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Pattern Analysis of Drug Procurement System With FP-Growth Algorithm

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ABSTRACT

The Medan Marelan Health Center is one of the health centers in the city of Medan. The supply of medicines is considered necessary so that these medicines can still be available at any time with various types and functions. In order not to experience difficulties in distributing medicines and anticipating the supply of medicines in the Puskesmas, research was carried out using the Data Mining method. In this study, a test will be carried out on the Association Rule which is used as a solution to problems with the pattern of the drug procurement system, and will display information about the value of support and confidence from each Data Mining process. Tests in this study using Weka Software to determine the procurement of drugs that are often needed. Information obtained from the stages of the FP-Growth Algorithm is to produce patterns in the procurement of medicines, and an itemset combination pattern has been formed using the FP-Growth Algorithm method so that the results of this study can be used in drug supply effectively and efficiently.

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1. INTRODUCTION

The Community Health Center (PUSKESMAS) is a service for health organized by the government in an effort to fulfill individual health at the first level, where the Puskesmas prioritizes prevention efforts in medical activities, so that health at the community level is as good as possible. Medan Marelan Public Health Center is one of the health centers in Medan City. To improve services at the Marelan Public Health Center, it is necessary to administer the right drugs to patients. The supply of medicines is considered necessary so that these medicines can still be available at any time with various types and functions. In order not to experience difficulties in drug distribution services as well as anticipating shortages and excess drug supplies, the Medan Marelan Health Center needs to have a strategy so that the control of drug supply control becomes better and more effective.[1]

Based on the problems above, the development of information technology is currently very advanced and rapid so it is needed in determining the level of data accuracy in the world of work and in everyday life. Every information is a very important thing in determining a certain decision. One of them is information in determining drug sales and drug supply at a pharmacy. Drug inventory is information to find out the number of transactions on drug sales that occur within a certain time and determine the target to be achieved. One method that can be used to determine the supply of the drug is to use the Data Mining Method.[2][3]

Data Mining is a process used to find patterns and relationships between interesting patterns based on large amounts of data, the data can be stored in a database, data warehouse and other information storage by applying relationship techniques between patterns such as statistical and mathematical calculations.

This drug procurement analysis uses the FP-Growth Algorithm, which has the ability to mine frequent patterns (patterns that often appear in data sets) efficiently. The FP-Growth algorithm is an algorithm used in the Frequent Itemset and Association Rule search process to recommend decisions. The Association Rule can associate one or more dataset attributes with other attributes, aiming to find hidden and significant relationships

between attributes, and generate if-then statements about attribute values in a rule. Algorithms are used in finding a frequent itemset process and rules as recommendations for making a decision.

2. METHOD

This research uses a methodology that identifies problems, analyzes problems, so as to get the best solution to the problem or in solving the problem. In this study, a problem solving is needed to procure medicines which will later be distributed to the community in the Medan Marelan area, so that the distribution of these drugs can be more effective and on target than before.[4]

The framework or framework of research thinking is seen in the following figure.

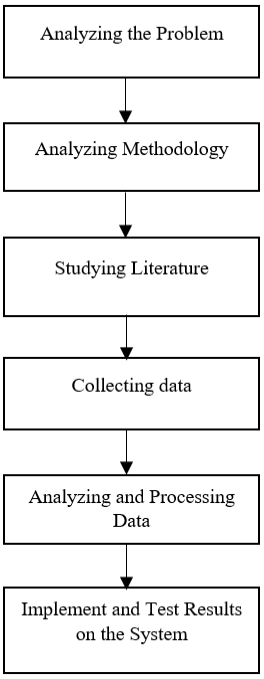

Figure 1. Research Framework

Based on Figure 1 above, the following is an explanation of each step which has been described as follows:

1. Analyzing the Problem
   This component is a very important aspect in determining the quality of scientific research, namely analyzing a problem to be studied. From the results of the analysis, it is the problems that exist in this research that will later find the best solution so that the research can be useful, so the variables will be measured conceptually. These variables will be supported by many theories to make it easier to determine indicators clearly and be described in more relevant theories. Furthermore, it will be analyzed first and managed, meaning that data can be collected.
2. Analyzing Methodology
   The method of analysis is the most important thing in a study. In this study, we will analyze the methodology using the FP-Growth Algorithm.
3. Studying Literature
   Researchers studied the literature by collecting theories about the Data Mining Method using the FP-Growth Algorithm. In this literature, references are taken from published scientific articles and journals.
4. Collecting Data
   At this stage, data collection will be carried out first with an understanding of the procurement of medicines in the Puskesmas and data collection in the form of information on the procurement of medicines in the Marelan Public Health Center for the last 8 (eight) months.
5. Analyzing and Processing Data

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The analysis uses the Association Rule to calculate the support and confidence values. In Data Mining, it is useful to find the relationship between one itemset and certain itemsets.

6. Implement and Test Result on the System
   The results are implemented and tested using a system to test the analysis that has been made, this test uses the Weka Tools.

3. RESULTS AND DISCUSSION

In this study, the analysis and design stages of the FP-Growth Algorithm are used. At the stage of the FP-Growth Algorithm, an FP-Tree will be built to search for Frequent Itemsets. Conditional pattern base, conditional pattern tree and frequent itemset search stages are very important processes in the FP-Growth Algorithm stage. [5]

To make it easier to analyze and design the system, a flow chart is needed based on the framework in the previous chapter 3, namely analyzing the problem, the research methodology used, studying the literature, collecting data, analyzing and processing data, and implementing it into a Data Mining application, namely Weka tools are used as test results. The flow chart can be seen in the figure below: [6]

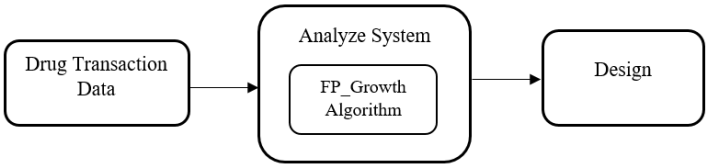

Figure 2. Flowchart Analysis and Design

3.1. Drug Transaction Data

In this study, the data source needed is drug transaction data for the last 3 (three) months, namely July 2021 to September 2021 at the Marelan Health Center. The data was obtained with a research permit accompanied by a research permit and data collection from the Dharmawangsa University Research Institute. The data consists of 30 data and has complete attributes including procurement numbers and names of drugs. The data has a procurement number based on the procurement of goods at the Marelan Health Center. Drug procurement data obtained from the Marelan Health Center can be seen in the table below:

Table 1. Data on Procurement of Medicines at Marelan Health Center January – August

Procurement Number	Drug Name
001/P-MRLN/VII/2021	Amoksisilin 500 mg tab
001/P-MRLN/VII/2021	Tetrasiklin 500 mg
001/P-MRLN/VII/2021	Acyclovir 400 mg tab
001/P-MRLN/VII/2021	Paracetamol Syrup
001/P-MRLN/VII/2021	Cetirizin syr , Cetirizin tab
001/P-MRLN/VII/2021	Bevalex cream (betametason)
001/P-MRLN/VII/2021	Civit Zink
001/P-MRLN/VII/2021	Proimbus
002/P-MRLN/VII/2021	Bevalex cream (betametason)
002/P-MRLN/VII/2021	Gentalex cream (Gentamicin)
002/P-MRLN/VII/2021	Lexigo (Betahistin)
002/P-MRLN/VII/2021	Glibenclamid 5 mg
002/P-MRLN/VII/2021	Hustap tab (Bromhexin)
002/P-MRLN/VII/2021	Cefadroxil 500
0003/P-MRLN/VII/2021……until……00030/P-MRLN/VII/2021	
029/P-MRLN/VII/2021	Neo Diagon (Attapulgite tab)
029/P-MRLN/VII/2021	Vit B Complex tab
029/P-MRLN/VII/2021	Vit B1 tab

Procurement Number	Drug Name
029/P-MRLN/VIII/2021	OBH Tropica syr
029/P-MRLN/VIII/2021	Cetirizin syr , Cetirizin tab
029/P-MRLN/VIII/2021	CTM 4 mg tab
030/P-MRLN/VIII/2021	Chloramphenicol 250 mg
030/P-MRLN/VIII/2021	Glibenclamid 5 mg
030/P-MRLN/VIII/2021	Amoksisilin 500 mg tab
030/P-MRLN/VIII/2021	Bevalex cream (betametason)
030/P-MRLN/VIII/2021	Neo Diagon (Attapulgite tab)
030/P-MRLN/VIII/2021	Paracetamol Syrup
030/P-MRLN/VIII/2021	Vit B complex tab

Based on the data above, the researcher gave the attribute code for each drug. The attribute code can be seen in the table below:

Table 2. Drug Procurement Data Attribute Code

No	Drug Name	Attribute Code
1.	Amlodipine 5 mg, 10 mg tab	A1
2.	Amoksisilin 500 mg tab	A2
3.	Cefadroxil 500	A3
4.	Chloramphenicol 250 mg	A4
5.	Metronidazole 500 mg	A5
6.	Tetrasiklin 500 mg	A6
7.	Gentalex cream (Gentamicin)	A7
8.	Acyclovir 400 mg tab	A8
9.	Simvastatin 10mg, 20 mg	A9
10.	Paracetamol Syrup	A10
11.	CTM 4 mg tab	A11
12.	Cetirizin syr , Cetirizin tab	A12
13.	Bevalex cream (betametason)	A13
14.	Glibenclamid 5 mg	A14
15.	Domperidon syr	A15
16.	Ketokenazol cream, Ketokonazol tab	A16
17.	Neo Diagon (Attapulgite tab)	A17
18.	Neo Kaominal syr	A18
19.	Ambroxol tab	A19
20.	Hustap tab (Bromhexin)	A20
21.	OBH Tropica syr	A21
22.	Antasida tab, Antasida syr	A22
23.	Lansoprazole 30 mg capsul	A23
24.	Natrium Bicarbonat tab	A24
25.	Lexigo (Betahistin)	A25
26.	Gentamicin tetes mata	A26
27.	Reco Tetes Telinga (Chloramphenicol)	A27
28.	Vit B1 tab	A28
29.	Vit B6	A29
30.	Vit B complex tab	A30
31.	Vitalex (as.folat,fe,vit c,vit B,Cal carbonat)	A31
32.	Phenobarbital (P)	A32
33.	Civit Zink	A33
34.	Proimbus	A34
35.	Tablet Tambah Darah	A35

3.2. Analyze System

Analyzing the system is a step taken in the FP-Growth Algorithm in determining the frequent itemset. In searching for frequent itemsets using the FP-Growth Algorithm, an extension of the use of a prefix tree or commonly referred to as an FP-Tree is required. Based on the explanation above, a flowchart or flow chart is made to describe the stages and steps in using the FP-Growth Algorithm, as shown below :[7]

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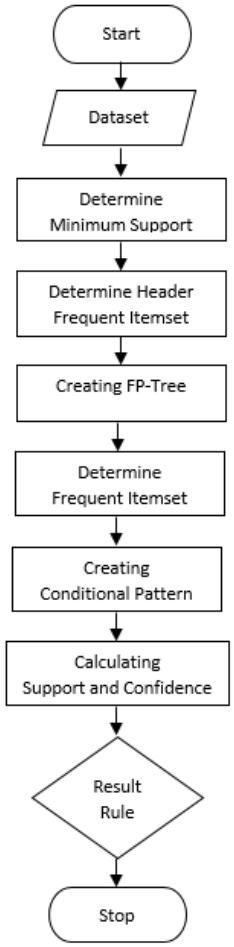

Figure 3. Process Flowchart on the FP-Growth Algorithm

a. Data Set

Data processing using Data Mining will be transformed based on the data that has been coded as in table 3 above. The following is the result of coding the data, it can be seen in the table below:

Table 3. Coding Results and Drug Procurement Data Items

No.	Procurement Number	Drug Name
1.	001/P-MRLN/VII/2021	A2, A6, A8, A10, A12, A13, A33, A34
2.	002/P-MRLN/VII/2021	A3, A7, A13, A14, A25, A20
3.	003/P-MRLN/VII/2021	A17, A21, A28, A30
4.	004/P-MRLN/VII/2021	A2, A4, A11,A12, A13, A14,
5.	005/P-MRLN/VII/2021	A10, A17, A23, A26, A30
6.	006/P-MRLN/VII/2021	A2, A4, A13, A27, A29, A31, A35,
7.	007/P-MRLN/VII/2021	A7, A11, A15, A17, A21
8.	008/P-MRLN/VII/2021	A1, A2, A7, A8, A13, A24
9.	009/P-MRLN/VII/2021	A9, A16, A19, A28, A32
10.	0010/P-MRLN/VII/2021	A10, A13, A18, A25, A31, A35
11.	0011/P-MRLN/VII/2021	A2, A11, A21, A22, A25
12.	0012/P-MRLN/VII/2021	A15, A17, A27, A29, A39
13.	0013/P-MRLN/VII/2021	A1, A6, A13, A16, A24
14.	0014/P-MRLN/VII/2021	A10, A16, A20, A28, A30
15.	0015/P-MRLN/VII/2021	A2, A21, A31, A35
16.	0016/P-MRLN/VII/2021	A4, A12, A13, A18, A22, A25
17.	0017/P-MRLN/VII/2021	A3, A5, A9, A20, A23
18.	0018/P-MRLN/VII/2021	A2, A8, A13, A17, A19, A22, A30
19.	0019/P-MRLN/VII/2021	A5, A7, A8, A26, A30, A31
20.	0020/P-MRLN/VII/2021	A2, A13, A15, A24, A29
21.	0021/P-MRLN/VII/2021	A16, A20, A24, A30
22.	0022/P-MRLN/VII/2021	A1, A2, A14, A17, A28

No.	Procurement Number	Drug Name
23.	0023/P-MRLN/VII/2021	A13, A17, A26, A30, A31
24.	0024/P-MRLN/VII/2021	A22, A25, A27
25.	0025/P-MRLN/VII/2021	A2, A4, A5, A13
26.	0026/P-MRLN/VII/2021	A14, A19, A23, A28, A31
27.	0027/P-MRLN/VII/2021	A3, A13, A7, A9, A15, A26
28.	0028/P-MRLN/VII/2021	A5, A10, A16, A24, A31
29.	0029/P-MRLN/VII/2021	A11, A12, A17, A21, A28, A30
30.	0030/P-MRLN/VII/2021	A2, A4, A10, A13, A14, A17

The next step is to calculate the frequency of occurrence of each item, the frequency of occurrence of each item, can be seen in the table below:

Table 4. Occurrence Frequency of each Item

Item	Frequency	*Support*	
A13	13	13/30	43,3%
A2	11	10/30	36,6%
A17	9	9/30	30%
A30	8	8/30	27%
A31	7	7/30	23,3%
A28	6	6/30	20%
A14	5	5/30	16,6%
A21	5	5/30	16,6%
A24	5	5/30	16,6%
A11	4	4/30	13,3%
A4	4	4/30	13,3%
A7	4	4/30	13,3%
A12	4	4/30	13,3%
A15	4	4/30	13,3%
A16	4	4/30	13,3%
A20	4	4/30	13,3%
A25	4	4/30	13,3%

b. Determine Minimum Support

The researcher determined the minimum support count ξ =25%. Based on the drug procurement data table above, the frequencies that have a support count ξ =25% are A13, A2, A30, A17.

Table 5. Scan Result Data

Item	Frequency
A13	13
A2	11
A17	9
A30	8

c. Determine Header Frequent Itemset

The table below is a process for listing the occurrences of items that are frequent and sorted by highest frequency. Each item that appears will be marked with 1 and items that do not appear will be marked with 0. The data below is based on the data on the procurement of medicines that has been made in table 6. Frequent Itemset header data above can be seen in the table below:

Table 6. Drug Procurement Data

No	Bevalex cream (betametason) (A13)	Amoksisilin 500 mg tab (A2)	Neo Diagon (A17)	Vit B Complex tab (A30)
1.	0	1	0	0
2.	1	0	0	0
3.	0	0	1	1
4.	1	1	0	0
5.	0	0	1	1
6.	1	1	0	0

No	Bevalex cream (betametason) (A13)	Amoksisilin 500 mg tab (A2)	Neo Diagon (A17)	Vit B Complex tab (A30)
7.	0	0	1	0
8.	1	1	0	1
9.	1	0	0	0
10.	0	1	0	0
11.	0	0	1	0
12.	1	0	0	0
13.	0	0	0	1
14.	0	1	0	0
15.	1	0	0	0
16.	1	1	1	0
17.	0	0	0	1
18.	1	1	0	0
19.	0	1	1	0
20.	1	0	1	1
21.	1	1	0	0
22.	0	0	0	1
23.	1	0	0	0
24.	0	0	1	1
25.	1	1	1	0

d. Creating FP-Tree
At this stage an FP-Tree will be formed and labeled null, a group of subtrees based on several items.[8][9]

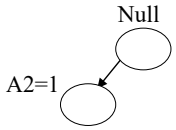

Figure 4. FP-Tree for TID 1

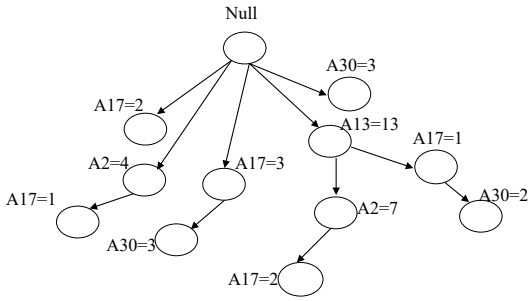

Figure 5. FP-Tree for TID 28

e. Determine Frequent Itemset
FP-Tree is needed in finding Frequent Itemset with a path ending in the smallest support count, namely A30 (Vit B Complex). Furthermore, items A17, A2 and A13 were also determined. The process of finding Frequent Itemset can be seen in the figure below :

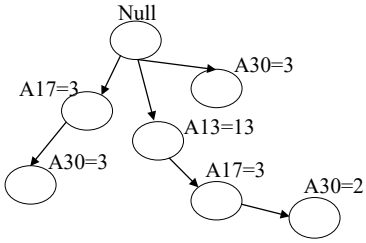

Figure 6. A path ending in vertex A17

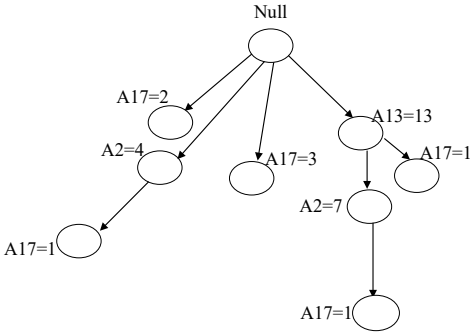

Figure 7. A path ending in vertex A2

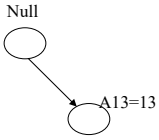

Figure 8. A path ending in vertex A13

f. Creating Conditional Pattern

After obtaining the frequent itemset based on the FP-Tree above, then several suffix endings are obtained as shown in the table below:[10]

Table 7. Suffix

Suffix	***Frequent Itemset***
A30	{A13,A17,A30}{A17,A30}{A30}
A17	{A13,A2,A17) {A13,A17}{A2,A17}{A17}
A2	{A13,A2}{A2}
A13	{A13}

g. Calculating Support and Confidence

The next step is to calculate the support and confidence values based on the FP-Tree that has been formed using the formula below: [11]

$$support(A) = \frac{\sum number\ of\ cases}{\sum total\ number\ of\ cases} x100\% \dots\dots\dots\dots\dots\dots\dots (1)$$

For Σ Items in the procurement of drugs if Bevalex cream (betamethasone) (A13), Neo Diagon (A17) then Vit B complex tab (A30) there are 2 procurements out of 25 procurements, the Support data is 2/25*100% = 8% .[12][13]

$$confidence = \frac{\sum \quad number\ of\ cases}{Number\ of\ Cases\ on\ Antecedent} x100\% \dots\dots\dots\dots\dots (2)$$

For Σ Items in the procurement of drugs if Bevalex cream (betamethasone) (A13), Neo Diagon (A17) then Vit B complex tab (A30) there are 2 procurements out of 8 procurements of Vit B complex tab (A30), then the Confidence is 2/8 *100% = 25%.

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Table 8. Support and Confident 2 Item

If Antecedent then Consequent	*Support*	*Confidence*
A13, A2	7/25=28%	7/11=64%
A13, A17	3/25=12%	3/9=33%
A13, A30	2/25=8%	3/8=38%
A2, A13	7/25=28%	7/13=54%
A2, A17	3/25=12%	3/9=33%
A17, A13	3/25=12%	3/13=23%
A17, A2	3/25=12%	3/11=27%
A17, A30	5/25=20%	5/8=63%
A30, A13	2/25=8%	2/13=15%
A30, A17	5/25=20%	5/9=56%

Table 9. Support and Confident 3 Item

If Antecedent then Consequent	*Support*	*Confidence*
A13, A2, A17	2/25=8%	2/9=22%
A13, A17, A30	2/25=8%	2/8=25%
A2, A13, A17	2/25=8%	2/9=22%
A17, A13, A2	2/25=8%	2/11=18%
A17, A13, A30	2/25=8%	2/8=25%
A30, A13, A17	2/25=8%	2/9=22%

h. Result Rule

The table below is a rule that has Support ≥ 8% and has Confidence ≥ 25%. The results of these rules can be seen in the table below:[14][15]

Table 10. Association Rule Result

If Antecedent then Consequent	*Support*	*Confidence*
A13, A2	7/25=28%	7/11=64%
A13, A17	3/25=12%	3/9=33%
A13, A30	2/25=8%	3/8=38%
A2, A13	7/25=28%	7/13=54%
A2, A17	3/25=12%	3/9=33%
A17, A2	3/25=12%	3/11=27%
A17, A30	5/25=20%	5/8=63%
A30, A17	5/25=20%	5/9=56%
A13, A17, A30	2/25=8%	2/8=25%
A17, A13, A30	2/25=8%	2/8=25%

4. CONCLUSION

Based on the results that have been obtained, the following conclusions can be drawn:

1. If the procurement of Bevalex Cream (Betamethasone) is followed by the procurement of Amoxicillin tab 500 mg with a support value of 28% and a confidence of 64%.
2. If you procure Bevalex Cream (Betamethasone), it is followed by the procurement of Amoxicillin 500 mg tab with a support value of 12% and a confidence of 33%.
3. If you procure Bevalex Cream (Betamethasone), then you will need to procure Vit B Complex tab with a support value of 8% and confidence 38%.
4. If you procure Amoxicillin 500 mg tab, you must procure Bevalex Cream (Betamethasone) with a support value of 28% and a confidence of 54%.
5. If you procure Amoxicillin 500 mg tab, it is followed by the procurement of Neo Diagon (Attapulgite tab) with a support value of 12% and a confidence of 33%.

6. If you procure Neo Diagon (Attapulgite tab), it is followed by the procurement of Amoxicillin 500 mg tab with a support value of 12% and a confidence of 27%.
7. If you procure Neo Diagon (Attapulgite tab), then you will need to procure Vit B Complex tab with a support value of 20% and confidence of 63%.
8. If you procure the Vit B Complex tab, it will be followed by the procurement of Neo Diagon (Attapulgite tab) with a support value of 20% and confidence of 56%.
9. If you are procuring Bevalex Cream (Betamethasone) and Neo Diagon (Attapulgite tab), then you are procuring Vit B Complex tab with a support value of 8% and confidence 25%.
10. Jika melakukan pengadaan Neo Diagon (Attapulgite tab) dan Bavalex Cream (Betametason) maka diikuti pengadaan Vit B Complex tab dengan nilai support 8% dan confidence 25%

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