Journal of Industrial and Systems Engineering
Vol. 11, No. 4, pp. 19-33
Autumn (November) 2018

JISE

Critical success factors of service quality in hospitals: A hybrid fuzzy multiple attribute decision-making approach

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Abstract

Healthcare systems help to improve the quality of working life. Therefore, high-quality services are essential in hospitals as the main party of healthcare systems. While there are limited resources in healthcare systems and hospitals, many factors may influence providing appropriate services. Therefore, finding and allocating rare resources of the hospitals to the most important factors can help to increase customer satisfaction. In this paper, a hybrid fuzzy multiple attribute decision-making approach is proposed to prioritize critical success factors (CSFs) of service quality of healthcare systems. The uncertainty of measuring qualitative factors has been modeled using fuzzy sets. The proposed hybrid approach consists of Fuzzy Delphi, Fuzzy DEMATEL, Fuzzy ANP, and Fuzzy VIKOR to find and prioritize the CSFs based on SEVQUAL method. The proposed hybrid approach has been applied to a real case study where its applicability and efficacy have been illustrated.

Keywords: SERVQUAL, fuzzy DEMATEL, fuzzy ANP, fuzzy VIKOR, fuzzy Delphi, health care system

1- Introduction

The cost of treatment of diseases and the associated social effects of such problem are so high and extensive that the countries are interested in organizing and managing effective high-quality healthcare systems. (Meesala & Paul,2018) Hospitals as one of the main parts of healthcare systems have a very effective role in the quality of healthcare performance. As the population is getting older, the birth rate drops dramatically, and illnesses and also death rate can strongly influence many aspects of economics and quality of work life. Crowded megacities are afflicted with high death rate caused by heart attack. Therefore, the governments have decided to build hospitals to provide services for these type of illnesses. Usually, as the demand rate for healthcare systems increases, the quality of services in hospitals may face some challenges. So, finding out and prioritizing the service quality of the hospitals can help the decision makers to allocate rare resources to factors with high priority (Büyüközkan, Çifçi, & Güleryüz, 2011; Chang et al., 2010; Dahlgaard, Pettersen, & Dahlgaard-Park, 2011; Ir M.S.Pillay et al., 2011; Muhammad Butt & Cyril de Run, 2010; Owusu-Frimpong, Nwankwo, & Daso, 2010; Pai & Huang, 2011).
Service quality concept has attracted several research papers throughout the world.

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ISSN: 1735-8272,

The decision makers present their preference on priority of CSFs using linguistic terms mixed with some uncertainties. The uncertainty of measuring qualitative factors has been modeled using the fuzzy sets. The proposed hybrid approach consists of Fuzzy Delphi, Fuzzy DEMATEL, Fuzzy ANP, and Fuzzy VIKOR to find and prioritize the CSFs based on SEVQUAL method. The proposed hybrid approach has been applied to a real case study where in its applicability and efficacy has been illustrated.

The next sections of this paper are organized as follows: In Section 2, the literature of previous research works is presented. The proposed Fuzzy MADM approach is presented in Section 3. Research methodology is presented in next section. The main aspects of research methodology are presented in Section 4. Data analysis presented in Section 5. The final section is devoted to conclusion remarks and future research suggestions.

2- Literature review and previous research works

SERVQUAL is one of the most popular models employed to evaluate service quality (Gounaris, 2005; Hu, Lee, & Yen, 2010; Parasuraman, Zeithaml, & Berry, 1988). After the introduction of this model by Parasuraman (Parasuraman, Zeithaml, & Berry, 1988; Parasuraman, Zeithaml, & Berry, 1985) not only was it applied in various industries, but also there was a tendency to improve it (Al-Eisa & Alhemoud, 2009; Antony, Antony, & Ghosh, 2004; Cui, Lewis, & Park, 2003; Ghorbani, Arabzad, & Tavakkoli-Moghaddam, 2014; Hu, Lee, & Yen, 2010; Jabnoun & Al-Tamimi, 2003; Jiang, Klein, & Crampton, 2000; Kannan, 2010; Krishnamurthy, SivaKumar, & Sellamuthu, 2010; Kumar, Kee, & Charles, 2010; Munusamy, Chelliah, & Mun, 2010; Padma, Rajendran, & Sai Lokachari, 2010; Shahin, Mehrparvar, & Shirouyehzad, 2013; Shirouyehzad et al., 2013; Tavakoli & Shirouyehzad, 2013; Wolniak & Skotnicka-Zasadzien, 2012; Yu et al., 2008).

The final version of SERVQUAL has five dimensions named empathy, assurance, tangibles, reliability, and responsiveness. These dimensions have some sub-criteria. The aim of this model is to measure the gap between the perception of the customers and the performance of the company. This gap shows the weaknesses and strengths of a company. Shieh, Wu, & Huang (2010) used DEMATEL method to find out the relationships among the main CSFs of service quality in Taiwan. They showed that communication and competent medical staff could increase the customer satisfaction. Büyüközkan & Çifçi (2012a) illustrated a combination model of fuzzy AHP and fuzzy TOPSIS to evaluate the service quality using strategic analysis. The contribution of their work was the employment of the internet to evaluate the service quality in Turkish hospitals. Büyüközkan, Çifçi, & Güleryüz (2011) evaluated service quality in Turkish hospitals using fuzzy AHP. They concluded that hospitals must pay more attention to the criterion of empathy. John, Yatim, & Mani (2011) showed the way to evaluate service quality in a dental healthcare center in Malaysia. They analyzed 481 dentists using SERVQUAL model with 20 sub-criteria and the dentists provided appropriate services fulfilling most criteria. Padma, Rajendran, & Sai Lokachari (2010) evaluated servi12ce quality of Indian hospitals. They asked the attendants and patients about service quality of Indian hospitals and they informed them of the way these hospitals could improve their service quality to gain more customers' satisfaction. Lee (2017) illustrated a HEALTHQUAL model for South Korea hospitals. In this research 389 people response to related questionnaires and the result showed that degree of improvement criterion is the highest priority among other criteria. Behdioğlu et al (2017) depicted fuzzy SERVQUAL in physiotherapy hospital. This model had 5 dimensions and 22 sub-criteria and 262 people answered to the questions. The result pointed out that there was the huge negative score in the tangibles dimension. Jabbari et al (2017) indicated healthcare services quality in Namazi hospital. They used univariate and multi-regression analysis for finding quality of services. The result showed that the level of service quality in Namazi hospital was suitable.

3- Preliminaries: Fuzzy MADM approaches

3-1- Fuzzy sets

The first concept of the fuzzy theory was developed by Zadeh, 1965. Some basic definitions are reviewed as follows (Zadeh, 1976):

Definition 1. A membership function on X is any function from X to the real unit interval [0, 1].

Definition 2. A fuzzy number is the generalization of a regular, real number in the sense that it does not refer to one single value but rather to a connected set of possible values, where each possible value has its own weight between 0 and 1.

Definition 3. A triangular fuzzy number (TFN) can be defined as (*a*, *m*, *b*). Triangular function is defined as:

$$\mu_{\tilde{A}} = \begin{cases} \dfrac{x-a}{m-a} & a \le x \le m \\ \dfrac{b-x}{b-m} & m \le x \le b \\ 0 & otherwise \end{cases} \quad (1)$$

3-2- Fuzzy DEMATEL

The DEMATEL method is used to show the relationship among the criteria in the form of a directed graph (Büyüközkan & Çifçi, 2012b; Shieh et al., 2010; Visalakshmi et al., 2015; Wu, 2012; Wu & Lee, 2007). The following steps are presented for DEMATEL.

Step 1. Design a matrix $A_{n\times n}$ where n denotes the number of criteria. These criteria are compared to each other through pairwise comparison. The preference of the decision maker (DM) for comparing criteria *i* with criteria *j* is shown as a_{ij}.

Step 2. Create the first normalized influences matrix using equation (2).

$$X = \frac{A}{max \sum_{j=1}^{n} a_{ij}}, 1 \le i \le n \quad (2)$$

Step 3. Obtain the total relation matrix N using equation (3).

$$N = X(1-X)^{-1} \quad (3)$$

Step 4. Show the relationship between the criteria by figuring out D and R

$$N = [t_{ij}]_{n\times n} \;\; i,j = 1,2,\dots,n \quad (4)$$

$$R = [\sum_{i=1}^{n} t_{ij}]_{1\times n} \;\; i,j = 1,2,\dots,n \quad (5)$$

$$D = [\sum_{j=1}^{n} t_{ij}]_{n\times 1} \;\; i,j = 1,2,\dots,n \quad (6)$$

All of the above mentioned steps can be used through replacing crisp numbers with a TFN in order to implement fuzzy DEMATEL.

3-3. Fuzzy ANP

Analytical network Process (ANP) is one of the multi-criteria decision making approaches introduced by Saaty (1994). ANP considers the correlations and interactions between the criteria (Keramati, et al., 2014; Ramkumar & Busi, 2016). In order to use fuzzy ANP the following steps are proposed.

Step1. Set goals, criteria, sub-criteria, and alternatives to the problems and structuring the problem

Step2. Prepare pairwise comparison questionnaires based on the correlations among all criteria and alternatives. Then, calculate the local weights using equation (7).

$Aw=\lambda_{max}w$ (7)

where w is the local weight, A is the preferences matrix, and λ_{max} is the biggest eigenvalue. All numbers are TFNs.

Step3. Calculate the inner dependence matrix by multiple local weights matrix into interdependent weights.

Step4. Calculate the normalized eigenvalue, showing and naming it as matrix B

Step5. Find the global weights.

3-4- Fuzzy VIKOR

VIKOR is an MADM technique introduced by Opricovic (1998). VIKOR uses ideal solution and anti-ideal solution (Liu et al., 2013; Rostamzadeh, et al., 2015). The fuzzy VIKOR uses linguistic scale to determine the DM preferences. The following steps are proposed to use fuzzy VIKOR.

Step1. Create a fuzzy decision making matrix that has n criteria and m alternatives. DM represents his/her preferences between each criterion and the alternative using a linguistic scale modeled through TFN $\tilde{a}_{mn}$.

$$\tilde{X} = \begin{bmatrix} \tilde{a}_{11} & \cdots & \tilde{a}_{1n} \\ \vdots & \ddots & \vdots \\ \tilde{a}_{m1} & \cdots & \tilde{a}_{mn} \end{bmatrix} \quad (8)$$

Step2. Form the normalized decision matrix $\widetilde{N}$ (9) using Equations (10) and (11) for benefit and cost criteria, respectively.

$$\widetilde{N} = [\tilde{n}_{ij}]_{m\times n} \quad (9)$$

Equation (9) is used for benefit criteria.

$$\tilde{n}_{ij} = (\frac{x_{ij}^{l}}{u_{ij}^{+}}, \frac{x_{12}^{M}}{u_{ij}^{+}}, \frac{x_{12}^{u}}{u_{ij}^{+}}) \text{ Where } u_{ij}^{+} = max_i x_{ij}^{u} \quad (10)$$

Equation (7) is used for cost criteria.

$$\tilde{n}_{ij} = (\frac{u_{ij}^{-}}{x_{ij}^{l}}, \frac{u_{ij}^{-}}{x_{ij}^{m}}, \frac{u_{ij}^{-}}{x_{ij}^{u}}) \text{ where } u_{ij}^{-} = min_i x_{ij}^{l} \quad (11)$$

Step3. Define references of positive and negative ideal solutions as A^{+} and A^{-}, respectively.

$$A^{+} = [\tilde{n}_{01}^{+}, \tilde{n}_{02}^{+}, \dots, \tilde{n}_{0n}^{+}], A^{-} = [\tilde{n}_{01}^{-}, \tilde{n}_{02}^{-}, \dots, \tilde{n}_{0n}^{-}] \quad (12)$$

Where,

$$\tilde{n}_{01}^{+} = \max_i \tilde{n}_{ij}, \tilde{n}_{01}^{-} = \min_i \tilde{n}_{ij} \quad (13)$$

Step4. Calculate the distance from positive, i.e., $\tilde{S}_i$, and negative , i.e., $\tilde{R}_i$, ideal solutions as equations (14) and (15), respectively,

$$\tilde{S}_i = \sum_{j=1}^{n} w_j (\frac{\tilde{n}_{0j}^{+} - \tilde{n}_{ij}}{\tilde{n}_{0j}^{+} - \tilde{n}_{0j}^{-}}) \quad (14)$$

$$\tilde{R}_i = \max_j [(\frac{\tilde{n}_{0j}^{+} - \tilde{n}_{ij}}{\tilde{n}_{0j}^{+} - \tilde{n}_{0j}^{-}})] \quad (15)$$

Where

$\widetilde{S^*} = {}^{min}_{i}\widetilde{s}_\iota, \widetilde{S^-} = {}^{max}_{i}\widetilde{S}_\iota, \widetilde{R^*} = {}^{min}_{i}\widetilde{R}_\iota, \widetilde{R^-} = {}^{max}_{i}\widetilde{R}_\iota$

4-Research methodology

In this section the research methodology is proposed briefly.

4-1- Definition of Criteria

The criteria were selected based on SERVQUAL framework. Then, fuzzy Delphi method was used to select the most suitable criteria on the basis of DMs preferences. The selected criteria for evaluation of service quality in hospitals are presented in table 1.

Table 1. selected criteria for evaluation of service quality in hospitals

Criteria	Sub-criteria	Abbrivation
Tangibles C_1	Suitable enviornment	C_{11}
	Personel neatness	C_{12}
	Updated facilities	C_{13}
	Visible signs	C_{14}
Responsiveness C_2	Suitable guidline	C_{21}
	Comminucation skills of personel	C_{22}
	Solving	C_{23}
	Conveying physician advice correctly	C_{24}
Trust (Reliability) C_3	Feeling secure	C_{31}
	Trusting physicians	C_{32}
	Skilled physicians	C_{33}
Assurance C_4	Accessble facilities	C_{41}
	Duration of treatment	C_{42}
	Emergency operation time	C_{43}
	Process of hospitalization	C_{44}
Empathy C_5	Description of illness state by physician	C_{51}
	Kind behavior of satff	C_{52}
	Services eagerly offered by staff	C_{53}
	Sympathy shown by the staff for treatment	C_{54}

4-2- Research samples

The sample of this research consists of 30 persons including the senior and middle managers of Tehran hospitals. These DMs hold master's degree or PhD having at least 10 years of experience in healthcare industry. Questionnaires are distributed among them by Email and Fax.

From this population 5 persons are women and rest of that are men.6 persons had 10-15 years, 8 persons had 16-20 years, 7 persons had 21-25 years and 9 persons had 26-30 years experiences.

4-3- Main steps of the research

As mentioned before, the most suitable criteria were selected using fuzzy Delphi method. Then fuzzy DEMATEL was used to identify the interactions among criteria in the form of a network. Then, fuzzy ANP was used to calculate the weights of the criteria and sub-criteria. Finally, the hospitals were ranked based on these weights using fuzzy VIKOR. Figure 1 shows the main steps of this research.

Step 1. In this step fuzzy Delphi is applied for finding suitable sub-criteria of SERVQUAL model. The reason of using fuzzy technique in this section is decision makers could tell their opinions truly. The triangular fuzzy numbers are used in this section.

Step 2. Triangular fuzzy numbers have applied for finding relationship among criteria and sub criteria

of model. The triangular fuzzy numbers are obtained based on Wu & Lee (2007) research.

Step 3. In fuzzy ANP as well as the decision makers faced to uncertainty environment fuzzy ANP had implemented. For fuzzy numbers Ayağ (2005) research has been used.

Step 4. In final step of using fuzzy numbers, fuzzy VIKOR has been used. Fuzzy data in this section helped to decision makers to make decision truly. The fuzzy numbers in VIKOR method is used from Wang et al. (2006).

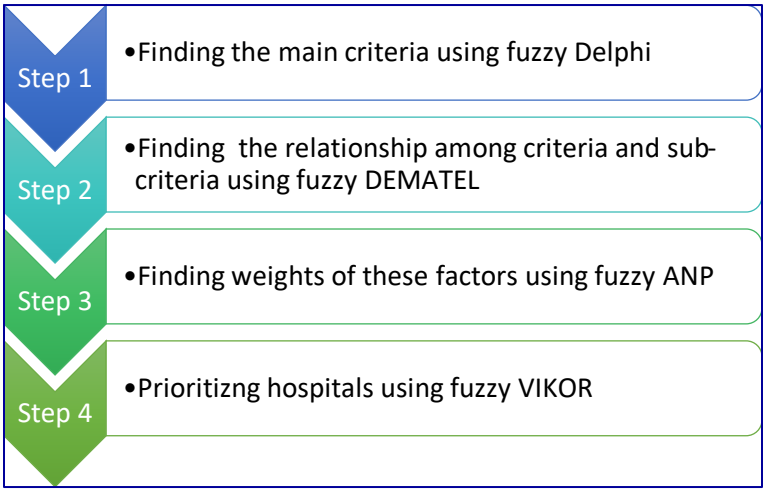

Fig 1. Main steps of the research

5- Results and discussion

In this section the results of application of the proposed hybrid method to assess the service quality of hospitals are presented and discussed. The case study includes 6 hospitals. The fuzzy Delphi method was used to select the most suitable criteria on the basis of SERVQUAL framework. Figure2 presents the main criteria and sub-criteria resulted on the basis of fuzzy Delphi approach.

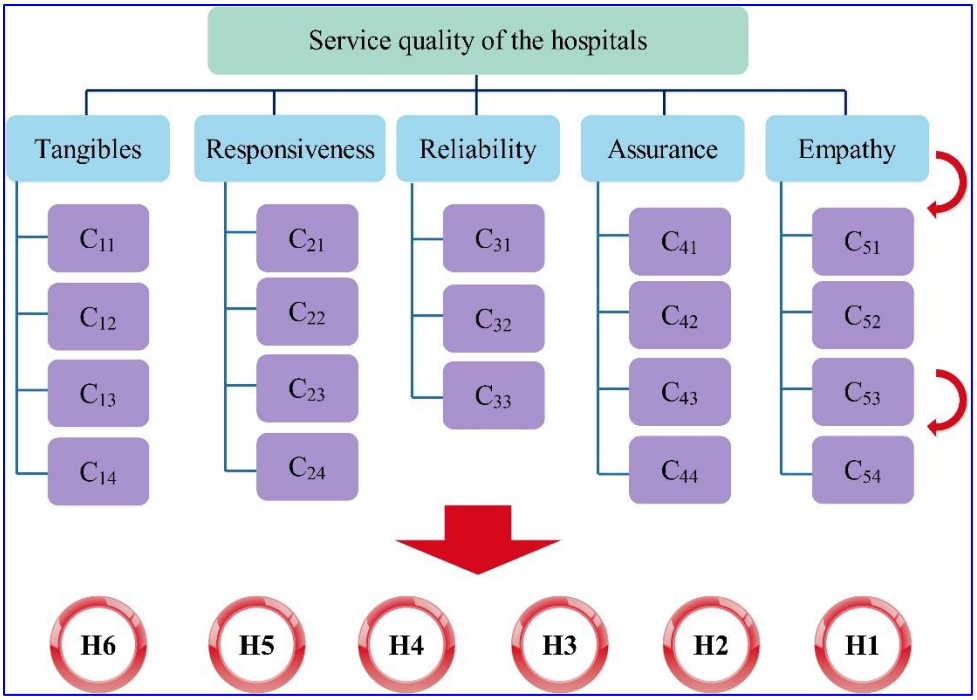

Fig 2. Selected criteria and sub-criteria using fuzzy Delphi method

Then, the fuzzy DEMATEL method was used to figure out the relationships among criteria in form of a network. The comparisons among criteria was accomplished using a linguistic terms parameterized though TFNs as presented in Table 2. DMs were asked to determine the relationships of criteria using the linguistic terms presented in table 2.

Table 2. Fuzzy DEMATEL linguistic terms

Crisp data	Fuzzy data	Language variable
0	(0.75,1,1)	Very powerful effect
1	(0.5,0.75,1)	powerful effect
2	(0.25,0.5,0.75)	small effect
3	(0,0.25,0.5)	Very small effect
4	(0,0,0.25)	Without any effect

Arithmetic mean was used to combine DMs judgments. The results are presented in Table 3 and show the direct relationships among the criteria. The relationship among two given criteria in Table 3 is shown in form of a TFN.

Table 3. Direct relationship matrix

	C1			C2			C3			C4			C5		
	L	M	U	L	M	U	L	M	U	L	M	U	L	M	U
C1	0	0	0	0.65	0.9	1	0.5	0.75	0.95	0.45	0.7	0.9	0.45	0.7	0.95
C2	0.35	0.6	0.85	0	0	0	0.45	0.7	0.9	0.4	0.65	0.85	0.4	0.65	0.8
C3	0.4	0.65	0.85	0.6	0.85	0.95	0	0	0	0.45	0.7	0.85	0.5	0.75	1
C4	0.4	0.65	0.8	0.55	0.8	0.9	0.5	0.75	0.9	0	0	0	0.5	0.75	0.85
C5	0.5	0.75	0.95	0.5	0.75	0.9	0.45	0.7	0.9	0.5	0.75	0.95	0	0	0

It is notable that the direct relationship matrix was calculated for sub-criteria. We have not presented the direct relationship matrix for sub-criteria in favor of brevity. The total fuzzy relationships among criteria are depicted in the table 4.

Table 4. Total Fuzzy Relationship among Criteria

	C1	C2	C3	C4	C5
C1	1.52	1.97	1.81	1.75	1.78
C2	1.5	1.56	1.615	1.56	1.58
C3	1.64	1.91	1.575	1.71	1.74
C4	1.61	1.87	1.735	1.51	1.71
C5	1.67	1.9	1.761	1.73	1.56

Table 5 shows the effects of the criteria and sub-criteria.

Table 5. Effects of criteria and sub-criteria

Criteria/sub-criteria	$\widetilde{R}$	$\widetilde{D}$	$\widetilde{R}+\widetilde{D}$	$\widetilde{R}-\widetilde{D}$
C1	10.28	9.286	19.57	0.997
C11	1.507	1.624	3.131	-0.117
C12	1.472	1.223	2.695	0.2499
C13	1.567	1.533	3.1	0.034
C14	1.514	1.682	3.196	-0.167
C2	9.157	10.55	19.71	-1.395
C21	1.443	1.353	2.795	0.0896
C22	1.404	1.433	2.837	-0.029
C23	1.368	1.416	2.784	-0.048
C24	1.358	1.371	2.728	-0.013
C3	6.645	6.763	13.41	-0.12
C31	1.044	1.051	2.094	-0.007
C32	1.026	1.014	2.04	0.0114
C33	0.854	0.858	1.713	-0.004
C4	9.688	9.627	19.31	0.061
C41	1.382	1.271	2.653	0.1118
C42	1.356	1.48	2.836	-0.124
C43	1.445	1.512	2.957	-0.067
C44	1.453	1.374	2.827	0.0788
C5	10.04	9.759	19.8	0.281
C51	1.154	1.257	2.411	-0.104
C52	1.176	1.151	2.327	0.0241
C53	1.202	1.203	2.404	-9E-04
C54	1.043	0.963	2.006	0.0805

The mean of relationship is assumed as threshold level. The relationship below the threshold is ignored and the remains form the network of interactions. The final network of interactions is presented in Figure 3.

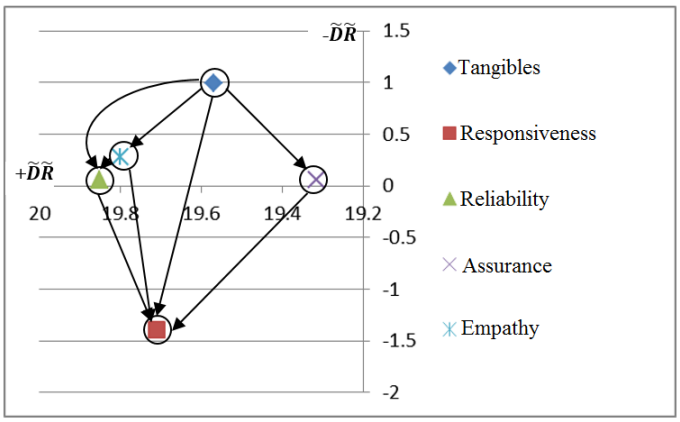

Fig 3-a. Network maps among main criteria

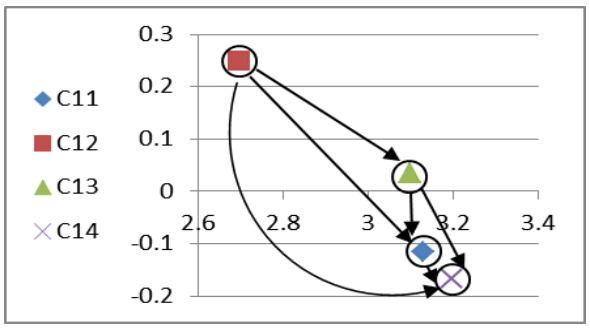

Fig 3-b. Network map of Tangibles criterion

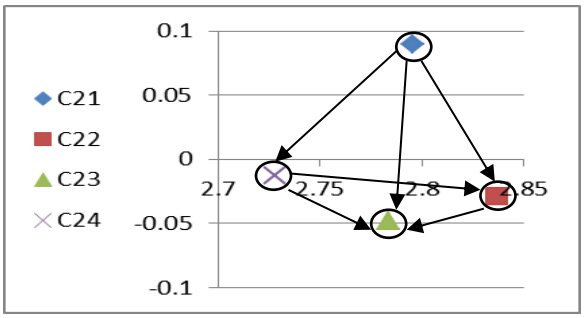

Fig 3-c. Network map of Responsiveness criterion

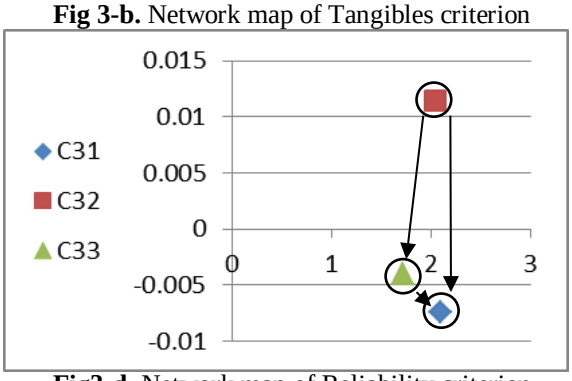

Fig3-d. Network map of Reliability criterion

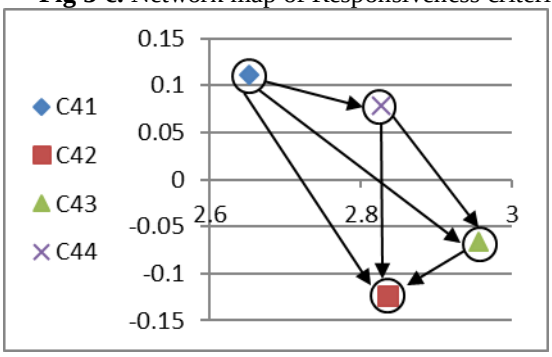

Fig 3-e. Network map of Assurance criterion

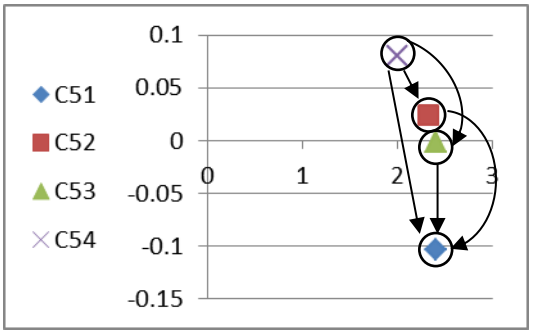

Fig 3-f. Network map of Empathy criterion

Fuzzy ANP is used to calculate the weights of criteria and sub-criteria according to the network of interactions achieved by fuzzy DEMATEL. Final weights of the criteria and sub-criteria are shown in table 6.

Table 6. Weights of criteria and sub-criteria

Weight and rank of criteria		Sub-criteria	Rank and local weights		Final ranking and weighting	
C_1	0.186 (5)	C_{11}	0.272	(2)	0.0506	(13)
		C_{12}	0.196	(4)	0.0364	(19)
		C_{13}	0.25	(3)	0.0465	(16)
		C_{14}	0.283	(1)	0.0526	(9)
C_2	0.22 (1)	C_{21}	0.238	(4)	0.0525	(10)
		C_{22}	0.259	(1)	0.0569	(4)
		C_{23}	0.257	(2)	0.0566	(5)
		C_{24}	0.246	(3)	0.0541	(7)
C_3	0.201 (2)	C_{31}	0.366	(1)	0.0735	(1)
		C_{32}	0.35	(2)	0.0703	(2)
		C_{33}	0.285	(3)	0.0573	(3)
C_4	0.195 (4)	C_{41}	0.223	(4)	0.0434	(17)
		C_{42}	0.263	(2)	0.0513	(12)
		C_{43}	0.27	(1)	0.0527	(8)
		C_{44}	0.244	(3)	0.0475	(15)
C_5	0.198 (3)	C_{51}	0.282	(1)	0.0558	(6)
		C_{52}	0.253	(3)	0.0501	(14)
		C_{53}	0.262	(2)	0.0519	(11)
		C_{54}	0.203	(4)	0.0402	(18)

In the final step the hospitals will be ranked by fuzzy VIKOR. The DMs were asked to compare the alternatives using the linguistic terms presented in table 7.

Table 7. Linguistic terms and associated TFNs used in fuzzy VIKOR

Preference	Very low	low	Appropriate	High	Very high
Fuzzy number	(1,1,3)	(1,3,5)	(3,5,7)	(5,7,9)	(7,9,9)

The steps of the fuzzy VIKOR method were accomplished in the real case. Table 8 shows the values of $\tilde{s}$ and $\tilde{R}$ respectively.

Table 8. Values of $\tilde{s}$ and $\tilde{R}$

	$\tilde{S}$			$\tilde{R}$		
A_1	-0.38	0.236	0.723	0.013	0.043	0.069
A_2	-0.36	0.231	0.737	0	0.037	0.071
A_3	-0.25	0.422	0.924	0.011	0.042	0.071
A_4	-0.39	0.153	0.61	-0.01	0.022	0.071
A_5	-0.34	0.171	0.586	0	0.034	0.051
A_6	-0.19	0.364	0.758	0.027	0.052	0.053

The best and worst values of $\tilde{s}$ and $\tilde{R}$ are presented in table 9.

Table 9. Best and worst values of s̃ and R̃

$\tilde{S}^*$	-0.19	0.364	0.758
$\tilde{S}^-$	-0.39	0.153	0.61
$\tilde{R}^*$	0.027	0.052	0.053
$\tilde{R}^-$	-0.01	0.022	0.071

Table 10 shows the final ranks of alternative considering the coefficient v=0.5.

Table 10. Final ranks of alternative

Rank	S̃		R̃		Q̃ V=0.5	
1	A4	0.125	A5	0.028	A4	0.044
2	A5	0.139	A4	0.028	A5	0.049
3	A1	0.194	A2	0.036	A2	0.122
4	A2	0.204	A3	0.041	A1	0.155
5	A6	0.311	A1	0.042	A6	0.215
6	A3	0.365	A6	0.044	A3	0.218

The results was analyzed by changing the coefficient of V. This sensitivity analysis showed that the ranking presented in table 10 is robust and reliable for several settings of V values. The results of sensitivity analysis are presented in figure 4.

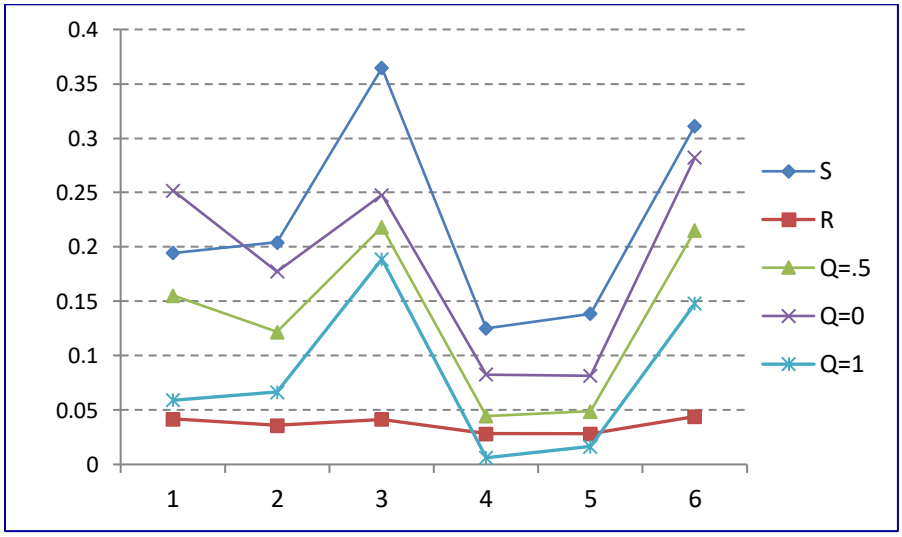

Fig 4. Sensitivity Analysis of Ranking for Several V Values

6- Conclusion remarks and future research directions

After the introduction of service quality concept many industries and companies seek to implement it in order to increase the customer satisfaction. One of the most well-known models of service quality is SERVQUAL. The final version of this model included 5 criteria and 22 sub-criteria. This model is applied in various industries.

In this paper, a hybrid fuzzy multiple attribute decision making approach is proposed to prioritize critical success factors (CSFs) of service quality of healthcare systems. The uncertainty of measuring the

qualitative factors has been modeled using the fuzzy sets. The proposed hybrid approach consists of Fuzzy Delphi, Fuzzy DEMATEL, Fuzzy ANP, and Fuzzy VIKOR to find and prioritize the CSFs based on SEVQUAL method. The proposed hybrid approach has been applied to a real case study where in its applicability and efficacy was illustrated.

Among five criteria of service quality responsiveness had highest priority among others. It means that these kinds of hospitals must be pay more attention to customers. Although they work hard but there are many hearth diseases occurred in Tehran which must response to them. The least important criterion is tangible. It pointed out that all hearth hospitals had suitable situation in this section. Among sub-criteria of this model feeling secure had highest priority among sub-criteria of model. It means that most of the patient did not have feeling secure and hospitals must be found out what factors causes to feel insecure among patient and then based on these factors they designed improvement projects. Personal neatness is the least important factors among others. It showed that most of the hospital personals were neat.

Among hospitals, the hospital number four had highest rank. This hospital is the newest one among the others. In addition, the facilities of hospital are new. The hospital could have employed expert physician and therefore is based on factors that mentioned it the highest rank. Hospital number three had the lowest rank. Its construction time was about fifty years. Its facilities are old-fashion and needs to be renewed.

DMs of this research were the physician or people who have studied about healthcare issues. Therefore, they had a little knowledge about the responses to the questionnaires. For further research, the researchers can employ the model proposed by this study in other industries. The proposed method of this study can be customized using Grey Relational Analysis (GRA) or MULTIMOORA method.

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