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APPLICATION OF FACTOR ANALYSIS ON THE SATISFACTION AT REGIONAL GENERAL HOSPITAL SOE

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Abstract

The demands to improve the quality of work in a hospital means that ever hospital needs to continually evaluate the existing work performance. One way is to evaluate the patients' satisfaction with the hospital services. This research aims to describe the covariance correlation among many related variables (multicollinearity), to know the factors that influence the satisfaction of hospitalized patients and to analyse the most dominant factors that influence the satisfaction of hospitalized patients, at the Soe Regional General Hospital.

This research was conducted at the Soe regional general hospital. The data used in this research was primary data through questionnaires, which were answered by 94 respondents as samples; and 1567 as the population, the error tolerance is 10%. The secondary data was obtained from the hospital. In this research, factors analysis was used to reduce seventeen variables, namely information clarity, accuracy of diagnosis, accuracy of drug administration, accuracy of food delivery, food hygiene, work speed, comfortable environment, additional equipment, security standard, hospital equipment security, work competence, hospital staff neatness, architectural design, price, location, image, and communication. Based on the analysis, three new variables were obtained called factors. These three factors are health staff competence, patients' comfort and the support for patients' comfort. The result shows that the dominant competency factor of health staff, influenced the hospitalized patients' comfort. Those factors consisted of accuracy of diagnosis, accuracy of drug administration, standard of feeding accuracy, food hygiene, work speed, image, and communication. This indicates that the work performance in hospitals, especially work competency in Soe regional general hospital, is quite good and it makes patients feel satisfied with the services available.

Keywords:*patients' satisfaction, hospital services, factor analysis.*

Introduction

In line with the overall and equitable development process in all aspects of life, health services are not only for the needs of certain people but is for everyone without considering social, economic or political characteristics. Therefore, the main task of the health sector is to maintain and to improve the health of all citizens.

The health service needed is not only to cure. Communities need quality health services, namely appropriate, friendly and trustworthy services, so that consumers can feel satisfied. Furthermore, Puspitasari (2011: 50)(G & M, 2011) states that patients are not just concerned with the result of recovery, but also assess what they see and feel in their hospitalization. This is also supported by Jacobis (2013: 620)(Jacobis, 2013) who states that hospital consumers or patients demand quality service which not only about recovery of physical illness or improving their health status, but is also about satisfaction on attitudes of the medical staff, the availability of facilities, the adequate infrastructure; and the comfortable physical environment.

Hospital is one of the health facilities where the medical process is carried out by maintaining approach, promotive, preventive, curative and rehabilitative. Based on this function, the hospitals must be able to provide quality health services, because the increasing of hospital services can improve the satisfaction of inpatients. Cronin et al. (Laoharsirichaikul, 2011:

4)(Laohasirichaikul, Chaipoopirutana, & Combs, 2011) argues that the quality of hospital services can also be observed from patients' satisfaction. Furthermore, Draper and Hill (1996: 457)(Draper & Hill, 1996) states that patient satisfaction information can be an important input to improve the quality services in a hospital. Therefore, the hospital management must have a plan and consistently continue to carry out monitoring and evaluation to observe what things are needed to fulfil the patient needs. By this evaluation, the hospital can make improvements and change in order to create quality service and patient satisfaction.

Soe Regional General Hospital is a health service center authorized by the local government for the people in Soe city. One of the services provided is hospitalization. Based on the observations conducted by researchers, the service provided is not maximal. This can be seen from the patients' complaints about services regarding nurses' disobedience, lack of facilities and the poor cleanness of the hospital environment. By examples of problems encountered, the researchers assumed that the hospital needed to conduct an evaluation on services carried out, particularly hospitalization services.

Factor analysis is a multiple variables method aiming to explain the correlation among many correlated variables, which are difficult to be observed; transforming into fewer variables that are possible to be observed (Supranto, 2004)(J, 2004). By this technique, we can observe a number of underlying factors and can identify what factors are represented conceptually.

According the above description, the researchers are interested in helping the hospital in evaluating the services provided by examining the patient satisfaction towards the available services. The researchers chose factor analysis to analyze the influence factors of patients' satisfaction towards services at the Soe Regional General Hospital.

Materials and Method

This research was conducted at Soe Regional General Hospital, South Central Timor Regency on December 27, 2010 until January 14, 2011. This type of research is quantitative research. This study was implemented at in 5 rooms at the hospital; the VIP Room, Orchid Room, Rose Room, Melati Room and the Bougenvil Room. The population was chosen 3 months before the study. In October, there were 548 patients, November 476 patients, and December 543 patients. The number of patients involved, as a population during October to December 2010, was 1576. Then, the researchers determined the sample with the criteria of the patients being sampled. The criteria is:

1. Patients who are hospitalized for at least 36 hours.
2. Patients who are less than 15 years old can be represented by parents.

The determination of the sample size used the Yamane formule. The population is 1567 using precision degree of 10%. Therefore, the sample size of 94 was obtained.

The data collection technique was conducted by distributing questionnaires to 94 samples. For each variable in the questionnaire, the researcher distributed 2 questions, where each question contained 5 answers with the lowest score of 1 and the highest score of 5. Thus, each variable has the smallest score of 2 and the largest score of 10. Based on the scale score given by each respondent for each variable, researchers can determine the correlation score of each factor formed in the next analysis, called a factor analysis. The score of the correlation of each factor is positive and negative. The smaller the scale score obtained, the correlation of these factors is negative. Conversely, if the larger scale score is obtained, the correlation of these factors is positive. By this correlation score, the researchers interpreted the factors formed in the next analysis, namely factor analysis.

Results and Discussions

Patients' Characteristic

a. *Patients' Age*

According to the age classification, the largest age bracket is from 20 to 24 years with 22.3%, while the smallest age bracket is 45 to 49 years with 3.19%.

b. *Gender*

Based on patients' sex classification, there were 43 female patients (45.74%) and 42 men (44.68%).

c. *Education*

The education degree of respondents varies from elementary school to college. The largest percentage of respondents had a high school education (36.17%) and the lowest percentage of respondents had college degrees (12.76%).

Factor Analysis

a. *Bartlett, Kaiser Meiyer Olkin Test (KMO) dan Measures Of Adequacy (MSA)*

Using SPSS 16.0 software, factor analysis was begun with a preliminary test, namely the test of Bartlett, Kaiser Meiyer Olkin (KMO) and Measures Of Adequacy (MSA). This showed that each variable is feasible to be analyzed both in terms of correlation, KMO and MSA, which bigger than 0.5. To know the magnitude of the correlation, the test used KMO and Bartlett's Test. The results of the analysis are as follows:

Table 1 shows that the chi-square score is 795,321 at the free degree 136, with a significance degree of 0,000 far under 0.05. It can also be seen that the KMO score is 0.887 (> 0.50), this shows that all variables are sufficient for factor analysis.

In the next stage, we see the score of the MSA (Measure of Sampling Adequacy) for each variable. This MSA score is needed to know the magnitude of partial correlation between variables. This test was carried out by observing the MSA numbers ranging from 0 to 1, with the criteria:

a. MSA = 1, variables can be predicted without errors by other variables
b. MSA ≥ 0.5, variables can still be predicted and can be analyzed further.
c. MSA <0.5, variables cannot be predicted and cannot be analyzed further or excluded from other variables.

The table of Anti-image Matrices showed that at the bottom (Anti-image Correlation), particularly on the correlation number with symbol *a* (diagonal direction from top left to bottom right); all MSA numbers are above 0.5, except the first variable of information clarity which is 0.436. This means that the other sixteen variables can be treated to factor analysis while the first, the clarity of information, must be eliminated. After retesting, we obtain the following results:

Table 2 shows the KMO score at 0.899 with significance 0.000. The process of eliminating variables with MSA under 0.5, is the information clarity variable (0.436). The previous result will increase the total of the KMO score from 0.887 to 0.899. Therefore, the number is above 0.5 and significantly under 0.05, so the factor analysis can be done at the next stage.

Significance is the ability to make a generalized conclusion. If there is significance degree of 0.000, it means that the data or sample is able to provide an overall conclusion about the population; that there is correlation among variables with 100% confidence degree and 0% error rate. In general, the error rate of 0.05 or 5% is rarely accepted. Therefore, a significance degree under 0.05 is the appropriate degree of significance to show that factor analysis is worthy to be used as further analysis.

As explained in the previous explanation, the determination of freedom among variables can be analyzed by the Chi square test considering the assumption that:

H_0 : Correlation matrix is identity matrix

H_1 : Correlation matrix is not identity matrix

To prove that there is unfreedom variable or correlation, it can be shown by rejecting H_0 or

$$\chi^2_{obs} > \chi^2 \alpha, \frac{p(p-1)}{2}$$

Where, $$\chi^2 = -\left[(n-1) - \frac{(2p+5)}{6}\right] \ln|R|$$

and the determinant score R always closes to zero, in such a case the determinant score used is 0.000136. The MSA score at each variable is greater than 0.5. Therefore, the factor analysis is feasible to be conducted and, it really has a correlation among variables.; this shows the influence among these variables. Therefore, the factor analysis is feasible to be carried out as further analysis. This is called the Main Component Analysis.

b. Factoring

Factoring is a core process in factor analysis which treats reductions on existing variables; one or more factors are formed containing a number of variables. There are many useful methods to carry out the reduction process. However, in this study, researchers used the main component method (Principal Component Analysis). In the main component method, we will determine how many main components will be formed; it will be used to analyze further until the factors are obtained.

Criteria for determining the number of factors formed can be seen from factors with eigen scores greater than 1. From the results of the correlation matrix, eigen scores were obtained as follows.

From table 3 we obtain:

$\lambda_1 = 7.397$ $\lambda_2 = 1.393$ $\lambda_3 = 1.072$ $\lambda_4 = 0.868$

$\lambda_5 = 0.825$ $\lambda_6 = 0.782$ $\lambda_7 = 0{,}618$ $\lambda_8 = 0.527$

$\lambda_9 = 0.480$ $\lambda_{10} = 0.38$ $\lambda_{11} = 0{,}356$ $\lambda_{12} = 0.349$

$\lambda_{13} = 0.30$ $\lambda_{14} = 0{,}231$ $\lambda_{15} = 0.209$ $\lambda_{16} = 0.200$

There are just λ_1, λ_2 and λ_3 which have scores above 1 so that there are just 3 factors that will be formed. In the main component method, determination of total diversity is needed to be able to observe how much information is expressed by the forming factors towards variables in that factor. Total diversity is obtained through:

$$\frac{\lambda}{tr(\lambda)} \times 100\%$$

$$tr(\lambda) = \sum_{i=1}^{16} \lambda_i = 16$$

$$\frac{\lambda}{tr(\lambda)} \times 100\%$$

$$tr(\lambda) = \sum_{i=1}^{16} \lambda_i = 16$$

Because there are just three factors formed, we obtained that:

a. Total diversity 1 = $\frac{7.397}{16}x100\% = 46.23\%$, means that factor 1 formed will explain 46.23%, for every variable included in factor 1.

b. Total diversity 2 = $\frac{1.396}{16}x100\% = 8.70\%$, indicating that factor 2 formed will indicate 8.70%, for every variable included in factor 2

c. Total diversity total 3 = $\frac{1.072}{16}x100\% = 6.70\%$, indicates that factor 3 formed will describe 6.70%, for every variable included into factor 3.

To see the variables included in every factor formed, the loading factor will be analyzed first. SPSS analysis obtained the component matrix shown in Table 4. The numbers in the table are loadings factor displaying correlation among variables with factor 1, factor 2, and factor 3.

The three factors are the most optimal numbers. The table of matrix components shows the distribution of the sixteen variables on the three factors formed. The process of determining what variables included into a factor is done by comparing the size of correlation on each row.

The correlation between diagnosis accuracy variable with factor 1 is 0.782 (strong because it is above 0.5), while the correlation between the diagnostic accuracy variables with factor 2 is -0.189 (low because it is under 0.5) and the correlation between the accuracy variables with factor 3 is -0.233 (low because it is under 0.5).

Since the largest loading factor number is in component number 1, the diagnosis accuracy variable can be included as component of factor 1. Thus, the sixteen variables have been reduced to be three factors, namely:

a. Factor 1

Factor 1 has a close and positive correlation with seven variables at once, namely accuracy of diagnosis, standard of feeding accuracy, accuracy of drug administration, food hygiene, work speed, image and communication. For ease of use, factor 1 is called the 'Health Officer Competency Factor'.

b. Factor 2

Factor 2 has a close and positive correlation to five variables all at once, namely; environmental security, equipment security, work competency, hospital staff neatness, and architectural design. For ease of use, factor 2 is called the 'Patient Comfort Factor'.

c. Factor 3

Factor 3 has a close and positive correlation to five variables, namely environmental comfort, additional facilities, price and location. For ease of use, this factor is called the 'Patient Comfort Supporting Factor'.

The Component Transformation Matrix component is used to see the magnitude of the correlation between factors formed with variables in these factors, and can also help to find the most dominant factor.

Based on the above, it can be obtained that the most dominant factor is the factor that has the biggest correlation value of 0.691. After obtaining the loading factor, the results will be analyzed as follows:

$$h_1^2 = \ell_{11}^2 + \ell_{12}^2 + \ell_{13}^2$$

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$$h_9^2 = \ell_{11}^2 + \ell_{12}^2 + \ell_{13}^2$$

$$h_1^2 = \ell_{11}^2 + \ell_{12}^2 + \ell_{13}^2$$

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$$h_9^2 = \ell_{11}^2 + \ell_{12}^2 + \ell_{13}^2$$

Then the scores are obtained as listed in table 6.

Table 6. shows the magnitude of the correlation between factors formed with commonalties. The existing scores indicate the ability of the factors formed in explaining the variance of commonalties. From the variable accuracy of diagnosis, it is found that the communal score is 0.701, which means that 70.1% of the factors formed are able to explain the variance of the accuracy of diagnosis variables; 45.1% of the factors formed are able to explain the variance of the variable accuracy of drug administration, and so on. The greater the communal score of a variable, the more closely related to the factors formed.

The final step in factor analysis is to form the factor analysis equation as follows:

$$X_1 - \mu_1 = L_{11}F_1 + L_{12}F_2 + \cdots + L_{1m}F_m + \varepsilon_1$$

$$\vdots$$

$$X_P - \mu_P = L_{P1}F_1 + L_{P2}F_2 + \cdots + L_{Pm}F_m + \varepsilon_P$$

Discussion

Factor analysis is a statistical analysis technique used to test the interrelationships of variables in a data set. Factor analysis has the advantage of being able to describe the diversity of data; many variables are reduced to be fewer variables, called factors, which can facilitate researchers to analyze data because it is small and realistic. The study on 17 factors can be compressed into 3 factors, so it can facilitate the interpretation of the results obtained. However, factor analysis cannot be conducted if there is no multicollinearity or correlation between variables. It can be seen from the results of data processing, that the information clarity variable, which has an MSA score under 0.5, must be eliminated; these variables are analyzed further without using the information clarity variable.

a. *Testing the Correlation Matrix using Bartlett Test.*

The determination of 17 variables, clarity of information, accuracy of diagnosis, accuracy of drug administration, standard of feeding accuracy, food hygiene, work speed, environmental comfort, additional equipment, security standards, hospital equipment security, work competency, hospital staff tidiness, design architecture, price, location, image, and communication are based on the observations of the researchers about what really supports patients' satisfaction. Before these variables are used in factor analysis, these variables are tested by preliminary analysis using Barttlet test, KMO test and MSA test. The Barttlet test tests the hypothesis that the correlation matrix is an identity matrix. From the results of data processing, the significant score of the Bartlett test is 0.000 (<0.5). The test using chi square approach, obtained a score of 772.592. If it is compared with the higher chi square test and the chi square table, the score is 773.064, which indicates that the correlation matrix is not an identity matrix. Therefore, the test result shows that factor analysis is feasible.

b. *Kaiser Meyer Olkin* (KMO)

KMO is a test used to compare the magnitude of the correlation coefficient with its partial correlation coefficient. In this test, a KMO score was obtained at 0.899 (> 0.5). The data obtained is sufficient; the suitability of the factor analysis model for the variables is also quite good.

c. *Measure of Sampling Adequacy* (MSA)

The score of MSA is presented in the table of anti-image matrices particularly at the bottom of the anti-image correlation. There are a set of numbers showing score of MSA. In the initial test, there is a variable with an MSA score under 0.5, namely variable of information clarity. Therefore, this variable must be eliminated and tested again. Then, in the second test, it was found that all MSA scores were above 0.5. This indicates that the variables correlate well and factor analysis can tested further.

d. *Factor Extraction*

In the factoring process, the method used to extract the sixteen variables is the main component method. Factor extraction is a phase aimed to produce a number of factors from existing data. The criteria for determining the number of new factors or components is the Latent Root criteria. Only factors with latent roots/eigenscore >1 are considered to fulfil the requirements as factors with eigen score7.397, 1.393 and 1.072, respectively. The uniqueness of these 16 root characteristics (Eigen score) obtained from the correlation matrix formed is that the number of all root characteristics are same as the number of variables analyzed, namely 16.

The selection of the main components formed is as much as m where m<p because, if the new component formed is same as communalities, the reduction goal is not reached. Therefore, new components are selected based on the criteria of greater eigen score or equal

to 1. A characteristic root shows the amount of contribution from each major component to the total diversity of all variables of the main component. With a diversity score smaller than one, it is not better than the communality because the communality has been standardized, which means the average is zero and its diversity is 1. From the sixteen variables, 3 components have an eigenscore which is bigger than 1. This can be seen in the tables and graphs of the existing plot scree. After obtaining new factors formed, we must look at loading factors that indicate the components of each factor formed from the existing variables. From the table presented, it can be seen that the variables accuracy of diagnosis, accuracy of feeding, accuracy of drug administration, food hygiene, work speed, environmental comfort, security standards, equipment security, work competency, hospital staff neatness, architecture design, price, location, and communication are included in factor 1 and the additional equipment variable is included in the second factor.

e. *Factors Rotation and Factors Naming*

The above description found a problem that there was no variables included in the third factor. However, there were three factors formed. Therefore, it is necessary to rotate the factors on all existing variables. The type of rotation used is the varimax rotation. The varimax rotation is included in orthogonal rotation. The superiority of varimax rotation, compared to other types of rotation, is that it is able to minimize the variable with high loading in the factor. As in the results of the previous data processing, there were 15 variables included in factor 1 after rotating, it was found that just 7 factors were included in factor 1, and when the variables with high loading in variable 1 is minimized, it will affect the number of components in factor 2; before rotated its components is 1, and after rotating the component, there becomes 5 factors for factor 3. Before rotating, it does not have a factor component but after rotating it has 4 components. The components of these three factors are formed from the existing variables, namely factor 1 consists of accuracy of diagnosis, accuracy of administration, accuracy of drug administration, food hygiene, work speed, image and communication. These factors are named as the competency factor of the officer. Factor 2 consists of standard environmental safety variables, equipment security, work competency, hospital staff neatness, architectural design. They are named as the patients' comfort factors. Factor 3 consists of the variables includes environmental comfort, additional equipment, price, and location. This factor is called the patients' comfort support factor. The three new components above have been able to describe most of the information contained in the communalities. This can be seen from the percentage of total diversity, which is equal to 61,641%; assuming that the extraction is stopped if the percentage of total diversity has reached at least 60% to 75% of all variants of the communality.

Conclusion

There are 17 variables analyzed, namely the clarity of Information, Accuracy of Diagnosis, Accuracy of Drug administration, Accuracy of Food delivery, Food Hygiene, Work Speed, Environmental Comfort, additional equipment, Security standards, Hospital Equipment Safety, Work Competence, Tidiness, Design Architecture, Price, Location, Image and Communication. Only the first variable that has a score of MSA (Measures of Sampling Adequacy) under 0.5, this means that all variables have sufficient observations to be predicted, except the first variable. Therefore, this variable must be eliminated and retested, and the remaining sixteen variables have sufficient observations to be analyzed. This shows the down side of factor analysis which can only reduce variables if these variables are multicollinearity. Based on the results of factor analysis with the main component method, the sixteen variables in this study were reduced to be 3 factors that strongly supported the satisfaction of hospitalized patients at Regional General Hospital Soe, namely: Officer Competency Factors, Patient Comfort Factors and Comfort Supporting Factors. The reduction process above indicates the advantages of factor analysis, which is able to reduce many variables into fewer variables so that it is easier to interpret the results. The dominant factor influencing the satisfaction of hospitalized patients, at the Regional General Hospital Soe, is the first factor, namely the Officer Competency factor; where the correlation score, based on the results of the Matrix Transformation Component, is 0.691.

Table 1. First Bartlett and KMO Test

Sampling Test for Kaiser-Meyer-Olkin (KMO)		0.887
Bartlett Test	Chi-square approach,	795.321
	free degree	136
	Significant	0.000

Table 2. The Second Barlett and KMO Test

The adequate sample testing of *Kaiser-Meyer-Olkin* (KMO)		0.899
Bartlett Test	Chi-square approach	772.592
	Free Degree	120

Significant.	0.000

Tabel 3. Eigen Score

Component	Eigen Score			Number of squares of weight		
	Total	% Variance	% cumulative	Total	% Variance	% cumulative
1	7.397	46.233	46.233	7.397	46.233	46.233
2	1.393	8.706	54.939	1.393	8.706	54.939
3	1.072	6.701	61.641	1.072	6.701	61.641
4	0.868	5.427	67.068			
5	0.825	5.158	72.225			
6	0.782	4.888	77.113			
7	0.618	3.862	80.976			
8	0.527	3.293	84.296			
9	0.428	2.998	87.267			
10	0.389	2.433	89.700			
11	0.356	2.224	91.924			
12	0.349	2.181	94.105			
13	0.304	1.900	96.005			
14	0.231	1.442	97.446			
15	0.209	1.303	98.750			
16	0.200	1.205	100.00			

Tabel 4. Matrix Components in Formed Factors

	Components		
	1	2	3

Accuracy of diagnosis	**0.782**	-0.189	-0.233
Standard of feeding accuracy	**0.573**	0.155	-0.314
Accuracy of Drug administration	**0.694**	-0.259	-0.289
Food hygiene	**0.640**	-0.152	-0.290
Work speed	**0.825**	0.086	-0.206
Comfortable Environment	**0.654**	0.430	-0.161
Addition equipments	0.466	**0.652**	0.266
Security Standard	**0.629**	0.025	0.452
Equipments security.	**0.627**	-0.347	0.396
Work Competence.	**0.715**	-0.284	0.192
Hospital staff neatness	**0.642**	-0.408	0.073
Architectural Design	**0.604**	-0.012	0.444
Price	**0.718**	0.256	-0.034
Location	**0.570**	0.414	0.057
Image	**0.825**	0.048	-0.086
Communication	**0.802**	-0.132	-0.027

Tabel 5. Component of Transformation Matrix

Component	1	2	3
1	**0.691**	0.544	0.476

2	- 0.268	**-0.419**	-0.868
3	-0.671	0.727	**0.144**

Tabel 6. Communalties

Variables	Extraction
Accuracy of diagnosis	0.701
Standard of feeding accuracy	0.451
Accuracy of Drug administration	0.632
Food Hygiene	0.516
Working speed	0.731
Comfortable environment	0.639
Additional equipment	0.713
Environment security	0.600
Equipment Security	0.670
Job competence	0.628
Hospital staff neatness	0.584
Design Architecture	0.562
Price	0.583
Location	0.499
Image	0.691
Communication	0.661

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