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Analytical Hierarchy Process (AHP) in Decision Support System for Assessing Service Performance of Puskesmas Muaro Jambi

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Abstract
This research explores the use of the Analytic Hierarchy Process (AHP) as a decision-making tool for evaluating Pusat Kesehatan Masyarakat (Puskesmas) service performance. The study aims to demonstrate the effectiveness and usefulness of AHP in navigating complex decision-making processes. The AHP approach was employed to analyze collected data and assign priority levels and weights to various criteria, including health promotion, environmental health, maternal and child health (including family planning), nutrition improvement, disease prevention, treatment initiatives, and health development efforts. The system encompasses various data processing stages – from user and criteria data to value categories, sub-criteria, alternatives, and assessments. Ultimately, the system generated output in the form of ranking reports and visually presented final results. Among the Puskesmas services assessed, Puskesmas Tanjung emerged as the top performer, scoring a final value of 0.743389.

Keywords: Analytic Hierarchy Process, AHP, Decision Making, Puskesmas, Service performance, Weights, Criteria, Sub-Criteria, Alternatives, Assessment, Puskesmas Tanjung
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1.0 INTRODUCTION

Indonesia's Ministry of Health Regulation No. 75 of 2019 defines health services as collaborative efforts undertaken by individuals and organizations (Kemenkes, 2019). These combined actions aim to maintain and improve the overall health and well-being of the community. The regulations emphasize achieving a level of community health that fulfills the public's aspirations and needs. This objective is pursued through the provision of effective services by healthcare personnel, while also recognizing the importance of addressing the needs and aspirations of these service providers within the healthcare system (Sanjaya, 2023). Puskesmas (Pusat Kesehatan Masyarakat) are public primary healthcare facilities in Indonesia which is a crucial component of the healthcare system in Indonesia (Kemenkes, 2019). Puskesmas is responsible for providing basic health services to the community at the primary level, and its role is pivotal in ensuring access to quality healthcare for the public. Despite various efforts to enhance Puskesmas' performance, challenges persist. One significant challenge lies in effective decision-making regarding resource allocation and service improvement. This complexity arises from multiple factors influencing Puskesmas performance, including human resources, medical equipment, physical facilities, and other intricate elements. In this context, the Analytic Hierarchy Process (AHP) offers a systematic and structured approach to assess Puskesmas' performance. AHP has many advantages in explaining the decision-making process, one is that it can be depicted graphically so that it is easy to understand for all parties involved in decision-making (Rahmawati & Maukar, 2021).

The AHP method enables decision-makers to identify the most significant factors in performance evaluation, measure the importance of each factor, and make pairwise comparisons among them. Consequently, AHP assists stakeholders in determining effective priorities for improvement and resource allocation. This research aims to enhance transparency, objectivity, and effectiveness in evaluating Puskesmas' performance. Meanwhile, the benefits of this research include Facilitating the Dinas Kesehatan Kabupaten Muaro Jambi in monitoring the performance of Puskesmas services and Providing information about Puskesmas services to the community. By integrating the AHP method with the Puskesmas context, the study provides a framework for informed decision-making by stakeholders, including Puskesmas management, to enhance community healthcare services. Thus, this research contributes to the overall improvement of healthcare delivery.

Evaluating Puskesmas' performance is vital for maintaining adequate healthcare quality and driving continuous improvement. In our research, we employ the Analytic Hierarchy Process (AHP) method to assess Puskesmas' performance. As part of our study, we examined several Puskesmas as alternative samples in Kabupaten Muaro Jambi, that is Puskesmas Jambi Kecil (A1), Puskesmas Penyengat Olak (A2), Puskesmas Sengeti (A3), Puskesmas Sekernan Ilir (A4), Puskesmas Tanjung (A5). By integrating the AHP method with these indicators, we aim to enhance healthcare delivery, allocate resources effectively, and ensure better health outcomes for the community.

There have been various studies conducted on decision support systems for evaluating the performance of community health centers. One such study was conducted by Sugianto (2021), which evaluated customer satisfaction with the service performance of Puskesmas Galis Pamekasan. The study employed the quality grade descriptor method to identify any discrepancies between the actual service provided and the expected service, with a particular focus on the facilities and infrastructure of the Community Health Center (Sugianto, 2021).

Fuad and Wahyudi (2022) conducted a research study to assess the satisfaction level of customers at the Puskesmas Peneleh in Surabaya. To measure this, the Tsukamoto Fuzzy Inference System (FIS) algorithm was employed. The study evaluated several variables such as service outcomes, service requirements, supporting facilities, officer friendliness, and location (Fuad & Wahyudi, 2022).

The next research paper is by Sanjaya (2023), which discusses the analysis of patient satisfaction with the quality of health services at the UPTD Puskesmas Limusnunggal Sukabumi. The objective of this research is to determine the gap between patient expectations and service performance. The KANO method is used to measure patient satisfaction, which refers to the attributes of health services based on a questionnaire assessment that includes physical evidence, reliability, responsiveness, assurance, and empathy (Sanjaya, 2023).

Based on the background explanation above, the researcher wants to implement the AHP method to assist Dinas Kesehatan Muaro Jambi in assessing the performance of community health center services in the district. The following key indicators serve as criteria for our evaluation: Health Promotion (C1), Environmental Health (C2), Maternal and Child Health (C3), Community Nutrition Improvement (C4), Prevention and Control of Communicable Diseases (C5), Treatment effort (C6), and Health Development Efforts (C7).

2.0 LITERATURE REVIEW

Analytical Hierarchy Process (AHP) is a method in multi-attribute decision-making (MADM). Previous studies have found that the AHP method is one of the powerful and flexible weighted scoring decision-making processes to help people set priorities and make the best decision for complex or unstructured problems. Through a hierarchical process, AHP can break down criteria into several sub-criteria levels, until decision alternatives are performed. The AHP is capable of accommodating the experience and knowledge of the experts in defining the criteria affecting the decision process (Okfalisa, et al., 2021).

Another definition states that AHP is a multi-criteria decision-making approach that allows several criteria or alternatives to be ranked and their relative importance to be evaluated. Hierarchically structured models can include measurable and unmeasurable, quantitative and qualitative elements, judgments, and subjective opinions. AHP allows decision-makers to balance quantitative and qualitative factors based on their relative relevance. When the decision-making process is complex and ambiguous, such as technology assessment or knowledge management, this technique is very useful. AHP can assist decision-makers in making better informed and accurate choices by combining expert views and subjective judgment (Abadi, Gumanti, Susianto, & Ariningrum, 2023)

AHP uses verbal quantity or quality to allow participants to combine their subjective expert research input, personal experience, expressed expert opinions, and intuition. One of the key strengths of AHP is the pair-wise comparison, as described in the case study, where the influence of the components at a given level is measured to a minimum. Once a matrix is formed, the relative weight of each element is obtained. (Sriram, Ramachandran, Chinnasamy, & Mathivanan, 2022)

The uniqueness of this method compared to other methods is that this method determines the criteria weights (Wj) based on the evaluation results of the criteria weight matrix rather than being determined in advance by stakeholders compared to other methods (Latif et al. 2018, p. 43). The process of weighting is carried out using intuitive pairwise comparisons (Marimin & Maghfiroh, 2011). One of the advantages of AHP is that it can take into account the validity to the limit of tolerance for in-concentration as the criteria and alternatives chosen by decision-makers (Adnan, et al., 2021). The stages of the problem-solving procedure using the AHP method are as follows (Kusrini. 2017, p.135):

1. Identify the problem and determine the desired solution, then compile a hierarchy of the problems faced.
2. Create a hierarchical structure that starts with the general goal, followed by criteria and alternative choices.
3. Create a pairwise comparison matrix that describes the relative contribution or influence of each element to the goals or criteria at the level above it. Comparisons are made based on the choice or judgment of the decision maker by assessing the level of importance of one element compared to other elements.
   a. Add up the values from each column in the matrix.
   b. Divide each value of the column by the total of the column in question to obtain the normalization matrix.
   c. Add up the values from each row and divide by the number of elements to get the average value.

4. Measure Consistency. The things done in this step are as follows:
   a. Multiply each value in the first column by the relative priority of the first element, the value in the second column by the relative priority of the second element, and so on.
   b. Add up each row
   c. The result of adding rows is divided by the relative priority element in question.
   d. Add up the quotient above with the number of elements present, the result is called λ max.
5. Calculate the Consistency Index (CI) with the formula: CI = (λmax – n)/n ..... (I)
   Where n = number of element
6. Calculate the Consistency Ratio (CR) using the formula: CR = CI/RI ..... (II)
   Where CR = Consistency Ratio
   CI = Consistency Index
   RI = Random Consistency Index
7. Checking the consistency of the hierarchy. If the value is more than 10%, then the judgment data assessment must be corrected. However, if the Consistency Ratio (CI/CR) is less than or equal to 0.1, then the calculated results can be declared correct.

3.0 METHODOLOGY

To assist in preparing this research, it is necessary to have a framework (framework) that has clear stages. This framework is the steps that will be taken in solving the problem that will be discussed. The research framework that will be used is as follows:

1. **Identify problems at the Puskesmas Muaro Jambi.** This is one of the research work steps that can be said to be the most important among others because this step will determine the quality of the research. In this step, researchers began to observe and identify problems at the Puskesmas Muaro Jambi.
2. **Analyzing problems at the Puskesmas Muaro Jambi**. After identifying the problem, researchers began to analyze the existing work system at the Muaro Jambi Health Office. To find out how it works and how to overcome problems with existing work systems. This analysis stage aims to find out what system is currently running at the Puskesmas Muaro Jambi.
3. **Collecting Community Health Center Data at the Puskesmas Muaro Jambi**. At this stage, data and information are collected by conducting interviews with the Sub-Coordinator of Primary Health Services and making direct observations to obtain accurate data.
4. **Analyze system requirements**. This step analyzes what data requirements are needed to implement the AHP method for the Muaro Jambi Community Health Center Service Performance Assessment System.
5. **Building Software.** The next step is to build web-based software that uses the Laravel programming language. This software is related to the implementation of the AHP method for the Muaro Jambi Community Health Center Service Performance Assessment System, which has several features such as information on community health center services that have received the best ranking.
6. **Implementing Software.** The next step is to implement the AHP method for the Muaro Jambi Community Health Center service performance assessment system.

4.0 RESULTS AND DISCUSSION

The result of this research is the implementation of the AHP method in the form of web-based Muaro Jambi Community Health Center service performance assessment decision support system software as follows

1. **Admin Register Interface.** The Admin Register Interface in Figure 1 below is used by the Admin to access the main menu, apart from that it is also used for security from unwanted things. Admin fills in the username and password before entering the main menu on Implementation of the Analytical Hierarchy Process Method for the Performance Appraisal System

Figure 1. Admin Register Interface

2. **Admin Dashboard Interface.** Figure 2 displays the admin dashboard interface used for inputting data related to the Implementation of the AHP Method for the Puskesmas Muaro Jambi Community Performance Assessment System.

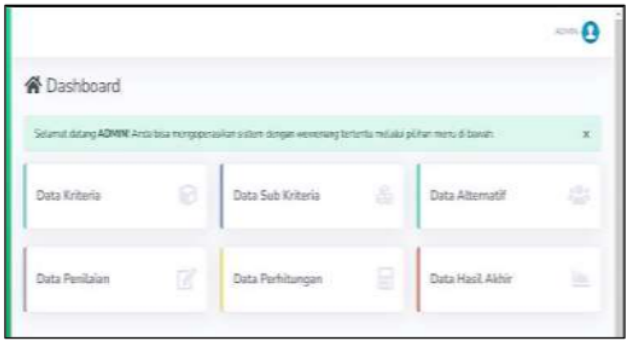

Figure 2. Admin Dashboard Interface

3. **Input Criteria Data Interface.**
Figure 3 shows the interface for the criteria data input for the Implementation of the AHP Method for the Puskesmas Muaro Jambi Performance Assessment System.

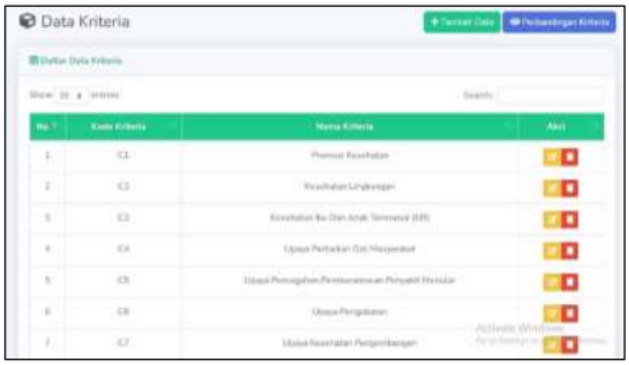

Figure 3. Input Criteria Data Interface

4. **Alternatives Data Input Interface.** The interface in Figure 4 contains an alternative data input page, namely data from the Community Health Center in Muaro Jambi Regency that will be assessed.

Figure 4. Alternatives Data Input Interface

5. **Criterion Value Data Input Interface.** The display in Figure 5 is the interface used by the admin to input the criterion value using pairwise comparisons based on a Saaty comparison scale of 1-9

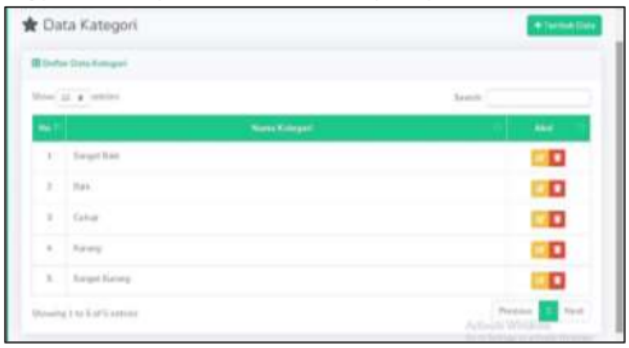

Figure 5. Weight Category Data Input Interface

6. **Pairwise Comparison Matrix Interface.** Figure 6 shows the interface pairwise comparisons matrix for each criterion.

Figure 6. Pairwise Comparison Matrix Interface.

7. **Data Normalization Interface.** After assigning values to the pairwise comparison matrix, the next step is to normalize the matrix data. Figure 7 below is an interface that displays the results of normalizing pairwise comparison matrix data.

Figure 7. Data Normalization Interface

8. **Matrix Addition Interface**. After normalizing the pairwise comparison matrix, the next step is to add up the values in each column of the matrix. Figure 8 below shows the interface displaying the results of adding each column of the matrix.

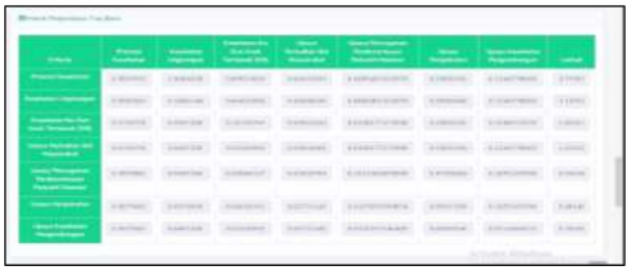

Figure 8. Matrix addition Interface

9. **Ratio Consistency Interface.** Figure 9 below displays the results of the consistency ratio of the pairwise comparison matrix data

Figure 9. Ratio Consistency Interface

10. **Ranking Output Interface.** The ranking results of each alternative for each assessment criterion are displayed in Figure 10 below

Figure 10. Ranking Output Interface

5.0 CONCLUSION

The Analytical Hierarchy Process (AHP) is a powerful tool that can help evaluate the performance of community health centers (Puskesmas). According to research, understanding the assessment criteria is critical to achieving successful outcomes. Assessment criteria can cover aspects like waiting time, service quality, and patient satisfaction. By utilizing AHP, relevant stakeholders can provide inputs that help determine the weightage for each criterion. This can help identify factors that significantly impact Puskesmas' performance, such as waiting time, medicine availability, medical staff expertise, facilities, and patient satisfaction. Additionally, AHP allows for sensitivity analysis, which helps assess how changes in criteria weights or rankings can affect the evaluation outcome. This feature can assist in evaluating uncertainties in the assessment process, making it a comprehensive evaluation method. By implementing the AHP method, Puskesmas can identify areas that need improvement and allocate resources accordingly. This, in turn, can help improve the quality of healthcare services provided to the community.

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