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Drug Inventory Management Using The Fuzzy Method In Determining Reorder Points and Maximum Stock in The Pharmacy Installation of Bogor City Hospital

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Abstract

The aim of this research is to determine the management of drug supplies in the Chemotherapy, Human Albumin and Antibiotic groups in the Pharmacy Installation at the Bogor City Regional Hospital, to find out the model for planning the need for drugs in the Chemotherapy, Human Albumin and Antibiotic groups using the Fuzzy Inventory Control Method in Bogor City Hospital Pharmacy Installation. The research that will be carried out is quantitative research, which is a type of research that produces discoveries that can be achieved (obtained) using statistical procedures or other methods of quantification (measurement). From the results of the discussion, it can be concluded that the management of the inventory of chemotherapy drugs, human albumin and antibiotics in the pharmacy installation at the Bogor City Regional Hospital is carried out in accordance with the Ministry of Health Regulation Number 72 of 2016, namely the drug planning process, drug request process, process receiving drugs, drug storage processes, and drug distribution processes. Model for planning the need for medicines for the Chemotherapy, Human Albumin and Antibiotic groups using the Fuzzy Inventory Control Method in the Pharmacy Installation of the Bogor City Regional Hospital by looking at the Reorder point and Maximal Stock values. It is known that the Fuzzy design model using input variables for the number of uses and waiting time produces output variables ROP value and maximum stock value. . Comparison of the planning of drugs in the group of Chemotherapy Drugs, Human Albumin and Antibiotics with and without the Fuzzy Inventory Control Method at the Pharmacy Installation of Bogor City Hospital is known to reduce the amount of inventory by 34.49%, streamline the inventory value by 33.97% and increase the ITOR value to 4 times so as to shorten the storage time .

Keywords : Inventory Management, Fuzzy Method, Reorder Point and Stock Maximum

INTRODUCTION

A hospital is a health care institution that provides comprehensive individual health care services, including inpatient, outpatient, and emergency care. Pharmacy services in hospitals are an integral part of the hospital's health care system, which is oriented towards patient care, providing quality and affordable pharmaceutical preparations, medical devices, and consumable medical materials for all levels of society, including clinical pharmacy services (Nurcahyo & Setiawan, 2022). Management of Pharmaceutical Preparations, including drugs, raw materials for drugs, traditional medicines, and cosmetics, is one of the pharmaceutical services in the Hospital Pharmacy Installation Unit. The Pharmacy Installation Unit is a functional implementation unit that organizes all pharmaceutical service activities in the hospital. Management of Pharmaceutical Preparations, Medical Devices, and Consumable Medical Materials is a cycle of activities, starting from selection, needs, data, receipt, storage, distribution, destruction and withdrawal, control, and administration (Grzesik, Kuźma, & Żurawski, 2016).

necessary for Pharmaceutical Service activities. Management of Pharmaceutical Preparations, Medical Devices, and Medical Expendable Materials must be carried out in a multidisciplinary, coordinated manner and using effective processes to ensure quality control and cost control (Al-Gerafi et al., 2024). Controlling drug inventory in hospitals is an important aspect of quality health service management. Efficient and well-managed drug inventory is key to ensuring sufficient, timely, and safe drug supplies for patients. In the hospital context, drug inventory control involves a series of activities designed to monitor, manage, and optimize drug use, both in terms of availability and safety. and their rational use. Drug inventory management must be carried out carefully and systematically to ensure that there are no shortages or excesses that could disrupt the care process. In managing drug inventory, hospitals must consider several key factors, including patient needs, applicable policies and procedures, government regulations related to drug management, and external factors such as changes in disease trends and developments in medical technology. Furthermore, drug inventory control also encompasses aspects such as procurement, storage, monitoring expiration dates, and disposal of unused drugs. With an effective drug inventory control system, hospitals can optimize resource use, reduce waste, improve patient safety, and provide better overall care. Therefore, this thesis will discuss in detail the strategies and best practices for managing drug inventory in a hospital environment, with the ultimate goal of improving operational efficiency and the quality of healthcare services (Abou Naaj, Mehdi, Mohamed, & Nachouki, 2023).

Bogor City Regional General Hospital is a hospital that provides general health services. Bogor City General Hospital is owned by the Bogor City Regional Government, but its budget is obtained from the BLUD (Regional Public Service Agency) budget. According to the organizational structure of Bogor City Regional General Hospital, the Pharmacy Unit is headed by a Head of Pharmacy Unit, who is under the auspices of the Deputy Director of Medical Services and reports directly to the Head of Medical Support.

The Pharmacy Unit itself manages approximately 1,500 items of drugs and consumable medical devices registered in its database. This creates its own problems, especially in terms of drug control, which is closely related to drug planning and procurement. Drug planning is carried out still using the consumption method, using data from the last three months and by checking the drug shelves to determine which drugs have run out or are about to run out (Garg, Kumar, & Garg, 2019). With Drug stockouts can lead to purchases from outside suppliers, such as having to purchase from other pharmacies or hospitals. This results in higher drug prices and additional costs for the hospital. Similarly, overstocking can lead to high inventory levels. Based on this phenomenon, researchers want to help develop a drug inventory control system at the Bogor City Hospital Pharmacy Unit by determining a more effective and efficient inventory management model.

According to Peterson (Abou Naaj R.; Mohamed, E. A.; Nachouki, M., 2023) the number of medicines in hospitals is so large that it is difficult to apply the method visually, so an additional control method is needed, namely the ABC analysis method. Classification with ABC analysis divides items into three levels. The background of this method was born from the principle that a small number of items play a large role in investment. ABC analysis is a strategy for classifying inventory items based on their level of importance, thus allowing for efficient resource allocation. The Pareto principle is applied in this method to identify the most valuable items. ABC analysis is carried out through two approaches: based on mutation and based on investment. These two approaches can be used together, especially to confirm the accuracy of the ABC status analysis of each drug. The ABC method has limitations in only looking at the amount of costs and the level of mutation of consumption, so additional analysis is needed to determine the vitality of the drug, namely the VEN analysis based on Vital, Essential, and Non-Essential (Muttaqi, Nurchim, & Ningsih, 2024). This analysis is based on the critical value and therapeutic effects of drugs on patient health, taking into account the efficient use of existing funds. Based on the results of initial data on drug use at Bogor City Hospital, there are 3 categories of drugs with the highest use for health services, namely Chemotherapy Drugs, Antibiotic Drugs and Human Albumin (Akbar, 2023).

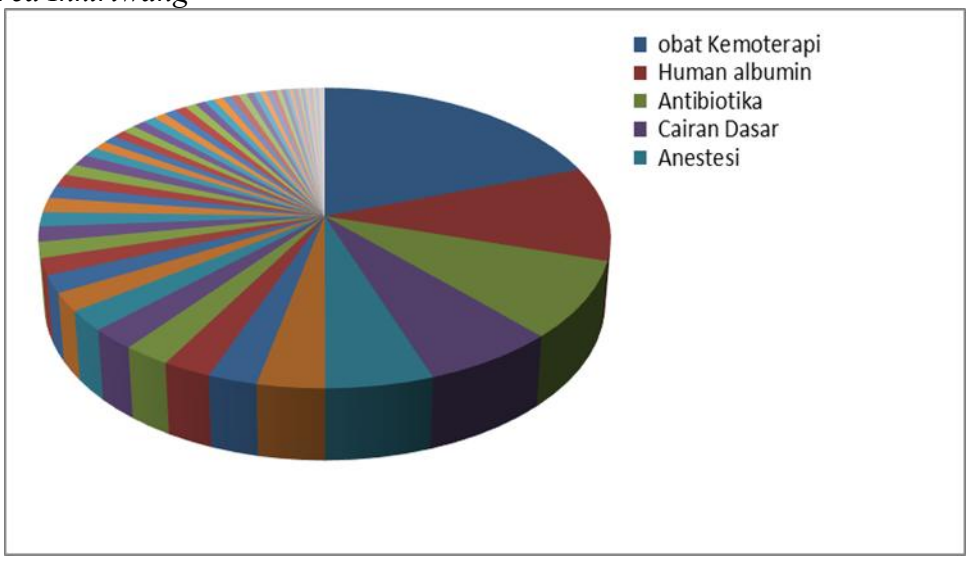

Figure 1. Diagram of Drug Use by Category in 2023

This study will provide recommendations for managing AV category drug inventory, namely drugs that fall into category A according to the ABC analysis, and V (vital) according to the VEN classification. The AV category was chosen because drugs in the AV category represent drugs that have a vital critical level with a high nominal usage amount. Drug items in this group require special attention and comprehensive analysis. After that, the next step will be carried out, namely providing recommendations for selecting an appropriate AV category drug inventory control method for the Pharmacy Installation of the Bogor City Regional General Hospital. In the matter of inventory control, there are two very important issues that must be understood: deciding when to make a purchase and how much to order. With the rate of drug usage and drug usage patterns that can change, an additional method is needed to calculate the Reorder Point and Maximum Stock, namely the Fuzzy Method. This method is expected to optimize inventory efficiency so that companies can use the drug purchasing budget appropriately. On the other hand, the EOQ method is more frequently used, but the application of EOQ (RAHMAH, 2023).

cannot be immediately applied to ordering all drugs in pharmaceutical installations, because the character of drug consumption is not uniform and does not align with the assumptions of EOQ. Therefore, modifications to the EOQ formula are made with various approaches. Identification and analysis of these problems are needed to find a solution in inventory control. Therefore, in this study, the researcher will also propose when to order (reorder point) and the maximum order quantity that should be ordered for the drug (Ariyanti, Russell, & Setiawan, 2021).

Fuzzy inventory control is an inventory management approach that uses fuzzy logic to address uncertainty and complexity in inventory decision-making. In this system, variables used to control inventory, such as inventory levels, demand levels, and order timing, are represented in the form of linguistic variables or fuzzy sets. The concept of fuzzy logic allows for a better depiction of uncertainty than traditional binary approaches, where

variables can only be true or false. With fuzzy logic, variables can have values between 0 and 1, reflecting the degree of membership in a linguistically defined set. By using fuzzy inventory control, companies can make inventory decisions that are more adaptive and responsive to demand fluctuations and uncertain market conditions, thus optimizing their inventory more effectively. This method can help reduce inventory costs, improve customer service, and increase overall operational efficiency. Fuzzy logic allows the system to better address uncertainty and fluctuations in drug demand, resulting in more adaptive and responsive decisions. The application of fuzzy inventory control in drug inventory allows for more accurate accounting of factors such as seasonal demand variations, drug priority levels, and patient safety aspects. Implementing the Fuzzy inventory control method can optimize drug inventory management by taking into account uncertainty in demand and lead time, as well as specific business preferences (Cayir Ervural, Zaim, Demirel, Aydin, & Delen, 2018).

RESEARCH METHODS

The research to be conducted is quantitative research, a type of research that produces findings that can be achieved (obtained) using statistical procedures or other methods of quantification (measurement). According to Kasiram (Alaa et al., 2019) quantitative research is a process of discovering knowledge that uses numerical data as a tool to analyze information about what is desired to be known. In this research, pre-experimental research will be conducted, which is one type of experimental quantitative research where in this research to test a group or various groups by applying cause and effect factors. The data analysis method is descriptive analysis which is to describe various characteristics of sample data in the form of numbers, pictures or diagrams (Fuadi, 2022).

1. Population is the entire object of research, whether living or non-living, or in the form of data. In this study, data will be taken from the drug inventory at the Pharmacy Installation.
2. The samples to be examined in this study are drug supplies in three categories: chemotherapy drugs, human albumin drugs, and antibiotics.
3. The sample was obtained from the 2023 AV Classification of Medicines and the 3 largest categories of use and purchases were selected at the Pharmacy Installation of Bogor City Hospital.

Operationalization of Research Variables

1. The input variables used are the amount of drug stock used and the amount of remaining stock/remaining inventory of existing goods.
2. The expected output variables are Reorder points and maximum stock.

This research was conducted by reading various references or libraries related to the research being conducted, such as reading books, journals, proceedings, theses, dissertations and research results that are relevant to the research being conducted.

This was done through observing the events that occurred in the availability of drugs at the Bogor City Hospital Pharmacy Installation by observing the inventory control process

starting from the drug inventory planning calculation process to obtain the reorder point value and maximum stock value (Saepudin, Miftah, Santya, & Mandala, 2019).

Drug inventory data for the Bogor City Regional Hospital Pharmacy Installation, namely initial stock, drug demand data, drug usage data, remaining drug inventory, ordering costs and storage costs, and the specified lead time. Simulation of inventory optimization value calculation using the EOQ formula, then determine the ROP value and

Maximum Stock Simulation without Fuzzy Measurement. This data will be used as a comparison when conducting data research using the Fuzzy Model.

a) The initial step in forming a fuzzy set is to determine the variables and the universe of speakers that contain input and output variables. In this study, there are two input variables: usage and remaining inventory/inventory quantity, while the output variables are the reorder point and the optimum maximum stock.
b) Next, linguistic values are determined, which are values or states that can describe certain conditions in a fuzzy set. The usage variable has linguistic values of low, medium, and high, while the remaining inventory/inventory quantity variable has minimum, normal, and maximum linguistic values.
c) The determination of linguistic values will also be adjusted to the results of the graphic range at the time of the research.
d) Determination of variables and speaker universe on the panel

The data analysis used in this study is descriptive analysis (Fadila, 2022). This analysis attempts to describe the data through statistical approaches such as mean, deviation, variance, etc. It also uses data visualization or graphs to facilitate the identification of optimal values. The analysis will be used to compare system performance. drug inventory management using the Fuzzy method with that using the conventional method.

RESULTS AND DISCUSSION

Medication Planning at the Pharmacy Installation of Bogor City Regional Hospital

Based on the research results, the management of pharmaceutical supplies in the Pharmacy Installation of Bogor City Hospital follows the Minister of Health Regulation No. 72 of 2016 which is outlined in the SOP (Standard Operating Procedure). Pharmaceutical supply management activities include: Selection is an activity to determine the type of pharmaceutical preparations, medical devices and disposable medical materials according to needs (Nasyuha, Hutasuhut, & Ramadhan, 2019). This activity is carried out with the aim of ensuring that pharmaceutical supplies comply with the specified requirements. Based on the SOP (Standard Operating Procedure), the selection of pharmaceutical preparations, medical devices and BHP (consumable materials) is carried out by the Pharmacy Installation together with the Pharmacy and Therapeutics Committee (KFT). The Pharmacy and Therapeutics Committee is a work unit in providing recommendations to the Hospital leadership regarding the policy of drug use in the Hospital whose members consist of doctors representing all specialties in the Hospital, Pharmacist of the Pharmacy Installation, and other health workers if needed. The selection of drug preparations is based on the hospital formulary, disease patterns, effectiveness and safety, quality and availability in the

market. The stages of developing a hospital formulary involve collecting drug proposals from each SMF (Functional Medical Staff) based on therapeutic standards or medical service standards. These proposals are then analyzed and reviewed to form a hospital formulary, which then serves as a reference in the planning and procurement process. In the inventory selection process, suppliers are also identified who meet the criteria and requirements, namely (Anjani & Marpaung, 2022):

a. The quality of the product/service received is in accordance with the specifications, based on the results of the inspection carried out by the appointed party or other evidence.
b. The price proposed by the partner is still appropriate and can be approved by the company.
c. Delivery time, which is according to schedule.
d. Payment terms, which are agreed by both parties.
e. Speed of service, provided by partners.
f. Addition of pharmaceutical supplies to the formulary can be done for drugs that do not have equivalents or generics with the approval of the KFT.

Planning Using Fuzzy Method

Drug planning and control are part of drug management activities that aim to meet drug needs without excess or shortage. To facilitate inventory control, ABC analysis can be used to classify drug inventory. Fuzzy-ABC classification is a method that combines the ABC analysis approach with fuzzy logic to group inventory items based on their importance (priority). Fuzzy logic is used to handle uncertainty and ambiguity, especially when determining boundaries between categories (A, B, C). There are no strict boundaries between categories, but rather based on degrees of membership. Each item has a specific membership level for category A, B, or C, allowing for more flexible grouping (Andrari, Maimunah, & Qadarsih, 2021).

To design the Fuzzy-ABC classification calculation, data was obtained with a total of 52 drug samples consisting of three drug categories: Chemotherapy Drugs, Antibiotic Drugs, and Human Albumin. Each item was assessed based on its level of importance, which is the variable (Y), the level of movement of goods mutations, which is the variable (X1), and the level of use (X2). The data was then subjected to Fuzzy Classification (Sari, Setyaningsih, & Wijayanti, 2021).

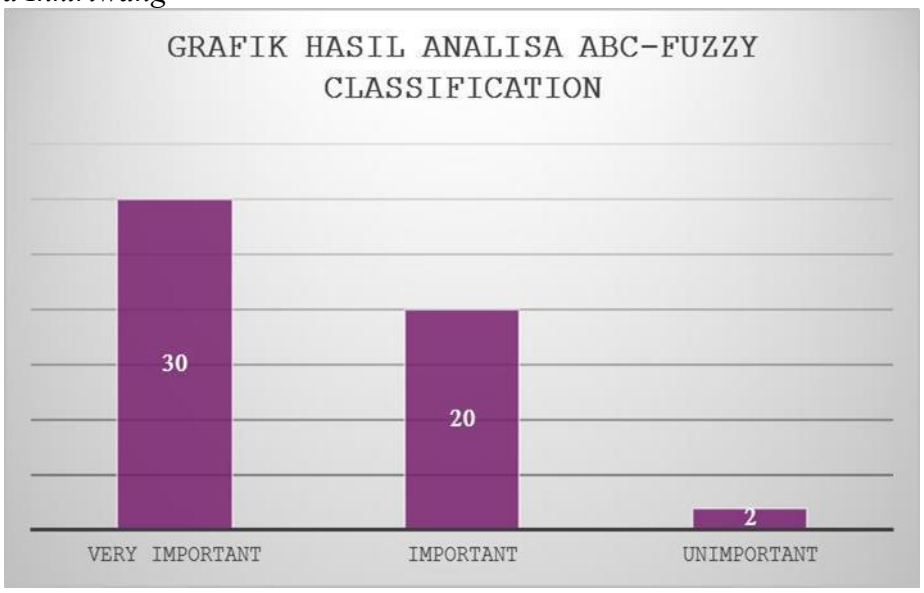

Figure 2. ABC-Fuzzy Analysis Results Graph

After grouping according to ABC analysis, the next thing to do is calculate the ROP (Reorder Point) and Maximum Stock values as a way to control the amount of inventory when making a plan (Arfyanti & Purwanto, 2012).

The input variables that form the basis for calculating ROP and maximum stock are the amount of usage in a certain period and the lead time. Based on the data obtained, the application used in the pharmaceutical warehouse when calculating ROP is constant, namely 14 days, while what occurs in the field is that the lead time for delivery of goods varies from the shortest, namely 2 days from the time the order letter is made to the longest, namely 30 days from the time the order letter is made. This fact provides an illustration that the waiting time for delivery of goods is not constant, so flexible calculations are also needed so that the calculation will be more accurate (Manurung, Marbun, & No, 2021).

In addition to lead time, usage also influences calculations for determining ROP and Maximum Stock (Hafiz, 2023). These two data points will be fuzzified to provide more flexible calculations for planning. The lead time and usage figures are displayed in the following table.

Fuzzification

This stage determines the fuzzy variables, fuzzy sets, universes of discourse, and ranges. The table below explains fuzzy sets, universes of discourse, domains, and membership functions.

Table 1. Fuzzification

Variables	Set	Universe of Conversations Range
Usage	Low	A little (b= [a+c/2])
	Currently	Medium ([a+b/2, b+c/2]

	Tall	[Min Usage Max Usage)	Many [b,c]
Waiting Time	Short		A little (b= [a+c/2])
	Currently	[Minimum waiting	Medium ([a+b/2, b+c/2]
	Long	time_Maximum waiting	Many [b,c]
		time)	
ROP	Low		A little (b= [a+c/2])
	Currently		Medium ([a+b/2, b+c/2]
	Tall	[ROP 7 days ROP 30 days]	Many [b,c]
Maximum stock	Minimum		A little (b= [a+c/2])
	Currently	[1 month stock 3 months	Medium ([a+b/2, b+c/2]
	Maximum	stock]	Many [b,c]

After determining the formula for the 52 items to be studied, substitute them into the table according to the provisions listed in the table, and the results obtained are listed in the following table.

After fuzzification of variables (X) and (Y), the ROP range is determined for a lead time of 7 days, 16 days, and 30 days according to the lead time range, namely the lowest is 3 days, the middle is 16.5 days, and the longest is 30 days. Then, also calculate the stock requirements for 1 month, 2 months, and 3 months.

Fuzzy rule determination

The next stage in designing a Fuzzy model is to determine the rules that will be used in the Fuzzy model to determine the control actions that will be carried out in response to the given input values.

Table 2. *Fuzzy Rules Table*

Code	Rules
R1	If usage is low and lead time is short, then the minimum stock is low.
R2	If usage is low and lead time is moderate, then the minimum stock is low.
R3	If usage is low and lead time is long, then the ROP is medium and the stock is medium.
R4	If Usage Is Medium And Lead Time Is Short Then Rop Is Low And Stock Is Medium
R5	If usage is medium and lead time is medium then ROP is medium and stock is medium
R6	If Usage Is Medium And Lead Time Is Long Then Rop Is High And Stock Is Medium

R7	If Usage is High and Lead Time is Short, then ROP is Medium and Stock is Maximum
R8	If Usage is High and Lead Time is Medium, then High Rop Maximum Stock
R9	If Usage is High and Lead Time is High, then Maximum Stock ROP is High

Fuzzy Inference

After going through the fuzzification and rule-determination stages, the next stage is to determine the implication function. The defined rule base states the relationship between *the input* and *output variables.*

Defuzzification

Perform the process of returning fuzzification values into the crips data with the Sugeno model, the calculation results obtained from each item are displayed in the following table.

Table 3. Calculation Results with the *Fuzzy Method*

ITEM CODE	NAME OF DRUG	CATEGORY	GROUP	Z1=ROP	Z2=Maximum Stock
AB 11	Ceftriaxone 1 gr inj	Antibiotic	AMP\VIAL	3,551	22,584
K1	Anastrozole 1 mg	chemotherapy drugs	TAB\CAPS.	968	6,909
AB 5	Cefixime 100 mg cap	Antibiotic	TAB\CAPS.	2,142	20,694
K26	letrozole 2.5 mg tablets	chemotherapy drugs	TAB\CAPS.	607	4,443
AB 15	Meropenem 1 gr injection	Antibiotic	AMP\VIAL	1,476	8,675
K16	Exemestane 25 mg	chemotherapy drugs	TAB\CAPS.	1,027	3,481
AB 10	Ceftazidime injection	Antibiotic	AMP\VIAL	323	1,733
K2	Ca. Folinate 5 ml inj	chemotherapy drugs	AMP\VIAL	381	1,973
K28	Nilotinib 150 mg	chemotherapy drugs	TAB\CAPS.	73	753
AB 9	Cefotaxime injection	Antibiotic	AMP\VIAL	652	4,757
AB 4	Cefadroxil 500 mg tablets	Antibiotic	TAB\CAPS.	866	7,049

AB 14	Levofloxacin Injection	Antibiotic	IV	260	2,096
AB 1	Amikacin 500 mg/2 ml	Antibiotic	AMP\VIAL	26	182
K30	Oxaliplatine 100 mg RTU	chemotherapy drugs	AMP\VIAL	17	100
K13	Doxorubicin 50 mg 25 ml/vial	chemotherapy drugs	AMP\VIAL	33	144
K22	Ifospamide 1 gr injection	chemotherapy drugs	AMP\VIAL	21	102
AB 12	Clobetasol cream	Antibiotic	CREAM\OINT	130	604
K4	Carboplatin 150 mg	chemotherapy drugs	AMP\VIAL	10	126
K33	Paclitaxel 300 mg injection	chemotherapy drugs	AMP\VIAL	9	79
K29	Octreotide LAR 30 mg/1 ml	chemotherapy drugs	AMP\VIAL	0	0
K17	Filgrastim injection	chemotherapy drugs	AMP\VIAL	4	45
K5	Carboplatin 450 mg/45 ml	chemotherapy drugs	AMP\VIAL	5	63
K25	Irinotecan Hcl 40 mg / 2 ml	chemotherapy drugs	AMP\VIAL	7	66
K14	Epirubicin 10 mg/5 ml	chemotherapy drugs	AMP\VIAL	16	87
K38	Zoledronic acid injection	chemotherapy drugs	AMP\VIAL	7	45
K15	Epirubicin 50 mg/25 ml	chemotherapy drugs	AMP\VIAL	11	56
AB 2	Ampicillin + Sulbactam injection	Antibiotic	AMP\VIAL	72	492
K36	Trantuzumab 440 mg inj	chemotherapy drugs	AMP\VIAL	5	11
K32	Paclitaxel 100 mg injection	chemotherapy drugs	AMP\VIAL	7	49
K34	Rituximab 10 mg/ml 50 ml	chemotherapy drugs	AMP\VIAL	2	9
K24	Irinotecan Hcl 100 mg / 2 ml	chemotherapy drugs	AMP\VIAL	7	61
K12	Doxorubicin 10 mg 5 ml/vial	chemotherapy drugs	AMP\VIAL	54	177

K27	Leuprorelin 37.5 mg	chemotherapy drugs	AMP\VIAL	9	22
K8	Cytarabine injection 1000 mg	chemotherapy drugs	AMP\VIAL	1	9
HA 2	Human Albumin 25% 100 ml	Human albumin	AMP\VIAL	32	198
K37	Vinorelbine tartrate injection	chemotherapy drugs	AMP\VIAL	7	34
K11	Docetaxel 80 mg injection	chemotherapy drugs	AMP\VIAL	8	93
K20	Goserelin 3.6 mg injection	chemotherapy drugs	AMP\VIAL	63	135
K6	Cyclophosphamide 1 Gr inj	chemotherapy drugs	AMP\VIAL	23	74
HA 1	Human Albumin 20% 100 ml	Human albumin	AMP\VIAL	15	154
K10	Docetaxel 20 mg injection	chemotherapy drugs	AMP\VIAL	9	94
AB 8	Cefoperazone 1 gr inj	Antibiotic	AMP\VIAL	244	1,829
K7	Cyclophosphamide 500 mg injection	chemotherapy drugs	AMP\VIAL	9	97
AB 13	Gentamicin 40 mg/2ml	Antibiotic	AMP\VIAL	73	627
K19	Fluorouracil 500 mg/10 ml	chemotherapy drugs	AMP\VIAL	241	878
AB 7	Cefixime ds 100 mg 30 ml	Antibiotic	SYR\DROPS	224	1,337
AB 6	Cefixime 200 mg cap	Antibiotic	TAB\CAPS.	2,813	33,106
K23	Imatinib mesylate 100 mg tablet	chemotherapy drugs	TAB\CAPS.	1,492	3,808
K3	Capecitabine 500 mg tablet	chemotherapy drugs	TAB\CAPS.	431	3,211
K21	Hydroxyurea tablets	chemotherapy drugs	TAB\CAPS.	359	1,272
K35	Tamoxifen 10 mg tablets	chemotherapy drugs	TAB\CAPS.	3,179	11,575
K9	Dacarbazine injection 200 mg	chemotherapy drugs	AMP\VIAL	-	0

Based on the table above, the results show that the Fuzzy design model uses the input variables of the amount of usage and waiting time to produce

output variables of the ROP value and maximum stock value (Shafiei, Jafarzadeh Haghighi Far, Monavari, Sabzalipour, & Fathian, 2022).

Comparison of Drug Needs Planning Using the *Fuzzy Inventory Control Method* and Without Using the *Fuzzy Inventory Control Method*

The reorder point (ROP) value used to calculate medication needs planning at Bogor City Hospital applies a 14-day lead time and a 15% buffer stock/safety stock requirement. The maximum stock is determined by warehouse capacity and available budget. For this purpose, the maximum procurement period for medications is 3 months. This calculation applies equally to all medications provided or purchased to meet the hospital's needs.

The results of the table above show that the number of ROP units calculated using the Fuzzy method will be lower than without the Fuzzy method with a value of 26.41%. Where the number of drugs with the Fuzzy method is 22,002 units and without the Fuzzy method as many as 31,800 units of drugs. So if calculated the difference between the two methods with an average percentage value of 26.41%. Meanwhile, from the maximum stock amount of 146,197 units with the Fuzzy method and 204,427 without the Fuzzy method if presented to an average of 34.49%. This means that the Fuzzy method reduces the amount of inventory by around 26.41% and 34.49% (Troussas, Krouska, Sgouropoulou, & Voyiatzis, 2020).

Comparisons were also made by calculating the budget expenditures using the Fuzzy method and without it. This was done to assess whether inventory calculated using the Fuzzy method would be more efficient compared to the non-Fuzzy method in terms of budget expenditures (Ban, Droj, Tuse, Droj, & Bugnar, 2022).

In addition to inventory quantity and inventory value, this study also compared the Inventory Turnover Ratio (ITOR) values of the drug inventory being studied. The ITOR value is calculated to determine the inventory turnover ratio. A high ITOR value indicates that product inventory can be sold and restocked quickly. A low ITOR value indicates a large amount of unsold stock. The two tables below will show which is more efficient and which has a better or higher ITOR (Sulastri, 2022).

From the table above, the results show that the Fuzzy method is more efficient by reducing the budget value by 16.44% from the minimum ROP (reorder point) value and by 33.97%.

% of the maximum inventory value stored in the warehouse. Meanwhile, the inventory turnover value (ITOR) shows that the Fuzzy method will be better than the non-Fuzzy method, with an ITOR value of 4 times, which means a shorter shelf life compared to 1 x without the Fuzzy method.

CONCLUSION

From the results of the discussion, it can be concluded that:

1. Medication planning is one of the pharmaceutical service standards in hospitals based on Minister of Health Regulation No. 72 of 2016, which is carried out by the Pharmacy Installation. Based on research results, the planning process in the Pharmacy

Installation uses the consumption method and calculates the ROP with the same lead time for all types of drugs, namely 14 days. The stock buffer added in the planning calculation is 15% for all types of drugs. The various procurement processes, namely direct purchases and purchases via e-catalog through LKPP, provide variations in lead time values.

2. The drug needs planning model for the Chemotherapy, Human Albumin and Antibiotic groups using the Fuzzy Inventory Control Method at the Bogor City Hospital Pharmacy Installation by looking at the Reorder point and maximum stock values is known that the Fuzzy design model using the input variables of the amount of use and waiting time produces output variables of the ROP value and maximum stock value.
3. Comparison of drug planning for the Chemotherapy, Human Albumin and Antibiotic groups with and without the Fuzzy Inventory Control Method at the Pharmacy Installation of Bogor City Hospital shows that the Fuzzy method is better to use compared to the manual method, where it is known that the Fuzzy method is better than the manual method by reducing the maximum inventory value by 34.49%, making the inventory budget value more efficient by 33.97% and increasing the ITOR value to 4 x thereby shortening the storage time of goods.

Suggestion

From the conclusions above, some suggestions in this research are:
Based on the conclusions above, the following research suggestions can be made:

1. Medication planning at the Bogor City Hospital Pharmacy Unit should consider lead time variations to ensure accurate quantity calculations. This is because the medication procurement process utilizes more than one procurement method.
2. The fuzzy inventory control method can be applied to calculate the planned quantities of chemotherapy, human albumin, and antibiotics, using usage and lead time as input variables. It is hoped that this method can also be applied to calculate the planned quantities of all types of drugs, thus making the calculation of planned quantities more precise and efficient.
3. The value and quantity of inventory in the Pharmaceutical Installation can be reduced if the planning calculation process uses the fuzzy inventory control method. The adoption of a fuzzy calculation pattern in the SIMRS application system is necessary, based on data on the fluctuating usage of each type of medication and the varying lead times for each type of medication. The Pharmaceutical Installation can also consider other variables as a basis for calculating medication planning to prevent stockouts or inventory buildup.

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