Analytical Hierarchy Process to Determine Drug Inventory at The Pharmaceutical Installation of UPT Puskesmas Mandala

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***Abstract –** Inaccurate planning of drug needs can hamper health services, especially in facilities such as UPT Puskesmas Mandala. This research aims to help the process of determining drug supplies effectively by applying the Analytical Hierarchy Process (AHP) method. This method is used to determine priority weights based on four main criteria which include price, availability, popularity, and effectiveness. Data were obtained through observations and interviews at UPT Puskesmas Mandala, then analyzed using RapidMiner software. The results of the analysis show that Vitamin C drugs have the highest score of 0.327915 so they are the top priority in procurement, while Cetirizine is ranked lowest. This finding proves that the AHP method is able to prioritize objectively and systematically, so that it can be a solution in improving the efficiency of planning drug needs at puskesmas.*

***Keywords** — AHP, Drug requirement, Decision making, Drug planning, RapidMiner*

1. INTRODUCTION

Drugs are an essential component in the healing process [1], because they play a direct role in accelerating the recovery of the patient's condition. Therefore, the existence of adequate drugs is an important part of an effective health care system [2]. One of the crucial factors in ensuring the availability of drugs is good needs planning [3], considering that this planning will affect the smooth process of procurement, distribution, and utilisation in various health care facilities [4]. Accuracy in planning [5] allows drugs to be available in the appropriate quantity, type, and quality and at the required time, so that the service process can run optimally [6].

In practice, drug management in health facilities such as hospitals [7] and health centres must be carried out routinely and continuously because it is urgent and cannot be delayed [8]. The imbalance [9] between the need and availability of drugs will cause a number of problems. Shortages can hamper medical services [10] and lead to more expensive sudden procurement needs. Conversely, overstocking risks incurring losses due to damaged or expired drugs [11]. These problems indicate that a systematic approach is needed to assist the drug requirement planning process to be more accurate and efficient.

Puskesmas have an important role as the frontline in basic health services in Indonesia. The success of medical services, promotive and preventive programmes, and the management of infectious and non-communicable diseases depends on the continued availability of pharmaceutical facilities including essential medicines, vaccines, consumables, and laboratory reagents. However, various reports from health offices show that there are still many classic challenges such as stock-outs, expired drugs, inaccurate requests, uneven distribution, and storage limitations, especially in remote areas or those with limited cold chain facilities [12].

In many regions, pharmaceutical logistics information systems are still fragmented, often using manual methods, Excel spreadsheets, or different systems between units so that logistics planning is often done reactively, not proactively. This condition causes budget wastage, delays in service to patients, and a decrease in the achievement of health department performance indicators. Therefore, a structured decision-making method is needed to assist relevant parties in prioritising interventions in pharmaceutical logistics management [6].

One potential solution is to apply data mining techniques. This technique enables large-scale data analysis to unearth patterns or trends that are not directly visible. By combining statistical science, machine learning, and database systems, data mining is able to provide support for a more precise, efficient, and data-driven decision-making process [13].

Metode Analytical Hierarchy Process (AHP) dapat dijadikan salah satu alternatif dalam membantu proses pengambilan keputusan yang kompleks[14]. AHP merupakan metode multikriteria yang dikembangkan oleh Thomas L. Saaty dengan pendekatan hierarki untuk menyederhanakan permasalahan[15]. Metode ini bekerja melalui pembandingan berpasangan terhadap elemen-elemen keputusan, baik yang bersifat kualitatif maupun kuantitatif[16]. Nilai numerik yang dihasilkan dari proses pembandingan ini akan digunakan untuk menyusun prioritas dan menghasilkan keputusan akhir yang konsisten serta logis[16].

The Analytical Hierarchy Process (AHP) method can be used as an alternative in helping complex decision-making processes [14]. AHP is a multicriteria method developed by Thomas L. Saaty with a hierarchical approach to simplify problems [15]. This method works through pairwise comparisons of decision elements, both qualitative and quantitative [16]. The numerical values resulting from this comparison process will be used to prioritise and produce a consistent and logical final decision [16].

This research focuses on the problems faced by UPT Puskesmas Mandala, namely the difficulty in determining the amount of drug supply effectively [12]. There are conditions where patients cannot redeem prescriptions due to stock shortages, which indicates that the existing drug demand planning system has not run optimally. To overcome this, this study proposes the application of the AHP method as part of a decision support system to help the process of determining more precise drug needs [17]. The use of RapidMiner software is expected to facilitate the implementation of this method and support the data analysis process in a more structured manner.

Thus, this study aims to examine how the AHP algorithm can be applied in the process of determining drug supply needs [13] at UPT Puskesmas Mandala and evaluate the most influential criteria in the planning process through the help of the RapidMiner application. The focus of the research is limited to the use of internal data from UPT Puskesmas Mandala and the application of the AHP algorithm [18] using the application that has been mentioned.

The results of this research are expected to provide real benefits. For students, this research is a forum for applying the theory that has been obtained during study, as well as fulfilling academic requirements. For educational institutions, this research can be an indicator in assessing student competence and as a reference for the development of similar research. Meanwhile, for users or health centres, the resulting system is expected to assist in the process of planning drug needs in a more objective, structured, and efficient manner.

2. RESEARCH METHODS

2.1. Research Framework

In this study, the method used is the Analytical Hierarchy Process (AHP) to determine priorities in managing drug supplies at the pharmaceutical installation of UPT Puskesmas Mandala [18]. This method was chosen because it is able to help the decision-making process systematically based on relevant criteria. The framework of this research is shown in Figure 1, which illustrates the stages involved in the model development process, starting from problem identification to the implementation stage. The framework includes the following stages:

1. Research and Information Collecting
   Problem identification is conducted through literature review, interviews, and observations to understand the needs and actual conditions in the field.
2. Planning
   Model development planning is done by formulating objectives, product specifications, and testing strategies. Data collection instruments were also prepared at this stage.
3. Develop Preliminary Form of Product
   Preparation of an initial prototype based on the data and information that has been collected, for example, the design of an AHP-based drug procurement model.
4. Preliminary Field Testing
   Small-scale trials are conducted to assess the weaknesses or shortcomings of the initial design.
5. Main Product Revision
   Product revision is carried out based on the findings from the initial trial, with a focus on technical improvements.
6. Main Field Testing
   Testing was again conducted on a larger scale to evaluate the effectiveness of the model.
7. Operational Product Revision
   Product improvements are made after the large-scale test, to ensure the product is ready for operational use.
8. Operational Field Testing
   Trials in real conditions involving more respondents or test locations.

9. Final Product Revision
   The final refinement stage based on the findings from the operational field test.
10. Dissemination and Implementation
   The developed product is prepared for dissemination and implementation in the intended user environment.

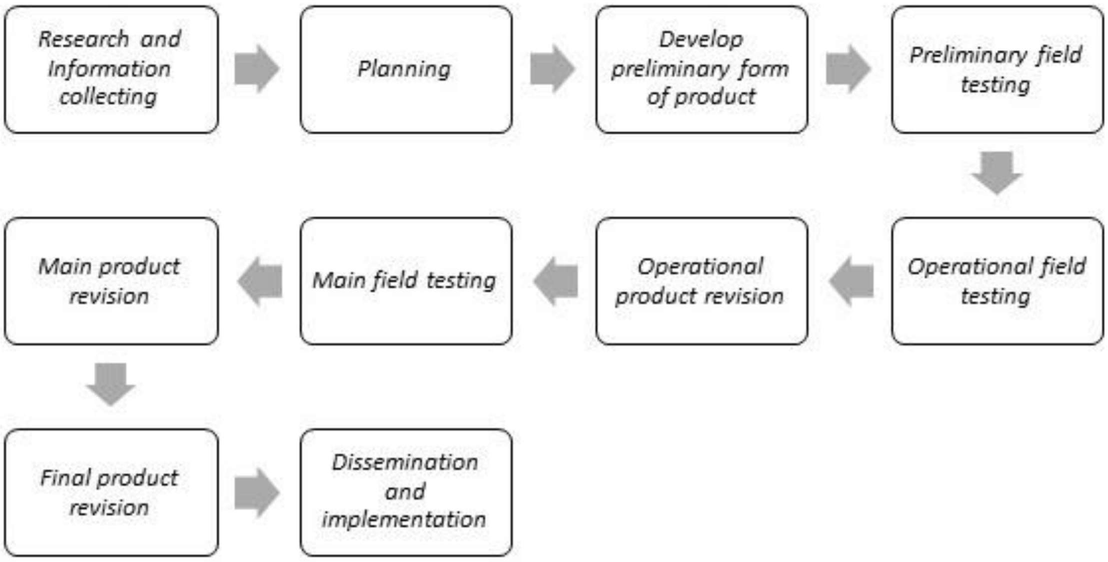


Figure 1. Research Framework

2.1.1. Problem Identification

With the problem of determining drug supplies at the UPT Puskesmas Mandala pharmaceutical installation to improve the efficiency and effectiveness of the company, it is necessary to calculate using the AHP method [19] in helping companies to determine drug supplies at the right pharmaceutical installation and potentially have a positive impact on the performance of UPT Puskesmas Mandala.

2.1.2. Data Collection

Data collection [20] is an activity of capturing data or information that is in accordance with the scope of the research. Collecting data for this study by conducting observations and interviews at UPT Puskesmas Mandala.

2.1.3. Data Analysis

Data analysis is carried out in determining the criteria and sub criteria used and then converted into weights to obtain priorities and data ratios. The method used is Analytical Hierarchy Processes [21].

2.1.4. Design

The following is the design of the Analytical Hierarchy Processes (AHP) method flowchart.

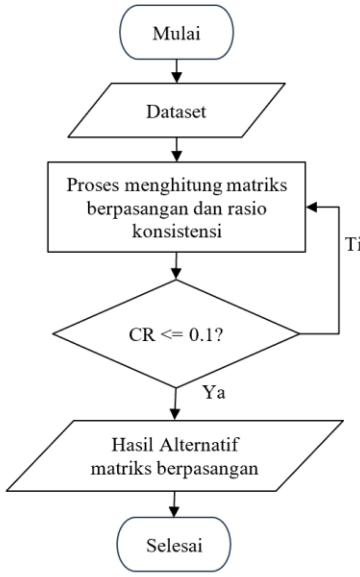


Figure 2. Flowchart of AHP Method

The following is a flowchart design of the AHP-based system to be developed:

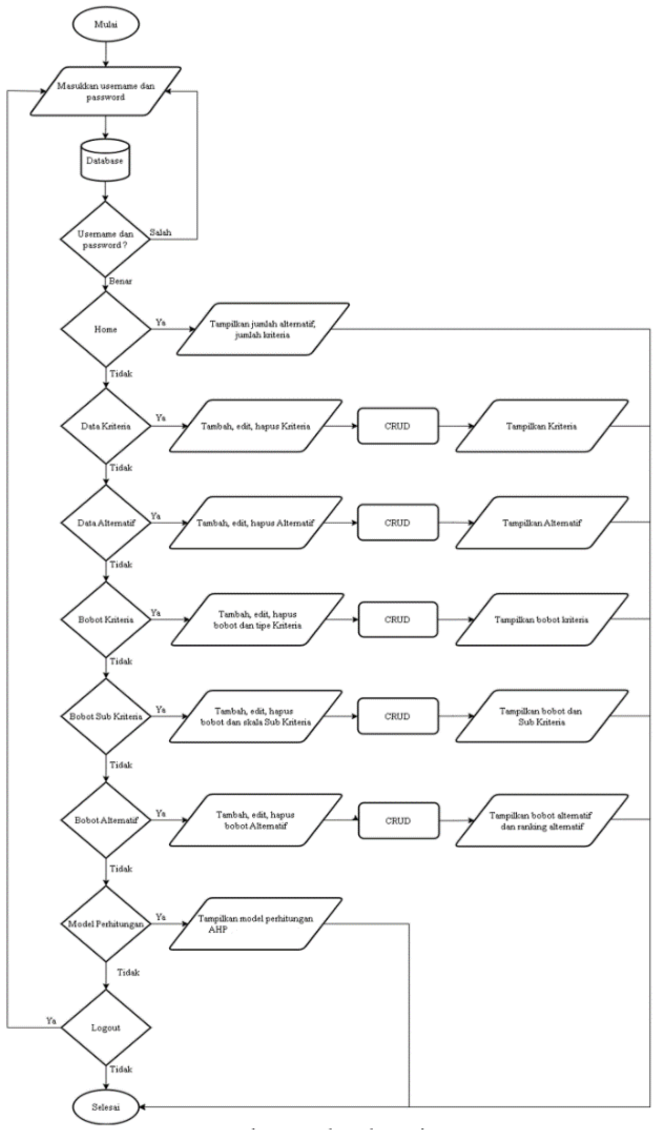


Figure 3. System Flowchat

In Figure 3 above is a system flowchart design based on the Analytical Hierarchy Process (AHP) method that will be built in this study.

1. Problem Identification and Objectives
   The initial step begins with identifying the problem to be solved and setting the objectives of decision making. In the context of this research, for example, the goal to be achieved is to determine the priority of drug procurement at the Puskesmas.
2. Developing a Hierarchical Structure
3. After the objectives are determined, a decision hierarchy structure is developed. This structure consists of:
   a. Level 1: The main objective (e.g., the most appropriate drug procurement).
   b. Level 2: Assessment criteria (e.g., price, effectiveness, availability, and expiry).
   c. Level 3: Preferred alternatives (e.g., Drug A, Drug B, and Drug C).
4. Developing a Pairwise Comparison Matrix
   Each element at one level is compared in pairs against the element at the level above it using Saaty's prioritisation scale (scale of 1 to 9). For example, comparing how important the effectiveness of a drug is compared to its price.
5. Calculating Priority Weight
   Based on the results of pairwise comparisons, the relative weight or priority vector of each criterion and alternative is calculated. This calculation is done using the eigenvector method.
6. Calculating Consistency Ratio (CR)
   The next step is to calculate the consistency ratio (CR) to ensure that the comparisons made are consistent. If $CR \leq 0.1$ then consistency is considered good. If $CR > 0.1$ then the comparison must be reviewed and revised.
7. Calculating Global Weight and Ranking Alternatives
   After the local weight of each element is known, the criteria and alternative weights are combined to obtain the global weight. From this global weight, an alternative ranking is obtained, where the alternative with the highest weight is considered the best choice.
8. Decision Making
   The final stage is decision making based on the results of alternative rankings. The alternative with the highest score is chosen as the best solution that best suits the original purpose of decision making.

2.1.5. Application of AHP Method

The application stage aims to test the Analytical Hierarchy Process (AHP) method [22] according to the priority weights that have been determined consistently, the alternatives used are the results of data collection at UPT Puskesmas Mandala, North Sumatra, in accordance with the criteria and sub criteria that have been determined so that they will get the results of the amount of UPT Puskesmas Mandala medicine.

3. RESULTS AND DISCUSSION

3.1. Data Analysis

Data collection was carried out at UPT Puskesmas Mandala on Jalan Cucak Rawa, Tegal Sari Mandala II, Kec. Medan Denai, Medan City, North Sumatra 20226. This study uses data on PT drugs at UPT Puskesmas Mandala, as in Table 1 below.

Table 1. Original Drug Data

Name of medicine	Price	Availability	Popularity	Effectiveness
Paracetamol	2000	3000	1970	9
Amoxicillin	5000	2500	1360	8
Ibuprofen	3000	2000	990	7
Cetirizine	4000	1500	845	8
Vitamin C	1500	3500	2930	9

3.1.1. Defınding Objectives, Criteria and Alternatives

Objective: Determine the best drug supply.
Criteria:

- Price
- Availability
- Popularity
- Effectiveness

Alternatives: Paracetamol, amoxicillin, ibuprofen, cetirizine, vitamin c.

3.1.2. Pairwise Comparison Matrix For Criteria

Pairwise comparison table between criteria based on Saaty scale (1-9):
1: Equally important
3: Somewhat more important
5: More important
7: Very much more important
9: Absolutely more important

Table 2. Data Normalisation

Criteria	Price	Availability	Popularity	Effectiveness
Price	1	3	5	7
Availability	1/3	1	3	5
Popularity	1/5	1/3	1	3
Effectiveness	1/7	1/5	1/3	1

Table 3. Matrix Normalisation

Criteria	Price	Availability	Popularity	Effectiveness
Price	1	3	5	7
Availability	1/3	1	3	5
Popularity	1/5	1/3	1	3
Effectiveness	1/7	1/5	1/3	1
TOTAL	1,67619	4,533333	9,333333	16

$$normalization = \frac{data\ awal}{total\ kolom}$$

$$\text{Price} = \frac{1}{1{,}67619} = 0{,}5966$$

$$\text{Availability} = \frac{3}{4{,}533333} = 0{,}6618$$

$$\text{Popularity} = \frac{5}{9{,}333333} = 0{,}5357$$

$$\text{Effectiveness} = \frac{7}{16} = 0{,}4375$$

Table 4. Data Normalisation Results

Criteria	Price	Availability	Popularity	Effectiveness
Price	0,5966	0,6618	0,5357	0,4375
Availability	0,1989	0,2206	0,3214	0,3125
Popularity	0,1193	0,0735	0,1071	0,1875
Effectiveness	0,0852	0,0441	0,0357	0,0625

$$price\ priority\ weight = \frac{0{,}5966 + 0{,}6618 + 0{,}5357 + 0{,}4375}{4} = 0{,}5579$$

$$availability\ priority\ weight = \frac{0{,}1989 + 0{,}2206 + 0{,}3214 + 0{,}3125}{4} = 0{,}2633$$

$$popularity\ weight = \frac{0{,}1193 + 0{,}0735 + 0{,}1071 + 0{,}1875}{4} = 0{,}1219$$

$$priority\ weight\ effectiveness = \frac{0{,}0852 + 0{,}0441 + 0{,}0357 + 0{,}0625}{4} = 0{,}0569$$

Table 5. Consistency Matrix Results

Criteria	Price	Availability	Popularity	Effectiveness	Priority Weight
Price	0,5966	0,6618	0,5357	0,4375	0,5579
Availability	0,1989	0,2206	0,3214	0,3125	0,2633
Popularity	0,1193	0,0735	0,1071	0,1875	0,1219
Effectiveness	0,0852	0,0441	0,0357	0,0625	0,0569

$$Price = 1 \times 0{,}5579 = 0{,}5579$$
$$availability = 3 \times 0{,}2633 = 0{,}7900$$
$$popularity = 5 \times 0{,}1219 = 0{,}6094$$
$$Effectiveness = 7 \times 0{,}0569 = 0{,}3982$$
$$price\ results = 0{,}5579 + 0{,}7900 + 0{,}6094 + 0{,}3982 = 2{,}3555$$

Table 6. Initial Priority Weight Results

Criteria	Price	Availability	Popularity	Effectiveness	Results
Price	0,5579	0,7900	0,6094	0,3982	2,3555
Availability	0,1860	0,2633	0,3656	0,2844	1,0994
Popularity	0,1116	0,0878	0,1219	0,1707	0,4919
Effectiveness	0,0797	0,0527	0,0406	0,0569	0,2299

$$Price = \frac{2{,}3555}{0{,}5579} = 4{,}222174676$$
$$availability = \frac{1{,}0994}{0{,}2633} = 4{,}174659294$$

$$popularity = \frac{0{,}4919}{0{,}1219} = 4{,}036199804$$

$$effectiveness = \frac{0{,}2299}{0{,}0569} = 4{,}040828887$$

Table 7. Priority Weighting Results

Criteria	Price	Availability	Popularity	Effectiveness	Results	Result/Weight
Price	0,5579	0,7900	0,6094	0,3982	2,3555	4,222174676
Availability	0,1860	0,2633	0,3656	0,2844	1,0994	4,174659294
Popularity	0,1116	0,0878	0,1219	0,1707	0,4919	4,036199804
Effectiveness	0,0797	0,0527	0,0406	0,0569	0,2299	4,040828887

Calculate the average quotient (λ_{max}):

$$\lambda_{max} = \frac{(4{,}222 + 4{,}174 + 4{,}036 + 4{,}0408)}{4} = 4{,}1184$$

Calculate Consistency Index (CI):

$$CI = \frac{\lambda_{max} - n}{n - 1}$$
$$CI = \frac{4{,}1184 - 4}{4 - 1} = 0{,}0394$$

Calculate Consistency Ratio (CR):

$$CR = \frac{CI}{RI} = \frac{0{,}394}{0{,}90} = 0{,}0438$$

Random Index (RI) is the reference value for calculating Consistency Ratio (CR) in Analytic Hierarchy Process (AHP). RI depends on the matrix size (n)-that is, the number of criteria being compared. The RI value is derived from a randomised experiment conducted by Thomas Saaty, the creator of the AHP method.

Conclusion
Since CR<0.1CR<0.1CR<0.1, the matrix is consistent.
Priority weights can be used to make decisions based on criteria.
The assessment of each alternative based on each criterion is carried out using a certain evaluation scale.
1-5: 1 (Very Poor) to 5 (Very Good)

Give a value or score based on the four criteria:
Price: For example in rupiah (smaller is better → minimisation).
Availability: The amount of medicine in stock (more is better → maximisation).
Popularity: Based on the amount of demand or usage rate (maximisation).
Effectiveness: Qualitative assessment that can be quantified (maximisation).

3.2. Data Pre-processing

The data pre-processing stage is carried out to prepare and convert initial data into a format suitable for analysis using the Analytical Hierarchy Process (AHP) method. This process includes scoring, data normalisation, integrated weight calculation, to determine the total score and final ranking of each drug alternative.

Then, the summation of all integrated weight values for each alternative is carried out. These results are presented in Table 12, which lists the total score of each drug as the final result of data processing.

The results show that Vitamin C occupies the first position with the highest score (0.327915), followed by Paracetamol, Ibuprofen, Amoxicillin, and finally Cetirizine.

Table 8. Score Data Results

Drug Name	Price	Availability	Popularity	Effectiveness
Paracetamol	4	4	4	5
Amoxicillin	1	3	3	4
Ibuprofen	3	2	2	3
Cetirizine	2	1	1	4
Vitamin C	5	5	5	5

In Table 8 above, displays the results of the assessment scores for five drug alternatives based on four criteria, namely Price, Availability, Popularity, and Effectiveness. Scores are given based on observations and secondary data with an ordinal scale of 1-5, where a score of 5 indicates the best value for each criterion.

Next, normalisation was performed on each column (criteria) as shown in Table 9 below, to avoid the influence of different scales between criteria. Normalisation is done with the formula:

$$normalization = \frac{dinitial\ data}{total\ columns}$$

Table 9. Normalisation of Assessment Scores

Drug Name	Price	Availability	Popularity	Effectiveness
Paracetamol	4	4	4	5
Amoxicillin	1	3	3	4
Ibuprofen	3	2	2	3
Cetirizine	2	1	1	4
Vitamin C	5	5	5	5
Total	15	15	15	21

$$normalization = \frac{data\ awal}{total\ kolom}$$

$$price = \frac{4}{15} = 0{,}2667$$

$$availability = \frac{4}{15} = 0{,}266666667$$

$$poupularity = \frac{4}{15} = 0{,}266666667$$

$$effectiveness = \frac{5}{21} = 0{,}238095238$$

Table 10. Availability, poupularity and effectiveness results

Name of medicine	Price	Availability	Popularity	Effectiveness
Paracetamol	0,266666667	0,266666667	0,266666667	0,238095238
Amoxicillin	0,066666667	0,2	0,2	0,19047619
Ibuprofen	0,2	0,133333333	0,133333333	0,142857143
Cetirizine	0,133333333	0,066666667	0,066666667	0,19047619
Vitamin C	0,333333333	0,333333333	0,333333333	0,238095238

$$price = 0{,}266666667 \times 0{,}5579 = 0{,}1488$$
$$availability = 0{,}266666667 \times 0{,}2633 = 0{,}070225363$$
$$poupularity = 0{,}266666667 \times 0{,}1219 = 0{,}032499363$$
$$effectiveness = 0{,}238095238 \times 0{,}0569 = 0{,}013545191$$

The results of normalisation of all alternatives are shown in Table 10 above, which shows the relative value of each drug against each criterion.

The next step is to multiply the normalised value by the priority weight of each criterion obtained from the AHP process. The results of this calculation are displayed in Table 11 below as the integrated value of each drug per criterion.

Table 11. Results of availability, poupularity and effectiveness

Drug Name	Price	Availability	Popularity	Effectiveness
Paracetamol	0,1488	0,070225363	0,032499363	0,013545191
Amoxicillin	0,0372	0,052669022	0,024374523	0,010836153
Ibuprofen	0,1116	0,035112681	0,016249682	0,008127114
Cetirizine	0,0744	0,017556341	0,008124841	0,010836153
Vitamin C	0,186	0,087781704	0,040624204	0,013545191

$$paracetamol = 0{,}1488 + 0{,}070225363 + 0{,}032499363 + 0{,}013545191 = 0{,}265041$$
$$amoxillin = 0{,}0372 + 0{,}052669022 + 0{,}024374523 + 0{,}010836153 = 0{,}125073$$

$$ibuprofen = 0{,}1116 + 0{,}035112681 + 0{,}016249682 + 0{,}008127114 = 0{,}171068$$
$$cetirizine = 0{,}0744 + 0{,}017556341 + 0{,}008124841 + 0{,}010836153 = 0{,}110903$$
$$vitamin\ c = 0{,}186 + 0{,}087781704 + 0{,}040624204 + 0{,}013545191 = 0{,}327915$$

Table 12. Availability, poupularity and effectiveness results

Drug Name	Price	Availability	Popularity	Effectiveness	Total
Paracetamol	0,1488	0,070225363	0,032499363	0,013545191	0,265041
Amoxicillin	0,0372	0,052669022	0,024374523	0,010836153	0,125073
Ibuprofen	0,1116	0,035112681	0,016249682	0,008127114	0,171068
Cetirizine	0,0744	0,017556341	0,008124841	0,010836153	0,110903
Vitamin C	0,186	0,087781704	0,040624204	0,013545191	0,327915

Then, the sum of all integrated weight values for each alternative is done. These results are presented in Table 12 above, which lists the total value of each drug as the final result of data processing.

Based on the total score, a ranking of the five drug alternatives is performed as shown in Table 13 below. The results show that Vitamin C occupies the first position with the highest score (0.327915), followed by Paracetamol, Ibuprofen, Amoxicillin, and finally Cetirizine.

Table 13: Ranking of Alternatives based on total score.

Drug Name	Total	Rank
Vitamin C	0,327915	1
Paracetamol	0,265041	2
Ibuprofen	0,171068	3
Amoxicillin	0,125073	4
Cetirizine	0,110903	5

1. The Vitamin C drug obtained the highest score of 0.327915, thus ranking first.
2. Cetirizine drug has the lowest score (0.110903) so it is ranked 5th.

These results show that Vitamin C drugs are the top priority in inventory based on AHP calculations with predetermined criteria.

3.3. Discussion

RapidMiner is an opensource software created using the java programming language so that it can be accessed by all operating systems. RapidMiner can be a solution in conducting data mining analysis, using descriptive and predictive techniques provided to users so that they can make the best decisions. RapidMiner used in this research is RapidMiner version 9.8.

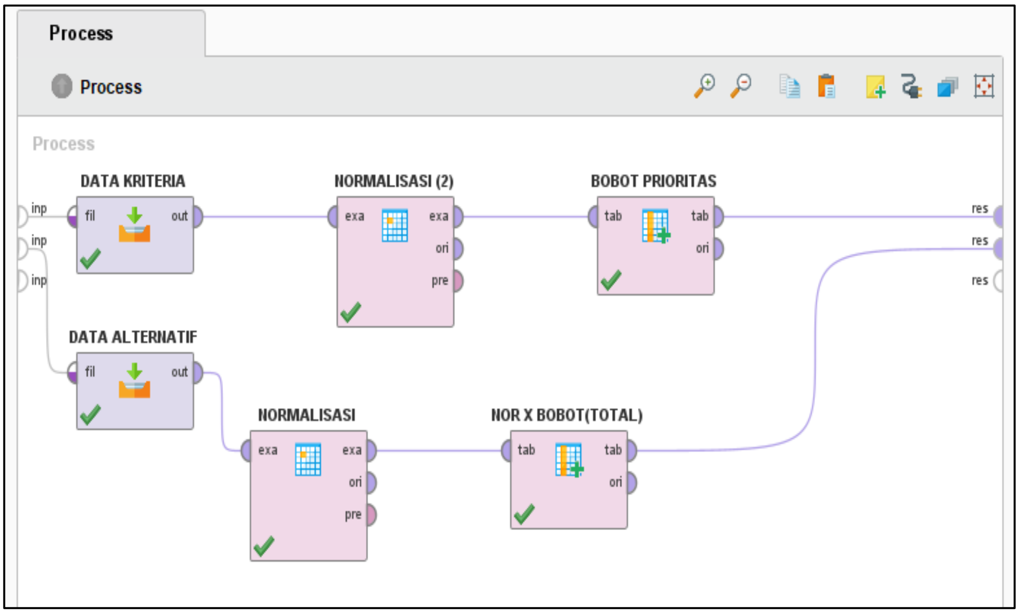


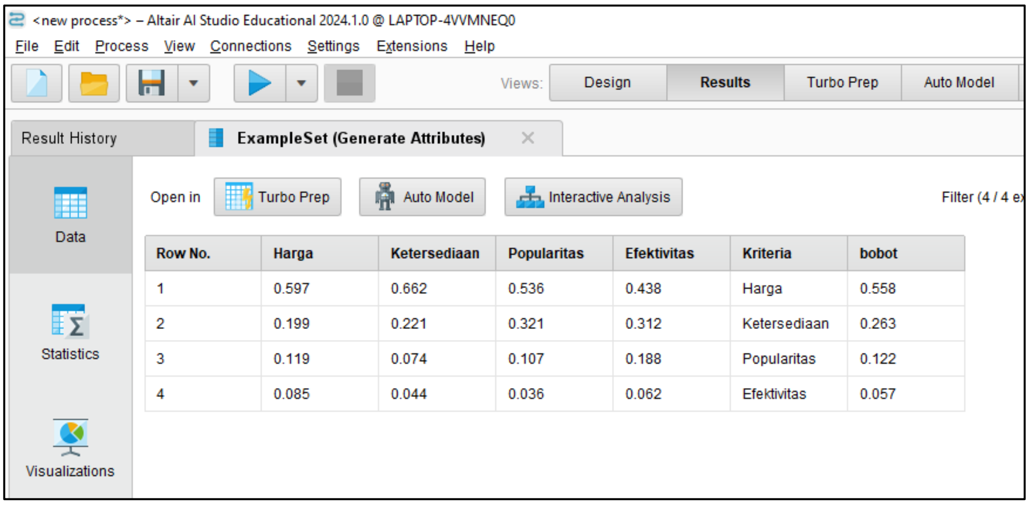
Figure 4. Normalisation of Pairwise Comparison Matrix for Criteria and Priority Weights

In Figure 4 above, illustrates the process of normalising the pairwise comparison matrix and calculating priority weights in the AHP method using RapidMiner. This process starts from two main inputs, namely Criteria Data and Alternative Data, which are entered in file format (Read Excel or Read CSV operator).

The first step is Normalisation (2) of the Criteria Data, which aims to standardise the pairwise comparison values so that each column has a total of 1. This is done to ensure that the calculation of criteria weights can be done proportionally.

The result of this normalisation is then passed to the Priority Weight operator, where the weights are calculated by taking the average of each row of the normalisation matrix. This weight represents the relative importance of each criterion in decision making.

In parallel, the Alternatives Data is also normalised through a similar process. The output of alternative normalisation is combined with the weighted results of the criteria in the Nor x Weight (Total) process. This operator multiplies the alternative normalisation scores with the previously calculated criteria weights. The goal is to produce a total score for each alternative based on the weight contribution of each criterion. This entire process results in a final priority value for each alternative, which is then used to determine the order or priority of the pharmaceutical logistics intervention programme based on the AHP method.



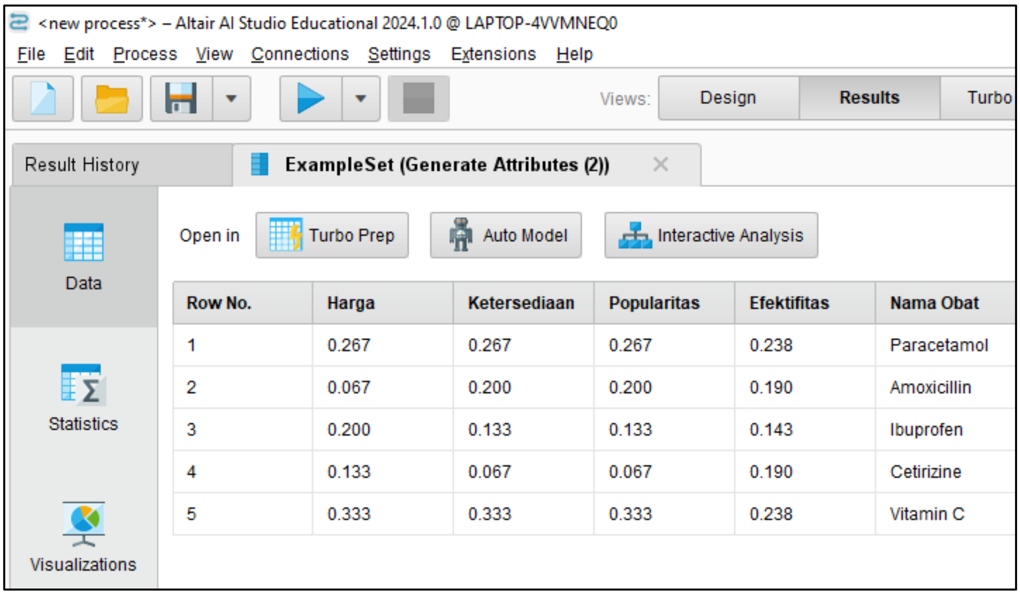
Row No.	Harga	Ketersediaan	Popularitas	Efektivitas	Kriteria	bobot
1	0.597	0.662	0.536	0.438	Harga	0.558
2	0.199	0.221	0.321	0.312	Ketersediaan	0.263
3	0.119	0.074	0.107	0.188	Popularitas	0.122
4	0.085	0.044	0.036	0.062	Efektivitas	0.057

Figure 5. Normalisation of Assessment Score 1

In Figure 5 above, displays the results of normalising the assessment matrix on each criterion in the AHP (Analytical Hierarchy Process) method, as well as determining the final weight of each criterion. This step begins with the normalisation process of comparison values between criteria such as Price, Availability, Popularity, and

Effectiveness which are then calculated on average to obtain the priority weight of each criterion. The weight value shows how much each criterion contributes to the final decision.
For example:

- The Price criterion has the highest weight of 0.558, meaning it is the most dominant factor in decision making.
- While Effectiveness is only 0.057, so it has the least influence.

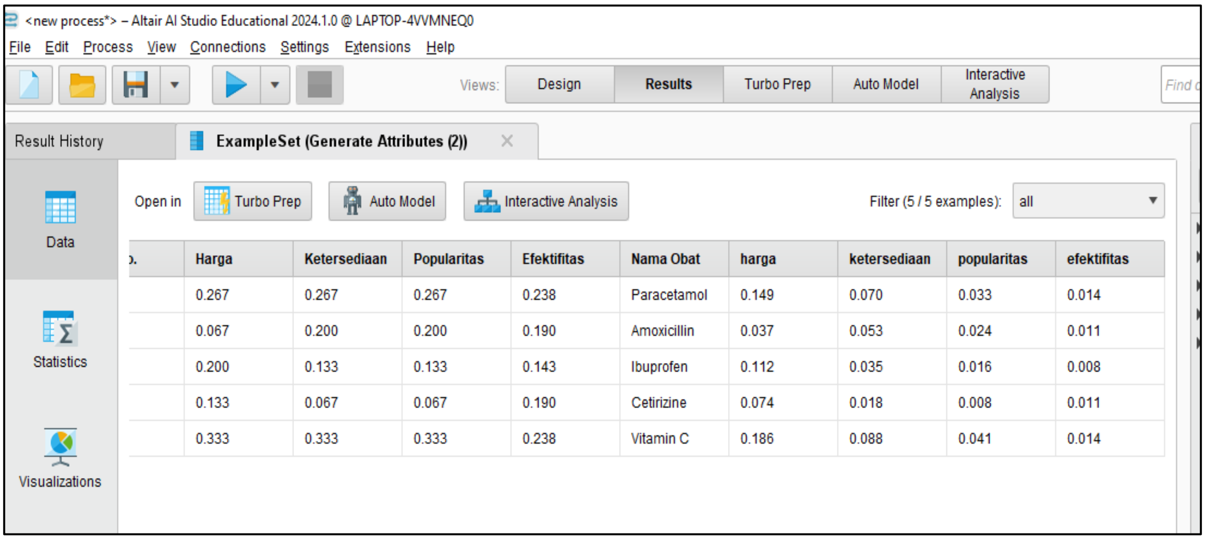


Row No.	Harga	Ketersediaan	Popularitas	Efektifitas	Nama Obat
1	0.267	0.267	0.267	0.238	Paracetamol
2	0.067	0.200	0.200	0.190	Amoxicillin
3	0.200	0.133	0.133	0.143	Ibuprofen
4	0.133	0.067	0.067	0.190	Cetirizine
5	0.333	0.333	0.333	0.238	Vitamin C

Figure 6. Normalisation of Assessment Score 2

In Figure 6 above, shows the results of normalising alternative assessment scores based on predetermined criteria, namely: Price, Availability, Popularity, and Effectiveness. This process is an advanced stage after the criteria weights are obtained from AHP (see Figure 5). The values in each row represent drug alternatives, while the columns display the normalised values of each criterion for each alternative. This normalisation aims to make all values on a comparable scale (generally between 0 and 1), making it easier to calculate the final score using the weights of each criterion.
Example:

- Paracetamol has a value of 0.267 for Price, Availability, and Popularity, and 0.238 for Effectiveness.
- Vitamin C occupies the highest score on the three main criteria (all 0.333), which indicates a relative advantage over other alternatives before multiplying by the weights.



Harga	Ketersediaan	Popularitas	Efektifitas	Nama Obat	harga	ketersediaan	popularitas	efektifitas
0.267	0.267	0.267	0.238	Paracetamol	0.149	0.070	0.033	0.014
0.067	0.200	0.200	0.190	Amoxicillin	0.037	0.053	0.024	0.011
0.200	0.133	0.133	0.143	Ibuprofen	0.112	0.035	0.016	0.008
0.133	0.067	0.067	0.190	Cetirizine	0.074	0.018	0.008	0.011
0.333	0.333	0.333	0.238	Vitamin C	0.186	0.088	0.041	0.014

Figure 7. Final Score Calculation Results for Each Alternative

In Figure 7 above, presents the final results of the calculation of the score of each alternative in the decision-making process using the AHP method. This score is obtained from the process of combining the normalised value of each alternative with the weight of each criterion. Each score in the table is the result of multiplying the normalised value of alternatives (such as price, availability, popularity, and effectiveness) with the priority weight of each criterion.

For example, the alternative "Paracetamol" has a multiplied value:

- Price: $0.267 \times 0.558 = 0.149$
- Availability: $0.267 \times 0.263 = 0.070$
- Popularity: $0.267 \times 0.122 = 0.033$
- Effectiveness: $0.238 \times 0.057 = 0.014$

Then all these values are summed up to get the final score of Paracetamol:

$$0.149 + 0.070 + 0.033 + 0.014 = 0.266$$

The same process is done for other alternatives such as Amoxicillin, Ibuprofen, Cetirizine, and Vitamin C. The total score becomes the basis for ranking the alternatives. This total score becomes the basis for determining the ranking or priority of each alternative, where the highest value indicates the most recommended alternative.

4. CONLUSIONS

Based on the results of the analysis conducted in this study, it can be concluded that Vitamin C drugs are the top priority in planning drug supply needs at UPT Puskesmas Mandala, with the highest score of 0.327915. Meanwhile, Cetirizine obtained the lowest score of 0.110903 and ranked last in the priority list. This finding shows that the Analytical Hierarchy Process (AHP) method is able to provide measurable results in determining the priority scale of drugs based on predetermined criteria.

5. SUGGESTIONS

The author realises that there are still shortcomings in the writing process and the development of the system used in this study, both from a technical and conceptual perspective. In addition, the limitations in taking drug datasets from UPT Puskesmas Mandala are also an important note, because there are still discrepancies that can affect the accuracy of the analysis results.

Therefore, it is recommended that in future research, the data collection process be carried out more thoroughly and systematically so that the results obtained become more accurate and can be used as a basis for making more optimal decisions.

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