



Ranking of healthcare services quality factors using COPRAS RUGH in Imam Reza hospital

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Abstract:

Background and Objective: One of the most important factor of developing countries is the quality of services in health and hygiene. In this paper previous study on factors affecting the quality of health services show that prioritization of all factors has not been done. Therefore, in this paper, it is attempted to identify and rank the factors affecting the quality of health services.,

Method: our purpose is to rank final factor for strengthening factor and increasing the quality of healthcare services according to experts from Imam Reza hospital by using COPRAS RUGH. This research is launched to identify an evaluation of criteria. The case of study is considered Imam Reza hospital and the questionnaire paper distributed between 400 patients.

Results: The identified criteria are timeliness, capitalization, feasibility, and infrastructure. Based on the obtained final rating, it is detected that the standard of healthcare services presented in a hospital is a factor that can be expanded than others. Considering the newly established Imam Reza hospital in Qom province, the presentation of healthcare services requires an evaluation and repetitious inquiry until this hospital enables to present high-quality healthcare services.. After calculating the final value of each factor from positive and negative criteria, the ultimate value of each option will be calculated and standard and skill factors evaluated first and second factors respectively.

Conclusion: In fact, the ranking of factors above is important in management decisions and could be conducive to the concentration of managers on expressed factors

Keywords: Services quality, Quality, COPRAS, RUGH

Background and Objective

Due to the importance of the healthcare services section in value creation, in the domestic and international economy, complex situation and unanticipated business environments in the healthcare part, the managers of healthcare parts are always trying to confirm the customer orientation in their managed hospitals. However, due to source restrictions, first, the managers have to identify the requirements and expectations of their customers. Then by measuring perceptions of them from incoming services, the distance between expectations and perceptions of them is determined, and also, by exploiting from this information an appropriate solution that takes the lowest cost and most effectiveness in filling the existing gap could be selected¹.

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The main mission of hospitals is providing good quality of care for patients and fulfills their requirements and expectations. For the implementation of this important mission, it requires to make a basic meaning of quality in each hospital in a way that each member of this services agency considers it not only for a part of their duties and an individual duty but also as their capitulary duty. Based on numerous studies in hospitals services quality evaluation and patients satisfactory from the care of hospital it reflects this fact that there are many challenges and inconsistencies in this context². It seems that by introducing the quality principles in health part the process of services presentation can be improved and provided the customer satisfaction as a significantly sensitive element in nowadays competition³. And also by assessing the effectiveness of these services we can ensure from their quality⁴. Thereby, considering the importance of service quality evaluation factors in the Servqual model and similarly, the effectiveness of each part in the study can be used to improve services and made a perfectly normal stage of development in organizations' performance. In this paper, according to the articles the research has explored the ranking of factors of healthcare services quality in Imam Reza hospital under the supervision of the social security organization of Qom province in 2017 by using a synthesis type of COPRAS RUGH method. This action cause to identify and choose effective factors and will have lots of benefits as to how to manage, allocation of appropriate funds to essential factors, improve services and performance of the organization. Improving healthcare services quality at Imam Reza hospital is one of the main objectives of this research. By the way,

first of all, we should determine these two secondary objectives:

1. Identifying the effective factors on hospital services quality in Imam Reza hospital under the supervision of the social security organization of Qom province.
2. Determining the importance of each above factor by using the COPRAS RUGH method.

This research was conducted in Imam Reza Hospital in 2017, under the supervision of the Social Security Organization of Qom province. This hospital already had 125 beds and 43 personals. In addition, the hypothetical society of this research was divided into two groups' nominated staff and patients. In the staffs' group, all employees that have been working at least 2 years in this hospital considered as a research sample and in the group of patients who have been at least 72 hours in the hospital and were accessible and willing to cooperate in research selected as a sample of research.

Background of research

The information has been collected through the questionnaire focusing on quality, accessibility, interpersonal issues and determining the integration between the factors and elements of people's dissatisfaction in terms of quantitative conditions. The research findings indicate the satisfactory of repliers from presented services at the time they refer to the hospital. Ozturkcan et al. case study in 2009 about the effectiveness of Marmara University's hospital services quality on customer's satisfactory and ultimate royalty of them were verified. Study results which took place in Egyptian hospitals exposed that

patient's expectation about the quality of hospital services has an impression on their satisfaction from services and exactly in selecting the type of hospitals (public or private)⁵. Skaltsas et al. in a study of expectations and perceptions of Greek patients examined the received quality of dental care. The result of this research shows that their perceptions from presented services quality were indicated their high satisfaction from the observance of disinfection principles and sterilization (assurance dimension)⁶. However, in terms of service quality dimensions, the average satisfaction result of experiments, also the variables related to more satisfaction than emergency department care has been shown, the expectations and demands about the sympathy dimension (patient approach) and assurance dimension were placed in the head of the patient's priorities. In a study entitled patient satisfaction in the Moroccan emergency department Damghi (2013) engaged in measuring the quality of healthcare and improving patient satisfaction by healthy cares with the purpose of verifying the reliability and trust. The most reported problems from patients were expected time and were as follows: emergency or emergency patients compared to non-emergency patients and expected time less than 15minutes and the variables related to less satisfaction were as follows: The distance between patients' home until hospital (less than 10km), admission days and level of literacy that eventually the people with lower level of education were less satisfied than those with great and high levels of education⁷. In a study articulated patients' perception from the quality of care in the emergency department and identifying the zones for improving the quality, research had carried out by Muntlin, Gunningberg

and Carlsson (2006) in an emergency department at the Hospital of Sweden University. The participants were 99 women and 101 men with an average age of 51 years. In this study, the quality questionnaire for the patient perception used to gather the data⁸. Eventually, factors such as friendly atmosphere in the work environment, clean scene, supportive environment, equipment and skill combination and at the end employees' profile in quality understanding were influenced. In 2000 Lim and Tang determined the expectations and patients' satisfactory in Singapore hospitals. Expectations and perceptions of patients were examined by using the Servqual method. The analysis of 252 questionnaires filled by patients indicates from perception of patients that the dimension of sympathy has the highest importance and the dimension of response has the lowest importance in the Servqual method. Also in 2016 Chen and Tsai used a data frame based on the RUGH collection theory⁹. They had exploited improvement decisions to choose the place of the restaurant. In this research, they used RUGH'S theory to predict the operation of the store instead of location factors. Wang, and Xie in 2016 used RUGH collection and Fuzzy Topsis in research for analyzing problems of being unsuccessful in unreal environments¹⁰. In fact, in this project, they used RUGH theory as a collection for extracting quality data. In another research, entitled sustainable mobility by using the fuzzy COPRAS method, Parezanović and partners worked on evaluating these sustainable mobility actions (provides present needs without jeopardize the ability of future generations in providing their needs) based on qualitative information¹¹. The advised method for assessing sustainable mobility

actions and choosing the type of actions is fuzzy COPRAS. In this method, 26 evaluating actions and the most hopeful aspect of them have been selected. Ultimately, three actions as follows; information and competitive marketing, reserved the bus and HOV lanes, and improving the efficiency of city logistics with the solution of communication and information technology are known as the most useful actions. By the way, the obtained results could help decision-makers to adopt appropriate decisions that which sustainable mobility actions for implementation are reasonable according to their importance and criteria. In a new study were designed the treatment of customers based on the axial design method and considering the high growth of the data sets. In this article, the rules of customer treatment examined by using ROUGH set theory in a set of mobile phones. Eventually, as a result, managers of mobile phone factors enable us to learn reasonable strategies with mapping with ROUGH set theories and a design structure including a mental to attracting and retain customers. However, in table 1 services quality factors identified and categorized. In this table the following abbreviations are considered for different criteria. Care (C1), Method (C2), Communication (C3), Skill (C4), Experience (C5), Innovation (C6), Physically (C7), on time (C8), Completion (C9), Readiness (C10), precision(C11), Image (C12), Building designer (C13), Hygiene (C14), Cost(C15), Compensation(C16), Standard(C17).

Method

Considering the type of this research shows that it is quantitative research because of

statistical analysis methods, AHP and COPRAS RUGH have been used to prioritize factors of healthcare services quality at Imam Reza hospital. In terms of purpose, the present research is applied research because it pays to applied theories in healthcare services quality and no theorization has done in this research. Also in terms of method, research can be postulated as descriptive research because the researcher doesn't interfere with the research situation but only it describes conditions. An apt and suitable method of descriptive researches for data collection is the survey method. According to the methods of statistical analysis, AHP and COPRAS RUGH, the poll should be conducted from two societies. First of all, a questionnaire based on identified factors from the literature of research provided to the patients of Imam Reza hospital to determine which identified factors is important for patients of this hospital. In this study, initially by using the Cochran formula for unlimited communities the number of questionnaires that will be distributed among the patients is obtained.

$$n = \frac{z^2 pq}{d^2}$$

By considering amounts of 0.5 for p and q, 1.96 for z and 0.05 to d about 384 patients were specified that for being more assurance about 400 questionnaires were distributed. The sampling method was simple random and based on patient's accessibility and also to ranking final factors of healthcare services quality, the opinions of experts should be used because for collecting required data we need to high proficiency and unlikely, the staff working in the hospital and the patients haven't enough information and proficiency for commenting

on elements. For this reason, people with sufficient expert and experience in quality and healthcare services at Imam Reza hospital in Qom city should be chosen. Since the society of present research experts includes experts in the field of quality and healthcare services at Imam Reza hospital, the researcher selected a limited community of experts in the form of sample size by non-probability sampling method with selective and judicial approach that included 15 person of hospital managers and university faculty that the selection method of them were judgmental, non-random and based on accessibility. In this study, a statistical questionnaire is made by researchers measured the importance of healthcare services factors, a questionnaire with paired comparisons of healthcare services quality factors assessment criteria by using the AHP method and ranking healthcare services quality factors based on final criteria using COPRAS RUGH method. The questionnaires which are used have patterns and only factors of this study are placed in them. Exactly, this paired comparison questionnaire which is made by researchers used to collect information about each factor, answers research questions and reaches its goals. Completing the required information for the arrangement of questions is consulted with professors and indeed, their constructive comments are used. The paired comparisons questionnaire is designed and adjusted by the researcher to investigate the relationship between variables using the following resources:

1. Utilization from the results of research and implemented studies at country and abroad
2. Studying essays and books related to multi-criteria decision making science

3. Using comments of professors and consultants

For being more confident about all investigated factors that have importance under consideration of patients, first in a questionnaire with a 5-point Likert scale table (1), it is appealed from patients to relate their comments on the importance of having each index for a referral to the hospital.

Table 1: Likert scale

Linguistic variable	Corresponding number
Rarely	0
Low	1
Average	2
Much	3
Too much	4

After specifying the final indexes, the second questionnaire which includes the following 4 criteria (cost, time, possibility, infrastructure). Thus, the research steps can be expressed as follows:

First step: In this level, according to articles and past studies it was heeded to the history of researches in the field of quality of healthcare services and also, examining considered factors by diverse researchers to measuring the quality of services.

Second step: Considering these factors, the identified total factors of healthcare services by other researchers paid attention to collect data from patients of Imam Reza hospital based on the importance of the factors under their opinions.

Third step: According to the collected data from patients, the general analysis is taken and identified factors are rated due to the patient's opinion.

Fourth step: At this level, based on articles and researches, the criteria for rating the

factors of healthcare services quality are determined.

Fifth step: Organizing a pairwise comparisons matrix and weighting to criteria based on ranking criteria of healthcare services quality.

Sixth step: At this stage, we solved the COPRAS RUGH model and ranking the

factors is conducted according to experts' opinions.

Last step: Finally, the last ranking of identified factors of healthcare services is carried out. Figure 1 shows the research steps completely.

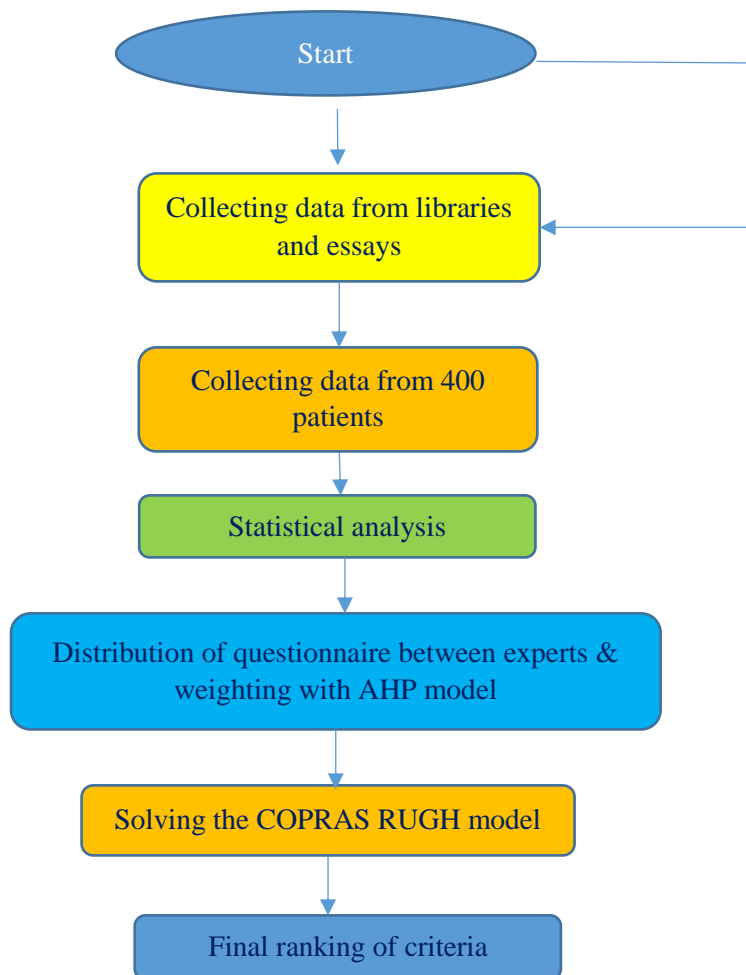


Figure 1. Steps of research implementation

The ranking method used in this study has also been considered by other researchers, which can be mentioned in Organ A, Yalçın (2016)¹², Nili Ahmad Abadi & Parsaei (2016)¹³ Das et al (2012)¹⁴. The main reasons

for choosing this method are as follows: 1. Recent research has used this technique to evaluate the quality of health services. 2 - Due to the large number of quality criteria in the field of health, it was necessary to use

appropriate technique to consider the quality criteria.

Results

Case Study:

Equipped Imam Reza Hospital, established by the Social Security Organization to provide services to policyholders covered by the organization, is out of reach of citizens due to the distance and inappropriate location, and which organization should access this duplicate story to facilitate access. The people of Qom create a place.

In terms of equipment and facilities, this hospital is not only one of the best hospitals in the province but also one of the top hospitals in the country that provides free social services to insured persons.

But the hospital's location is located on a transit road that crosses the 17 provinces of the country, a road that is not only convenient but also very dangerous and has suffered numerous accidents so far.

Results:

After that required information and data have been collected, extracted and classified, we tried to solve the model and analyze the information. The collected data are meaningless numbers that can be meaningful from quantitative methods to use them for the purpose of the research. Analyzing the information as a part of the

process of scientific research method is one of the main foundations of any study and research that based on this; all research activities are controlled and directed until approaching a consequence. In other words, in this part the researcher uses diverse methods of analysis to answer the problem or formulated questions so, it is important to mention that the analysis of obtained data is not solely sufficient to find out the answers of research questions, furthermore, the interpretation of these data is needed. In this section, first, the demographic analysis of two communities (patients and experts) is discussed. Then the statistical examination of the result of the questionnaire and determining the important healthcare services factors evaluation are discussed by patients. This analysis is conducted by a t-test to determine whether an index had importance more than average for all patients or not. In the following, after defining the indexes of performance evaluation of the healthcare services, we decided to rank the criteria for defining the factors importance by using AHP and determining the weight and final rank of each factor by using COPRAS RUGH. First, in the table (2) we are discussed in examining descriptive statistics and factors such as average and variance about collected data from the opinion of experts on each factors of the evolution of healthcare services quality at Imam Reza hospital.

Table 2. Descriptive statistic

Criteria	Average	Standard deviation	variance
Care	4.027	1.190	1.417
Style	2.947	1.0511	1.105
Communication	3.538	0.851	0.726
Skill	3.937	1.179	1.391
Experience	3.219	1.209	1.464

Criteria	Average	Standard deviation	variance
Innovation	2.013	1.909	3.647
Physical	2.456	0.841	0.709
On time	3.936	0.801	0.642
Fulfillment	2.718	0.926	0.858
Preparation	3.726	0.99	0.981
Accuracy	3.632	0.809	0.655
Image	2.343	0.978	0.957
Building designer	2.837	0.892	0.796
Hygiene	4.125	0.832	0.693
Cost	4.635	0.905	0.82
Compensation	3.726	0.876	0.768
Standard	3.542	0.992	0.986

To investigate the presented factors in the research and examining the opinions of patients in Imam Reza hospital about the significance of each factor we needed to examine all hypothesizes. Due to this, the inferential statistic is used. Each hypothesis is defined in a way that the importance of each factor is greater than 3 and we have a hypothesis of zero that illustrates us the importance of each factor is less than or

equal to 3. For this purpose, according to the 5-point Likert scale, if from the view of society, the factor which has higher importance than average means 3, it shows us this factor has importance for measuring the performance of healthcare services of the hospital otherwise, if it is less than or equal to 3 it means it doesn't have importance. In the Table (3) the results of the t-test are presented.

Table 3 Investigating the result of hypothesizes of the importance of each factor

Criteria	t- statistic	Degree of liberation	Significance level	Average	Standard deviation	Average score	Result of the review
Care	36.136	384	0.000	4.027	1.190	3	Accept
Style	1.215	384	0.001	2.947	1.051	3	Reject
Communication	2.108	384	0.000	3.538	0.851	3	Accept
Skill	25.382	384	0.000	3.937	1.179	3	Accept
Experience	15.327	384	0.000	3.219	1.209	3	Accept
Innovation	0.948	384	0.002	2.013	1.909	3	Reject
Physical	1.433	384	0.001	2.456	0.841	3	Reject
On time	24.397	384	0.001	3.936	0.801	3	Accept
Fulfillment	1.752	384	0.000	2.718	0.926	3	Reject
Preparation	19.436	384	0.000	3.726	0.990	3	Accept
Accuracy	17.911	384	0.000	3.632	0.809	3	Accept
Image	1.265	384	0.001	2.343	0.978	3	Reject
Building designer	1.804	384	0.003	2.837	0.892	3	Reject
Hygiene	29.357	384	0.000	4.125	0.832	3	Accept
Cost	37.941	384	0.000	4.635	0.905	3	Accept
Compensation	18.396	384	0.000	3.726	0.876	3	Accept
Standard	15.499	384	0.000	3.542	0.992	3	Accept

According to table 4, the obtained results of examination expose that 6th of them aren't more important in the opinion of the statistical community for assessing the performance of healthcare services and these rejected factors should be eliminated from the model. These factors include style, innovation, physical, and image and building designer. By eliminating these 6 items, the remaining 11 factors are finally determined and in the following, to rating these factors the COPRAS, RUGH method is considered. Previously, the weighting of each criterion was assessed by using the AHP method that is shown in the following table (4).

Table 4. Ultimate factors

factor	Under the criteria
Empathy	care
	communication
	Skill
Maintenance	Experience
	On-time

Table 5. Average opinions of experts

Criteria	Timeliness	Capitalization	Feasibility	infrastructure
Timeliness	1.000	0.530	3.104	1.320
Capitalization	1.888	1.000	5.073	2.402
Feasibility	0.322	0.197	1.000	0.416
Infrastructure	0.758	0.416	2.402	1.000

After calculating the average, the results of the weighting of each criterion are

distinguished by using Expert choice software which is presented in the table (7).

Table 7. Results of calculating the weight of the criteria with AHP

Criteria	Timeliness	Capitalization	Feasibility	Infrastructure	Ultimate weight	Ultimate rank
Timeliness	0.252	0.247	0.268	0.257	0.256	2
Capitalization	0.476	0.467	0.438	0.468	0.462	1
Feasibility	0.081	0.092	0.086	0.081	0.085	4
Infrastructure	0.191	0.194	0.207	0.195	0.197	3

factor	Under the criteria
Responsiveness	Preparation
	Accuracy
Reliability	Hygiene
	Cost
Assurance	Make up for damages
	Standard

Ranking the criteria by using AHP

First of all, for determining the weight of each criterion, the AHP questionnaire including 4 criteria in a table that is comparisons binary (side by side) taken placed, and the result of the investigation of these 15 experts are outlined in the following. The method of averaging the collected opinions was truly a geometric mean method that considering the nature of the collected data is experts' opinion. however, we need to use the geometric mean method to calculate the mean. In the table (5), the obtained mean is displayed:

Therefore, based on the calculation, it is determined that the capitalization is an important criterion from the opinion of experts because the financial and budgetary limitations are threatening the hospital severely. Also, the timeliness is ranked in the second stage and according to experts; the time used to improve each factor of healthcare services has great importance. Additionally, in the third stage, the infrastructure development of factors is placed. To evolve any factors there must be a series of hardware and software infrastructure that developing healthcare factors should be based on it. At least,

according to the importance of other criteria and investigating the feasibility of factor the illustrations inferred that feasibility is ranked in the fourth stage. Thus, the weights of each factors are determined and based on these weights, the primary matrix of **COPRAS** can be completed.

Ranking the factors by using COPRAS RUGH

In order to obtain expert opinions and convert the collected comments into **RUGH** numbers, the following steps are presented in Table (7) which provides a sample of an expert's activity:

Table 7. Sample expert questionnaire

Expert 1	Timeliness	Capitalization	Feasibility	Infrastructure	
	Negative		Negative	Positive	Positive
Care	3		1	7	7
Communication	5		7	7	7
Skill	3		7	5	9
Experience	5		9	5	5
On time	3		5	9	1
Preparation	3		1	9	5
Accuracy	1		5	7	3
Hygiene	7		3	9	7
Cost	7		5	3	5
Compensation	9		3	3	5
Standard	5		3	5	9

In accordance with the Table (8), similar to expert 1 from another 14 experts these data

are collected. According to the following Table (8), the comments of expert 1 are converted to **RUGH** numbers.

Table 8. Convert comments of expert 1 to RUGH numbers

factors	Timeliness		Capitalization		Feasibility		Infrastructure	
Care	5.00	2.33	4.20	1.00	7.00	3.00	7.00	4.60
Communication	6.00	3.00	7.00	6.00	7.00	6.60	7.00	4.20
Skill	6.60	3.00	8.00	5.50	5.50	4.50	9.00	7.40
Experience	6.40	5.00	9.00	5.60	5.67	3.500	6.20	5.00
On time	5.00	3.00	6.50	4.33	9.00	5.00	4.80	1.00
Preparation	5.50	2.00	4.00	1.00	9.00	4.40	7.00	4.67
Accuracy	5.60	1.00	7.50	4.50	7.00	3.40	5.40	3.00
Hygiene	7.67	5.00	6.25	2.50	9.00	6.80	7.50	6.00
Cost	7.00	4.40	5.67	3.50	6.20	3.00	5.00	4.20
Compensation	9.00	3.40	3.00	1.80	7.20	3.00	5.00	2.20
Standard	6.00	4.33	5.40	3.00	6.00	5.00	9.00	7.00

The above process is calculated through software for every 15 expert person. Then, according to the Table (9), the average

opinions of experts are obtained as the first **COPRAS RUGH** matrix.

Table 9. The first COPRAS RUGH matrix consists of Average experts' opinion

factors	Timeliness		Capitalization		Feasibility		Infrastructure	
Care	6.04	2.57	5.64	2.81	4.33	1.80	6.09	3.04
Communication	5.16	2.49	6.75	5.10	6.92	6.28	5.64	2.81
Skill	7.62	5.52	7.12	5.34	5.70	4.12	8.28	6.49
Experience	7.43	5.50	7.17	4.17	5.51	2.84	7.12	5.34
On time	5.70	4.30	7.16	4.49	7.00	3.13	6.44	3.16
Preparation	6.35	2.92	6.00	2.15	6.08	3.00	7.68	5.23
Accuracy	7.32	3.74	8.13	5.49	4.48	2.38	6.96	3.91
Hygiene	7.19	4.36	7.20	3.61	8.18	5.29	7.62	5.52
Cost	5.55	3.28	5.51	2.84	7.51	4.84	4.68	3.72
Compensation	5.16	1.88	2.28	1.32	8.42	5.68	3.12	1.34
Standard	6.28	4.49	6.28	8.81	6.70	5.30	7.70	6.30
Weight of criteria	0.256		0.462		0.085		0.197	

In the above matrix, we are calculated the average opinions of experts and this matrix is used as the rudimentary matrix in

COPRAS RUGH'S calculations. By the way, in the Table (10) the normalized matrix is submitted.

Table 10. Normalized matrix

factors	Timeliness		Capitalization		Feasibility		Infrastructure	
Care	0.11	0.05	0.10	0.05	0.08	0.03	0.10	0.05
Communication	0.09	0.04	0.12	0.09	0.12	0.11	0.10	0.05
Skill	0.14	0.10	0.12	0.09	0.10	0.07	0.14	0.11
Experience	0.13	0.10	0.12	0.07	0.10	0.05	0.12	0.09
On time	0.10	0.08	0.12	0.08	0.12	0.05	0.11	0.05
Preparation	0.11	0.05	0.10	0.04	0.11	0.05	0.13	0.09
Accuracy	0.13	0.07	0.14	0.10	0.08	0.04	0.12	0.07
Hygiene	0.13	0.08	0.12	0.06	0.14	0.09	0.13	0.09
Cost	0.10	0.06	0.10	0.05	0.13	0.08	0.08	0.06
Compensation	0.09	0.03	0.04	0.02	0.15	0.10	0.05	0.02
Standard	0.11	0.08	0.11	0.15	0.12	0.09	0.13	0.11
Weight of criteria	0.256		0.462		0.085		0.197	

In the Table (11), the normalized weights of each healthcare service factor are calculated based on four criteria. The next step is to

multiply the weight of the criteria in the normalized matrix and finally, the balanced normalized matrix is obtained.

Table 11. Balanced normalized matrix

factors	Timeliness		Capitalization		Feasibility		Infrastructure	
Care	0.028	0.012	0.045	0.023	0.006	0.003	0.020	0.010
Communication	0.024	0.012	0.054	0.041	0.010	0.009	0.019	0.009
Skill	0.035	0.025	0.057	0.043	0.008	0.006	0.028	0.022
Experience	0.034	0.025	0.057	0.033	0.008	0.004	0.024	0.018
On time	0.026	0.020	0.057	0.036	0.010	0.005	0.021	0.011
Preparation	0.029	0.013	0.048	0.017	0.009	0.004	0.026	0.017
Accuracy	0.034	0.017	0.065	0.044	0.007	0.004	0.023	0.013
Hygiene	0.033	0.020	0.058	0.029	0.012	0.008	0.025	0.018

factors	Timeliness	Capitalization	Feasibility	Infrastructure
Cost	0.026	0.015	0.044	0.012
Compensation	0.024	0.009	0.018	0.010
Standard	0.029	0.021	0.050	0.021

Table (12) is exposing the balanced normalized matrix. That means, the normalized matrix is multiplied in weight of the criteria according to the mathematical rules of RUGH numbers and consequently,

the normalized matrix is balanced. Also, Table (13) discusses the final value of the alternatives in the positive and negative criteria according to the method described in chapter 3.

Table 12. The final value of alternatives in positive criteria

factors	Positive value of factor	value
Care	S1+	0.020
Communication	S2+	0.024
Skill	S3+	0.032
Experience	S4+	0.027
On time	S5+	0.023
Preparation	S6+	0.028
Accuracy	S7+	0.023
Hygiene	S8+	0.032
Cost	S9+	0.023
Compensation	S10+	0.018
Standard	S11+	0.032

Table 13. The final value of alternatives in negative criteria

factors	Negative value of factor	Value
Care	S1-	0.054
Communication	S2-	0.065
Skill	S3-	0.080
Experience	S4-	0.075
On time	S5-	0.070
Preparation	S6-	0.054
Accuracy	S7-	0.080
Hygiene	S8-	0.070
Cost	S9-	0.054
Compensation	S10-	0.031
Standard	S11-	0.085

After calculating the final value of each factor from positive and negative criteria,

the ultimate value of each option will be calculated in accordance with the Table (14).

Table 14. Calculating the final value

factor	factor of final value	Final value
Care	Q1	0.093
Communication	Q2	0.097
Skill	Q3	0.105
Experience	Q4	0.100

factor	factor of final value	Final value
On-time	Q5	0.097
Preparation	Q6	0.101
Accuracy	Q7	0.096
Hygiene	Q8	0.105
Cost	Q9	0.096
Compensation	Q10	0.091
Standard	Q11	0.105

Based on the table above, it is determined how much the final weight of each of the factor of assessment of healthcare services

performance is. However, according to the Table (14), specifically the Table (15) is the terminal ranking based on Q value.

Table 15. The final ranking of the factors of the evaluation of healthcare services performance

factors	final value of factor	Final value	Final ranking	Sensitivity analysis
Standard	Q11	0.1055	1	(0.1052,0.1055)
Skill	Q3	0.1052	2	(0.1051,0.1052)
Hygiene	Q8	0.1051	3	(0.1015,0.1051)
Preparation	Q6	0.1015	4	(0.1002,0.1015)
Experience	Q4	0.1002	5	(0.0971,0.1002)
Communication	Q2	0.0971	6	(0.0968,0.0971)
On time	Q5	0.0968	7	(0.0965,0.0968)
Accuracy	Q7	0.0965	8	(0.0964,0.0965)
Cost	Q9	0.0964	9	(0.093,0.0964)
Care	Q1	0.093	10	(0.0911,0.093)
Compensation	Q10	0.0911	11	(0,0.0911)

Thus, due to the final ranking, it was determined that the standard of provided healthcare services at the hospital, is factor that can be developed relative to other factors. It means, in terms of criteria of possibility, time, cost and infrastructure, this factor is taken in a better position. According to these, the subsequent factors are arranged by the sequence after standard: skill, hygiene, and preparation, and experience, communication, on time, accuracy, cost, care, and compensation.

Conclusion

After identifying the primary factor, the researcher prepared a questionnaire to evaluate and examine the patients' opinions about the Imam Reza hospital and finally, the researcher puts the identified factors into the questionnaire and distributes it among 400 patients. Then, the results are compiled

and due to this, it is determined indeed that which patients perceived the factor as the basis for assessing the quality of healthcare services at Imam Reza hospital. The obtained results based on relevant statistical tests revealed that some of the identified factor are eliminated and some of them confirmed. Based on the calculations, it's demonstrated that capitalization (cost) is the most important criterion for experts because the budgetary constraints threat the hospital drastically. However, timeliness is located in second place and according to the experts' opinion; the time used to improve each factor of healthcare services has great importance. Furthermore, in the third stage, the infrastructure improvement of factors is placed. To develop any factor there must be a series of hardware and software infrastructure that improving healthcare factors should be based on it. Consequently,

the feasibility is in the latest rank. As it remarked in the prior sentence, by considering the importance of other criteria

in the Table (16), examining the feasibility of factors is settled in fourth place.

Table 16. The final ranking of the factors of healthcare services quality evaluation

factors	factor of final value	Final value	Final ranking
Standard	Q11	0.105	1
Skill	Q3	0.105	2
Hygiene	Q8	0.105	3
Preparation	Q6	0.101	4
Experience	Q4	0.100	5
Communication	Q2	0.097	6
On time	Q5	0.096	7
Accuracy	Q7	0.096	8
Cost	Q9	0.096	9
Care	Q1	0.093	10
Compensation	Q10	0.0911	11

The following are important managerial insights in the following sections:

1-Implementation and enforcement of hospital accreditation guidelines or standards in accordance with ISO9001: 2015, OHSAS18001: 2007, ISO14001: 1015 and HSE-MS standards.

2. Focus on attracting specialist and specialist physicians to improve patient satisfaction.

3 - Holding courses to improve the quality of communication skills with patients and strengthen communication skills of medical staff with patients.

4. Reduce health care costs for patients who do not have social security insurance.

Finally, research priorities for future researchers can be mentioned in the following sections:

1- Ranking Qom hospitals based on the ratings in this study and prioritizing the hospitals.

2. Ranking the identified indicators in the research using other MCDM methods and comparing the results.

3. Assessment of patients' satisfaction with the quality of medical services in public and private hospitals.

4- Evaluation of health service evaluation indicators in public and private hospitals.

Competing Interests

The authors declare no competing interests.

Authors' Contributions

The authors contributed equally to the writing of the article

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