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Presenting a Model to Rank Hospital Wards on the Base of Service Quality Case Study: An Iranian Hospital

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ABSTRACT

In the disputive healthcare environment of today, it is only service quality to meet vital needs of competence and excellence. Research in service quality has recently led to different interpretations by various stakeholders. In this paper we tried to measure service providers' perceptions and preferences towards quality of healthcare services and to present a model for ranking service quality among four Iranian hospital wards by using a 20-item scale questionnaire based on a modified SERVQUAL model developed by Parasuraman, Zeithaml and Berry (1988). The studied wards orderly ranked as Dialysis Unit, Emergency Unit, Coronary Care Unit, and Intensive Care Unit, based on different levels of the service quality, by using the algorithm of Preference Ranking Organization Method for Enrichment Evaluations.

KEYWORDS: Service Quality, SERVQUAL, Healthcare Industry, PROMETHEE

1. INTRODUCTION

Nowadays, service sector has been the main part of the modern economy. The idea of remaining compatible and excellent requires focusing on each field of services which could be organized the best.

Healthcare industry undoubtedly plays an important role in such growth. This is why to meet the quality in this industry has been one of the main concerns of the governments. Good health, responsiveness to the expectations of its people, and financial contribution to the nation are the goals for health care systems of a country (WHO, 2000). However, an overview of the health scenario all over the world indicates that despite having numerous excellent health care facilities, there is a sufficiently large gap between the demand and delivery (Heidari Gorji and Farooquie, 2000), so that to identify the gaps in service quality is still effective. Indeed, quality orientation is one of the main priorities of any progressive organization (Tabibi et al., 2001), so that to understand, measure, and improve it are important challenges for all health service organizations (Taner T. and Antony J., 2006; Karassavidou E. Et al., 2009) to increase the number of satisfied patients, and thereby, customer loyalty (Karassavidou E. Et al., 2009; Arasli H., et al. 2008).

However, different from some previous studies which have been done on the case of what patients' perceptions or Physicians' ideas about healthcare service quality are, the aim of this study primarily was to determine the preferences of quality dimensions on the viewpoint of service providers' as a mediator of Physicians(experts) and patients by using a modified SERVQUAL instrument, among top managers; healthcare and quality managers; and clinical staff in an Iranian Social Security Organization's hospitals.

At the second step it attempted to rank the quality of services in four critical wards of Emergency Unit, Intensive Care Unit, Coronary Care Unit, and Dialysis Unit, since critical care is one of healthcare's high-technology and high-budget areas. It aimed to find opportunities of improvement, and utilize resources more efficiently.

This paper presents a model to rank some hospital wards' performance based on the level of service quality and has been performed in three main phases: verifying some attributes for evaluating the level of service quality in selected wards (using an adopted SERVQUAL model), criteria weighting, and finally ranking hospital wards based on the level of service quality (using Preference Ranking Organization Method for Enrichment Evaluations: PROMETHEE II).

2. RESEARCH BACKGROUND REVIEW

2.1. Service Quality in Healthcare Industry

Quality in health services entails two dimensions: technical quality (outcome quality) and functional quality (process quality). Technical quality focuses on the accuracy of medical diagnoses and procedures whereas functional quality refers to the way in which health care services are delivered to patients (Lin H. C. et al., 2004). Since most patients lack the required knowledge to assess the technical quality of services (Bopp, 1990), so this makes most

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patients evaluate healthcare on its functional aspects alone (Bankauskaite V., Saarelma O., 2003). In order to assure that medical procedures are effective not only from the experts' viewpoint (technical quality) but also having the ability to satisfy the functional quality, patients' expectations must be considered in health service delivery. Hence, it is essential to evaluate services, explicitly and implicitly, based on consumer's viewpoints (Hamidi, 1998).

Parasuraman, Zeithaml and Berry (1988) constructed a multi-item scale as SERVQUAL that can be used for measuring perceptions and expectations of service quality as perceived by consumers; along five dimensions: assurance, reliability, empathy, responsiveness, and tangibles (Parasuraman, A. et al., 1988).

In health industry these dimensions can be defined as: the knowledge and courtesy of personnel and their ability to inspire trust and confidence (assurance), the hospital's ability to perform the promised services dependably and accurately (reliability), the hospital staffs' ability to provide a caring and individualized attention to patients (empathy), the hospital's willingness to help patients and provide prompt service (responsiveness), and hospital physical facilities, equipment, appearance of personnel, and communication materials (tangibles).

Since its publication, SERVQUAL has been the target of substantial scrutiny whilst also dominating service quality assessment (Brady M.K. et al., 2002; Hemmasi M., and Strong K.C., 1994; Ko Y.J., and Pastore D.L. 2004; Newman K., 2001; Newman K., 2001; Robinson S., 1999), being applied to numerous settings, including health (Asubonteng P. et al., 1996; Babakus ., Mangold G.W. 1992; Clow K.E. et al., 1995; Desombre T., Eccles G., 1998; O'Connor S.J. et al., 1994). However a considerable part of the academic debate over the past two decades has discussed the conceptual accuracy of SERVQUAL's perception minus expectation equation and whether performance-only measures would be more appropriate (Cronin J.J., Taylor S.A., 1992; Teas R.K., 1993). Applying SERVQUAL in its pure form (i.e. without modification) to any service is widely criticized in the literature (Robinson S., 1999; Cronin J.J., Taylor S.A., 1994). However, tailoring the instrument to a specific setting by adding additional items or modifying existing questions to supplement knowledge and understanding, SERVQUAL can give a unique insight into the service quality (Parasuraman A., Zeithaml V., Berry L.L., 1994).

2.2. Conceptual Model Construction

In this part, a model for ranking the service quality of hospital wards has been proposed. Parasuraman, Zeithaml and Berry confirm adaptations to SERVQUAL are necessary if an accurate measure of service quality is to be established across a diverse range of industries They emphasized that the use of SERVQUAL can be supplemented with additional qualitative or quantitative research and that it is a useful starting point, not the final answer for assessing and improving service quality (Parasuraman A., Zeithaml V., Berry L.L., 1991). Reviewing the literature, some attributes have been selected, and then it has shared through some experts to assure the validity of research instrument and to finalize the structure of the model. That means a committee of decision-makers was formed. The members of this committee included top managers and clinical service providers who have worked in health care sector as well as some academic experts. It is assumed that the group members would carry out adequate brain storming sessions.

The model was formed by seven main attributes (Table1) and twenty sub-attributes (Table2) which has been localized with some sub-attributes derived from Iran's healthcare background. Moreover, this model presents a way for ranking service quality in healthcare sector.

Table 1: Attributes of the conceptual model

Attributes	Reference list
Assurance	Parasuraman, Zeithaml, and Berry(1988), Cock et al.(2006), Lin et al.(2009-a,b), Aghamolaei, Zare (2008), Zarei et al. (2012), Nekoei-Moghadam, Amiresmaili (2011), Suki, Lian, Suki (2011)
Empathy	Parasuraman, Zeithaml, and Berry(1988), Cock et al.(2006), Lin et al.(2009-a,b), Aghamolaei, Zare (2008), Zarei et al. (2012), Narang (2010), Nekoei-Moghadam, Amiresmaili (2011), Suki, Lian, Suki (2011)
Reliability	Parasuraman, Zeithaml, and Berry(1988), Cock et al.(2006), Lin et al.(2009-a,b), Aghamolaei, Zare (2008), Zarei et al. (2012), Nekoei-Moghadam, Amiresmaili (2011), Suki, Lian, Suki (2011)
Responsiveness	Parasuraman, Zeithaml, and Berry(1988), Cock et al.(2006), Lin et al.(2009-a,b), Aghamolaei, Zare (2008), Zarei et al. (2012), Nekoei-Moghadam, Amiresmaili (2011), Suki, Lian, Suki (2011)
Tangibles	Parasuraman, Zeithaml, and Berry(1988), Cock et al.(2006), Lin et al.(2009-a,b), Aghamolaei, Zare (2008), Zarei et al. (2012), Nekoei-Moghadam, Amiresmaili (2011), Suki, Lian, Suki (2011), Experts
Core Medical Service	Parasuraman, Zeithaml, and Berry(1985), Narang (2010), Lee al.(2000), Maxwell(1984), Experts
Social Responsibility	Maxwell(1984), Experts

Table 2: Sub-Attributes of the conceptual model

Code	Sub Attributes	Reference list
SA1	**Trust**	Parasuraman, Zeithaml, and Berry(1988), Aghamolaei, Zare (2008), Zarei et al. (2012), Suki, Lian, Suki (2011)
SA2	**Confidence**	Parasuraman, Zeithaml, and Berry(1988), Aghamolaei, Zare (2008), Zarei et al. (2012)
SA3	**Caring**	Parasuraman, Zeithaml, and Berry(1988), Aghamolaei, Zare (2008), Zarei et al. (2012), Narang (2010), Suki, Lian, Suki (2011)
SA4	**Attention**	Parasuraman, Zeithaml, and Berry(1988), Aghamolaei, Zare (2008), Zarei et al. (2012),Zarei et al. (2012), Narang (2010), Suki, Lian, Suki (2011)

SA5	**Accuracy**	Parasuraman, Zeithaml, and Berry(1988), Aghamolaei, Zare (2008), Zarei et al. (2012)
SA6	**Dependency**	Parasuraman, Zeithaml, and Berry(1988), Aghamolaei, Zare (2008), Zarei et al. (2012)
SA7	**Willingness**	Parasuraman, Zeithaml, and Berry(1988), Aghamolaei, Zare (2008), Zarei et al. (2012), Suki, Lian, Suki (2011)
SA8	**Readiness**	Parasuraman, Zeithaml, and Berry(1988), Aghamolaei, Zare (2008), Zarei et al. (2012), Suki, Lian, Suki (2011)
SA9	**Medical Equipment**	Parasuraman, Zeithaml, and Berry(1988), Aghamolaei, Zare (2008), Zarei et al. (2012), Narang (2010), Suki, Lian, Suki (2011)
SA10	**Automatic Supporting Systems**	Suki, Lian, Suki (2011), Experts
SA11	**Physical Facilities**	Parasuraman, Zeithaml, and Berry(1988), Aghamolaei, Zare (2008), Zarei et al. (2012), Narang (2010), Suki, Lian, Suki (2011)
SA12	**Distribution of Physical Facilities**	Suki, Lian, Suki (2011), Experts
SA13	**Environment**	Aghamolaei, Zare (2008), Zarei et al. (2012)
SA14	**Appearance of Contact Personals**	Parasuraman, Zeithaml, and Berry(1988), Cock et al.(2006), Aghamolaei, Zare (2008), Zarei et al. (2012), Suki, Lian, Suki (2011)
SA15	**Appropriateness and Relevance**	Lee et al.(2000), Maxwell(1984), Experts
SA16	**Effectiveness**	Lee et al.(2000), Maxwell(1984), Narang (2010), Experts
SA17	**Efficiency (Benefits)**	Lee et al.(2000), Maxwell(1984), Narang (2010), Experts
SA18	**Accessibility**	Parasuraman, Zeithaml, and Berry(1985), Narang (2010), Maxwell(1984), Experts
SA19	**Patient Rights**	Maxwell (by equity)(1984), Experts
SA20	**Social Rights**	Maxwell(by social acceptability)(1984), Experts

Figure 1 demonstrates the conceptual model.

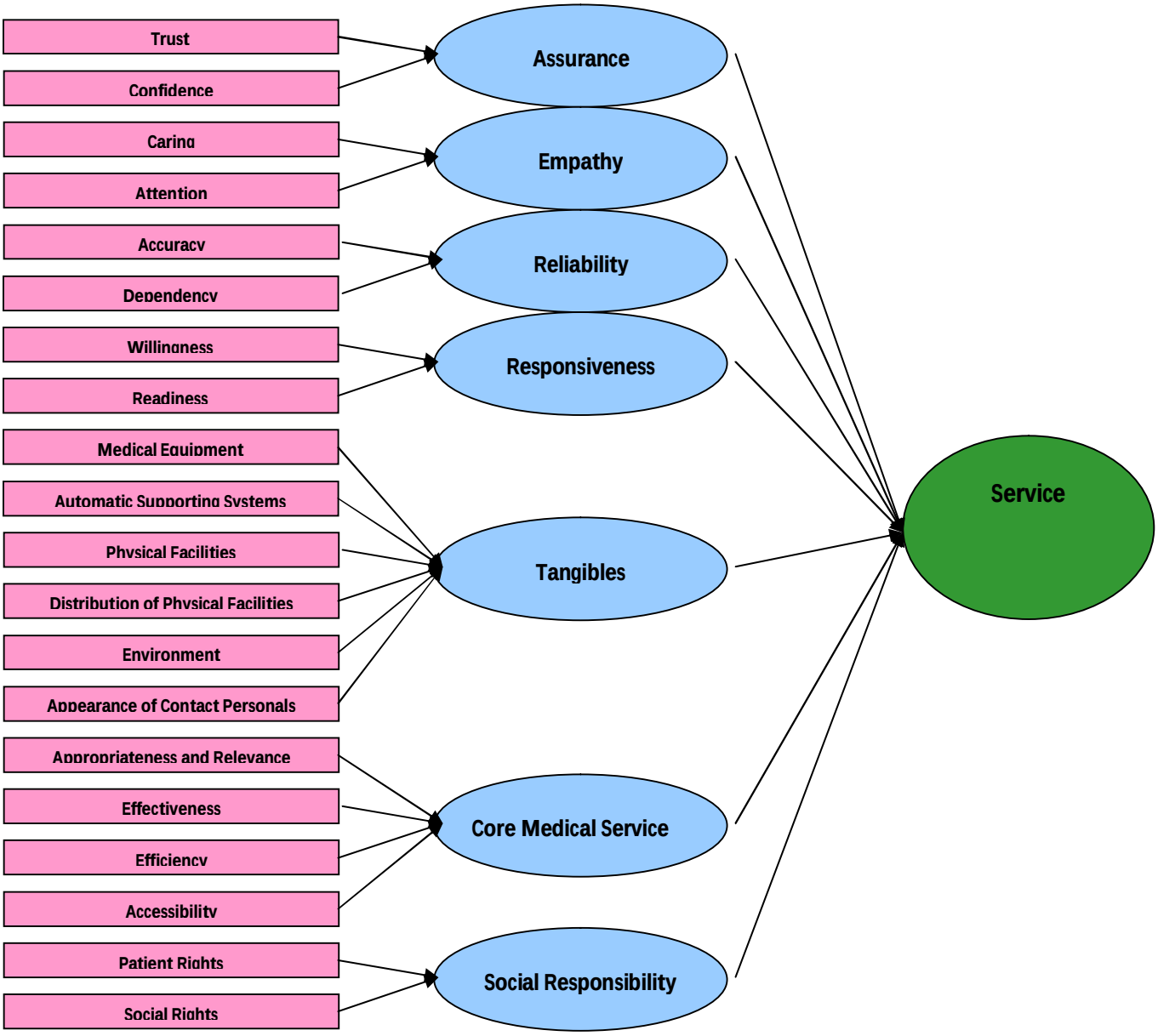

Figure1- Conceptual Model

3. RESEARCH METHODOLOGY AND FINDINGS

The PROMETHEE methods were designed to treat multi-criteria problems and their associated evaluation table. The additional information requested to run PROMETHEE is particularly clear and understandable by both the analysts and the decision-makers. It consists of: information between the criteria; and information within each criterion. The preference structure of PROMETHEE is based on pair wise comparisons. In this case the deviation between the evaluations of two alternatives on a particular criterion is considered. For small deviations, the decision-maker will allocate a small preference to the best alternative and even possibly no preference if he considers that this deviation is negligible. The larger the deviation, the larger the preference. There is no objection to consider that these preferences are real numbers varying between 0 and 1. This means that for each criterion the decision-maker has in mind a function:

$$P_{j(a,b)} = F_j[d_j(a,b)] \forall a,b \in A,$$

where:

$$d_j(a,b) = g_{j(a)} - g_j(b)$$

and for which:

In case of a criterion to be maximized, this $0 \le P_{j(a,b)} \le 1.$ function is giving the preference of over for observed deviations between their evaluations on criterion g(0). It should have the following shape (see Figure 2).

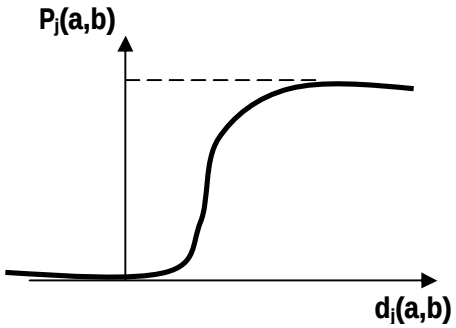

Figure 2- Preference Function

The healthcare service providers (experts) were asked to rate the services quality preferences by answering to each item of questionnaire from 0 to 100 points according to the degree of its importance. They were then asked to evaluate how satisfied each item is in understudy hospital wards. Table 3 illustrates the service providers' preferences of service quality. Following, there is stated a step by step method to evaluate.

Table 3: Preferences of Attributes

Question	Sub-attributes	Geomean	Preference
1	Trust	85.28	1
8	Readiness	81.78	2
3	Caring	80.81	3
2	confidence	80.81	4
16	Effectiveness	80.81	5
13	Environment	80.32	6
5	Accuracy	79.37	7
15	Appropriateness	77.49	8
19	Patient Rights	77.25	9
7	Willingness	74.95	10
18	Accessibility	74.30	11
9	Medical Equipment	72.30	12
6	Dependably	71.46	13
14	Appearance of Contact Personals	70.59	14
4	Attention	69.34	15
12	Distribution of Physical Facilities	68.10	16
17	Efficiency (Benefits)	66.70	17
20	Social Rights	66.44	18
11	Physical Facilities	63.00	19
10	Automatic Supporting Systems	58.57	20

3.1. Verifying the Attributes

As it has been listed in table 1, the instrument was an adaptation of the original SERVQUAL model. However, some changes were made to modify the model to real situation. Finally, it was made up of twenty semi-metric scale items (week to strong) measuring seven postulated dimensions of service quality, consisting of assurance (2 items), empathy (2 items), reliability (2 items), responsiveness (2 items), tangibles (6 items), core medical service (4 items), social responsibility (2 items).

3.2. Weighting Sub-attributes

There are several methods to weight the attributes in decision making sciences. In this paper, based on the number of attributes and to include all of experts' ideas, group method based on geometric mean has been used. Then the final semi-metric scaled questionnaire was distributed among the experts, as service providers of the understudy hospital, to state their ideas about the degree of each sub-attribute of service quality in mentioned wards.

3.3. Creating the Decision Making Matrix

To promote the ranking algorithm, decision making matrix should be shaped. So the findings of experts' ideas about the significance of each sub-attribute have been used to form the decision making matrix. So the percentage of each sub-attributes' preference were turned into a unit amount by using geometric mean through the equation (1). Then the weight of each sub-attribute has been normalized through the equation (2). Table 4 demonstrates normalized geometric means and weighed sub-attributes.

$$W_j = \left(\prod_{j=1}^{n} W_j\right)^{1/n} = \sqrt[n]{\prod_{j=1}^{n} W_j} \qquad (1)$$

$$W_j = a_{i,j} / \sum_{k=1}^{n} ak_j \left(\forall_i = 1,2,3,\ldots, n\right) \qquad (2)$$

Table 4: Normalized Geometric Means & Weighed Sub-Attributes

Row	Sub Criterion	Experts														Geomean	Normalizing	Weight
		1	2	3	4	5	6	7	8	9	10	11	12	13	14			
1	Trust	90	90	90	70	90	90	70	70	90	90	90	90	90	90	85.28141721	0.057636042	6
2	confidence	70	70	70	90	90	70	70	90	90	70	90	90	90	90	80.81022356	0.054614259	5
3	Caring	90	70	90	90	90	70	70	90	70	70	90	90	70	90	80.81022356	0.054614259	5
4	Attention	70	50	70	50	50	70	90	90	70	90	90	90	50	67	69.33755728	0.046860646	5
5	Accuracy	90	70	70	90	90	70	70	90	70	70	90	90	70	90	79.37253933	0.053642624	5
6	Dependably	50	70	70	90	70	50	70	90	70	70	90	70	90	67	71.45751972	0.048293388	5
7	Willingness	90	50	90	70	50	70	70	90	90	70	90	90	70	79	74.94641829	0.050651303	5
8	Readiness	90	70	90	90	90	50	90	90	70	90	90	90	70	90	81.7750199	0.055266301	6
9	Medical Equipment	90	70	70	70	70	50	70	70	90	70	90	50	90	79	72.3034159	0.048865073	5
10	Automatic Supporting Systems	70	50	70	30	50	30	70	70	90	50	70	70	70	67	58.56713885	0.039581636	4
11	Physical Facilities	50	50	70	70	70	50	90	70	70	50	70	70	50	67	63.00089029	0.042578114	4
12	Distribution of Physical Facilities	70	50	70	90	90	50	90	70	90	70	50	70	50	67	68.10398177	0.046026955	5
13	Environment	90	70	70	90	90	90	90	70	90	50	90	70	90	90	80.3201711	0.054283065	5
14	Appearance of Contact Personels	70	50	90	70	70	50	90	70	90	70	90	50	70	79	70.5864107	0.047704663	5
15	Appropriateness	90	70	90	70	70	70	50	70	90	70	90	90	90	90	77.4876621	0.052368761	5
16	Effectiveness	90	70	70	90	90	90	70	90	70	90	70	90	70	90	80.81022356	0.054614259	5
17	Efficiency (Benefites)	70	50	70	50	50	90	90	70	70	70	50	90	50	90	66.69504808	0.04507475	5
18	Accessibility	90	70	90	70	70	50	50	70	90	70	90	70	90	90	74.30170977	0.050215587	5
19	Patient Rights	90	70	90	90	70	50	90	70	70	70	90	90	90	67	77.24560077	0.052205167	5
20	Social Rights	90	50	70	70	50	30	50	70	70	90	90	70	90	79	66.44113497	0.044903147	4

3.4. Ranking the Wards Based on PROMETHEE II

Preference ranking organization method for enrichment evaluations (PROMETHEE) is one of the most recent multi criteria decision making (MCDA) methods that was developed by Brans and further extended by Vincke and Brans (Behzadian et al., 2009). It is an outranking method for a defined set of alternative actions to be ranked and selected among criteria, which are often conflicting. It is also a quite simple ranking method in conception and application compared with the other methods for multi-criteria analysis (Brans et al., 1986).

Regarding the circumstances of the problem, in this study the algorithm of PROMETHEE II is counted as a compensatory model. The stages of the method will be followed in seven steps briefly.

Step1. Determining the threshold values- First of all a threshold value has been determined for each sub-attribute in the decision matrix, through equation (3).

$$Threshold \quad Value = \frac{Max_{i=1}^{r}\ i, j - Min_{i=1}^{r} i, j}{2} \qquad (3)$$

Step2. Calculating the difference between the elements and threshold value- Secondly the difference between the values of both elements of the decision matrix to the related threshold has been calculated. Table 5 states threshold values of Sub-attributes and their difference with threshold values.

Table 5: Threshold Values

Wards	SA1	SA2	SA3	SA4	SA5
Emergency	74.31191	74.98892	73.64165	71.2782	79.33336
Dialysis	85.02319	92.02342	89.28526	85.81038	89.36502
CCU	84.8203	87.19366	89.49357	78.36949	88.57981
ICU	79.05581	72.70771	84.50348	81.98318	87.29452
weight	6	5	5	5	5
Threshold	5.355641	9.657856	7.925957	7.266089	5.015832
II E,D	-2	-1.7638	-1.97372	-2	-2
II E,C	-1.96212	-1.26371	-2	-0.97594	-1.84345
II E,I	-0.88578	0.236203	-1.37041	-1.47328	-1.58721
II D,E	2	1.763797	1.973718	2	2
II C,E	1.962117	1.263712	2	0.975943	1.843453
II I,E	0.885777	-0.2362	1.370413	1.473279	1.587207
II D,C	0.037883	0.500086	-0.02628	1.024057	0.156547
II D,I	1.114223	2	0.603305	0.526721	0.412793
II C,D	-0.03788	-0.50009	0.026282	-1.02406	-0.15655
II I,D	-1.11422	-2	-0.60331	-0.52672	-0.41279
II C,I	1.076339	1.499914	0.629587	-0.49734	0.256246
II I,C	-1.07634	-1.49991	-0.62959	0.497336	-0.25625
Wards	SA6	SA7	SA8	SA9	SA10
Emergency	78.86505	79.53602	82.33871	91.29959	80.14597
Dialysis	88.26031	85.13163	87.35617	92.3888	82.41143
CCU	87.14263	81.88307	87.47982	91.06372	81.10091
ICU	82.67733	71.82791	84.65561	88.29429	79.15771
weight	5	5	6	5	4
Threshold	4.697631	6.651862	2.570554	2.047259	1.626858
II E,D	-2	-0.84121	-1.9519	-0.53203	-1.39254
II E,C	-1.76207	-0.35284	-2	0.115214	-0.58698
II E,I	-0.81153	1.15879	-0.90132	1.467966	0.607465
II D,E	2	0.84121	1.951897	0.532034	1.392535
II C,E	1.762075	0.352841	2	-0.11521	0.586983
II I,E	0.811532	-1.15879	0.901322	-1.46797	-0.60746
II D,C	0.237925	0.488369	-0.0481	0.647248	0.805552
II D,I	1.188468	2	1.050575	2	2
II C,D	-0.23793	-0.48837	0.048103	-0.64725	-0.80555
II I,D	-1.18847	-2	-1.05058	-2	-2
II C,I	0.950543	1.511631	1.098678	1.352752	1.194448
II I,C	-0.95054	-1.51163	-1.09868	-1.35275	-1.19445

Table 5: Threshold Values- continue

Wards	SA11	SA12	SA13	SA14	SA15
Emergency	67.67085	67.53191	85.01383	90.76486	85.18105
Dialysis	76.51073	74.04358	93.63351	92.79405	92.16225
CCU	77.62008	64.58447	92.72792	94.09655	88.85875
ICU	49.61728	43.9848	87.79034	86.18812	87.42085
weight	4	5	5	5	5
Threshold	14.0014	15.02939	4.309841	3.954215	3.490598
II E,D	-0.63136	-0.43326	-2	-0.51317	-2
II E,C	-0.71059	0.196112	-1.78988	-0.84257	-1.0536
II E,I	1.289412	1.566738	-0.64422	1.157432	-0.64167
II D,E	0.631357	0.433262	2	0.513172	2

Π C,E	0.710588	-0.19611	1.789877	0.842568	1.053601
Π I,E	-1.28941	-1.56674	0.644225	-1.15743	0.641667
Π D,C	-0.07923	0.629374	0.210123	-0.3294	0.946399
Π D,I	1.920769	2	1.355775	1.670604	1.358333
Π C,D	0.079231	-0.62937	-0.21012	0.329396	-0.9464
Π I,D	-1.92077	-2	-1.35578	-1.6706	-1.35833
Π C,I	2	1.370626	1.145652	2	0.411934
Π I,C	-2	-1.37063	-1.14565	-2	-0.41193
Wards	**SA16**	**SA17**	**SA18**	**SA19**	**SA20**
Emergency	80.25121	75.73392	83.92308	78.51771	73.54632
Dialysis	83.8943	84.02942	81.33527	87.23175	80.28408
CCU	81.33285	79.20672	78.57432	85.62303	79.50878
ICU	76.15587	72.55748	69.34734	80.20493	76.0812
weight	5	5	5	5	4
Threshold	3.869215	5.735969	7.287866	4.357023	3.368879
Π E,D	-0.94156	-1.44622	0.355084	-2	-2
Π E,C	-0.27955	-0.60544	0.733926	-1.63078	-1.76986
Π E,I	1.058441	0.553776	2	-0.38724	-0.75244
Π D,E	0.941559	1.446224	-0.35508	2	2
Π C,E	0.279551	0.605442	-0.73393	1.630775	1.769863
Π I,E	-1.05844	-0.55378	-2	0.387243	0.752439
Π D,C	0.662008	0.840782	0.378842	0.369225	0.230137
Π D,I	2	2	1.644916	1.612757	1.247561
Π C,D	-0.66201	-0.84078	-0.37884	-0.36922	-0.23014
Π I,D	-2	-2	-1.64492	-1.61276	-1.24756
Π C,I	1.337992	1.159218	1.266074	1.243533	1.017424
Π I,C	-1.33799	-1.15922	-1.26607	-1.24353	-1.01742

Step3. Applying preference function with 0- Thirdly according to the status of sub-attributes being positive or negative, one of the preference functions through the equation (4) or (5) has been used for all elements of the matrix. Table 6 states applying preference function with 0 Threshold Values.

For Positive Sub-attributes

$$\begin{cases} if\ \pi(i,j) < 0 \longrightarrow 0 \\ else \longrightarrow \pi(i,j) \end{cases} \quad (4)$$

For Negative Sub-attributes

$$\begin{cases} if\ \Pi(1,j) < 0 \longrightarrow -\pi(i,j) \\ else \longrightarrow 0 \end{cases} \quad (5)$$

Table 6: Applying preference function with 0Threshold Values

Function	**SA1**	**SA2**	**SA3**	**SA4**	**SA5**
Π E,D	0	0	0	0	0
Π E,C	0	0	0	0	0
Π E,I	0	0.236203	0	0	0
Π D,E	2	1.763797	1.973718	2	2
Π C,E	1.962117	1.263712	2	0.975943	1.843453
Π I,E	0.885777	0	1.370413	1.473279	1.587207
Π D,C	0.037883	0.500086	0	1.024057	0.156547
Π D,I	1.114223	2	0.603305	0.526721	0.412793
Π C,D	0	0	0.026282	0	0
Π I,D	0	0	0	0	0
Π C,I	1.076339	1.499914	0.629587	0	0.256246
Π I,C	0	0	0	0.497336	0
Function	**SA6**	**SA7**	**SA8**	**SA9**	**SA10**
Π E,D	0	0	0	0	0
Π E,C	0	0	0	0.115214	0
Π E,I	0	1.15879	0	1.467966	0.607465
Π D,E	2	0.84121	1.951897	0.532034	1.392535
Π C,E	1.762075	0.352841	2	0	0.586983

Π I,E	0.811532	0	0.901322	0	0
Π D,C	0.237925	0.488369	0	0.647248	0.805552
Π D,I	1.188468	2	1.050575	2	2
Π C,D	0	0	0.048103	0	0
Π I,D	0	0	0	0	0
Π C,I	0.950543	1.511631	1.098678	1.352752	1.194448
Π I,C	0	0	0	0	0
Function	**SA11**	**SA12**	**SA13**	**SA14**	**SA15**
Π E,D	0	0	0	0	0
Π E,C	0	0.196112	0	0	0
Π E,I	1.289412	1.566738	0	1.157432	0
Π D,E	0.631357	0.433262	2	0.513172	2
Π C,E	0.710588	0	1.789877	0.842568	1.053601
Π I,E	0	0	0.644225	0	0.641667
Π D,C	0	0.629374	0.210123	0	0.946399
Π D,I	1.920769	2	1.355775	1.670604	1.358333
Π C,D	0.079231	0	0	0.329396	0
Π I,D	0	0	0	0	0
Π C,I	2	1.370626	1.145652	2	0.411934
Π I,C	0	0	0	0	0
Function	**SA16**	**SA17**	**SA18**	**SA19**	**SA20**
Π E,D	0	0	0.355084	0	0
Π E,C	0	0	0.733926	0	0
Π E,I	1.058441	0.553776	2	0	0
Π D,E	0.941559	1.446224	0	2	2
Π C,E	0.279551	0.605442	0	1.630775	1.769863
Π I,E	0	0	0	0.387243	0.752439
Π D,C	0.662008	0.840782	0.378842	0.369225	0.230137
Π D,I	2	2	1.644916	1.612757	1.247561
Π C,D	0	0	0	0	0
Π I,D	0	0	0	0	0
Π C,I	1.337992	1.159218	0	1.243533	1.017424
Π I,C	0	0	0	0	0

Step4. Applying preference function with 1- Then preference function with 1 has been applied through the equation (6).

$$\begin{cases} if \quad \pi \quad (i, \quad j) \rangle 1 \quad \longrightarrow \quad 1 \\ else \quad \longrightarrow \quad \pi \quad (i, \quad j) \end{cases} \qquad (6)$$

Table 7 states applying preference function with 1 Threshold Values.

Table 7: Applying preference function with 1Threshold Values

Function	**SA1**	**SA2**	**SA3**	**SA4**	**SA5**
Π E,D	0	0	0	0	0
Π E,C	0	0	0	0	0
Π E,I	0	0.01181	0	0	0
Π D,E	0.06	0.05	0.05	0.05	0.05
Π C,E	0.06	0.05	0.05	0.048797	0.05
Π I,E	0.053147	0	0.05	0.05	0.05
Π D,C	0.002273	0.025004	0	0.05	0.007827
Π D,I	0.06	0.1	0.030165	0.026336	0.02064
Π C,D	0	0	0.001314	0	0
Π I,D	0	0	0	0	0
Π C,I	0.06	0.05	0.031479	0	0.012812
Π I,C	0	0	0	0.024867	0
Function	**SA6**	**SA7**	**SA8**	**SA9**	**SA10**
Π E,D	0	0	0	0	0
Π E,C	0	0	0	0.005761	0
Π E,I	0	0.05	0	0.05	0.024299

Π D,E	0.05	0.042061	0.06	0.026602	0.04
Π C,E	0.05	0.017642	0.06	0	0.023479
Π I,E	0.040577	0	0.054079	0	0
Π D,C	0.011896	0.024418	0	0.032362	0.032222
Π D,I	0.05	0.05	0.06	0.05	0.04
Π C,D	0	0	0.002886	0	0
Π I,D	0	0	0	0	0
Π C,I	0.047527	0.05	0.06	0.05	0.04
Π I,C	0	0	0	0	0
Function	**SA11**	**SA12**	**SA13**	**SA14**	**SA15**
Π E,D	0	0	0	0	0
Π E,C	0	0.009806	0	0	0
Π E,I	0.04	0.05	0	0.05	0
Π D,E	0.025254	0.021663	0.05	0.025659	0.05
Π C,E	0.028424	0	0.05	0.042128	0.05
Π I,E	0	0	0.032211	0	0.032083
Π D,C	0	0.031469	0.010506	0	0.04732
Π D,I	0.04	0.05	0.05	0.05	0.05
Π C,D	0.003169	0	0	0.01647	0
Π I,D	0	0	0	0	0
Π C,I	0.04	0.05	0.05	0.05	0.020597
Π I,C	0	0		0	0
Function	**SA16**	**SA17**	**SA18**	**SA19**	**SA20**
Π E,D	0	0	0.017754	0	0
Π E,C	0	0	0.036696	0	0
Π E,I	0.05	0.027689	0.05	0	0
Π D,E	0.047078	0.05	0	0.05	0.04
Π C,E	0.013978	0.030272	0	0.05	0.04
Π I,E	0	0	0	0.019362	0.030098
Π D,C	0.0331	0.042039	0.018942	0.018461	0.009205
Π D,I	0.05	0.05	0.05	0.05	0.04
Π C,D	0	0	0	0	0
Π I,D	0	0	0	0	0
Π C,I	0.05	0.05	0	0.05	0.04
Π I,C	0	0	0	0	0

Step5. Creating weighted matrix- In fifth step the weighted matrix has been shaped, each column of the matrix based on its related sub-attribute.

Step6. Forming collective utility function- Then the collective utility function has been calculated by the equation of (7).

$$\rho = \sum_{j=1}^{n} \pi(j,i) - \sum_{i=1}^{n} \pi(i,j) \qquad (7)$$

Step7. Ranking of alternatives- In the final step, alternatives (four hospital wards) have been ranked. In the other word, the studied wards have been ranked, based on different levels of the service quality, by using the algorithm of PROMETHEE II.

Table 8 illustrates the results of performing this model in four studied wards: Dialysis Unit, Emergency Unit, Coronary Care Unit, and Intensive Care Unit

Table 8: Ranking the Wards

Wards	∑π (j,i)	∑π (i,j)	ρ		Rank	Wards
Emergency	0.474	1.965	-1.49		1	Dialysis
Dialysis	2.203	0.042	2.161	►►►►►	2	CCU
CCU	1.541	0.474	1.067		3	Emergency
ICU	0.436	2.173	-1.74		4	ICU

4. Conclusion

Research findings suggest that in order to evaluate service quality, judgment about the differences and similarities of the organizations through a ranking process could be more effective. By means of some valid and reliable evaluating instruments such as SERVQUAL, to identify and deploy functional preferences to the decision makers might clarify the areas should be better organized and opportunities to improve. As if in the studied hospital comparing four acute wards and ranking them can lead the managers and policy makers to maintain Dialysis and Coronary Care Units' excellences, and to plan some promotions in Emergency and Intensive Care Units. Therefore, it recommends that in health care industry there is a necessity to focus equally on technical quality or service providers' attitude, and functional quality or patient's perception as well.

However more researches are needed to investigate how much patient's desires and rational expectations is considered and covered by service providers' perception about the committed services. For understudy organization it is recommended to study the probable gaps between service providers (not only physicians) and patient perceptions to converge their ideas as well.

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