Combining ABC-Fuzzy Classification Model for Drugs Inventory Planning in a Pharmaciutical unit of a Public Health Center (Puskesmas) Djombang East Java Indonesia

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Submission date: 17-Jul-2020 12:38PM (UTC+0800)
Submission ID: 1358509688
File name: n_a_Pharmaciutical_Unit_of_a_Public_Health_Center_Puskesmas.pdf (934.03K)
Word count: 5468
Character count: 29036

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ABSTRACT

In the public health center,especially in pharmaceutical unit that supplies drugs, it is importance to manage the inventory management of drugs, since the availability of drugs needed by the patients is one of the importance component in making the better service for public health. This study was conducted on 117 items of common types of drugs at the pharmaceutical unit of the public health center (Puskesmas) in Bandar Kedungmulyo, Jombang, east Java. The purpose of this study is to provide an alternative models for inventory planning of drugs with combining ABC-Fuzzy *classification*.

Qualitative and quantitative criteria was use in this study. The inventory model proposed in this strudy conducting by grouping the item of drugs inventory models known as ABC and Fuzzy classification. The classification done by considering the usage level per year, criticality, severity and scarcity of drugs. The results of this study note that the 37 items or 32% of the total items are in the category "very important", 33 items or 28% of the total items are in the category "important", and 47 items or 40% of total drug items are in the category of "unimportant". The proportion of inventory control based on the category of the group, which placed the "very important" item have to become the considerable focus of major concern, the "important" items become a moderate degree of control, and the "unimportant" items become the most lenient than the other groups. The comparison analysis between *ABC* models and combination *ABC-Fuzzy classification*, shows that there is better accuracy classification results of the drugs in t he combination of ABC-Fuzzy classification.

Keywords : *Inventory, ABC-Fuzzy Classification, ABC Model, Fuzzy Classification,*

Background

Public Health Center (Puskesmas) is one of institutions that provide health services to the community. The level of health care quality is measured by the ability of Puskesmas in dealing with patients. One of measurements is the availability of needed drugs for patients. Based on the preliminary survey, it is stated that the management of Puskesmas, especially when planning to supply the needed drugs, is not well implemented yet. Determination of drug supply planning based solely on consumption patterns and seasonal disease patterns and data from the last period. So that the accuracy of the number and types of drugs available is less precise than the needs of the patient.

Type of drug supplies in Puskesmas varies with a lot of different items. The thing to note is that each item of inventory has a different interest rate, so it cannot be equated with each other. Therefore we need a model of optimal inventory planning by considering the priority level of each item. One model that is used to plan the supply of drugs is the model of ABC (Always Better Control), in which this model divides inventory into three groups based on the Pareto principle criteria of annual dollar usage.

But the ABC model is considered as a traditional model because it only assumes on one criterion alone, so it cannot provide proper information about the supply (Guvenir & Erel, 1998; Huiskonen, 2001; Partovi & Anandarajan, 2002) in (Chu: 2008). Hence it is needed to have another model to support the ABC model. Fuzzy classification is a model that can handle multiple combinations of important items in order to plan the supply of drugs at the public health center (*Puskesmas)*. This model can cover the shortcomings of the traditional ABC model that only uses one criterion which is less suited to the characteristics of the inventory at the health center.

Based on previous research Chu, Liang, Liao (2008) the combination of these two models can be used as a tool to manage inventory through classification model item because it has a high degree of accuracy. ABC-Fuzzy Classification is a combination of traditional ABC model and fuzzy classification in which this approach can handle multiple combinations of attribute information items that are essential for managerial interests.
"Puskesmas Bandar Kedungmulyo", Jombang is one of the health centers that fall within the program "Idol of the Health Centers", is a term for the health center with an excellence service. Jombang District Government through the Department of Health made a program of health care reform in the health center. This activity started in 2005 which aims to organize the quality of health care.

In line with the problem of medicines in pharmaceutical unit clinic, there are some medications that are not available in the clinic (stockout) when the patient is in need, while the drug has a very high interest rate. The Health Center has hundreds of types of supplies of medicines, where the inventory was not planned based on the priority value of each item

there. The priority value is measured by the level of interest of the item itself based on the number of drug consumption, functionality, and other variables. In addition, there has been no classification of the level of interest based on the criticality value. Considering these reasons the author will do the planning needs of drug supply by: first classifying the inventory in Bandar Kedungmulyo health center pharmacy installation using a combination of analysis of ABC-Fuzzy Classification.

In this study will be discussed, how the management of drug supplies at the health center, and how the application of a combination of the ABC model and Fuzzy Classification in the supply of drugs in health centers, and how the comparison between traditional ABC classification results and model of the combination of ABC-Fuzzy Classification. The results of this study are expected to help the health center to find out where the inventory item that should be a major concern in implementing the strategy planning of optimal inventory needs.

The material in this study is limited to common types of drug supplies which are examined as many as 117 items. The data used in this research is data of drug use in 2013, and the discussion in this study focuses on the implementation of the inventory item classification model using a combination of drugs ABC-Fuzzy Classification.

Conceptual Framework

Supply

According to Jacobs Chase Aquilano (2009) inventory is all stock or resources used by companies either in the form of raw materials, semi-finished goods, finished goods, components complementary products and goods in process. Meanwhile, according Assauri (1998) cited in Novantara (2012) definition of inventory is a supply that includes the company's goods with intent to sell within a period of normal selling time or stock of goods which are still in the process / production processes or raw materials inventory waiting for its use in a production process.

Rangkuti (1996) mentions supplies are a number of materials, parts and materials supplied in the process contained in the company's production process, and finished goods / products provided to meet the demand of the consumer or customer every time. Other literature mentions that inventories are a number of materials or goods which are available for use at any time in the future that occurs when the amount of materials or goods to be held is more than the amount which will be used (Pardede: 2005).

There are various kinds of such supplies mentioned in the book "Operations Management: Analysis and Case Studies" Prawirosentono (2009), the type of inventory can be sorted by the state of the stages in the production process:

1. Inventories of raw materials (raw materials). This inventory is the supply of raw materials to be processed in the production process.
2. Inventories of spare parts (spare parts). Supplies to be used in the production process, for example "engine block" vehicle. Without a supply of spare parts, the assembly process will be hampered.
3. Inventories of intermediate goods (work in process). It held as a result of the first phase of the production process to support the next stage of the production process.
4. Inventories of raw materials auxiliary. The auxiliary raw materials essential to be provided for without the auxiliary raw materials, production processes would not be able to walk. Example: water, etc.
5.

Finished goods (finished goods). Finished goods inventory prepared or processed and ready for sale to consumers, including the final consumer.

Inventory in the Pharmaceutical unit of Public Health Center (Puskesmas)

One of the most important parts in the scope of the hospital management or health center is the pharmacy (pharmaceutical units). This unit plays an important role in maintaining the smooth flow of the hospital or health center operations. Inefficiencies in the management will have an impact on the health center itself both medically and economically. This section is required to provide pharmaceutical supplies ranging from management, procurement, planning, monitoring, and maintenance.

According Aditama (2003) in his book "Management of Hospital Administration" second edition, the inventory in question is that most have a cost center or the regular budget of the largest in the hospital that pharmaceutical supplies. Inventories are divided into:

1. Drug Supplies. In this inventory group includes drugs kind of essential, non-essential, drugs quickly exhausted, and also medicines that long disuse.
2. Inventory of chemicals. It includes supplies for laboratory operations and internal pharmaceutical production, as well as non-medical activities.

3. Inventory medical gas. At rooms for patient care activities for surgical, ICU, ICCU, require some kind of medical gases such.
4. Supply of medical equipment. Various equipments are needed for activities and medical care that can be classified as consumables and durables or non-electronic equipment and electronics.

Management of medicines both in hospitals and in primary health care is the most important aspect of management, because the supply of drugs holds the key to the smooth flow of operations in a public health cener. Relation to the management of medicines in the health center, there are several stages in the process of its controlling including planning, procurement, storage, distribution, and the inter-related use to each other.

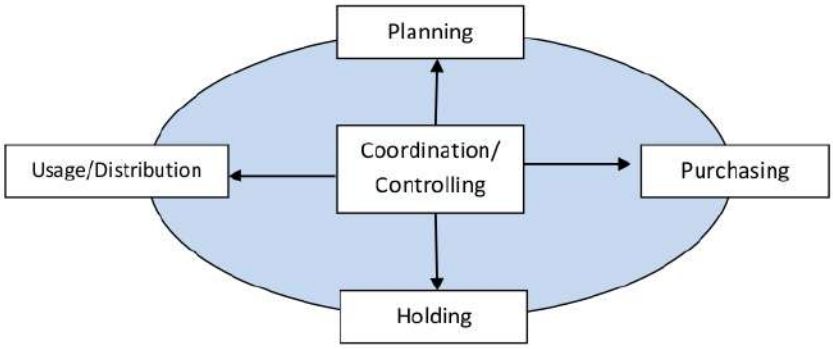

Exhibit -1

Cycle Management of Drugs in Hospital
Source: Maimun (2008)

The success or failure of the medicines management prescribed by weak activity of its cycle (Seto: 2004). If weak in the planning, for example, in determining the number of item that should be supplied within a period of approximately 1000 units, but the plan stated 10,000 units, it will result in a waste of budget and procurement cost overruns.

Inventory Planning

In inventory management at a company especially at the medical world should have a function related to inventory planning, including inventory system that can determine which one should be the top priority in management. According to Stevenson (2010)

system is a system that is able to classify the stock (inventory). One model that can be used to classify the type of inventory is with ABC and Fuzzy Classification.

ABC analysis

ABC classification model is a technique of classification / categorization based on the Pareto principle to determine which items that should be given priority in the management of inventory at a company. The parameter used in this classification model is the value of annual usage per item. Where existing stocks are categorized into three classes A, B, and C. Class A are items that require more power to manage, item C that get little attention and item B is between them (Ravinder: 2014). Mitchell A. Millstein, Liu Yang, Haitao Li (2013) The ABC approach classifies inventory items based on the amount of the transaction value. A small number of items may explain a large part of the total volume, while the intermediate category may have moderate volume percentage, and a large number of items can occupy the proportion of low volume. This category often called classification A, B, and C. It is often found that a small percentage of items that contribute to the majority of sales and earnings of the company. This is known as the 80-20 rule that is, 20% of the items were classified as A, the next 30% are classified items B and the bottom 50% classification C. Alternatively stated that the item A with the highest value of 5% of the value of the dollar, item C bottom with 75% and item B in the middle of just 20%.

Analisis *Fuzzy Classification*

Fuzzy classification analysis is a model used to analyze the data set that is a combination of the dependent attributes that are nominal and some independent attributes that are nominal and non-nominal (Chu: 2008). Treatment of nominal attributes and non-nominal membership function in a different form it is in because of the nature of the data is nominal and non-nominal different. Here are the rules in forming the membership function according to Chu (2008):

a. **Nominal attribute independent**

   Y is nominal attribute *dependent* and $X_1, X_2. X_3, \ldots, X_n$ is nominal *independent attribute*. Then the membership function can be formed based on the following stages (Chu: 2008):

For every Y and Xo, data classification is based on the value of *dependent* attribute Cj and the value of *independent attribute* Vi, and the result showed in frequence table frekuensi of even with *occurrence frequency calculation*.

1. For every single arrow, the sum value is equal to 1 (one),
2. (i.e., $g_{ik} = \frac{f_{ij}}{\sum_{k=1}^{n} f_{ik}}$ dan $\sum_{k=1}^{n} g_{ik=} 1$)..... (2.1)
3. For every j, 1 ≤ j ≤ n, *membership function* is defined :

$$\mu_{Y=C_j}(Xo) = \begin{cases} g_{1j}, & \text{if } Xo = V_1 \\ g_{2j}, & \text{if } Xo = V_2 \\ \ldots & \ldots \\ g_{mj}, & \text{if } Xo = V_m \end{cases} \quad \ldots\ldots (2.2)$$

Diketahui :

μ_Y : *membership function* for nominal independent attribute

C_j : The value of *dependent attrubute*-j

X_0 : *nominal independent attribute*

V_1 : The value of *nominal independent attribute*

g_{mj} : *occurrence frequency* value Y and Xo

b. Atribut *non-nominal independent*

Membership function for non-nominal attributes independent formulation results obtained from the average value and standard deviation. Membership function of the non-nominal attributes independently formed by the following steps:Hitung nilai *cut value* Xc_{12}, Xc_{23} dan *threshold value* $X_{2L}, X_{3L}, X_{1R}, dan\, X_{2R}$ yang didefinisikan seperti rumus dibawah ini.

$$X_{C_{12}} = \frac{S_1\overline{X_2} + S_2\overline{X_1}}{S_1 + S_2}, \quad X_{C_{23}} = \frac{S_2\overline{X_3} + S_3\overline{X_2}}{S_2 + S_3} \quad \ldots\ldots (2.3)$$

$$X_{2L} = \overline{X_2} - 3S_2, \quad X_{3L} = \overline{X_3} - 3S_3$$
$$X_{1R} = \overline{X_1} + 3S_1, \quad X_{2R} = \overline{X_2} + 3S_2 \quad \ldots\ldots (2.4)$$

S = *standart deviation value of* attribute Y and X_2

X = average value of attribute Y and X_2

1. Find the *membership function value* $\mu_{Y=C_1}$ (Xo) for Y= C_1, $\mu_{Y=C_2}$ (Xo) for Y=C_2, and $\mu_{Y=C_3}$ (Xo) for Y=C_3, if X_{2R}>X_{2L} and then*membership function* can bi defined like the formulation below :

$$\mu_{Y=C_1}(X_0)=\begin{cases}1, & X_0 < X_{C_{12}}\\ \frac{X_{1R}-X_0}{X_{1R}-X_{C_{12}}}, & X_{C_{12}} \leqslant X_0 < X_{1R}\\ 0, & X_{1R} \leqslant X_0\end{cases} \quad \text{..... (2.5)}$$

$$\mu_{Y=C_2}(X_0)=\begin{cases}0, & X_0 < X_{2L} \text{ or } X_0 \geqslant X_{2R}\\ \frac{X_0-X_{2L}}{X_{C_{12}}-X_{2L}}, & X_{2L} \leqslant X_0 < X_{C_{12}}\\ 1, & X_{C_{12}} \leqslant X_0 < X_{C_{23}}\\ \frac{X_{2R}-X_0}{X_{2R}-X_{C_{23}}}, & X_{C_{23}} \leqslant X_0 < X_{2R}\end{cases} \quad \text{..... (2.6)}$$

$$\mu_{Y=C_3}(X_0)=\begin{cases}0, & X_0 < X_{3L}\\ \frac{X_0-X_{3L}}{X_{C_{23}}-X_{3L}}, & X_{3L} \leqslant X_0 < X_{C_{23}}\\ 1, & X_{C_{23}} \leqslant X_0\end{cases} \quad \text{.....(2.7)}$$

Diketahui :

μ_Y : *membership function* for *non-nominal independent attribute*

C_j : atribut *dependent* value - *j*

X_0 : *non-nominal independent value*

So Fuzzy Classification rules can be described by the following steps, based on the reference of journal Chu (2008):

1. Find the *dependent* nominal attribute *Y* and *independent attrubute* both nominal and non-nominal *Xo (0=1,2,...n)*.
2. Find the value of *dependent attribute Y* and *independent attribute Xo and use* notation of $C_1, C_2, \ldots, C_n$ for the *dependent attribute Y*, then $V_1, V_2, \ldots, V_m$ for notation the value of the *independent attribute*.
3. Formulate *membership function of* nominal *independent attribute based on the steps aboves*.
4. Formulatd *membership function* of non-nominal *independent attributes based on the steps above*.
5. The notation for inventory is I_t. Based on the third and fourth steps, subtitute the n V_i *value* into the *membership function, then the value is* $\mu_Y^{I_t} = C_1(V_i), \ldots, \mu_Y^{I_t} = C_n(V_i)$.
6. Define $\mu_{Y=C_j}(I_t) = \frac{\sum_{i=1}^{k} \mu_Y^{I_t=C_j(V_i)}}{k}$, that is represented the *grade of membership of* I_t at the $Y=C_j$ *class. The rule of fuzzy classification can be define as follows* : if $\mu_{Y=C_t}(I_t)$ max $\{\mu_{Y=C_1}(I_t), \mu_{Y=C_2}(I_t), \ldots, \mu_{Y=C_n}(I_t)\}$ then the inventory item I_t put into C_t. Class

Combined analysis of ABC-Fuzzy Classification

Chu et al (2008) describes the steps to perform the ABC-Fuzzy Classification is as follows:

1. Fomulati the critical function of the inventory item,

   $Y=f(X_1, X_2)$

   Where Y is the critical item of inventory that is the dependent attribute (very critical, critical and not critical). X_1 *is the severity level, the impact of the stock out of inventory (very severity, severity and not severity).* X_2 *is the frequency of using an inventory item in the palnning horizon*

   Classified all of the inventory item with the ABC tradisional. The results are three groups (Group A, Group B and Group C) and the notation are A_1, A_2, dan A_3.
2. Use *Fuzzy Classification to classify the groups* k A_1, A_2, and A_3. Inventory item in every groups can be devided into sub group based on the critical value

In the combined analysis of ABC-Fuzzy Classification obtained nine groups each item of inventory management requires different. Reduction in the number of combinations aims to simplify the process of managing the inventory. Therefore, from the nine groups are then classified into three groups combined as follows:

Table -1
Matrix Combination of *ABC-Fuzzy Classification*

ABC	FUZZY CLASSIFICATION		
	Very Critical	Critical	Not Critical
	B1	B2	B3
A1	A1B1	A1B2	A1B3
A2	A2B1	A2B2	A2B3
A3	A31	A3B2	A3B3

Source : Chu (2008)

Highly important group : $\{A_1B_1, A_2B_1, A_1B_2\}$
Important group : $\{A_3B_1, A_2B_2, A_1B_3\}$
Unimportant group : $\{A_3B_2, A_2B_3, A_3B_3\}$

Research Method

This research was conducted at the health center pharmacy installation of Bandar Kedungmulyo Jombang to 117 items common types of drugs. Source of data used are primary data source in the form of interviews and direct observation in the research object while secondary data sources in the form of a collection of information gathered from the research object on the data usage of drugs, drug prices, the type of drug, the patient visits the data, the data prescribing, drug procurement data, etc. . In addition, other secondary data derived from the study of literature from books, journals, and other related references.

Here is the data collection procedure used in this study:

1. Preliminary Survey

First preliminary survey conducted directly by visiting the object of research. The purpose of this observation is to observe the environment and identify the problems that arise in the research object, which then made the subject matter to be studied. Observations were made on drug supplies are managed by the City Health Center Pharmacy Installation of Kedungmulyo Jombang.

2. Literature Study.

A process of collecting secondary data derived from scientific books, journals, and other literature relating to the subject matter of research used as reference material by researchers.

3. Field Studies.

It is done by going to the field to obtain data from the object of research. The techniques used in the field study are:

a. Observation

Observation is a monitoring process made by researchers to come to the direct object of research in this case is the Puskesmas of Bandar Kedungmulyo Jombang.

b. Interview

A data collection techniques and information by asking questions directly to the speakers or related parties. Interviews in the study done by a question and answer at the pharmacy, pharmacist parts and parties involved in the health center.

c. Documentation

A data collection techniques by means of recording and requesting documents relating to the object of research is being investigated at the health center.

The analysis technique used in this research is to perform grouping items of drug supplies using traditional ABC prior to the criteria of usage per year. Then perform classification using fuzzy classification models with attributes used are criticality level, fatality, scarcity and drug consumption rate items drugs during this period. Before performing a fuzzy classification first determining membership function of each attribute is used. After getting the results of classification using fuzzy, then do a combination of traditional ABC classification results and the fuzzy classification through a combination of ABC- fuzzy classification matrix as a material consideration in the planning of optimal inventory. The steps of the data analysis can be described as follows:

1. Grouping items of drug supplies by using ABC analysis.
2. Determine the membership function for each attribute in fuzzy classification.
   The attribute is used as an attribute criticality level dependent (Y) which consists of three classifications (very critical, critical, and not critical). Fatality (severity) as a result of running out of supplies become independent nominal attributes (X_1) which consists of three classifications (very fatal, fatal and non-fatal), scarcity drug into the second independent nominal attributes (X_2) consisting of (very rare, rare and endangered), then the criteria item consumption of drugs in the period as a non-nominal attributes independent (X_3)

   a. *Membership function* for the nominal independent attributes
      1. Calculate the *occurrence frequency of every item of drugs from the data fuzzy*
      2. *Calculate relative frequency with the formula:*

(i.e., $g_{ik} = \frac{f_{ij}}{\sum_{k=1}^{n} f_{ik}}$ dan $\sum_{k=1}^{n} g_{ik=} 1$)..... (3.1)

      3. Formulate the final *membership function of the* nominal independent attribute

$$\mu_{\gamma = C_J}(Xo) = \begin{cases} g_{1j,} & \text{if } Xo = V_1 \\ g_{2j,} & \text{if } Xo = V_2 \\ \ldots & \ldots \\ g_{mj,} & \text{if } Xo = V_m \end{cases} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (3.2)$$

μ_Y : *membership function* of the nominal independent attribute

C_j : critical value of j

X_0 : severity level and scarcity

V_1 : the value of severity level and scarcity

g_{mj} : *occurrence frequency* value Y and Xo

b. *Membership function* of non-nominal independent attributes

1. Calculate the value of *cut value* Xc_{12}, Xc_{23} *and the constrain or threshold value* $X_{2L}, X_{3L}, X_{1R}, dan\ X_{2R}$.

$$X_{C_{12}} = \frac{S_1\overline{X_2} + S_2\overline{X_1}}{S_1 + S_2}, \quad X_{C_{23}} = \frac{S_2\overline{X_3} + S_3\overline{X_2}}{S_2 + S_3} \qquad \text{..... (3.3)}$$

$$X_{2L} = \overline{X_2} - 3S_2, \quad X_{3L} = \overline{X_3} - 3S_3$$
$$X_{1R} = \overline{X_1} + 3S_1, \quad X_{2R} = \overline{X_2} + 3S_2 \qquad \text{..... (3.4)}$$

S = *standar deviation of the critikal and consumption attributes*

X = the average of critical attributes and consumption level

2. Formulate the *membership function* of the non-nominal independent attributes

$$\mu_{Y=C_1}(X_0) = \begin{cases} 1, & X_0 < X_{C_{12}} \\ \frac{X_{1R} - X_0}{X_{1R} - X_{C_{12}}}, & X_{C_{12}} \leqslant X_0 < X_{1R} \\ 0, & X_{1R} \leqslant X_0 \end{cases} \qquad \text{..... (3.5)}$$

$$\mu_{Y=C_2}(X_0) = \begin{cases} 0, & X_0 < X_{2L} \text{ or } X_0 \geqslant X_{2R} \\ \frac{X_0 - X_{2L}}{X_{C_{12}} - X_{2L}}, & X_{2L} \leqslant X_0 < X_{C_{12}} \\ 1, & X_{C_{12}} \leqslant X_0 < X_{C_{23}} \\ \frac{X_{2R} - X_0}{X_{2R} - X_{C_{23}}}, & X_{C_{23}} \leqslant X_0 < X_{2R} \end{cases} \qquad \text{.....(3.6)}$$

$$\mu_{Y=C_3}(X_0) = \begin{cases} 0, & X_0 < X_{3L} \\ \frac{X_0 - X_{3L}}{X_{C_{23}} - X_{3L}}, & X_{3L} \leqslant X_0 < X_{C_{23}} \\ 1, & X_{C_{23}} \leqslant X_0 \end{cases} \qquad \text{..... (3.7)}$$

μ_Y : *membership function* of consumption level of drugs item C_j :

the critical attribute j

X_0 : the level consumption of drug item.

3. Grouping items of drug supplies based fuzzy classification analysis.
4. Grouping items of drug supplies based matrix analysis of the combination of ABC-Fuzzy Classification.
5. Comparing the results of grouping traditional ABC classification model with the results of clustering model of combination of ABC-Fuzzy Classification.

Analysis and Results

Inventory Management of Medicines in the Health Center

Inventory management of drugs at the health center of Jombang Bandar Kedungmulyo still done in a conventional manner by habit and experience of the staff. Drugs in the storage and installation are classified by the type of preparation and are not based on the value of its investment and its criticality point.

At the time of drug procurement planning, parts manager drugs estimate drug needs to predict how the drug needs for the next two months based on the previous year drug consumption. In addition, the procurement of drugs also consider the level of seasonal diseases at certain moments which can increase the amount of drug quota reserved to GFK or to another public pharmacies. Planning the amount of drug that is ordered is accomplished by adding a percentage (%) need additional medication.

Puskesmas procure drugs bimonthly periodical in accordance with SOPs of Pharmacy Warehouse District / *Gudang Farmasi Kabupaten* (GFK), which standard procedure recommended in the health center is to procure bi-monthly basis but did not rule out the booking is made more than once in a month. This can be done by a health center with a record may be made with consideration of an increase in cases of the disease in the month and the stock of drugs in the Pharmacy Warehouse District (GFK) still exist. In addition, the procurement of drugs was also done independently by purchasing generic drugs pharmacy to another, this can be done if the drug is needed by health centers in GFK so no perceived need to hold independently.

Medication ordering is done by health centers send the list to the drug needs Pharmacy Warehouse District (GFK) after the GFK following requests from the health center then sends the drugs ordered bi-monthly periodical. Booking is also performed independently to the public pharmacy; it can be done if the drug is needed

by the health centers do not exist in GFK. Medicines in health centers managed with FIFO (Fist In Firts Out), where the drug in the beginning will be issued in advance. This is consistent with the expiry date of the drug where the drug that came late to have a longer expiration date than the drugs that come early.

Combined Analysis of ABC-Fuzzy Classification

The combination of these two models will be the final result of the grouping of items in order to improve the accuracy of the inventory control of drugs in health centers Bandar Kedungmulyo Jombang. Based on the results of the analysis using a combination of the ABC-model of Fuzzy Classification matrix is obtained as follows:

Table 1
Matrix Combination Result of *ABC-Fuzzy Classification*

ABC	FUZZY CLASSIFICATION		
	Very Critical	Critical	Not Critical
	B1	B2	B3
A1	14	0	9
A2	23	1	11
A3	23	0	36

Source: Authors' Data Processing

Note:

A1 : Group A in ABC Model
A2 : Group B in ABCModel
A3 : Group C in ABC Model

B1 : Very critical group (fuzzy)
B2 : Critical group (fuzzy)
B3 : Not critical group (fuzzy)

Matrix Conclusion:

Very importance group (light blue : 37 item of drugs
Importance group (Green) : 33 item of drug
Not Importance group (orange) : 47 item of drugs

From the results of the above matrix can be described results of clustering to 117 items of drugs in health centers of Bandar Kedungmulyo Jombang by using a combination of ABC-Fuzzy Classification is as follows:

a. In the category of "very important" There are 37 items in it. This category has a very high interest rate and a top priority in inventory control of medicines in the health center.
b. In the category of "important", there are 33 items of drugs. This falls in the category of medium priority in controlling the supply of medication compared very important item in the category.
c. In the category of "non-essential" there are 47 items of drugs. Priority inventory control of drugs in this category is less restrictive than the two previous categories.

Results are shown from this combination model considering both qualitative and quantitative criteria of the constituent models. A change in the value of each drug item category is caused by the criteria used as a parameter grouping.

The end result of this combination model represents the use of the ABC model and fuzzy simultaneously can change the item category and increase the accuracy in the classification of items of drugs at the health center pharmacy installation Bandar Kedungmulyo Jombang.

Comparative Analysis of ABC and the combination of ABC-Fuzzy Classification

In order to know which model produces the highest level of accuracy in the classification of common drug type supplies at Puskesmas Bandar Kedungmulyo Jombang, authors will make a comparison between ABC grouping using a combination of regular and ABC-Fuzzy Classification.

This comparison is designated to determine the level of accuracy by percentage (%) of each grouping the results of the model, as well as to explain the changes in each item category. The given table below is showing the comparison of the two models.

Table 2
Comparison of The Two Models

Model	Group		
	A (Very Importance	B (importance)	C (Not importance)
ABC Analysis	23	35	59
ABC-Fuzzy Classification	37	33	47

Source : Authors' Data Processing

Based on the results of the comparison table above it shows the grouping of the two models different results from both. By using the ABC model, there are 23 items included in group A (very important), or approximately 20% of the total drug items, for group B (important) there are 35 items in it or around 30%, while the items included in group C totaling 59 items or 50% of total drug items.

Other results indicated if using a model of the combination of ABC-Fuzzy Classification. In the group of items "very important" there are 37 items in it or around 32%. Groups of items that fall into the category of "importance" of 33 items or 28% of total drug items, while the results for items that fall into the category of "not important" amounted to 47 items, or about 40%.

Change the item category drugs as seen in the brand drug Pyridoxine (Vit.B6) tablets 10 mg (HCl), on the ABC model of this item is included in the category A (very important) this is because the level of consumption of these drugs is high and the value of use (annual dollar usage) of these drugs is high. After the inclusion of qualitative criteria that the fatality and scarcity on the model-Fuzzy Classification ABC combination of these items into the category of "important". This is because based on data from the training data set is fuzzy this item included in the class is not critical; it is not fatal, and not rare.

The changes were also seen in drug category Phenytoin Sodium Capsules brand 100 mg, this item is included in group C (not important) to grouping by using the ABC, after adding qualitative criteria in the ABC model-Fuzzy Classification these items into the category of "important". For items other drugs can be seen by comparing the results with ABC grouping and clustering results using a combination model of ABC-Fuzzy Classification.

The results of the grouping and the percentage change in the category of each item of this drug showed that the addition of qualitative criteria in the model drugs grouping items by using the ABC-Fuzzy Classification will increase the accuracy of the results of classification, where this increase occurred on the item with the category of "very important".

This increased accuracy will help the drug management section at the pharmacy installation of Puskesmas Bandar Kedungmulyo Jombang in order to plan the drug needs to consider qualitative criteria without ignoring the quantitative criteria that have been frequently used in ordinary clustering models.

8 Conclusion

Based on the analysis and discussion in the previous chapter, it can be concluded as follows:

1. Inventory drugs are conventionally administered under the FIFO (First In First Out), experiences and habits of the pharmacy staff. Grouping drugs have not considered the value of investments and the level of criticality of the drug the drug. Planning is estimated based on the level of consumption of the previous period. Drug procurement conducted periodically bimonthly based SOPs of Pharmacy Warehouse District (GFK), in addition to the procurement also be done independently.
2. Results of grouping by using a model-Fuzzy Classification ABC combination is as follows:
   a) In the category of "very important" There are 37 items in it. This category has a very high interest rate and a top priority in inventory control of medicines in the health center.
   b) In the category of "important", there are 33 items of drugs. This falls in the category of medium priority in controlling the supply of medication compared very important item in the category.
   c) In the category of "non-essential" there are 47 items of drugs. Priority inventory control of drugs in this category is less restrictive than the two previous categories.
3. Comparison of the results of clustering with traditional ABC and ABC combination model-Fuzzy Classification.

The difference in results between these two models grouping showed that the addition of qualitative criteria in the model drugs grouping items by using a combination of ABC-Fuzzy Classification can improve the accuracy of the results of classification numbers. This will help the drug management of Puskesmas Bandar Kedungmulyo Jombang in planning needs to consider the medicines qualitative criteria without having to ignore the quantitative criteria that have been commonly used in the model grouping in general.

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PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7

PAGE 8

PAGE 9

PAGE 10

PAGE 11

PAGE 12

PAGE 13

PAGE 14

PAGE 15

PAGE 16

PAGE 17

PAGE 18