Implementation of Analytical Hierarchy Process in Selection of Prospective Nurses

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Abstract—Nurses are the spearhead of whether or not health services are provided to patients because for 24 hours nurses always interact with patients. Good service is inseparable from the commitment of nurses to provide good service to patients. The decision support system (DSS) is the application of an information system that is intended only as a management tool in decision making. The decision support system is designed to produce a variety of alternatives offered to decision makers in carrying out their duties. AHP was developed to compile a problem into a hierarchy which is then weighted (determining priorities) based on the perception of decision makers to choose the best decision. In decision making, the thing that needs to be considered is at the time of data collection, where this data is expected to be close to the real value, for example, the degree of consumer interest can be done with a pairwise comparison approach. The process of recruiting prospective nurses depends on the number of nurses needed. If the nurses needed are 5 people, then prospective nurses named Nurse 1, Nurse 2, Nurse 3, Nurse 4, and Nurse 5 have a greater chance of being accepted as nurses.

Keywords: AHP, Application, Decision Support System, Decision Making, Decision Makers

1. INTRODUCTION

The hospital is an organization that was formed because of the increasingly complex demands of community needs because people began to realize the importance of health. This requires hospitals to provide maximum service to the community. These demands will be made more severe in facing the current era of globalization whose changes are very fast and simultaneous if not followed by the existence of professional and high-quality hospital Human Resources (HR). In the health care system in hospitals, in addition to doctors, nurses and midwives also have a very important position. Nurses are the spearhead of whether or not health services are provided to patients because for 24 hours nurses always interact with patients. Good service is inseparable from the commitment of nurses to provide good service to patients.

Nursing services in hospitals are an inseparable part of health services as a whole. Even as one of the determining factors for the quality of services and the image of the hospital. The field of nursing is one of the structural organizations within the hospital that is administrative and coordinative, under the coordination and responsibility of the Deputy Director of Medical and Nursing Services. In improving services to patients, the Hospital selectively recruits nurses, so that the test process, both written and practical, is carried out so that the standard is accepted or not in accordance with the test results. However, the process of assessing the results of the nurse test at the Hospital is carried out by manual calculation, which is to add up the importance values and divided by the number of criteria, nurses who meet the value criteria determined by the Hospital will be sorted by value to be taken the best according to needs[1]–[3].

The management of human resources of a company greatly affects many aspects of determining the work success of the company. If human resources can be organized properly, it is hoped that the company can carry out all its business processes properly. Likewise, in a hospital, the involvement of nurses in a hospital is very vital. Proper selection is needed so that in the future nothing unexpected happens. Therefore, the existence of a Decision Support System is very necessary for the selection / acceptance of nurses in hospitals. In this case, the Decision Support System will help the personnel management in carrying out an assessment of the selection / acceptance of nurses so that the personnel management can get prospective nurses who have the best value without taking a long time and costing a large enough time, so that the person is worthy of working at the hospital optimally and can last for a long time[4], [5].

The decision support system (DSS) is the application of an information system that is intended only as a management tool in decision making. The decision support system is designed to produce a variety of alternatives offered to decision makers in carrying out their duties. The decision support system unites the capabilities of computers in interactive service to their users with the process of processing or manipulating data that utilizes unstructured models or rules so as to produce situational decision alternatives. DSS can improve communication and collaboration among decision makers. Under the right circumstances, the DSS can provide a means to share

facts and assumptions. Data regarding DSS on the company's operations are available to managers and therefore can encourage fact-based decision making. Frequent increased data accessibility is a key motivation for building a DSS.

Analytical Hierarchy Process (AHP) is a measurement method used to find the best ratio scale of discrete and continental paired comparisons[6]. AHP is very suitable and flexible is used to determine decisions that help a person to make efficient and effective decisions based on all aspects he has[7]–[10]. AHP was developed to compile a problem into a hierarchy which is then weighted (determining priorities) based on the perception of decision makers to choose the best decision[11], [12]. In decision making, the thing that needs to be considered is at the time of data collection, where this data is expected to be close to the real value, for example, the degree of consumer interest can be done with a pairwise comparison approach[13], [14]. Pairwise comparisons are often used to determine the relative importance of the elements and the existing criteria. The paired comparison is repeated for all elements in each level. The element with the highest weight is a choice of decisions worth considering to take[15]–[18]. For each criterion and alternative, we must do a pairwise comparison, that is, comparing each element with the other elements at each level of the hierarchy in pairs so that the value of the element's importance is obtained in the form of a qualitative opinion[19], [20].

The Analytic Hierarchy Process (AHP) method is one of the methods in the Multi Criteria Decision Method (MCDM) that can provide solutions to support decision makers in determining the quality of teachers to be assessed. The results of this study are in the form of an application to determine the quality of teachers based on assessments assessed from four criteria with 19 sub-criteria. Based on the experimental results, the criteria used for the consistency of weighted priority level analysis were found to be consistent and the best teacher quality based on all available alternatives. So that the results of alternative rankings can be used as a basic guideline to help decision making.

2. RESEARCH METHODS

2.1 Stages of Research

To carry out the research requires several stages that must be carried out[21]. There are three outlines of the research stages, namely the planning stage, the research implementation and the research reporting stage[22]. Research activities are a process that is used to acquire or obtain knowledge or solve problems faced which are carried out systematically, and logically[23]. These stages of research are generally carried out for all types of research of any kind, because broadly speaking these stages have similar elements, although there are some differences such as poking in their implementation by researchers according to the conditions and situations faced without neglecting the general principles used in the research process[24], [25].The stages of the research carried out can be seen in Figure 1.

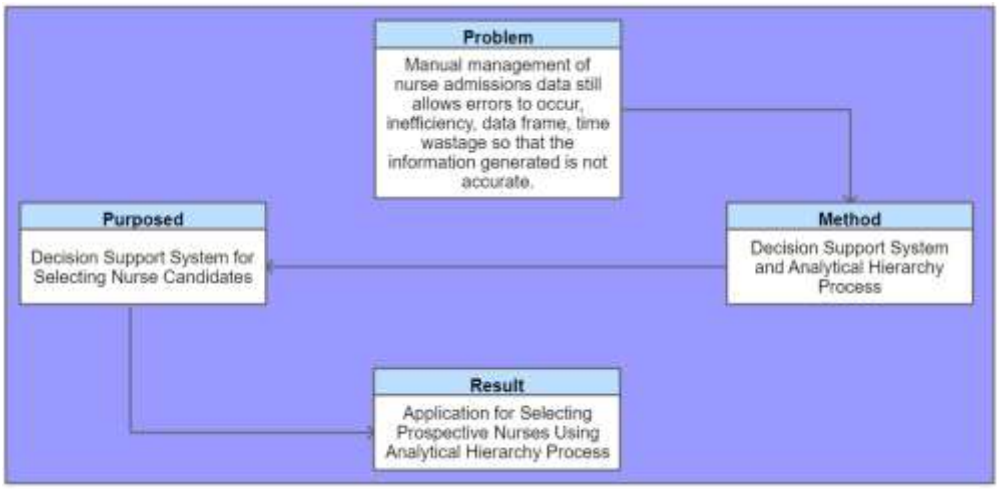

Figure 1. Stages of Research

The first stage of determining the problem in the selection of nurse candidates is obtained based on interviews and obervation there is a problem, namely Manual management of nurse admissions data still allows errors to occur, inefficiency, data frame, time wastage so that the information generated is not accurate. The next stage of the method used is the decision support system and analytical hierarchy process. The goal to be achieved in this study is the decision support system for selecting nurse candidates. The desired result is an application for selecting prospective nurses using analytical hierarchy process.

2.2 Analytical Hierarchy Process (AHP)

The procedures or steps in the AHP method include[26]:

a. Define the problem and determine the desired solution, then build a hierarchy of the problem at hand.
b. Determine the priority of the element.
   1. The first step in determining the priority of elements is to make a comparison of pairs, that is, to compare the elements in pairs according to the given criteria.
   2. Pairwise comparison matrices are filled using numbers to represent the relative importance of an element to another.
c. Synthesis
   Considerations of pairwise comparisons are censored to obtain the overall priority. The things that are done in this step are:
   1. Sum the values of each column on the metric
   2. Divide each value of a column by the total of the corresponding column to obtain matrix normalization
   3. Sum the values of each row and divide them with the number of elements to get the average value
d. Bend Consistency
   In decision making, it is important to know how good consistency there is because we do not want decisions based on considerations with low consistency. The things that are done in this step are:
   1. 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
   2. Sum each row
   3. The result of the summation of rows divided by the corresponding relative priority element
   4. Sum up the quotient above with the number of elements present, the result is called λ max
e. Calculate index (CI) consistency with the formula:
   $$(CI) = (\lambda \text{ max-n})/n \quad (1)$$
   where n = number of elements
f. Calculate the Consistency Ratio (CR) with the formula
   $$CR = CI / RC \quad (2)$$
   where :
   CR = Consistency Ratio
   CI = Consistency Index
   IR = Random Consistency Index
g. Check the consistency of the hierarchy.
   If the value is more than 10%, then the assessment of the judgment data should be corrected. However, if the consistency ratio (CI /IR) is less or equal to 0.1, then the calculation results can be declared correct. The list of Random Consistency Indexes (IR) can be seen in table 1 as follows:

Tabel 1. List of Consistency Random Indexes

Matrix Size	Value IR
1,2	0,00
3	0,58
4	0,90
5	1,12
6	1,24
7	1,32
8	1,41
9	1,45
10	1,49
11	1,51
12	1,48
13	1,56
14	1,57
15	1,59

3. RESULTS AND DISCUSSIONS

3.1 AHP Calculation Steps

The criteria used in this study are Written Test Scores (UT), Intelligence Scores (UI), Interview Scores (NW), Practice Scores (NP). The first process carried out is the calculation of the hierarchical weighting factor for all criteria. The number 1 in the UT column of the UT row describes the same level of importance between UT and UT, while the number 2 in the NW column of the UT row indicates that NW is slightly more important than UT, and so on. Then the comparison matrix of the results of the above preferences is

Tabel 1. Pairwise Comparison Matrix

	UT	NI	NW	NP
UT	1	2	2	3
NI	0.5	1	2	2
NW	0.5	0.5	1	2
NP	0.33	0.5	0.5	1
Sum	2.33	4	5.5	8

The number 1 in the UT column of row NI is the result of the calculation of 1 / value in the UT column of row NI (2). Other figures are obtained in the same way.

Tabel 3. Criteria Value Calculation Matrix

	UT	NI	NW	NP	Sum	Priority
UT	0.43	0.5	0.36	0.38	1.67	0.42
NI	0.21	0.25	0.36	0.25	1.08	0.27
NW	0.21	0.13	0.18	0.25	0.77	0.19
NP	0.14	0.13	0.09	0.13	0.48	0.12

The value of 0.43 in the UT column of the UT row is obtained from the UT column value of the UT row of table 7 divided by the number of UT columns of table 7 as well as other numbers obtained in the same way. The priority value obtained from the summation on each row is then divided by the number of criteria, in this case 4.

Tabel 4. Matrix Of The Sum Of Each Row

	UT	NI	NW	NP	Sum
UT	0.42	0.54	0.38	0.36	1.70
NI	0.21	0.27	0.38	0.24	1.10
NW	0.21	0.14	0.19	0.24	0.78
NP	0.14	0.14	0.1	0.12	0.50

The value of 0.42 in the UT row of the UT column is obtained from the ut row priority in table 8 (0.43) multiplied by the value of row K of column K in table 7 (1). The value in the sum column is obtained from the summation on each row.

Tabel 5. Consistency Ratio Calculation

	Sum	Priority	Result
UT	1.70	0.42	2.12
NI	1.10	0.27	1.37
NW	0.78	0.19	0.97
NP	0.50	0.12	0.62
Jumlah			5.08

Furthermore, the maximum priority value (λ maximum) is obtained by summing the results of the Consistency Ratio calculation and then divided by n (the number of criteria). The maximum priority values that can be obtained are:

$$\lambda \text{ maksimum} = \frac{\text{Number of Consistency Ratio Results}}{n} = \frac{5{,}08}{4} = 1{,}27$$

Since the matrix is ordered 4 (i.e. consists of 4 criteria), the value of the consistency index obtained :

$$CI = \frac{\lambda \text{ max}}{4} - \frac{n}{4} = \frac{1{,}27}{4} - \frac{4}{4} = -2{,}73 = -0{,}68$$

for n=4, RI= 0.90 (Tabel *Saaty*), so:

$$CR = \frac{CI}{RI} = \frac{-0{,}68}{0{,}90} = -0{,}75 < 0{,}1$$

because the CR < 0.1 means that respondents' preferences are consistent.

3.2 Calculation of Selection of Nurse Candidates Using AHP

Example of value data on 10 prospective nurses in table 3. below, based on the test results obtained scores:

Tabel 6. Prospective Nurse Value Data

Number	Name	Assessment of Prospective Nurses			
		UT	NI	NW	NP
1	Nurse 1	77	80	84	78
2	Nurse 2	85	90	75	88
3	Nurse 3	90	80	78	80
4	Nurse 4	80	87	85	90
5	Nurse 5	89	78	90	85
6	Nurse 6	76	75	65	68
7	Nurse 7	78	85	78	75
8	Nurse 8	78	87	86	68
9	Nurse 9	90	78	85	87
10	Nurse 10	78	87	76	78

After the calculation process is carried out using AHP, the results are obtained

Tabel 7. Final Results

Number	Name	Assessment of Prospective Nurses				
		UT	NI	NW	NP	Total
1	Nurse 1	32.34	21.6	15.96	9.36	79.26
2	Nurse 2	35.7	24.3	14.25	10.56	84.81
3	Nurse 3	37.8	21.6	14.82	9.6	83.82
4	Nurse 4	33.6	23.49	16.15	10.8	84.04
5	Nurse 5	37.38	21.06	17.1	10.2	85.74
6	Nurse 6	31.92	20.25	12.35	8.16	72.68
7	Nurse 7	32.76	22.95	14.82	9	79.53
8	Nurse 8	32.76	23.49	16.34	8.16	80.75
9	Nurse 9	37.8	21.06	16.15	10.44	85.45
10	Nurse 10	32.76	23.49	14.44	9.36	80.05

Finally, make a ranking of the final grades of prospective nurses by determining the ranking of the highest prospective nurses

Tabel 8. Results Based on Rankings

Rank	Name	Nurse Candidate Assessment				
		UT	NI	NW	NP	Total
1	Nurse 5	37.38	21.06	17.1	10.2	85.74
2	Nurse 9	37.8	21.06	16.15	10.44	85.45
3	Nurse 2	35.7	24.3	14.25	10.56	84.81
4	Nurse 4	33.6	23.49	16.15	10.8	84.04
5	Nurse 3	37.8	21.6	14.82	9.6	83.82
6	Nurse 8	32.76	23.49	16.34	8.16	80.75
7	Nurse 10	32.76	23.49	14.44	9.36	80.05
8	Nurse 7	32.76	22.95	14.82	9	79.53
9	Nurse 1	32.34	21.6	15.96	9.36	79.26
10	Nurse 6	31.92	20.25	12.35	8.16	72.68

The results of the calculation using the AHP method above are obtained : The process of recruiting prospective nurses depends on the number of nurses needed. Based on the final calculation results then Nurse 5 got a score of 85.74, Nurse 9 got a score of 85.45, Nurse 2 got a score of 84.81, Nurse 4 got a value of 84.04, Nurse 3 got a value of 83.82, Nurse 8 got a score of 80.75, Nurse 10 got a value of 80.05, Nurse 7 got a value of 79.53, Nurse 1 get a score of 79.26, Nurse 6 gets a score of 72.68.

4. CONCLUSION

The criteria used in this study are Written Test Scores (UT), Intelligence Scores (UI), Interview Scores (NW), Practice Scores (NP). Based on the final calculation results then Nurse 5 got a score of 85.74, Nurse 9 got a score of 85.45, Nurse 2 got a score of 84.81, Nurse 4 got a value of 84.04, Nurse 3 got a value of 83.82, Nurse 8 got a score of 80.75, Nurse 10 got a value of 80.05, Nurse 7 got a value of 79.53, Nurse 1 get a score of 79.26, Nurse 6 gets a score of 72.68.The process of recruiting prospective nurses depends on the number of nurses needed. If the nurses needed are 5 people, then prospective nurses named Nurse 1, Nurse 2, Nurse 3, Nurse 4, and Nurse 5 have a greater chance of being accepted as nurses. As for prospective nurses who pass outside the top 5, they still have a chance if there are prospective nurses in the top 5 positions who fail to be tested last, namely medical tests.

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