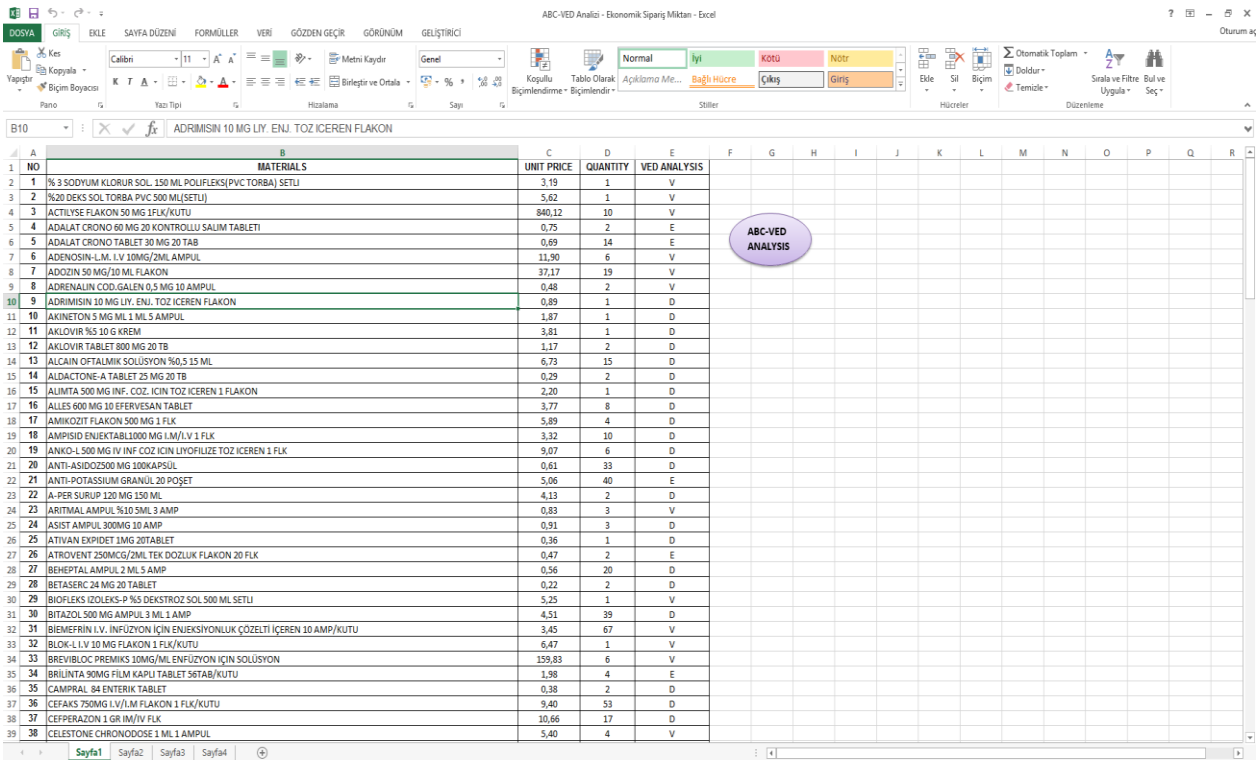
ABC-VED matrix analysis

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.



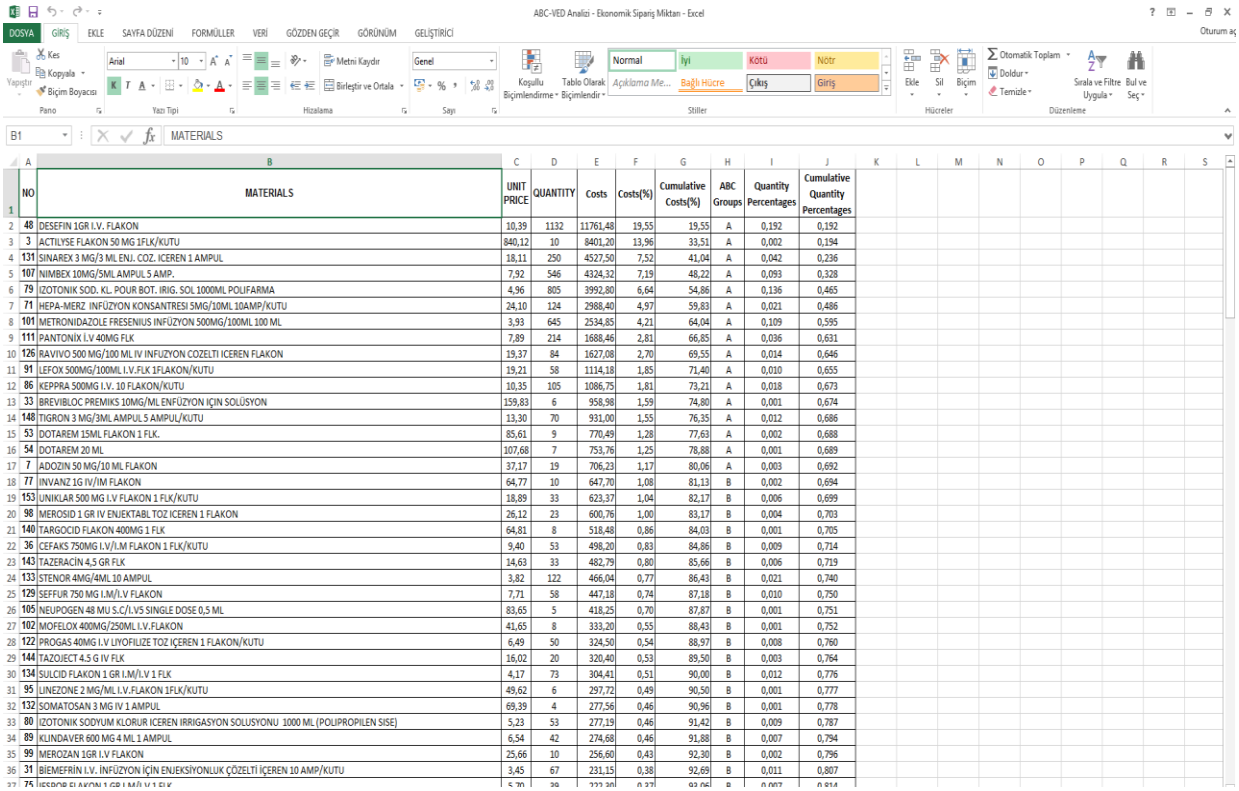
NO	MATERIALS	UNIT PRICE	QUANTITY	VED ANALYSIS
1	% 3 SODYUM KLORUR SOL. 150 ML POLIFLEKS(PVC TORBA) SETLI	3,19	1	V
2	%20 DEKS SOL TORBA PVC 500 ML(SETLI)	5,62	1	V
3	ACTILYSE FLAKON 50 MG 1FLK/KUTU	840,12	10	V
4	ADALAT CRONO 60 MG 20 KONTROLLU SALIM TABLETI	0,75	2	E
5	ADALAT CRONO TABLET 30 MG 20 TAB	0,69	14	E
6	ADENOSIN-L.M. I.V 10MG/2ML AMPUL	11,90	6	V
7	ADOZIN 50 MG/10 ML FLAKON	37,17	19	V
8	ADRENALIN COD.GALEN 0,5 MG 10 AMPUL	0,48	2	V
9	ADRIMISIN 10 MG LIY. ENJ. TOZ ICEREN FLAKON	0,89	1	D
10	AKINETON 5 MG ML 1 ML 5 AMPUL	1,87	1	D
11	AKLOVIR %5 10 G KREM	3,81	1	D
12	AKLOVIR TABLET 800 MG 20 TB	1,17	2	D
13	ALCAIN OFTALMIK SOLÜSYON %0,5 15 ML	6,73	15	D
14	ALDACTONE-A TABLET 25 MG 20 TB	0,29	2	D
15	ALIMTA 500 MG INF. COZ. ICIN TOZ ICEREN 1 FLAKON	2,20	1	D
16	ALLES 600 MG 10 EFERVESAN TABLET	3,77	8	D
17	AMIKOZIT FLAKON 500 MG 1 FLK	5,89	4	D
18	AMPISID ENJEKTABL1000 MG I.M/I.V 1 FLK	3,32	10	D
19	ANKO-L 500 MG IV INF COZ ICIN LIYOFILIZE TOZ ICEREN 1 FLK	9,07	6	D
20	ANTI-ASIDOZ500 MG 100KAPSÜL	0,61	33	D
21	ANTI-POTASSIUM GRANÜL 20 POŞET	5,06	40	E
22	A-PER SURUP 120 MG 150 ML	4,13	2	D
23	ARITMAL AMPUL %10 5ML 3 AMP	0,83	3	V
24	ASIST AMPUL 300MG 10 AMP	0,91	3	D
25	ATIVAN EXPIDET 1MG 20TABLET	0,36	1	D
26	ATROVENT 250MCG/2ML TEK DOZLUK FLAKON 20 FLK	0,47	2	E
27	BEHEPTAL AMPUL 2 ML 5 AMP	0,56	20	D
28	BETASERC 24 MG 20 TABLET	0,22	2	D
29	BIOFLEKS IZOLEKS-P %5 DEKSTROZ SOL 500 ML SETLI	5,25	1	V
30	BITAZOL 500 MG AMPUL 3 ML 1 AMP	4,51	39	D
31	BIEMEFRİN I.V. İNFÜZYON İÇİN ENJEKSİYONLUK ÇÖZELTİ İÇEREN 10 AMP/KUTU	3,45	67	V
32	BLOK-L I.V 10 MG FLAKON 1 FLK/KUTU	6,47	1	V
33	BREVIBLOC PREMIKS 10MG/ML ENFÜZYON IÇIN SOLÜSYON	159,83	6	V
34	BRİLİNTA 90MG FİLM KAPLI TABLET 56TAB/KUTU	1,98	4	E
35	CAMPRAL 84 ENTERIK TABLET	0,38	2	D
36	CEFAKS 750MG I.V/I.M FLAKON 1 FLK/KUTU	9,40	53	D
37	CEFPERAZON 1 GR IM/IV FLK	10,66	17	D
38	CELESTONE CHRONODOSE 1 ML 1 AMPUL	5,40	4	V

Figure 1.Excel-based inventory control program.

Table1. Results of ABC Analysis

Category	No of Items	Annual Expenditure(TL)	% of Items	% Expenditure
A	16	48.167,48	10%	80%
B	36	10.203,04	23%	17%
C	105	1.796,86	67%	3%
Total	157	60.167,38	100%	100%

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.



NO	MATERIALS	UNIT PRICE	QUANTITY	Costs	Costs(%)	Cumulative Costs(%)	ABC Groups	Quantity Percentages	Cumulative Quantity Percentages
48	DESEFIN 1GR I.V. FLAKON	10,39	1132	11761,48	19,55	19,55	A	0,192	0,192
3	ACTILYSE FLAKON 50 MG 1FLK/KUTU	840,12	10	8401,20	13,96	33,51	A	0,002	0,194
131	SINAREX 3 MG/3 ML ENJ. COZ. ICEREN 1 AMPUL	18,11	250	4527,50	7,52	41,04	A	0,042	0,236
107	NIMBEX 10MG/5ML AMPUL 5 AMP.	7,92	546	4324,32	7,19	48,22	A	0,093	0,328
79	IZOTONIK SOD. KL. POUR BOT. IRIG. SOL 1000ML POLIFARMA	4,96	805	3992,80	6,64	54,86	A	0,136	0,465
71	HEPA-MERZ INFÜZYON KONSANTRESI 5MG/10ML 10AMP/KUTU	24,10	124	2988,40	4,97	59,83	A	0,021	0,486
101	METRONIDAZOLE FRESENIUS INFÜZYON 500MG/100ML 100 ML	3,93	645	2534,85	4,21	64,04	A	0,109	0,595
111	PANTONİX İ.V 40MG FLK	7,89	214	1688,46	2,81	66,85	A	0,036	0,631
126	RAVIVO 500 MG/100 ML IV INFUZYON COZELTI ICEREN FLAKON	19,37	84	1627,08	2,70	69,55	A	0,014	0,646
91	LEFOX 500MG/100ML I.V.FLK 1FLAKON/KUTU	19,21	58	1114,18	1,85	71,40	A	0,010	0,655
86	KEPPRA 500MG I.V. 10 FLAKON/KUTU	10,35	105	1086,75	1,81	73,21	A	0,018	0,673
33	BREVIBLOC PREMIKS 10MG/ML ENFÜZYON IÇIN SOLÜSYON	159,83	6	958,98	1,59	74,80	A	0,001	0,674
148	TIGRON 3 MG/3ML AMPUL 5 AMPUL/KUTU	13,30	70	931,00	1,55	76,35	A	0,012	0,686
53	DOTAREM 15ML FLAKON 1 FLK.	85,61	9	770,49	1,28	77,63	A	0,002	0,688
54	DOTAREM 20 ML	107,68	7	753,76	1,25	78,88	A	0,001	0,689
7	ADOZIN 50 MG/10 ML FLAKON	37,17	19	706,23	1,17	80,06	A	0,003	0,692
77	INVANZ 1G IV/IM FLAKON	64,77	10	647,70	1,08	81,13	B	0,002	0,694
153	UNIKLAR 500 MG I.V FLAKON 1 FLK/KUTU	18,89	33	623,37	1,04	82,17	B	0,006	0,699
98	MEROSID 1 GR IV ENJEKTABL TOZ ICEREN 1 FLAKON	26,12	23	600,76	1,00	83,17	B	0,004	0,703
140	TARGOCID FLAKON 400MG 1 FLK	64,81	8	518,48	0,86	84,03	B	0,001	0,705
36	CEFAKS 750MG I.V/I.M FLAKON 1 FLK/KUTU	9,40	53	498,20	0,83	84,86	B	0,009	0,714
143	TAZERACİN 4,5 GR FLK	14,63	33	482,79	0,80	85,66	B	0,006	0,719
133	STENOR 4MG/4ML 10 AMPUL	3,82	122	466,04	0,77	86,43	B	0,021	0,740
129	SEFFUR 750 MG I.M/I.V FLAKON	7,71	58	447,18	0,74	87,18	B	0,010	0,750
105	NEUPOGEN 48 MU S.C/I.VS SINGLE DOSE 0,5 ML	83,65	5	418,25	0,70	87,87	B	0,001	0,751
102	MOFELOX 400MG/250ML I.V.FLAKON	41,65	8	333,20	0,55	88,43	B	0,001	0,752
122	PROGAS 40MG I.V LIYOFILIZE TOZ IÇEREN 1 FLAKON/KUTU	6,49	50	324,50	0,54	88,97	B	0,008	0,760
144	TAZOJECT 4.5 G IV FLK	16,02	20	320,40	0,53	89,50	B	0,003	0,764
134	SULCID FLAKON 1 GR I.M/I.V 1 FLK	4,17	73	304,41	0,51	90,00	B	0,012	0,776
95	LINEZONE 2 MG/ML I.V.FLAKON 1FLK/KUTU	49,62	6	297,72	0,49	90,50	B	0,001	0,777
132	SOMATOSAN 3 MG IV 1 AMPUL	69,39	4	277,56	0,46	90,96	B	0,001	0,778
80	IZOTONIK SODYUM KLORUR ICEREN IRRIGASYON SOLUSYONU 1000 ML (POLIPROPILEN SISE)	5,23	53	277,19	0,46	91,42	B	0,009	0,787
89	KLINDAVER 600 MG 4 ML 1 AMPUL	6,54	42	274,68	0,46	91,88	B	0,007	0,794
99	MEROZAN 1GR I.V FLAKON	25,66	10	256,60	0,43	92,30	B	0,002	0,796
31	BİEMEFRİN I.V. INFÜZYON İÇİN ENJEKSİYONLUK ÇÖZELTİ İÇEREN 10 AMP/KUTU	3,45	67	231,15	0,38	92,69	B	0,011	0,807

Figure2. Results of ABC Analysis

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).

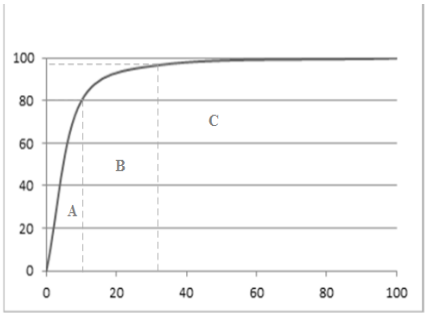


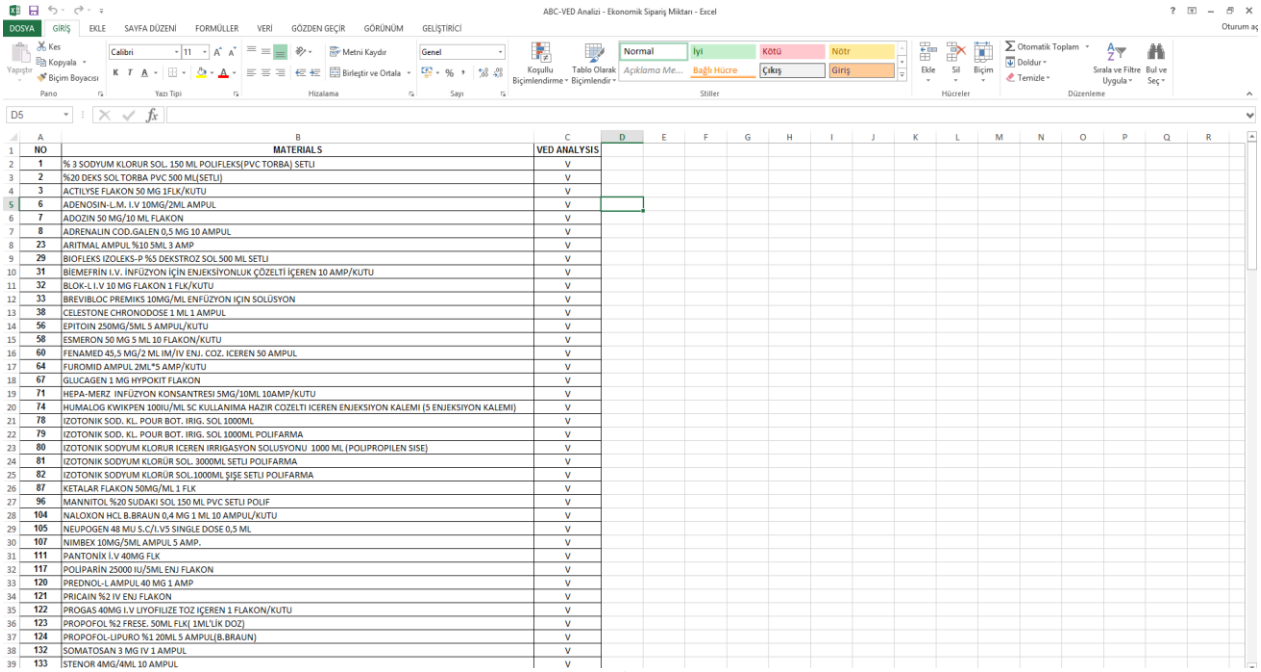
Figure3. ABC Analysis cumulative curve (2015)

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

Table 2.VED Analysis

Category	No of Items	Annual Expenditure (TL)	% of Items	% Expenditure
V	38	25.921,29	24.20%	43.08%
E	22	11.563,71	14.01%	19.22%
D	97	22.682,38	61.78%	37.70%
Total	157	60.167,38	100%	100%

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.



NO	MATERIALS	VED ANALYSIS
1	% 3 SODYUM KLORUR SOL. 150 ML POLIFLEKS(PVC TORBA) SETLI	V
2	%20 DEKS SOL TORBA PVC 500 ML(SETLI)	V
3	ACTILYSE FLAKON 50 MG 1FLK/KUTU	V
6	ADENOSIN-L.M. I.V 10MG/2ML AMPUL	V
7	ADOZIN 50 MG/10 ML FLAKON	V
8	ADRENALIN COD.GALEN 0,5 MG 10 AMPUL	V
23	ARITMAL AMPUL %10 5ML 3 AMP	V
29	BIOFLEKS IZOLEKS-P %5 DEKSTROZ SOL 500 ML SETLI	V
31	BİEMEFRİN I.V. İNFÜZYON İÇİN ENJEKSİYONLUK ÇÖZELTİ İÇEREN 10 AMP/KUTU	V
32	BLOK-L I.V 10 MG FLAKON 1 FLK/KUTU	V
33	BREVIBLOC PREMIKS 10MG/ML ENFÜZYON İÇİN SOLÜSYON	V
38	CELESTONE CHRONODOSE 1 ML 1 AMPUL	V
56	EPITOIN 250MG/5ML 5 AMPUL/KUTU	V
58	ESMERON 50 MG 5 ML 10 FLAKON/KUTU	V
60	FENAMED 45,5 MG/2 ML IM/IV ENJ. COZ. ICEREN 50 AMPUL	V
64	FUROMID AMPUL 2ML*5 AMP/KUTU	V
67	GLUCAGEN 1 MG HYPOKIT FLAKON	V
71	HEPA-MERZ INFÜZYON KONSANTRESI 5MG/10ML 10AMP/KUTU	V
74	HUMALOG KWIKPEN 100IU/ML SC KULLANIMA HAZIR COZELTI ICEREN ENJEKSIYON KALEMI (5 ENJEKSIYON KALEMI)	V
78	IZOTONIK SOD. KL. POUR BOT. IRIG. SOL 1000ML	V
79	IZOTONIK SOD. KL. POUR BOT. IRIG. SOL 1000ML POLIFARMA	V
80	IZOTONIK SODYUM KLORUR ICEREN IRRIGASYON SOLUSYONU 1000 ML (POLIPROPILEN SISE)	V
81	IZOTONIK SODYUM KLORÜR SOL. 3000ML SETLI POLIFARMA	V
82	IZOTONIK SODYUM KLORÜR SOL.1000ML ŞİŞE SETLI POLIFARMA	V
87	KETALAR FLAKON 50MG/ML 1 FLK	V
96	MANNITOL %20 SUDAKI SOL 150 ML PVC SETLI POLIF	V
104	NALOXON HCL B.BRAUN 0,4 MG 1 ML 10 AMPUL/KUTU	V
105	NEUPOGEN 48 MU S.C/I.V5 SINGLE DOSE 0,5 ML	V
107	NIMBEX 10MG/5ML AMPUL 5 AMP.	V
111	PANTONIX I.V 40MG FLK	V
117	POLİPARİN 25000 IU/5ML ENJ FLAKON	V
120	PREDNOL-L AMPUL 40 MG 1 AMP	V
121	PRICAIN %2 IV ENJ FLAKON	V
122	PROGAS 40MG I.V LIYOFILIZE TOZ İÇEREN 1 FLAKON/KUTU	V
123	PROPOFOL %2 FRESE. 50ML FLK(1ML'LİK DOZ)	V
124	PROPOFOL-LIPURO %1 20ML 5 AMPUL(B.BRAUN)	V
132	SOMATOSAN 3 MG IV 1 AMPUL	V
133	STENOR 4MG/4ML 10 AMPUL	V

Figure 4. Results of VED Analysis

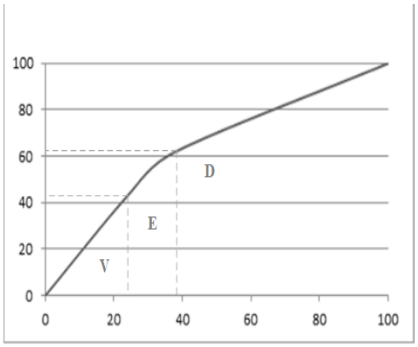


Figure5. VED Analysis cumulative curve (2015)

Table 3 shows the results obtained by ABC-VED matrix analysis. ABC-VED matrix reclassifies the items based on the results of ABC and VED analyses. There are nine different subcategories (AV, BV, CV, AE, AD, BE, CE, BD and CD) in the ABC-VED matrix analysis which are further grouped into three main categories, categories I, II and III.

Table 3.ABC-VED Matrix Analysis

	No of Items	Annual Expenditure (TL)	% of Items	% Expenditure
1st Category (AV+BV+CV+AE+AD)	47	51.028,38	29.94%	84.81%
2nd Category (BE+CE+BD)	39	8.054,69	24.84%	13.39%
3rd Category (CD)	71	1.084,31	45.22%	1.80%
Total	157	60.167,38	100%	100%

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).

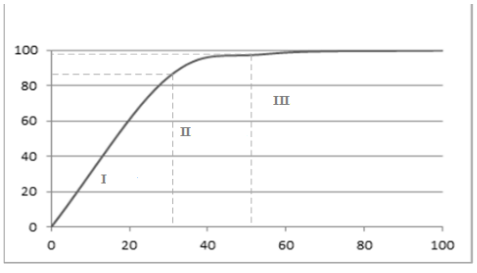
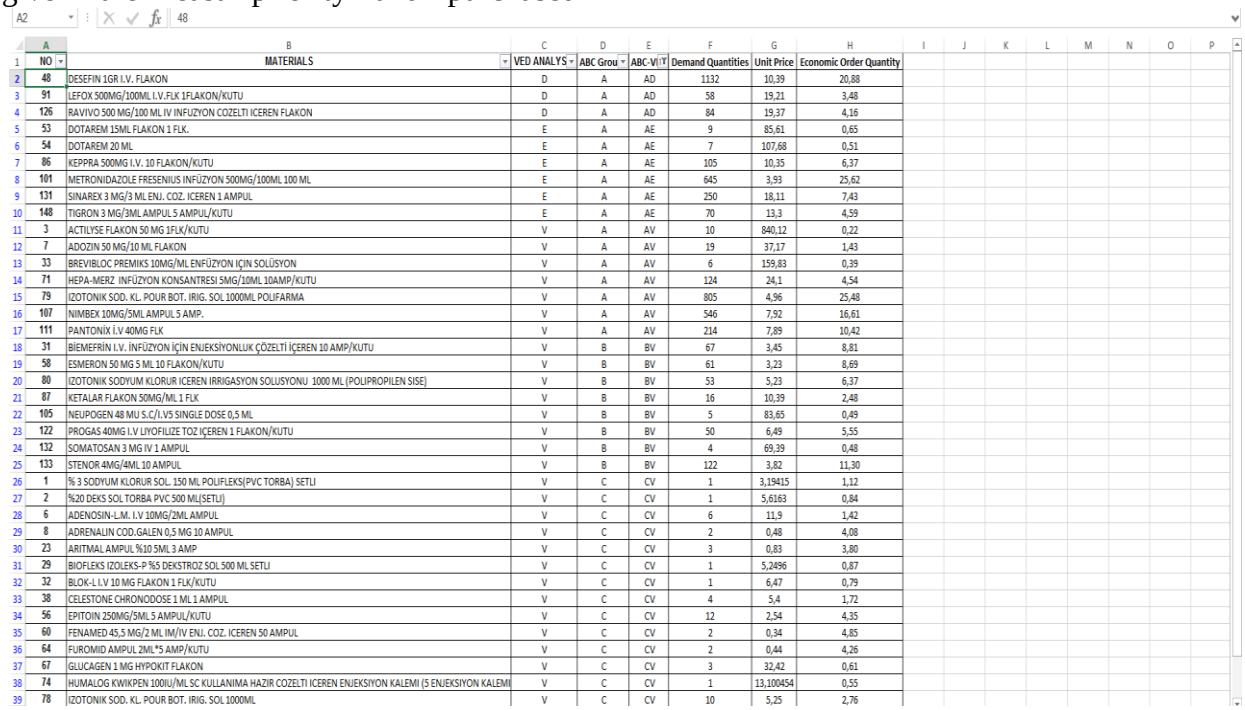


Figure6. ABC-VED matrix cumulative curve (2015)

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

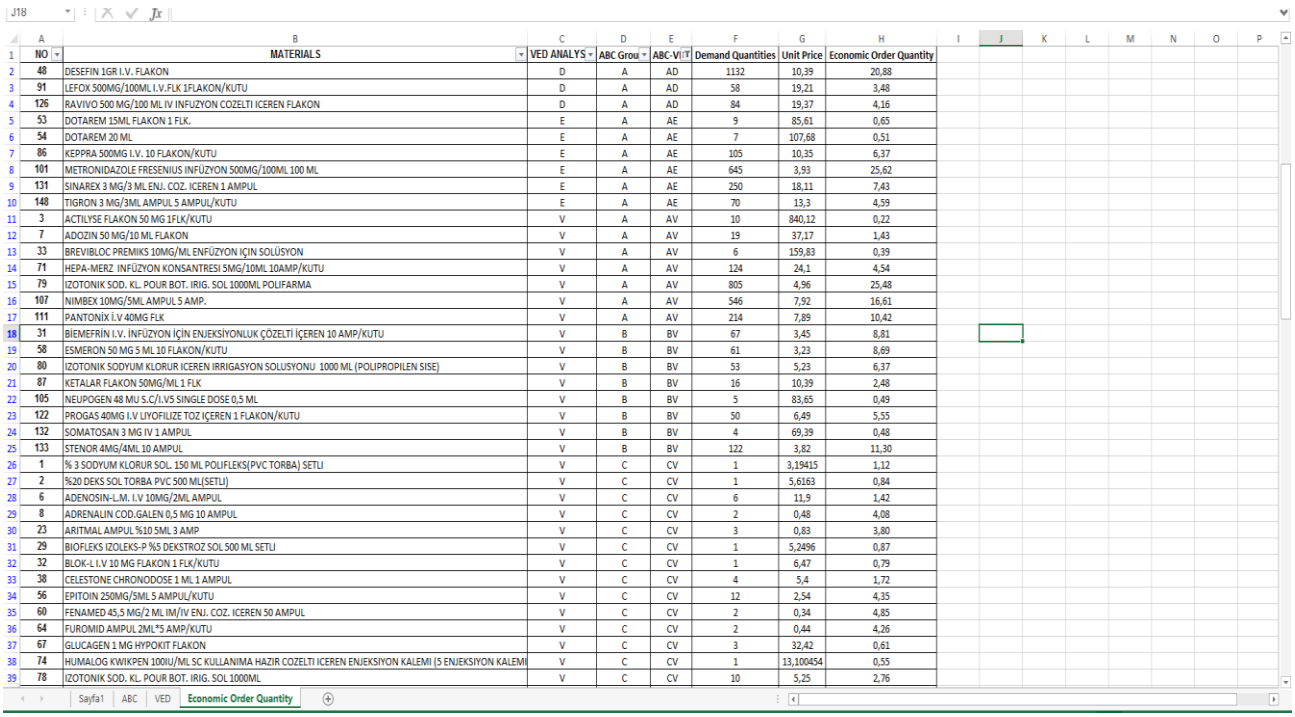
cheap and desirable. These drugs should be given the least priority and purchased periodically.



NO	MATERIALS	VED ANALYS	ABC Grou	ABC-VI	Demand Quantities	Unit Price	Economic Order Quantity
48	DESEFIN 1GR I.V. FLAKON	D	A	AD	1132	10,39	20,88
91	LEFOX 500MG/100ML I.V.FLK 1FLAKON/KUTU	D	A	AD	58	19,21	3,48
126	RAVIVO 500 MG/100 ML IV INFUZYON COZELTI ICEREN FLAKON	D	A	AD	84	19,37	4,16
53	DOTAREM 15ML FLAKON 1 FLK.	E	A	AE	9	85,61	0,65
54	DOTAREM 20 ML	E	A	AE	7	107,68	0,51
86	KEPPRA 500MG I.V. 10 FLAKON/KUTU	E	A	AE	105	10,35	6,37
101	METRONIDAZOLE FRESENIUS INFÜZYON 500MG/100ML 100 ML	E	A	AE	645	3,93	25,62
131	SINAREX 3 MG/3 ML ENJ. COZ. ICEREN 1 AMPUL	E	A	AE	250	18,11	7,43
148	TIGRON 3 MG/3ML AMPUL 5 AMPUL/KUTU	E	A	AE	70	13,3	4,59
3	ACTILYSE FLAKON 50 MG 1FLK/KUTU	V	A	AV	10	840,12	0,22
7	ADOZIN 50 MG/10 ML FLAKON	V	A	AV	19	37,17	1,43
33	BREVIBLOC PREMIKS 10MG/ML ENFÜZYON IÇIN SOLÜSYON	V	A	AV	6	159,83	0,39
71	HEPA-MERZ INFÜZYON KONSANTRESI 5MG/10ML 10AMP/KUTU	V	A	AV	124	24,1	4,54
79	IZOTONIK SOD. KL. POUR BOT. IRIG. SOL 1000ML POLIFARMA	V	A	AV	805	4,96	25,48
107	NIMBEX 10MG/5ML AMPUL 5 AMP.	V	A	AV	546	7,92	16,61
111	PANTONİX İ.V 40MG FLK	V	A	AV	214	7,89	10,42
31	BİEMEFRİN I.V. İNFÜZYON İÇİN ENJEKSİYONLUK ÇÖZELTİ İÇEREN 10 AMP/KUTU	V	B	BV	67	3,45	8,81
58	ESMERON 50 MG 5 ML 10 FLAKON/KUTU	V	B	BV	61	3,23	8,69
80	IZOTONIK SODYUM KLORUR ICEREN IRRIGASYON SOLUSYONU 1000 ML (POLIPROPILEN SISE)	V	B	BV	53	5,23	6,37
87	KETALAR FLAKON 50MG/ML 1 FLK	V	B	BV	16	10,39	2,48
105	NEUPOGEN 48 MU S.C/I.V5 SINGLE DOSE 0,5 ML	V	B	BV	5	83,65	0,49
122	PROGAS 40MG I.V LIYOFILIZE TOZ IÇEREN 1 FLAKON/KUTU	V	B	BV	50	6,49	5,55
132	SOMATOSAN 3 MG IV 1 AMPUL	V	B	BV	4	69,39	0,48
133	STENOR 4MG/4ML 10 AMPUL	V	B	BV	122	3,82	11,30
1	% 3 SODYUM KLORUR SOL. 150 ML POLIFLEKS(PVC TORBA) SETLI	V	C	CV	1	3,19415	1,12
2	%20 DEKS SOL TORBA PVC 500 ML(SETLI)	V	C	CV	1	5,6163	0,84
6	ADENOSIN-L.M. I.V 10MG/2ML AMPUL	V	C	CV	6	11,9	1,42
8	ADRENALIN COD.GALEN 0,5 MG 10 AMPUL	V	C	CV	2	0,48	4,08
23	ARITMAL AMPUL %10 5ML 3 AMP	V	C	CV	3	0,83	3,80
29	BIOFLEKS IZOLEKS-P %5 DEKSTROZ SOL 500 ML SETLI	V	C	CV	1	5,2496	0,87
32	BLOK-L I.V 10 MG FLAKON 1 FLK/KUTU	V	C	CV	1	6,47	0,79
38	CELESTONE CHRONODOSE 1 ML 1 AMPUL	V	C	CV	4	5,4	1,72
56	EPITOIN 250MG/5ML 5 AMPUL/KUTU	V	C	CV	12	2,54	4,35
60	FENAMED 45,5 MG/2 ML IM/IV ENJ. COZ. ICEREN 50 AMPUL	V	C	CV	2	0,34	4,85
64	FUROMID AMPUL 2ML*5 AMP/KUTU	V	C	CV	2	0,44	4,26
67	GLUCAGEN 1 MG HYPOKIT FLAKON	V	C	CV	3	32,42	0,61
74	HUMALOG KWIKPEN 100IU/ML SC KULLANIMA HAZIR COZELTI ICEREN ENJEKSIYON KALEMI (5 ENJEKSIYON KALEMI	V	C	CV	1	13,100454	0,55
78	IZOTONIK SOD. KL. POUR BOT. IRIG. SOL 1000ML	V	C	CV	10	5,25	2,76

Figure7. Results of ABC-VED matrix

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.



NO	MATERIALS	VED ANALYS	ABC Grou	ABC-VI	Demand Quantities	Unit Price	Economic Order Quantity
48	DESEFIN 1GR I.V. FLAKON	D	A	AD	1132	10,39	20,88
91	LEFOX 500MG/100ML I.V.FLK 1FLAKON/KUTU	D	A	AD	58	19,21	3,48
126	RAVIVO 500 MG/100 ML IV INFUZYON COZELTI ICEREN FLAKON	D	A	AD	84	19,37	4,16
53	DOTAREM 15ML FLAKON 1 FLK.	E	A	AE	9	85,61	0,65
54	DOTAREM 20 ML	E	A	AE	7	107,68	0,51
86	KEPPRA 500MG I.V. 10 FLAKON/KUTU	E	A	AE	105	10,35	6,37
101	METRONIDAZOLE FRESENIUS INFÜZYON 500MG/100ML 100 ML	E	A	AE	645	3,93	25,62
131	SINAREX 3 MG/3 ML ENJ. COZ. ICEREN 1 AMPUL	E	A	AE	250	18,11	7,43
148	TIGRON 3 MG/3ML AMPUL 5 AMPUL/KUTU	E	A	AE	70	13,3	4,59
3	ACTILYSE FLAKON 50 MG 1FLK/KUTU	V	A	AV	10	840,12	0,22
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111	PANTONİX İ.V 40MG FLK	V	A	AV	214	7,89	10,42
31	BİEMEFRİN I.V. İNFÜZYON İÇİN ENJEKSİYONLUK ÇÖZELTİ İÇEREN 10 AMP/KUTU	V	B	BV	67	3,45	8,81
58	ESMERON 50 MG 5 ML 10 FLAKON/KUTU	V	B	BV	61	3,23	8,69
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105	NEUPOGEN 48 MU S.C/I.V5 SINGLE DOSE 0,5 ML	V	B	BV	5	83,65	0,49
122	PROGAS 40MG I.V LIYOFILIZE TOZ IÇEREN 1 FLAKON/KUTU	V	B	BV	50	6,49	5,55
132	SOMATOSAN 3 MG IV 1 AMPUL	V	B	BV	4	69,39	0,48
133	STENOR 4MG/4ML 10 AMPUL	V	B	BV	122	3,82	11,30
1	% 3 SODYUM KLORUR SOL. 150 ML POLIFLEKS(PVC TORBA) SETLI	V	C	CV	1	3,19415	1,12
2	%20 DEKS SOL TORBA PVC 500 ML(SETLI)	V	C	CV	1	5,6163	0,84
6	ADENOSIN-L.M. I.V 10MG/2ML AMPUL	V	C	CV	6	11,9	1,42
8	ADRENALIN COD.GALEN 0,5 MG 10 AMPUL	V	C	CV	2	0,48	4,08
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38	CELESTONE CHRONODOSE 1 ML 1 AMPUL	V	C	CV	4	5,4	1,72
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60	FENAMED 45,5 MG/2 ML IM/IV ENJ. COZ. ICEREN 50 AMPUL	V	C	CV	2	0,34	4,85
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74	HUMALOG KWIKPEN 100IU/ML SC KULLANIMA HAZIR COZELTI ICEREN ENJEKSIYON KALEMI (5 ENJEKSIYON KALEMI	V	C	CV	1	13,100454	0,55
78	IZOTONIK SOD. KL. POUR BOT. IRIG. SOL 1000ML	V	C	CV	10	5,25	2,76

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.

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