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Analysis of the implementation of drug inventory control using the ABC-EOQ-ROP method at Sundari Hospital Medan

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ABSTRACT

Pharmaceutical supplies are one of the resource elements that must be controlled in the operational management of a hospital to support hospital services in order to provide maximum health services. The study aims to analyze the Implementation of Drug Inventory Control with the ABC-EOQ-ROP method at Sundari Hospital, Medan. The research method used was descriptive qualitative which was carried out at Sundari Hospital, Medan in October-November 2024. Informants were the head of the pharmacy installation, pharmacy staff, and head of the room. Data were analyzed using interactive analysis. The results of the study showed that the availability of drugs before the implementation of the EOQ and ROP methods based on the type and quantity of drugs was not sufficient to meet the needs where there were still some drugs that could not be met in a timely manner. The availability of drugs after the implementation of the EOQ and ROP methods in the pharmacy warehouse when viewed based on the type and quantity of drugs was sufficient to meet the needs of the pharmacy installation in a timely manner. It is recommended that drug inventory control in this study only emphasizes the calculation of drug inventory control that requires greater management (category I) quantitatively.

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INTRODUCTION

Half from overall invested assets by A business consists of from inventory, which is Wrong One the most expensive component. Every business, good That factory, shop, or provider services , of course provide supply stored items For used furthermore (Jonatan Persada Siregar et al., 2023). Without supplies, entrepreneurs will faced with on risk lost chance For get the benefits that should be they get Because business they Possible No can fulfil request customers (Bairizki, 2022)(Siahaan et al., 2022)(E. Siregar, 2022). As a result, the supply of goods and services is very important for every business (Sukendar et al., 2020).

One of the companies that must make supplies is a hospital. Hospitals must make supplies, and one of them is drug supplies (Rodiansyah, 2021)(Aliyah & Mandasari, 2021)(B. S. M. Siregar et al., 2024). Drug supplies in hospitals are one of the most important parts in providing good service to patients, which increases patient confidence in the quality of the hospital. More

than 90% of hospital health services depend on pharmaceutical supplies, and 50% of all hospital income comes from managing pharmaceutical supplies (Kuwawenaruwa et al., 2020). Thus, the unit responsible for ensuring drug availability is the Hospital Pharmacy Installation (Alakel, 2019).

One of the resources that must be controlled in the operational management of a hospital is pharmaceutical supplies (Anastasia et al., 2023). Due to the large benefits obtained, pharmaceutical supplies require very careful, effective, efficient, and cost-effective management. More efficient methods are often needed to manage large quantities of inventory (Haris et al., 2023)(Suratminingsih et al., 2024)(Suprayitno et al., 2024). In a hospital, the success and efficiency of procurement and control are very influential in supporting hospital services so that they can provide maximum health services (Malinggas et al., 2015).

One of the private type C hospitals in Medan City is Sundari Hospital, Medan City, and this hospital often experiences a decrease in inventory. Initial survey results show that drug procurement is based on usage. Sundari Hospital, Medan City uses a consumption method in drug planning, which often causes unplanned drugs to be purchased immediately at outside pharmacies or borrowed from other hospitals. It was noted that in 2023, the purchase of drugs and consumable medical supplies reached 30 million rupiah, and there was a shortage of twelve drugs (Nurhidayah et al., 2023)(Afriani, 2024). This can cause financial losses and hospital services, because there is a discrepancy between the listed inventory figures and the physical inventory recorded manually and with the computer system/Hospital Management Information System.

Calculation of drug inventory is still a problem because hospitals have difficulty in managing the inventory of various types of drugs. and is one of the reasons why drug purchasing services to external pharmacies or prescriptions are not available. Sundari Hospital, Medan City, experiences shortages and excesses of drug inventory because of the many types of drugs that must be controlled by the hospital. One way to calculate inventory is by ABC analysis, which divides goods into three levels for classification. As is the case with the pharmacy room at Sundari Hospital, Medan City, which lacks drugs, which hinders and ineffectively serves patients. Drug shortages can cause increased ordering costs due to continuous ordering. Inventory or maintenance costs can increase as a result of excess drug inventory. Therefore, the EOQ method is also needed to determine the ideal amount of drug orders to meet the needs of the hospital's patients.

The ROP method for classifying drugs in ABC, EOQ, SS analysis can reduce the total inventory value and facilitate the regulation of drug procurement frequency (Bintang Sri M Siregar et al., 2023). The Pharmacy Installation Section of Sundari Hospital, Medan City, uses up a lot of drugs when patients need them, so the drug ordering time is ineffective. To avoid drug shortages, the Reorder Point (ROP) calculation can be used to determine the limit or amount of goods available in the warehouse for reordering. This study aims to analyze the Implementation of Drug Inventory Control using the ABC-EOQ-ROP method at Sundari Hospital, Medan.

RESEARCH METHOD

This research is qualitative with a descriptive approach, the research was conducted at Sundari Hospital Medan in October-November 2024. The informants of this research consist of key informants, main informants and supporting informants, namely the head of the pharmacy installation, pharmacy staff, head of the room. Data collection techniques are carried out by observation, interviews, questionnaires and documentation. Data were analyzed using interactive analysis. Activities in analyzing qualitative data include 1) Data Reduction , 2) Data Presentation , 3) Conclusion Drawing.

RESULTS AND DISCUSSIONS

Based on the results of the review of data documents for the period January to December 2023, patent groupings were obtained based on groups A, B and C. The following are the results of the ABC analysis based on the amount of use in 2023.

Table 1. Analysis A B C usage period January-December 2023

Group Drug	Type drug	Percentage type usage (%)	Amount usage	Percentage usage (%)
A (Usage Tall)	13	11.08	38,563	50.02
B (Usage Currently)	17	16.42	23,342	18.39
C (Usage Low)	78	53.45	9.356	11.5

Table 1 shows patent group A has amount usage the highest, namely 38,563, or 50.02% of total usage 13 types of drugs, or 11.08% of the total types. Patent group B has amount usage moderate, namely 23,342, or 16.42% of total usage 17 types of drugs, or 18.39%. Patent group C has amount lowest usage, namely 38,563, or 50.02 % of total usage 17 types of drugs, or 18.39%. Results from ABC analysis based on mark investment the year 2023 is as following: for know grouping drug based on previous ABC analysis, you must moreover formerly understand mark critical from each patent.

Although availability Patent Group A in Warehouse Pharmacy House Sick Sundari City of Medan Enough for fulfil needs, but problem like lack and scarcity drug on eight Items Which patented Still Possible happened. Thing This based on results interview to informant:

"*I think That enough, if of course required must buy Cito Because delivery the medicine pending Because pharmacy or warehouse out of stock supplies, or reason other.*" *(Informant 1).*

" *So far, patent availability is very high because the patents mentioned above will definitely be processed quickly. Actually, Citoper exists, but not often. This is because the patents above move quickly, so our supply is always sufficient.* ' ' *(Informant 2)*

"Although the quantity and amount of the eight patented drugs are in accordance with our wishes, supplies may not be sufficient and timely delivery of the drugs may not be possible." (Informant 3)

This is also supported by the results of a review of pharmaceutical warehouse drug request data documents . Results study shows that based on the amount and type of drugs, patent group A has available in drug warehouse before done test clinical with method EOQ And ROP.

Changes in consumer demand (doctors) usually cause drug shortages or shortages. This change causes drug development behavior to change from slow progress to rapid progress, or vice versa. This is because the implementation of the prescription is still not optimal. The increasing demand for certain drugs due to high cases of disease in hospitals, shortages of inventory in warehouses, and vacancies in factories and distributors are other factors . This is evidenced by the following interview excerpt:

"The first factor may be drug shortages. Doctors use drugs in different ways, and sometimes they switch. For example, I will use brand A this month, but next month, because of collaboration with other stakeholders, we will use brand B. The first step is to reduce the supply of drugs. One way is to establish drug standardization to ensure that prescriptions are adhered to. Please do not prescribe drugs that are not on the prescription if possible so that doctors can comply with the prescription in the future. '' *(Informant-1)*

"There is a shortage of drugs. Although I am not here often, it is true that there is a shortage of drugs, especially since the trend of doctor usage has changed. There is not enough stock to meet the demand for disease trends related to drugs because of high demand and empty stocks. (Informant -2)

"There was a shortage of drugs here, which is usually caused by factory availability. In addition, the trend of using certain drugs is very high, even drugs that are usually used by 10 people are now used by 50 people, all because of the behavior of doctors who do not comply with drug forms." (Informant -3)

Doctors should always use drugs from their pharmacy warehouse, not other brands, even if the drugs are sold under other brands. The best option is to ask for help, but doctors do not want it. Warehouse staff will seek drugs from distributors when possible when restocking drugs in the warehouse. However, if this is not possible, the Pharmacy warehouse staff will purchase them from pharmacies outside the hospital. This is evidenced by the following interview results:

"The pharmacy contacts the doctor if the prescribed medicine is not available. The doctor replies that there is none. For example, there is a medicine B that must be taken in the same way, but it depends on which doctor wants to replace it. We will buy Cito, no matter whether it is pleasant or not." (Informant-1).

"If the required medicine is not available, the doctor can replace it with the same one if it is available. This only applies if the doctor wants it; otherwise, you have to buy it cito." (Informant -2).

"If the medicine runs out, contact the doctor and ask for an equivalent replacement if we want or do not have to take the medicine. I usually buy the medicine outside" (Informant-3)

However, currently the pharmaceutical warehouse is compiling the minimum and maximum inventory which will later be used as a reference for the amount of inventory that must be available in the pharmaceutical warehouse. This is evidenced by the results of interviews with informants:

"*For objective management, we use inventory For know whether a drug approach time expired or Already expired, usually every three month, However month front we want to do This a month very, And Then we planning use at least One card inventory For know whether a drug Already approach time expired or Already expired track supply we (Informant 1).*

"*Here, the control is mostly inventory inventory, matching the inventory card with the physical medicine to see the expiration date of the medicine, the inventory card as a daily record in the warehouse to know how many medicines have gone out and how many have come in, the defect book is a book for recording requests for goods from the pharmacy to the warehouse*" (Informant -2).

"*So far, the control here in the warehouse, both in the pharmacy, is mostly stock opname, matching the physical amount of drugs with the amount of drugs on the inventory card, stock opname every three months, but starting next month it seems like it will be changed to once a month, and there is also a defect book, so if the pharmacy needs drugs, we write it in the defect book to ask for it from the warehouse, if in the warehouse there is a stock card, it is recorded every day in the warehouse so that we know the amount of drugs in the warehouse*" (Informant -3)

Before the ABC critical index method trial began, the availability of patents group A, EOQ and ROP based on the type and quantity of drugs, did not meet the needs. Based on the results of interviews and document reviews, it is known that the availability of patents group A for two weeks in August 2024 was 85.72%, or 21 requests, of the total demand. Because the number of drugs available in the warehouse is limited when demand increases and the warehouse inventory is empty, all of these requests have not been met. Increased demand due to outbreaks or increasing certain diseases in hospitals, changes in doctor trends in drug use, and distributor vacancies cause shortages and shortages of drugs in pharmacy warehouses.

Researchers determine the amount and time of profitable reorders by looking at patents using EOQ and ROP calculation techniques. The data needed for EOQ calculations are the amount of daily usage, ordering costs, and storage costs. There is no special calculation used to determine how many drugs are ordered, especially patents, at Other Hospitals. Sundari Hospital, Medan City determines the amount of drug orders in the pharmacy warehouse based on the amount of drug requests from the pharmacy installation. If the availability of drugs cannot be met, the pharmacy warehouse officer will record the amount of drugs that are lacking, plus safety stock.

This is proven by the results of interviews with informants:

"There is no specific calculation for our order quantity. Instead, we determine the order quantity based on the pharmacy's demand. For example, the pharmacy has 10 orders, and we order 3 for the buffer" (Informant -1).

"*So far, there is no special calculation method for the amount of our orders. At most, if the order is in accordance with what the pharmacy requested, we also look at the stock in the warehouse, and if we order*

fast drugs, we order" (Informant 2)

Table 2. EOQ patent calculation results abc analysis critical index period January-December 2023

Name Drug	Usage	Cost Booking	Cost storage	EOQ
Ceftriaxone 1 gr (OGBDEXA) @10 vial	9035	1955	4,862	81.3748013
Terfacef1 gr	2360	1955	54626	16.9116233
Lizor500 mg	3444	1955	7579	54.8472191
Amoxsan 500 mg capsule	7978	1955	801	256,779147
Fixiphar200 mg	6076	1955	7722	72.1727043
Prolic300 mg	3929	1955	1859	118.285174
Claneksi 500mg tab	3733	1955	3117	89.0409097
Baquinor500 mg	2587	1955	3603	68.943778

In addition to the EOQ calculation, the ROP method is also used to calculate the reorder time. Based on the results of the EOQ calculation shown in table 2, it can be seen that the largest economic order quantity is Amoxsan 500 mg capsules with 256.7 or rounded to 257 capsules, while the smallest economic order quantity is Terfacef 1 gr with an order quantity of 16.91 or rounded to 17 vials. This is proven by the results of interviews with informants:

"*So far, we have ordered twice a week, but we are not sure of the day. The plan is Monday, Thursday, but sometimes it happens Tuesday, Friday, so we don't know the day. No, our ordering time is only twice a week based on our experience. However, if there is urgent demand, we will still order, and if the stock in the warehouse is low, we will order again.*" (Informant-1).

In determining safety stock, the target achievement or service level is required. If the buffer stock has a service level of 98%, then the Z value is 2.05. However, for psychotropic drugs, the waiting time for the drug is one day. The following are the results of interviews with informants:

"*If we get here quickly, we will order the medicine this morning this afternoon, if not tomorrow at the latest, except for the psychotropic drugs which require two days.*"

Table 3. Patent ROP calculation results ABC analysis critical index period January-December 2023

	Amount usage per day	Lead time	Safety stock	ROP
Ceftriaxone 1gr (OGB dexa) @10 vials	25 vials	1 day	51.25	76.25
Terfacef 1 gr	6 vials	1 day	12.3	18.3
Lizore 500 mg	9 tablets	1 day	18.54	27.54
Amoxsan 500 mg capsules	22 capsule	1 day	45.32	67.32
Fixiphar 200 mg	17 tablets	1 day	34.85	51.85
Prolic 300 mg	11 tablets	1 day	22.55	44.55
Claneksi 500 mg tab	10 tablets	1 day	20.5	30.5
Baquinor 500 mg	7 tablets	1 day	14.35	21.35

Furthermore researcher do implementation results calculation on For see availability patented drugs group A in warehouse pharmacy House Sick Sundari Medan City. Based on results interview deep with informant known that after done test try method analysis EOQ and ROP methods, availability of patents group A for 2 weeks on September more Good compared to availability on month previously, because If Look based on type and amount drug warehouse pharmacy Already sufficient request installation pharmacy. In addition that also with implementation EOQ and ROP methods in patent group A are found *buffer stock* that has been taken into account with use formula calculation *buffer stock*. Here results interview with informant:

" *If Now yeah rich Far more Good yes, yes if Now There is Keep going the stock from aspect number of patents granted ask for the same pharmacy, if Formerly right sometimes pharmacy ask for the medicine is*

200 apparently supply here only 100, yeah so want No want the 100 We order first, later if Already come yes direct We ampulrah".

This matter Also in support based on results observation and review request data document drug in warehouse pharmacy, it is known that condition availability of patent group A percentage availability namely amounting to 100% of the total demand for 2 weeks on September 2024, namely 19 patent applications. The following list request and group patent fulfillment A for 2 weeks.

Based on explanation that has been in explain previously can in conclude that patent availability after in do implementation method ABC index analysis critical, EOQ and ROP if seen from type and amount drug Already Enough for fulfil request installation pharmacy, besides That for 2 weeks on process implementation method problem emptiness and lack drug in fulfil request as well as purchase *cito* for patent group A no happen.

Discussion

Grouping of Patented Drugs Based on Investment Value (Groups A, B and C) Using the ABC Analysis Method

Inventory control is distinguished based on the value of usage and investment used in one period. Usually, inventory is divided into three, namely, A, B, C, The ABC classification used in this hospital is used as an inventory application that uses the Pareto principle by focusing inventory control on high-value inventory items rather than low-value ones.

In principle, this ABC model classifies inventory into three categories, namely group A, group B and group C. From the results of document review of data on the number of drug usage during the period from January to December 2023, it is known that the number of drugs in group A is the drug with the fewest types, namely 10 types of drugs, but in terms of usage, it is the drug with the highest number of uses, namely 70.02% of the total drug usage.

The use of the ABC method allows management to find out which items have a significant impact on inventory performance, so that management can carry out effective monitoring and concentrate on items with few items without ignoring other items. From the results of the document review of data on the number of uses and unit prices of drugs in the January-December 2023 period, it is known that the number of group A drugs is the type of drug with the fewest items, namely 11 types, but in terms of investment value, it is the drug with the highest investment value, namely 70.16% of the total investment value of drugs in the pharmacy warehouse. So that drug monitoring for the group must be more intensive compared to groups B and C because group A drugs consist of the most important supplies and incur the largest investment costs.

In addition, group A, the purchase quantity and reorder point for group A drugs must be carried out with careful calculation. Meanwhile, group B drugs are drugs with a moderate number of drug items, namely 22 types of drugs with a total investment value of 1.44% of the total investment value of drugs in the pharmacy warehouse. Group B drugs consist of fairly important supplies and incur moderate investment costs and usually require quite intensive monitoring but not more intensive than group A. In addition, supplies in group B for monitoring can be carried out every 3 months. Furthermore, group C drugs are drugs with the most types of drugs, namely 76 types of drugs but have the lowest investment value, namely 10.40% of the total investment value of drugs in the pharmacy warehouse. Group C consists of less important supplies with relatively small investment costs in inventory and monitoring techniques that seem ordinary.

The application of ABC analysis in hospitals requires other supporting methods because it is known that the need for drugs in hospitals is very diverse, sometimes even though the investment value is low but it is very vital in patient services (Norachuriya et al., 2024) **.** The critical value of patient services is assessed by drug users which will later be used to determine supplies with categories A, B and C, so that the monitoring and control process can be more assured.

The Number of Patent Drugs to be Ordered Through Calculation Using the EOQ Method

Based on the results of the study, the availability of drugs in this group before the ABC critical index method, EOQ and ROP were applied, when viewed in terms of type and quantity, it was not sufficient to meet the needs or demands. In August 2023, it was known that there were 21 requests for group A drugs, but when the needs were met, there were 3 requests that were not sufficient in quantity to meet the demands of the pharmaceutical installation. Based on the results above, it is known that the Sundari Hospital pharmacy warehouse has not been able to provide all the requests for the pharmaceutical installation, both in terms of the type and quantity of drugs to meet the needs. The failure to fulfill all requests for the pharmaceutical installation is due to the problem of emptiness and shortage of drugs in the pharmacy warehouse (Hikmah Harun & Firdaus Mohamad, 2022). The cause of the emptiness and shortage of drugs in the Sundari Hospital pharmacy warehouse in Medan City is due to changes in user behavior in prescribing drugs, where drugs that were previously *slow moving* become *fast moving*, and even users prescribe new drugs that are not yet on the hospital formulary list, so that the drugs needed cannot be prepared because there is no stock in the pharmacy warehouse (Rahmah & Barizah, 2020). In addition, the cause of the emptiness of drugs in the pharmacy warehouse at Sundari Hospital in Medan City is because there is an emptiness in the drug distributor and because of an increase in demand for drugs so that the available stock is not sufficient to meet the needs. Various causes of the emptiness resulted in the pharmaceutical warehouse of Sundari Hospital, Medan City, being unable to serve pharmaceutical installation requests in a timely manner.

Cito purchases result in losses in the form of cost inefficiencies and broken relationships with customers. Based on the results of the study, it is known that stock opname, inventory cards and defect books are inventory control methods that have been carried out by the pharmacy warehouse of other Hospitals to ensure the availability of drugs so that they are always available when needed to meet demand (Bloomfield et al., 2021). Stock opname is an activity carried out to match the physical amount of drugs in the warehouse with the recording of the amount of drugs on the inventory card (Al-Najjar et al., 2018). Stock opname in the pharmacy warehouse of Sundari Hospital, Medan City is carried out every 3 months but will change to once a month in September.

With various forms of inventory control that have been carried out by the pharmaceutical warehouse of Sundari Hospital, Medan City so far, in fact the pharmaceutical warehouses of other hospitals are still experiencing problems related to the availability of drugs, especially the problem of empty and insufficient quantities of drugs.

Reorder Time for Patented Drugs (ROP) and the Ideal Buffer Stock Amount to Avoid Stock Outs in Hospitals

Seeing the availability of drugs after using EOQ and ROP requires data on planning needs first. Planning for drug needs in the pharmacy warehouse of Sundari Hospital, Medan City is based on the number of drug requests from the pharmacy installation based on previous consumption. This is in line with the Director General of Pharmaceutical and Medical Device Development in 2014 which stated that planning needs are based on consumption, epidemiology, a combination of consumption and epidemiology methods and adjusted to the available budget. However, the process of determining needs in other hospitals does not have annual planning needs. Planning for hospital drug needs is only based on requests from the pharmacy installation whose procurement realization is carried out every 2 times a week.

This is not in line with the Director General of Pharmacy and Medical Devices (2016) who stated that the planning of needs with the consumption method must be based on the analysis of drug consumption data from the previous year, which is used to calculate the amount of drugs needed. The availability of drugs is one of the demands of health services, therefore, drug management that is not carried out properly will cause problems related to drug availability (Alsharif et al., 2019). As previously explained, group A drugs are a group of drugs that are critical to the function and operation of a hospital, the inventory level of this group must be carefully

monitored. One important aspect in drug management is inventory control. Inventory control is a very important managerial function to control costs and ensure the availability of goods when needed, in the sense of always ensuring that inventory does not experience stockout or overstock.

Group A drugs should be controlled by using the EOQ and ROP models to avoid stock shortages, cito purchases, and prescriptions purchased outside the hospital pharmacy. The EOQ method is a method to answer how much inventory to order to make inventory costs more efficient, while the Reorder Point (ROP) method is used to find out when is the ideal time to reorder drugs. The benefits of applying the EOQ method to drug classification in ABC analysis can reduce the total inventory value and facilitate the regulation of drug procurement frequency. In addition to having safety stock, the company can find out how much raw material must be ordered to avoid costs due to overstock and the company can also find out when the reorder point (ROP) should be. The ROP method can help pharmaceutical planning in calculating and ordering drugs so that there is no shortage of drugs and minimize ordering costs (Memarzia et al., 2021).

This is in line with the 2016 Directorate General of Pharmaceutical and Medical Devices Development standards which state that the availability of drugs and vaccines in hospitals must reach 100%. From these results, it can be concluded that the application of the ABC critical index, EOQ and ROP methods is more effective than the previous control methods carried out in pharmaceutical warehouses (Wakchaure & Ganguly, 2018). This is said because the availability of group A drugs after the application of the EOQ and ROP methods reached 100% of the total demand in September 2023. These results have met the needs when compared to the percentage achievement before the application of the EOQ and ROP methods, the availability of which only reached 85.71% of the total demand in August 2023.

CONCLUSION

Grouping of patented drugs is done based on their investment value (groups A, B and C) using the ABC analysis method. The application of the EOQ and ROP methods based on the type and quantity of drugs has not been able to meet the needs where there are still some drugs that in fulfilling their needs cannot be met on time. The time to reorder patented drugs (ROP) and the ideal amount of buffer stock is applied by the application of the EOQ and ROP methods in the pharmaceutical warehouse when viewed based on the type and quantity of drugs is sufficient to meet the needs of the pharmaceutical installation on time.

This research makes an important contribution to the science of hospital pharmacy management, especially in the aspect of efficient and evidence-based inventory control. By combining ABC, EOQ, and ROP methods in an integrated manner, this research demonstrates the effectiveness of quantitative approaches in reducing the risk of shortages and overstocks, providing a model that is adaptive to fluctuations in drug demand due to changes in doctors' clinical behavior and disease epidemics.

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