

Designing a Comprehensive Fuzzy Model for Evaluating the Performance of Hospitals Using the Combined Methods of Sustainable Balanced Scorecard, Swara and Multimoora ¹

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Research Paper

1. INTRODUCTION

In terms of lack of resources and the importance and sensitivity of treatment and community health, performance appraisal has a special place in health care services. Although various measures have been taken in Iran to evaluate the performance of hospitals and medical centers and a "management dashboard" has been prepared in this regard, there is still no comprehensive performance appraisal system that can evaluate the performance of various aspects of hospitals based on stakeholder interests. This study aims to present a novel model for the first time called the "fuzzy comprehensive model" to experimentally evaluate hospitals' performance using the combined methods of Sustainable Balanced Scorecard, Swara, and Multimoora. To achieve the objectives of the study, the basic research questions are as follows: 1) How can a comprehensive fuzzy model be designed to more accurately evaluate the performance of hospitals? 2) What are the most important fuzzy performance indicators for evaluating performance in hospitals? 3) What are the most important indicators of fuzzy stability to evaluate performance in hospitals? 4) What are the most important indicators of fuzzy reputation to evaluate performance in hospitals? 5) Hospitals' priority for performance appraisal which of the following is a functional fuzzy model perspective, sustainable development, and reputation?

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The results of Gao, Chen, and Feng (2018) and Aujirapongpan et al. (2020) research show that indicators such as the percentage of staff costs from total costs, the ratio of total revenue to total costs, patient satisfaction percentage, patient complaint rate, average length of stay, bed occupancy rate, per capita educational costs, rate Staff satisfaction affected the performance of hospitals. In a study, Vachova and Hajdikova (2018) used key indicators in evaluating the performance of hospitals in the Czech Republic, including activity ratios, solid waste management, payroll productivity, speed of patient care, cost structure, pollutant management, and quality service delivery. High to patients, profit after tax in the form of debts, participation in charitable activities, and adherence to professional ethics in medical practices. Recently, Wagdi and Abouzeid (2021) also studied the improvement of the performance of health care institutions under the Covid-19 virus using a balanced scorecard. The results show that the Balanced Scorecard is weak in measuring the risks faced by health care providers, both financial (liquidity risks) and non-financial risks (hazardous waste risks). The results of this study on performance indicators selected for financial evaluation, internal processes, customer and growth, and learning of hospitals, are consistent with the results of research by Gao et al. (2018) and Aujirapongpan et al. (2020). Also, the results of this study on the key indicators of hospitals to evaluate environmental performance, social responsibility, and reputation, are consistent with the results of research by Vachova & Hajdíková (2018) and Wagdi & Abouzeid (2021).

Figure 1 shows the research pattern and causal relationships between the study variables. The basis of this model is based on the theoretical foundations and questions presented and the "seven-dimensional stable balanced assessment" which is presented below.

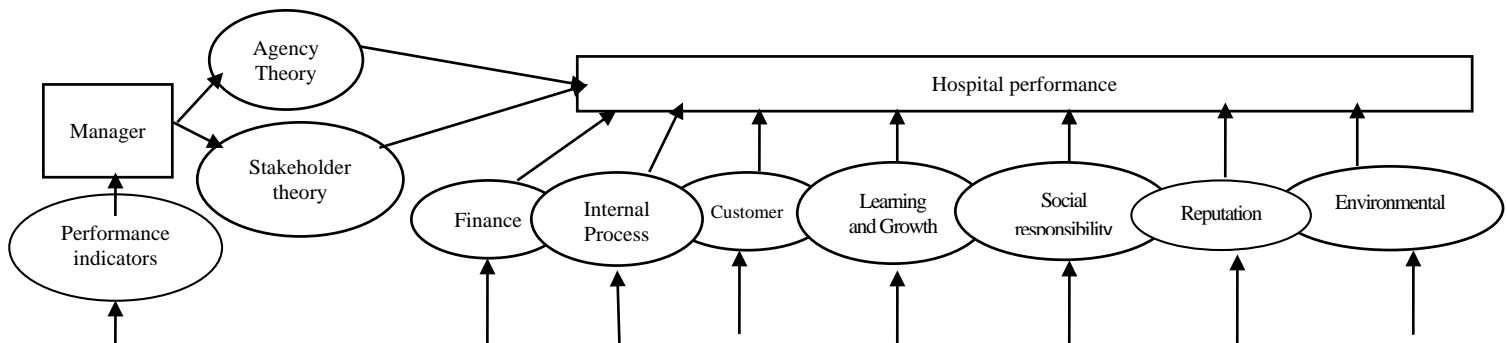


Figure 1: Conceptual model of research

2. MATERIALS AND METHODS

First, the list of available indicators for evaluating the performance of hospitals, prepared by the Ministry of Health and Medical Education of Iran, was reviewed. Then, using the content analysis method (Neondorf, 2011) and using the articles of reputable domestic journals related to the research topic and external sites (Emerald, Sage Journals, Science Direct, Elsevier, Google, etc.), the initial list of performance indicators, sustainability development and The reputation of balanced evaluation in the performance evaluation of hospitals, which included 206 indicators, was extracted. Finally, a list of initial indicators in a questionnaire consisting of 144 finalized indicators was prepared separately for each perspective and sub-category, and to reach a consensus on the final indicators, the fuzzy Delphi method (Suye, 2013) was used. The research population includes all active hospitals in Iran. According to the hospital statistics and information system of the Deputy Minister of Health, in 1398, there are 907 hospitals, of which 570 are public hospitals and 337 are private hospitals. In this study, to increase the internal and external validity of the study, no sampling was performed. Using the halving method and Spearman-Brown formula, the reliability of the questionnaire and the value of the reliability coefficient was 0.92, and also in Cronbach's alpha results, $\alpha = 0.915$ was obtained. In this study, the Swara method was used to weight the performance evaluation indicators of hospitals (Cresulin, Zavadaskas, and Torskis, 2010) and the Multimooraa method was used to rank the performance evaluation indicators of hospitals.

3. RESULTS AND DISCUSSION

Using the fuzzy Delphi method, finally, 81 indicators were selected twenty_ eight indicators were in internal processes and 10, 6, 8, 9, and 12 indicators in finance, customer, environmental, social responsibility, and reputation aspects, respectively. In the next step, using the Swara method, each of the indicators related to different aspects of the stable balanced scorecard, weighting, and the

importance of each of them were determined. The results of weighting the indicators showed that in the financial aspect, the total revenue indicator of the hospital; in the growth and learning aspect, the staff satisfaction rate indicator of the average income; in the internal processes aspect, the bed occupancy rate indicator; in the customer aspect, the percentage of complaints received from patients; in the environmental aspect, pollutants management indicator; in the social responsibility aspect, speed of action in providing services to patients and in the reputation aspect, organizational ethics indicator were the most important. Finally, according to the results of weighting the indicators and using the Multimoor method, 368 hospitals were ranked in terms of each of the various aspects of the Sustainable Balanced Scorecard and reputation. Due to the reduction in the volume of the article, the results of the ranking of the first 30 hospitals, using the multimeter method and a comprehensive performance model, are shown in Table 1.

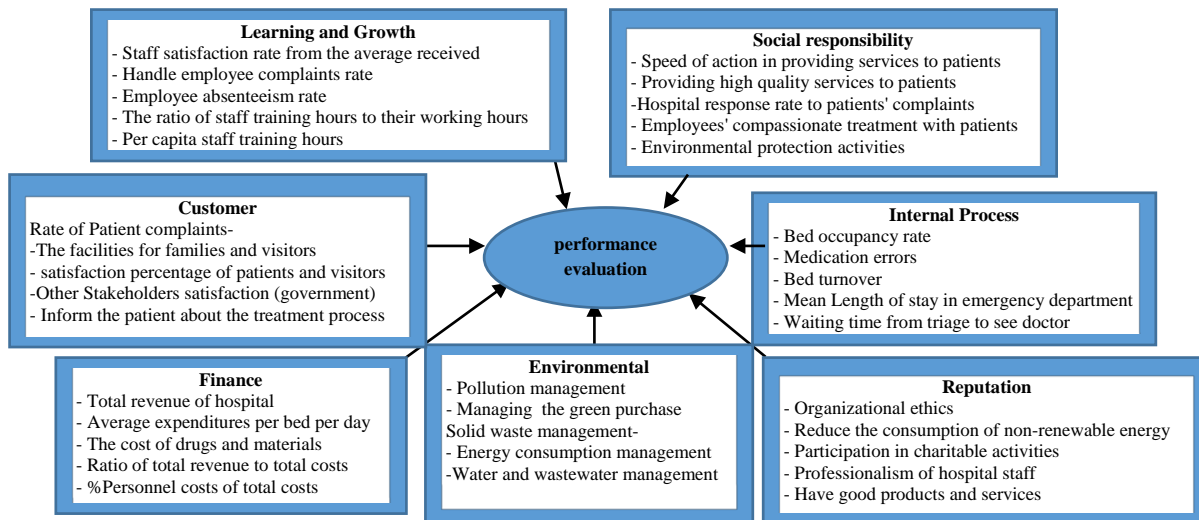


Figure 2: Fuzzy performance evaluation model for Iranian hospitals with a Sustainable Balanced Scorecard approach and reputation

Table 1. Ranking of hospitals by multimora method (Private hospitals are marked in dark colors).

Rank	Private	Public	Private	Public	Private	Public	Private	Public	Private	Public	Private	Public	Private	Public
1	305	1	131	1	40	1	286	1	223	1	241	1	246	
2	83	2	87	2	46	2	256	2	183	2	222	2	180	
3	89	3	112	3	151	3	293	3	221	3	298	3	170	
4	32	4	144	4	220	4	334	4	261	4	70	4	199	
5	73	5	11	5	23	5	353	5	193	5	347	5	341	
6	85	6	352	6	254	6	251	6	24	6	279	6	237	
7	92	7	30	7	251	7	178	7	32	7	357	7	284	
8	13	8	204	8	132	8	203	8	174	8	326	8	189	
9	317	9	36	9	192	9	297	9	219	9	4	9	322	
10	320	10	106	10	210	10	339	10	5	10	307	10	351	
11	298	11	223	11	45	11	358	11	212	11	78	11	9	
12	75	12	276	12	172	12	263	12	195	12	300	12	18	
13	322	13	191	13	169	13	346	13	157	13	23	13	294	
14	54	14	295	14	191	14	186	14	176	14	335	14	194	
15	86	15	210	15	207	15	173	15	218	15	129	15	66	
16	96	16	68	16	64	16	327	16	214	16	319	16	186	
17	187	17	365	17	173	17	204	17	274	17	61	17	167	
18	303	18	93	18	273	18	287	18	197	18	95	18	281	
19	94	19	172	19	255	19	281	19	280	19	219	19	123	
20	336	20	267	20	285	20	182	20	192	20	288	20	243	
21	206	21	229	21	274	21	292	21	22	21	235	21	104	
22	294	22	327	22	27	22	300	22	159	22	42	22	94	
23	9	23	185	23	323	23	183	23	178	23	273	23	280	
24	51	24	242	24	137	24	278	24	173	24	117	24	15	
25	279	25	55	25	15	25	219	25	169	25	37	25	283	
26	127	26	261	26	304	26	221	26	145	26	260	26	47	
27	284	27	74	27	63	27	365	27	29	27	75	27	230	
28	313	28	125	28	95	28	190	28	23	28	292	28	55	
29	16	29	248	29	347	29	288	29	271	29	54	29	282	
30	292	30	270	30	2	30	172	30	211	30	225	30	176	

Also, the number and percentage of private and public hospitals in the first 15 hospitals in terms of the importance of aspects and the first aspect of performance evaluation, are shown in Tables 2 and 3, respectively.

Table2. Number and percentage of private and public hospitals in the top 15 hospitals in terms of the importance of aspects.

aspect	finance		Internal Process		Learning and Growth		Customer		Environmental		social responsibility		Reputation	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
private hospitals	10	67%	8	53%	0	0	9	60%	2	13%	3	20%	5	33%
public hospitals	5	33%	7	47%	15	100%	6	40%	13	87%	12	80%	10	67%

Table3. Number and percentage of private and public hospitals in the first perspective of performance evaluation.

aspect	finance		Internal Process		Learning and Growth		Customer		Environmental		social responsibility		Reputation	
	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%	Number	%
private hospitals	27	22%	18	14%	15	12%	23	18%	14	11%	16	13%	12	10%
public hospitals	31	13%	39	16%	42	17%	19	8%	36	15%	38	15.5%	38	15.5%

4. CONCLUSION

According to the comprehensive model presented in Figure 1, the final model of fuzzy performance evaluation for Iranian hospitals with the approach of a Sustainable Balanced Scorecard and reputation is presented in Figure 2. The results of weighting the indicators showed that in the financial aspect, the total revenue indicator of the hospital; in the growth and learning aspect, the staff satisfaction rate indicator of the average income; in the internal processes aspect, the bed occupancy rate indicator; in the customer aspect, the percentage of complaints received from patients; in the environmental aspect, pollutants management indicator; in the social responsibility aspect, speed of action in providing services to patients and in the reputation aspect, organizational ethics indicator were the most important. Of the 368 questionnaires received, 243 questionnaires were related to public hospitals, and 125 questionnaires were related to private hospitals. The results show that hospitals prioritize different indicators to evaluate their performance. According to Tables 1 and 2, among the top 15 hospitals in the financial aspect, there were 10 private hospitals and 5 public hospitals, and in the customer aspect, there were 9 private hospitals and 6 public hospitals, which shows the private hospitals, financial aspect, and customer aspect, prioritize more to evaluate performance respectively. On the other hand, in the growth and learning aspect, all 15 top hospitals were public, which shows that public hospitals prioritize growth and learning to evaluate performance. In addition, according to Tables 2 and 3, among all private hospitals, 22% and 18% of them, prioritize financial and customer aspects, respectively. Also among all public hospitals, 17% and 16% of them, prioritize growth and learning and internal process aspects, respectively. The results show that only 10% of private hospitals and 8% of public hospitals prioritize reputation and customer aspects respectively, to evaluate performance.

Keywords: Hospital Performance Evaluation. Fuzzy Performance Pattern. Sustainable Balanced Scorecard Method, Swara Method, Multimoor Method.

JEL Classification: M14, L2.

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