Prioritizing Drug Procurement Using ABC, VEN, EOQ and ROP Combination

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Abstrak

Ketersediaan obat menjadi salah satu hal yang harus diperhatikan karena bila sampai terjadi kekurangan atau kelebihan dapat menimbulkan kerugian atau gangguan dalam perawatan pasien. Proses untuk melakukan pengadaan obat yang masih dilakukan dengan pertimbangan yang tidak pasti akan membuat ketidakteraturan penjadwalan, hal tersebut akan memberikan dampak pada Cost persediaan karena menumpuknya persediaan di gudang atau ketidakadaan persediaan obat tersebut.

Penelitian ini bertujuan untuk menghasilkan sistem pendukung keputusan pengadaan obat menggunakan kombinasi metode ABC, analisis VEN, ROP dan EOQ.

Hasil pengujian menunjukan bahwa sistem dapat memberikan 3 recommendation bagi pengambil keputusan dengan pertimbangan dari hasil matrik ABC dan VEN dan perhitungan pengadaan berdasarkan EOQ dan ROP. Hasil perhitungan total Inventory Cost pada contoh kasus obat orodin berdasarkan perhitungan apotek adalah Rp 708.500 sedangkan perhitungan menggunakan metode Economic Order Quantity adalah Rp 689.381 dari hasil perhitungan mendapatkan penghematan sebanyak Rp 19.119.

Kata kunci— *Klasifikasi persediaan obat, Reorder Point, Economic Order Quantity, Metode ABC, Analisis VEN.*

Abstract

The availability of drugs is one of the things that must be considered because if there is a deficiency or excess it can cause loss or disruption in patient care. The process to procure drugs that are still being carried out with uncertain considerations will create scheduling irregularities, this will have an impact on inventory costs due to accumulated inventory in warehouses or the absence of these drugs.

This study aims to produce a decision support system for drug procurement using a combination of ABC methods, VEN analysis, ROP and EOQ.

The test results show that the system can provide 3 recommendations for decision makers with consideration of the results of the ABC and VEN matrices and procurement calculations based on EOQ and ROP. The result of calculating the total Inventory Cost in the case example of the orodine drug based on the pharmacy calculation is IDR 708,500 while the calculation using the Economic Order Quantity method is IDR 689,381 from the calculation results obtained a savings of IDR 19,119.

Keywords— *Classification of drug supplies, Reorder Point, Economic Order Quantity, ABC method, VEN analysis.*

1.   INTRODUCTION

Pharmacy installation is a supporting service that is a cost center and is expected to be a revenue center, a large enough budget requires proper and efficient management to control costs so that it is hoped that it can also provide good revenue for the pharmacy provider [1], in pharmaceutical guidance in drug management planning has a cycle. planning, procurement, receipt, storage, distribution, drug administration, control, deletion, reporting and evaluation [2]. Procurement of drugs that are still carried out with uncertain considerations will create scheduling irregularities, this has an impact on inventory costs due to accumulated inventory in warehouses or the absence of these drugs, the activity of safeguarding drug supplies has a cycle such as in pharmaceutical supplies. [3]

The start of the pharmaceutical supply cycle is the planning stage. Planning activities start from selecting the type of drug, compilation of use, calculating needs and evaluating the design of drug supplies. The next stage is to compile the use and calculation of needs. The last stage is to conduct planning evaluations, evaluation activities at the planning stage will use a combination of ABC, VEN and EOQ methods.

The ABC method is used for the calculation of drug investment, VEN analysis is used for medicine and the EOQ method is used to determine the waiting time and the estimated demand during that time so that it can replenish the inventory with the right amount to optimize the turnover rate [4]. The reasons for planning the drug supply system are the anticipation of costs for procurement, unexpected demand, seasonal demand, fluctuation in demand, anticipation of price increases [5].

2.   METHODS

2.1 Architecture System

In this research, the system has a workflow for each of the methods used, then the methods are combined to get more efficient results.
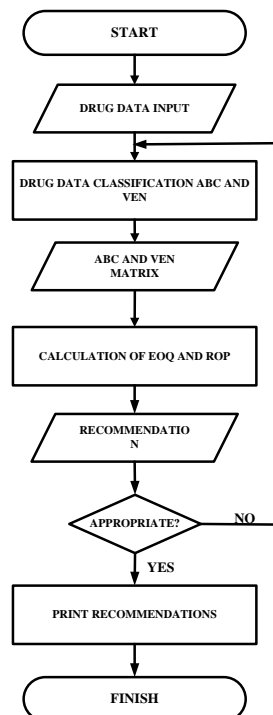

Figure 1 System Workflow Flowchart

The system user enters the drug dosage data and the costs allocated for procurement in the specified period. ABC and VEN classifications will get drug class classifications from the investment and impact. From the results of the ABC and VEN analysis, the next stage is to calculate pharmaceutical supplies using the EOQ and ROP methods, then the combined results are used as recommendations for drug procurement

2.2 ABC Method Analysis Calculation System

The main principle of ABC analysis is to place the types of pharmaceutical supplies in descending order, starting with the type with the largest budget, ABC analysis is a method of making groups or classifications based on the ranking of values from the highest to the lowest, and is divided into 3 major groups called groups A, B and C. [6]
1. Group A is an inventory of about 20% of the items but has an investment value of about 70% of the total inventory value and has a critical index value of 3.
2. Group B is an inventory of about 30% of the items but has an investment value of about 20% of the total inventory value and has a critical index value of 2.
3. Group C is an inventory with a total of about 50% of items but has an investment value of about 10% of the total inventory value and has a critical index value of 1.

Table 1 Sample data on drug types and prices

No	Medicine Name	Amount	Price	
1	Orodin	1.000	IDR	1.000,00
2	Betadin	1.000	IDR	2.000,00
3	Alkohol	3.000	IDR	1.000,00

2.2.1　Looking for usage / Cost

The percentage of use value is obtained from the amount of usage in one period, then the proportion of usage is calculated with the equation (1).

Cost = Amount + Price　　　　　　　　　　　　　　　　　　　　　　　(1)

Table 2 Looking for Usage value /Cost

No	Medicine Name	Amount	Price		Cost	
1	Orodin	1000	IDR	1.000,00	IDR	2.000,00
2	Betadin	1000	IDR	2.000,00	IDR	3.000,00
3	Alkohol	3000	IDR	1.000,00	IDR	4.000,00
	Total				IDR	9.000,00

From the table above, the following calculations are obtained:
Cost = Amount (Medicine) + Price
　　= 1000 (orodin) + IDR 1.000
　　= IDR 2.000,00

2.2. 2　Looking for Investment Value / cumulative

The investment value is obtained by multiplying the amount of usage by the unit price. Then, the proportion of investment per drug item is calculated by calculating with Equation (2) as follows:

Investment = cumulative value + Cost　　　　　　　　　　　　　　　　(2)

Table 3 Looking for Investment Value / cumulative

No	Medicine Name	Amount	Price		Cost		Cumulative
1	Orodin	1000	IDR	1.000,00	IDR	2.000,00	IDR 2.000,00
2	Betadin	1000	IDR	2.000,00	IDR	3.000,00	IDR 5.000,00
3	Alkohol	3000	IDR	1.000,00	IDR	4.000,00	IDR 9.000,00
	Total				IDR	9.000,00	

From the table above, the calculation is as follows:
Investment = cumulative value + Cost
$\quad\quad\quad$ = IDR 2.000 + IDR 3.000 = IDR 5.000

2.2.3   Looking for the value Percentage value in use / Cost

The percentage of value in use is obtained from the amount of usage in a period, then the percentage of usage in the equation is calculated

Table 4 Percentage Value in use/Cost

No	Medicine Name	Amount	Price		Cost		%Cost
1	Orodin	1000	IDR	1.000,00	IDR	2.000,00	22,2
2	Betadin	1000	IDR	2.000,00	IDR	3.000,00	33,3
3	Alkohol	3000	IDR	1.000,00	IDR	4.000,00	44,4
Total					IDR	9.000,00	

From the table above, the following calculations are obtained:
Percentage of value in use = $\underline{\text{Cost}}$ x 100% = $\underline{2.000\text{ x}}$ 100% = 22,2 %
$\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ 9.000

2.2.4   Finding the Percentage Value of the Investment Value / Cumulative

The investment value is obtained by multiplying the amount of usage by the unit price. After obtaining the amount of investment per item during the period then calculated the proportion of investment per drug item using the Equation (3).

Investment Percentage = $\left(\dfrac{y}{\Sigma y}\right)$ x 100 %$\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ (3)

Table 5 Looking for the% investment value /Cumulative

No	Medicine Name	Amount	Price	Cost	Cumulative	%Cumulative
1	Orodin	1000	IDR 1.000,00	IDR 2.000,00	IDR 2.000,00	22,2
2	Betadin	1000	IDR 2.000,00	IDR 3.000,00	IDR 5.000,00	55,6
3	Alkohol	3000	IDR 1.000,00	IDR 4.000,00	IDR 9.000,00	100
Total				IDR 9.000,00		

From the table above, the calculation is as follows:
Investment Value Percentage Value /Cumulative = $\underline{\text{Cumulative x}}$ 100%
$\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ Total Cost
$\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ = $\underline{\text{IDR 2.000x}}$ 100%
$\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ IDR 9. 000
$\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ = 22,2 %

2.2.5   Finding the Critical Index Value (CIV)

The critical index value can be calculated by calculating the Equation 4. Furthermore, the preparation will be classified into 3 groups at intervals based on the Equation (4).

CIV = %Cost + %Cumulative$\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad\quad$ (4)

Table 6 Critical index value

No	Medicine Name	%Cost	%Cumulative	Category	CIV
1	Orodin	22,2	22,2	A	3
2	Betadin	33,3	55,6	B	2
3	Alkohol	44,4	100	C	1

2.2 Analysis Ven Method

The VEN system helps regulate distortions in the pharmaceutical procurement process and thus the health effects of available funds. When the Amount has to be subtracted [7], the combination of the VEN and ABC classifications gives a matrix consisting of nine categories. Each group of the matrix above management policies and management is different, as below:

1. AV represents a drug that has a high level of importance with a high amount of use.
2. Coverage of drugs by use that contributed substantially to the total supply but were nonessential drugs.
3. CV includes drugs that should always be available, but these drugs do not have a major impact on the financial aspect.
4. CN is a group of drugs that are only slightly essential.
5. AE and BV are groups that cannot be ignored because AE is an important group based on value, while BV is important based on medical treatment,
6. BE, BN, and CE can be controlled with a moderate inventory level. The analysis is based on past usage.

Table 7 Combination Matrix ABC and VEN

ABC VEN Group Analysis				
Category I	AV	AE	AN	BV	CV
Category II	BE	CE	BN		
Category III	CN				

Types of drugs that are categorized as Category A are really needed to overcome most diseases and the status of these drugs must be E and part V. In fact, the types of drugs with status N should be included in Category C, used to determine priority for drug procurement where the existing budget is not appropriate needs.

Table 8 Combined results of ABC and VEN analysis

No	Medicine Name	%Cost	%Cumulative	Category	CIV	ABC + VEN
1	Orodin	22,2	22,2	A	3	AV
2	Betadin	33,3	55,6	B	2	BE
3	Alkohol	44,4	100	C	1	CN

2.3 Drug Procurement Calculations

Amandha Pharmacy, purchases drug supplies at Pharmaceutical Wholesalers (PBF) or their business partner distributors. The grace period between purchasing the drug supplies until it is around one or two days, but usually if not related to one day only. If there is defect / damage when the goods arrive, purchase returns can be made. The following is a table of data on the purchase of drug supplies at the Amandha Pharmacy during 2019.

Table 9 Amandha Pharmacy Drugstore Purchase Data Sample 2019

Month	Orodin
January	100
February	0
March	0
April	0
Mei	100
June	0
July	0
August	100
September	0
October	0
November	100
December	0
Total	400

Based on the table above, the Amandha Pharmacy for one year purchased Orodin's drug supplies in January, May, August, and November, which were 100 tablets each per order sePrice IDR.109,000, so the total purchase of drug supplies for one year was 400 tablets.

2.3.1 Cost Storage

In the storage cost, a percentage of the inventory value is carried out, namely the number of units from the inventory every time the order is ordered and the inventory price depends a lot on the number of units ordered with a percentage of the storage cost of 5% of the inventory value per order.

Table 10 calculation of drug storage costs

	Orodin
Cost Purchase Each Order	IDR 109.000 (IDR 1.090 × 100 tablet)
Percentage	5%
Cost Storage	IDR 5.450

Based on the table above, it shows that the storage cost for drugs in one procurement, Orodin is IDR. 5,450.

2.3.2 Sales of Medicinal Supplies

As a trading company, the operational activity of a pharmacy is to sell drug supplies to consumers plus profits without changing the form and function of the drug.

Table 11 Sales of drugs

Month	Orodin
January	30
Februariy	15
March	44
April	36
Mei	79
June	0
July	20
August	20
September	47
October	10
November	40
December	20
	360

Based on the table above, it shows that Orodin sales in May amounted to 79 medicinal tablets and at least 10 tablets in October, and the total sales for one year was 360 tablets.
1) Calculation of EOQ
Calculation of the quantity of Orodin drug procurement using the Economic Order Quantity Equation for 2019 Orodin based on the Equation (5).

$$EOQ = \sqrt{\frac{2xSxD}{H}} \tag{5}$$

$$=\sqrt{\frac{2x400xRp\ 109.000}{IDR\ 5.450}}$$

$$=\sqrt{\frac{87.200.000}{Rp5.450}}$$

$$=\sqrt{16000}$$
$$= 126,49= 126$$

Frequency $= \dfrac{400}{126} = 3,17$
round to 3 times
Recycling procurement
$\dfrac{365}{3} = 121,6 = 127$

Based on the above calculations, it shows that the optimum point for drug procurement for each order uses the Economic Order Quantity method. There are 126 tablets of Orodin with a purchase frequency of 3 times a year, as well as recycled procurement every 127 days.

2.4 Calculation of Safety Stock

The purpose of calculating Safety Stock is to reduce the risk of running out of inventory due to late delivery of inventory, thereby minimizing sales losses due to stock out. [8] This is because the procurement requires lead time. The following is a table for calculating the standard deviation along with the calculation of Safety Stock from the pharmacy

Table 12 Safety Stock calculations

Month	Sales	Estimate	Deviasi	Kuadrat
	X	μ	(X-μ)	(X-μ)²
January	30	21	9	81
February	15	21	-6	36
March	44	21	23	529
April	36	21	15	225
Mei	79	21	58	3364
June	0	21	-21	441
July	20	21	-1	1
August	20	21	-1	1
September	47	21	26	676
October	10	21	24	576
November	40	21	24	576
December	20	21	-1	1
		252	109	5837

2.4.1 Orodin's calculations

Frequency = 9060 = 1.5 rounded to 2 times Procurement Recycling 3652 = 182.5 = 183 days Lead time is the grace period / time interval when procuring supplies until the supplies arrive. In Amandha pharmacy the service level of 95% indicates that the probability of drug supply being able to meet the demand / sale during the grace period is 95%, while the risk of inventory shortages (Stock Out Risk) is 5%. Amandha Pharmacy uses a standard deviation of 5% with a value of 1.65. based on the Equation (6)

Safety Stock Orodin $= Z \times \sigma$ (6)

$\sigma = \sqrt{\dfrac{5837}{12}}$
$= \sqrt{486,41}$
$= 22,05$
$Z = 1,65$

Safety Stock Orodin
$= Z \times \sigma$
$= 1,65 \times 22,05$
$= 36,38= 36$

Based on the above calculations 6 , it shows that the safety stock of Orodin for Orodin is 36 tablets.

2.5   Calculation of Procurement Points (Reorder of point)

The point of re-procurement is the minimum amount of inventory in the warehouse so that it can be bought back to the distributor / supplier to replenish the inventory in the warehouse. [9] Re-procurement requires lead time. Lead time is the grace period / interval when procuring supplies until the supplies arrive. The following is the calculation of the point of re-procurement for the three types of drugs *Orodin* based on the Equation (7).

Lead Time (LT) = 1 day

Average Usage (AU) = $\dfrac{360}{365} = 0{,}98 = 1$

Safety Stock (SS) = 38

ROP = (LT × AU) + SS   (7)

= (1 × 1) + 36= 37

Based on the above calculations, it shows that the reorder of points for Orodin medicine is 37 tablets. So the Orodin drug can be bought back when the inventory amount in the warehouse counts 37 tablets

2.6   Maximum Inventory Calculation (Maximum Inventory)

The purpose of calculating the maximum inventory is to prevent the amount of inventory in the warehouse from accumulating excessively so that it affects the turnover of capital because the funds for capital stock can be allocated to other costs / investments that are much more profitable (opportunity cost). [10]

based on the Equation (8). Here is the maximum inventory calculation.Maximum Inventory

= *Safety Stock + Economic Order Quantity*   (8)

 Maximum Inventory Orodin = 36 + 126 = 162 tablets.

Based on the above calculations, it shows that the maximum amount of supplies that can be stored in the warehouse for Orodin is 164 tablets.

2.7   Total Inventory Cost (TIC)

To find out how much savings can be made by using the Economic Order Quantity method, it can be done by comparing the calculation of the maximum total cost of inventory according to the Economic Order Quantity method with the calculation of the total inventory cost according to the pharmacy. The following is a comparison of the calculation of the total inventory cost of the three types of drugs.TIC based on the Equation (9)

$$= \dfrac{(H)(Q)}{2} + \dfrac{(S)(D)}{Q} \qquad\qquad (9)$$

TIC Orodin according to the pharmacy = $\dfrac{(\text{IDR } 5.450 \times 100)}{2} + \dfrac{(\text{IDR } 109.000 \times 400)}{100}$

= IDR 272.500 + IDR 436.000

= IDR 708.500

TIC Orodin EOQ metods = $\dfrac{(\text{IDR } 5.450 \times 126)}{2} + \dfrac{(\text{IDR } 109.000 \times 400)}{126}$

= IDR 343.350 + IDR 346.031,74 =IDR 689.381

Based on the above calculations, it shows that the total cost of Orodin medicine supplies is IDR.708,500, while the total cost of Orodin medicine supplies according to the Economic Order Quantity method is IDR 689.382, resulting in a saving of IDR 19.000 in inventory costs.

3. RESULT AND DISCUSSION

3.1 Current drug procurement system

Table 13 Drug Order list

DRUG ORDER LIST					
Medicine Name	Type of Medicine	Unit Price	Amount Buy	Total Price	Expired
Disopyramide	solution	IDR 2.000	100	IDR 200.000	19/10/2021
Articaine	Pill	IDR 4.000	100	IDR 400.000	19/10/2021
Bupivacaine	Capsule	IDR 3.200	100	IDR 320.000	19/10/2021
Cinetedine	Suspension	IDR 6.500	100	IDR 650.000	19/10/2021
Sotalol	powder	IDR 4.300	100	IDR 430.000	19/10/2021

From Table 13, drug procurement data is obtained from the current system, the system only provides the Amount of drugs to be ordered without considering the drug classification from the investment value and does not consider the drug class from the impact classification. previous drug sales data.

3.2 Recommendations using methods

The calculation of drug procurement is carried out using the EOQ, ROP and safety stock methods, the recommendations generated by the system come from the ABC and VEN matrix results where there are 3 categories, namely

1. Category I has matrix classes AV, AE, AN, BV and CV

Figure 2 Recommendation I

From the results of Recommendation I, it was found that 88 types of drugs were recommended for procurement because they had met the minimum safety stock standards in the drug warehouse.

2. Category II has matrix classes BE, CE, BN,

SIM APOTEK

Rekomendasi 2
Stok Tanggal 01/01/2021

No	Kode	Nama Obat	ABC+VEN	Stok	Safety Stock	EOQ	ROP	Maksimum	Harga	Jml Pesan	Biaya
1	APP0005	Betadine Hygiene	BE	1	2	89	2	91	19.000	89	1.710.000
2	APP0042	Asam Salsilat 3%	BE	1	1	77	1	78	21.000	77	1.617.000
3	APP0086	Bisolvon Elix 60 ml	BE	1	0	53	0	53	47.500	52	2.470.000
4	APP0092	Liposin Salep 10g	BE	1	0	53	0	53	27.500	52	1.430.000
5	APP0058	Mebendazol	BE	1	0	45	0	45	78.000	44	3.432.000
6	APP0056	Aminofilin supp 200mg	BE	1	0	40	0	40	144.000	39	5.616.000
7	APP0044	Vaksin Hepatitis B	CE	1	0	42	0	42	200.000	41	8.200.000
8	APP0020	Asiklovir krim 5%	BN	1	2	89	2	91	7.500	89	675.000
9	APP0021	Atropin Tetes Mata	BN	1	1	77	1	78	14.500	77	1.116.500
10	APP0100	Stopain Cr 30 G	BN	1	1	58	1	59	22.000	58	1.276.000
11	APP0049	Retinol	BN	1	0	49	0	49	275.000	48	13.200.000
12	APP0097	Sterimar Nasal Spray 50ml	BN	1	0	37	0	37	160.000	36	5.760.000

Figure 3 Recommendation II

From the results of recommendation II, 12 types of drugs were obtained for procurement.

3. Category III has a CN matrix class

SIM APOTEK

Rekomendasi 3
Stok Tanggal 01/01/2021

No	Kode	Nama Obat	ABC+VEN	Stok	Safety Stock	EOQ	ROP	Maksimum	Harga	Jml Pesan	Biaya

Figure 4 Recommendation III

From the results of recommendation III, there is no type of drug that is recommended for procurement.

From the results of the tests that have been carried out, the old system uses the drug data that comes out as an estimated data recommendation for further procurement, while the new system uses the EOQ and ROP methods as the calculation of drug procurement, this EOQ model not only determines the optimal order Amount but more importantly again is that which concerns the financial aspects of decisions about the quantity of the order, the ROP method takes into account the safety stock, and can find out the point in time when to order goods for the next period.

4. CONCLUSION

Planning and control made by taking into account the ABC analysis of usage, investment and the ABC critical index analysis to then make EOQ and ROP models to determine the economic order Amount and the order back point for drugs. The incomplete and inadequate system for recording and reporting drug requests and use in the pharmaceutical department is a problem in the planning and control process of drugs.

Given the increasingly complex types of diseases and types of drugs that will be available in the market, it would be better if the preparation of drug Equation ries should be carried out immediately to reduce the budget burden on drug procurement in general.

To reduce the amount of EN drugs, as well as the dead stock, in the short term it is necessary to make clear rules, especially for the demand for new drugs, where there are standard rules made by management to limit the amount of unused drug items, which in turn will give rise to EN drugs, and dead stock continues to increase. To get a recommendation calculation, it must match the drug sold.

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