VAN YÜZÜNCÜ YIL ÜNİVERSİTESİ
İKTİSADİ VE İDARİ BİLİMLER FAKÜLTESİ DERGİSİ
2024 / 9(17) / 1-20
Araştırma Makalesi

ISSN 2651-3943
e-ISSN 2757-8941

Gönderim Tarihi:14.09.2023 Kabul Tarihi: 15.10.2023 Yayınlanma Tarihi: 30.06.2024

CLASSIFICATION OF PUBLIC AND PRIVATE HOSPITALS IN IRAQ IN TERMS OF HEALTH SERVICES QUALITY*

Yener ALTUN[1]

Ayad Faisal ISSA [2]

Rizgar Maghdid AHMED [3]

Abstract

In this search, the quality of health services was taken into account as the most important criterion. Public and private sectors provide services in health systems and generally play an important role in improving the quality of society's health services. The purpose of this search was determined as the classification of public and private hospitals in Erbil province of Iraq in terms of health services quality. A quantitative cross-sectional questionnaire based on the SERVQUAL dimensional model is part of this research. In 2020, considering the random stratified sampling method, 370 questionnaire forms were distributed to patients in all departments of 11 different public and private hospitals in Erbil. Using factor analysis and discriminant analysis with ROC curve in the 25th version of IBM – SPSS software, current data were analyzed. Seven factors accounting for 64% of the total variance in public and private hospitals were found by factor analysis. It was determined that the correct classification rate was 78.1% and that public and private hospitals were separated by discriminant analysis. In addition, the discriminant model of the ROC curve criterion and the AUC value of the area under the ROC curve were obtained with the analysis results as 0.863. This means that the diagnostic test has perfect discrimination. In this search, the most important and effective variables in terms of patient satisfaction between factor analysis and discriminant analysis are X1: Modern equipment in the hospital, X7: The hospital staff get things done the first time and X8: Providing timely services. In conclusion, the analysis results reveal that there is a notable difference between public hospitals and private hospitals.

Keywords: Factor analysis, Discriminant analysis, ROC curves, Patient, Service quality.

Jel Classification*: C40.*

---

* Bu çalışma "CLASSIFICATION OF PUBLIC AND PRIVATE HOSPITALS IN TERMS OF HEALTH SERVICES QUALITY: A SAMPLE OF ERBIL PROVINCE" isimli tezden üretilmiştir.

[1] Doç. Dr., Van YYÜ, E-posta: yeneraltun@yyu.edu.tr, ORCID:0000-0003-1073-5513

[2] Yüksek Lisans Öğrencisi, E-posta: ayad86.faisal@gmail.com, ORCID: 0009-0001-5821-9481

[3] Dr, Salahaddin Üniversitesi, Irak, E-posta: rzgarstat@gmail.com, ORCID: 0000-0003-1788-2647

Atıf: Altun, Y., Faisal ISSA, A., Maghdid AHMED, R., (2022). Classification of public and private hospitals in Iraq in terms of health services quality. *Van Yüzüncü Yıl Üniversitesi İktisadi ve İdari Bilimler Fakültesi Dergisi*, 9(17), 1-20.

DOI: 10.54831/vanyyuiibfd.1359806

SAĞLIK HİZMETLERİ KALİTESİ AÇISINDAN IRAK'TAKİ KAMU VE ÖZEL HASTANELERİN SINIFLANDIRILMASI

Öz

Bu araştırmada sağlık hizmetlerinin kalitesi en önemli kriter olarak dikkate alınmıştır. Kamu ve özel sektör sağlık sistemlerinde hizmet sunmakta ve genel olarak toplumun sağlık hizmetlerinin kalitesinin artırılmasında önemli bir rol oynamaktadır. Bu araştırmanın amacı sağlık hizmetleri kalitesi açısından Irak'ın Erbil ilindeki kamu ve özel hastanelerin sınıflandırılması olarak belirlenmiştir. SERVQUAL boyutsal modeline dayanan niceliksel bir kesitsel anket bu araştırmanın bir parçasıdır. 2020 yılında rastgele tabakalı örnekleme yöntemi dikkate alınarak Erbil'deki kamu ve özel 11 farklı hastanenin tüm bölümlerinde 370 anket formu hastalara dağıtıldı. IBM – SPSS yazılımının 25. versiyonunda faktör analizi ve ROC eğrisi ile diskriminant analizi kullanılarak, mevcut veriler analiz edilmiştir. Faktör analizi sonucunda kamu ve özel hastanelerdeki toplam varyansın %64'ünü oluşturan yedi faktör bulunmuştur. Doğru sınıflandırma oranının %78,1 olduğu, kamu ve özel hastanelerin birbirinden ayrıldığı Diskriminant analizi ile tespit edilmiştir. Ayrıca, ROC eğrisi kriterinin ayrımcı modeli ve ROC eğrisi altında kalan alanın AUC değeri 0,863 olduğu analiz sonuçları ile elde edildi. Bu da tanısal testin mükemmel ayrımcılık taşıdığı manasına gelir. Bu araştırmada hasta memnuniyeti açısından faktör analizi ile diskriminant analizi arasında en önemli ve etkili değişkenler X1: Hastanedeki modern donanım, X7: Hastane personelinin işleri ilk seferde yaptırması ve X8: Hizmetlerin zamanında sağlanması değişkenleridir. Sonuç olarak analiz sonuçları kamu hastaneleri ile özel hastaneler arasında dikkate değer fark olduğunu ortaya koymaktadır.

Anahtar Kelimeler: Faktör analizi, Diskriminant analizi, ROC eğrileri, Hasta, Hizmet kalitesi.

***Jel Kodları**: C40.*

INTRODUCTION

The most significant factor in the effectiveness and survival of health organizations is the quality of health services, thereby increasing loyalty and customer satisfaction of supplier organizations (Ibarra et al., 2014). In order to be considered customer-oriented institutions, the quality of services, particularly in institutions facing high visitor volumes, should be used as a crucial measure; this has contributed to the satisfaction of service users and the growth of activities of health organizations, contributing to the effectiveness and efficiency of health service organizations (Aghamolaei et al., 2014). In addition, patients are becoming more open to competitive change and more familiar with health care facilities, so the standard of service alone might not be enough to preserve a long-term patient-hospital partnership (Gaur et al., 2011). Quality of service is consumers' perception of how well a service meets or exceeds its expectations, and customers judge it, not organizations. The collaborative design of the service process results in the client's quality evaluation directly after the delivery and success of that service (Douglas and Connor, 2003).

In the healthcare sector, identifying and assessing service quality has been a major challenge, because it requires intangibility, heterogeneity and inseparability. In hospitals, service quality has

historically concentrated solely on the quality of medical care, but today it encompasses both medical services and hospitality. The service sector maintains two types of quality, namely the technological aspects and the functional aspects of the services. Professional consistency consists of procedural and diagnostic technical precision. Functional consistency refers to the delivery to patients of health care services. The technological quality of facilities can not necessarily be measured by patients, so functional quality is generally accepted as a determinant of patient satisfaction in hospitals. Since the perceived quality of health care services has a direct effect on health service consumption behavior and behaviors, it is necessary to understand the preferences and perceptions of health service quality patients (Baltussen et al., 2002).

In Iraq, health services are divided into public and private sectors. In the public sector, all types of health services such as medicine, oxygen, all types of rays, medical tests, food, surgery, patient transportation equipment like (Ambulance, wheelchair and patient bed ….) and patient accommodation, car parking, heating or cooling systems and equipment, hospital hygiene and also all hospital employees and medical service staff such as specialist doctors, nurses, administrative staff, servants, etc. all of these services must be provided by the government without any expectation to obtain patient satisfaction. But in the private sector, all the health services mentioned in the public sector are done through payment by person or company.

Considering the relevant literature, Mensah et al. (2016), Alijanzadeh et al. (2016), Amin and Nasharuddin (2013), Taner and Antony (2006), Eggleston et al. (2010), Irfan and Ijaz (2011), Alumran et al. (2020) and D'Cunha and Suresh (2015), conducted scientific studies that will contribute to the literature on the relations between patients and health personnel in public and private hospitals and their effects on patient satisfaction.

The purpose of this research can be listed as follows:

1. Using two advanced statistical ways which are factor analysis and discriminant analysis to reach the most important factors that affect the quality of health care in hospitals.

2. Estimate the distinguish formula between public and private hospitals using discriminant function.

3. Using receiver operating characteristic (ROC) curves criterion as an important measure to evaluate the model.

The fundamental objectives of factor analysis are to reduce dimensions and to investigate the structure of relationships among variables, in other words, to classify variables. As can be understood from the explanations above, in factor analysis, there is no structure referred to as dependent and independent variables among the variables considered. All variables are interrelated variables that collectively constitute a structure (Eygü and Karaman, 2013).

1. METHODOLOGY

This study is intended to make classification and evaluation model of the quality health services rendered by public and private hospitals in Erbil Province. For better developing, the action of quality health service problems from public and private hospitals in north Iraq, with good and rescannable solution, we prefer statistical data that had been analyzed through factor and discriminant analysis with ROC curve to evaluate the model. Therefore to get the data, we will apply the mechanism which explained below:

We applied the SERVQUAL instrument, widely used in contemporary research (Sohail, 2003; Mostafa, 2005; Wiesniewski and Wiesniewski, 2005), in the study. The study questionnaire consists of two parts; the first section includes demographic characteristics of the hospitalized patient such as gender, age, marriage, profession, economic status and education, and the second section includes 22 variables related to quality health services. We adopted all the original SERVQUAL questions without modification, the SERVQUAL scale was based on the five dimensions of service quality namely Tangibles, Reliability, Responsiveness, Assurance and Empathy. The perception and expectation variables were measured on a five point Likert scale ranging from 1="strongly disagree" to 5="strongly agree". Then this questionnaire form is distributed randomly among 370 patients in all departments of eleven different hospitals including public and private hospitals in Erbil province in the year 2020.Moreover, stratified random sampling has been used. Thus, they are 188 patients in public hospital and 182 patients in private hospital.

The data is then manually gathered and entered into the IBM SPSS statistics V: 25 program (statistical package for the social sciences) to be analyzed. In addition, codes are defined for the variables; the data were analyzed by applying the multivariate method focusing on factor analysis to reveal the most important variables affecting patient satisfaction with public and private hospitals. Considering Varimax rotation, loadings above 0.5 were used to interpret the components. Stepwise discriminant analysis was performed to construct a model based on the subset of variables that best discriminates between public and private hospitals. Additionally, ROC curve criterion was used to evaluate the discriminant model.

2. RESULTS AND DISCUSSION

This research depended on questionnaire forms and was distributed randomly among 370 patients in all departments of eleven different hospitals including public and private hospitals in Erbil city in the year 2020. Moreover, stratified random sampling has been used and analyzed data by IBM SPSS Statistics V: 25 program. In the first stage, descriptive statistics reflecting the mean and standard deviation for each service quality structure were used to improve understanding of the public and private hospital classification of quality health care for patients against each service quality dimension. At the second stage, factor analysis was performed to extract the most important variable for public and private

hospitals. At the third stage discriminant analysis was performed to distinguish between public and private hospital. At the fourth stage ROC curve criterion was performed to evaluating the model.

2.1. Demographic profile of patients

To demographic profile of the patient, we used descriptive statistics which are focused on frequency for eight variables such us (gender, age, marital status, occupation, economic condition …etc.). After that we used bar chat for each variables to measure value or frequency, Figure from 1 to 8 illustrate the demographic respondent profile of the patient.

2.1.1. Gender of patients

Figure 1 shows the demographic profile of the patients. A total of 370 respondents by gender represented that, (41.9%) 155 of the patientss were male and (58.1%) 215 were female.

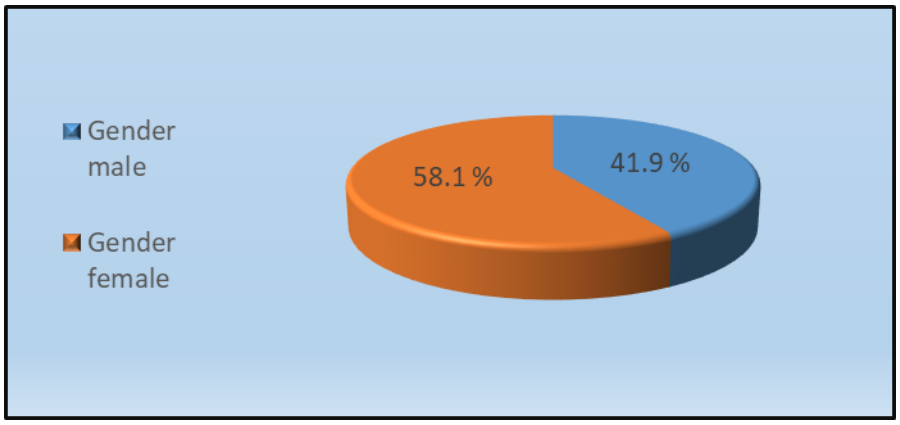

Figure 1. Gender of patients

2.1.2. Age of patients

Figure 2 shows the age patient that (18.1%) 67 of the patient's age were under 25 years old, (26.8%) 99 of the patient's age were 25–39 years old, (20%) 74 of the patient's age were 40-54 years old and (35.1%) 130 were equal or more than 55 years old.

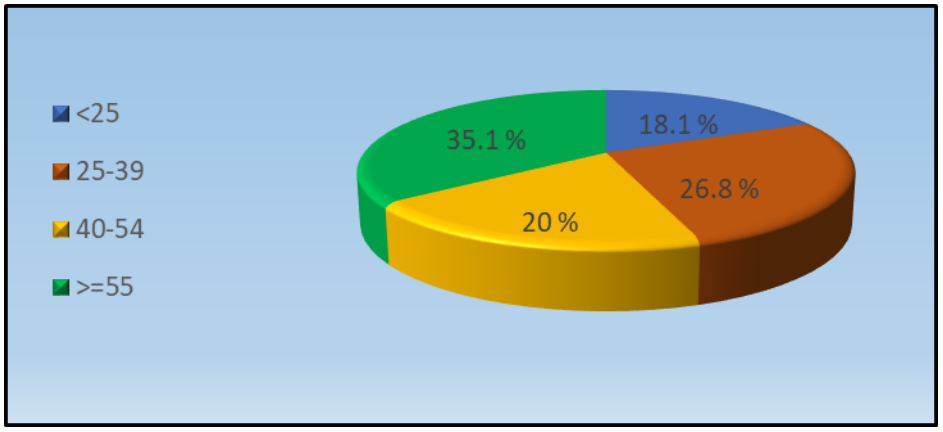

Figure 2. Age of patients

2.1.3. Marital Status of patients

Figure 3 shows marital status for the patients that (70.5%) 261 of the patients were married, (15.9%) 59 of the patients were single,(0.8%) 3 of the patients were divorce and (12.7%) 47 were another status.

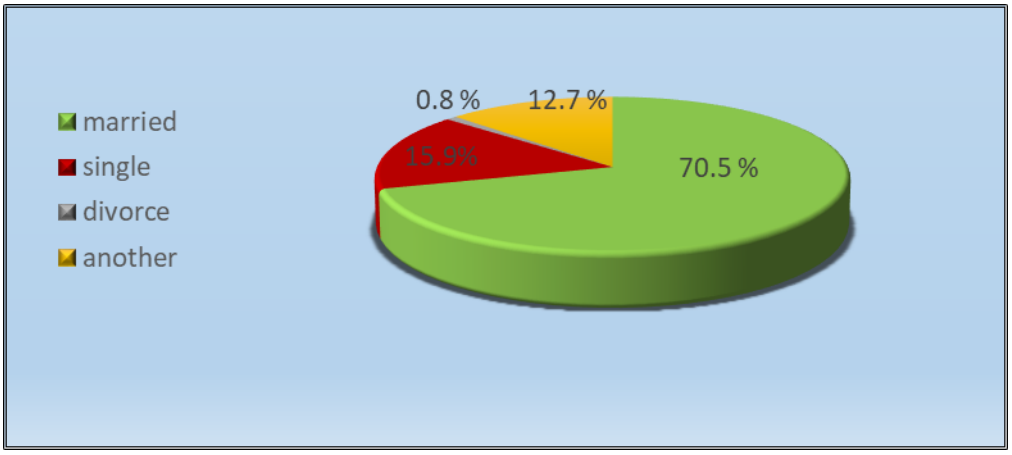

Figure 3. Marital status of patients

2.1.4. Occupation of patients

Figure 4 shows the output of occupation represented that (14.1%) 52 of the patients were employee, (13.8%) 51 patients were retired, (37.8%) 140 patients were wife home, (17.3%) 64 patients were worker, (7.6%) 28 patients were impotence and (9.5%) 35 were students.

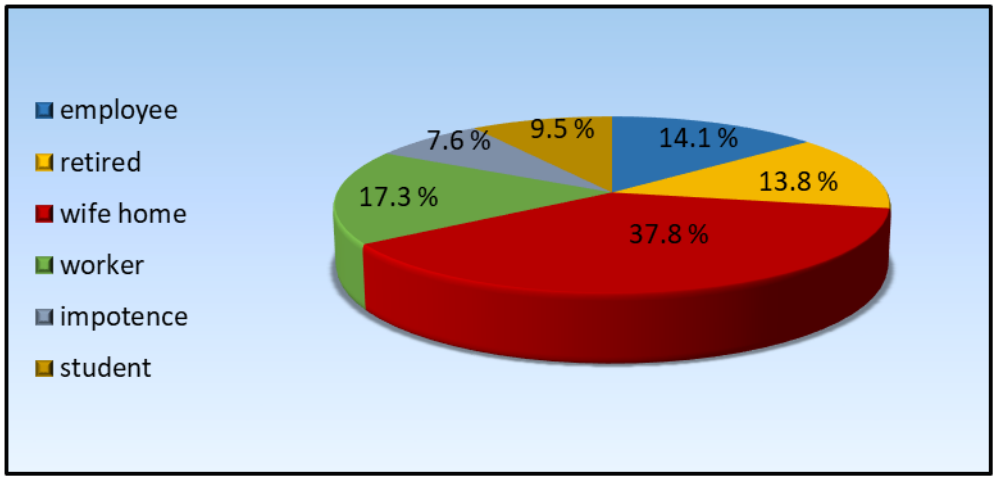

Figure 4. Occupation of patients

2.1.5. Economic condition of respondents

Figure 5 shows economic condition for the patients that (24.6%) 91 of the patients had bad economic, (46.2%) 171 patients had middle economic, (28.1%) 104 patients had good economic and(1.1%) 4 patients had very good economic

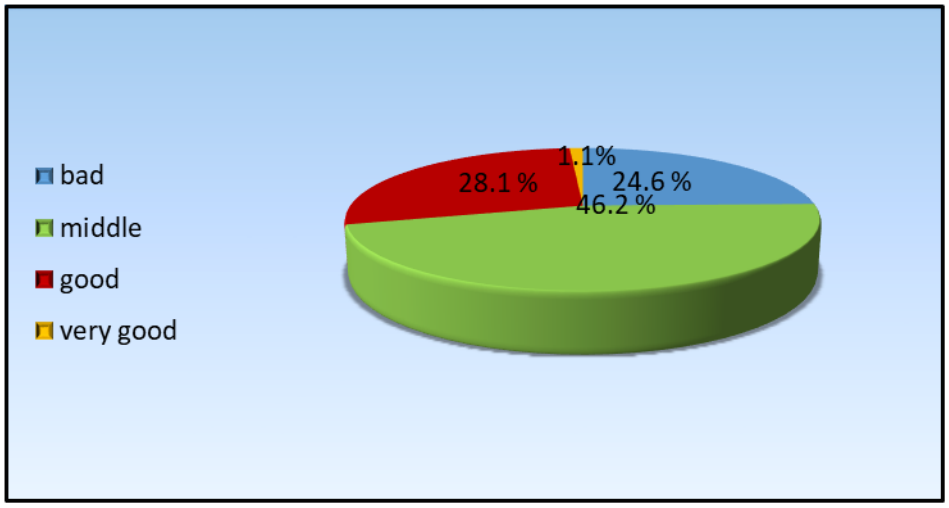

Figure 5. Economic condition of respondents

2.1.6. Education of respondents

Figure 6 shows education for the patients that (36.8%) 136 of the patient's illiterate, (14.3%) 53 patients could just read and write, (10%) 37 patients had primary degree, (13.5%) 50 patients had intermediate degree, (7.6%) 28 patients had secondary degree, (7.6%) 28 patients had institute degree, (9.2%) 34 patients had bachelor degree and(1.1%) 4 patients had higher certificate.

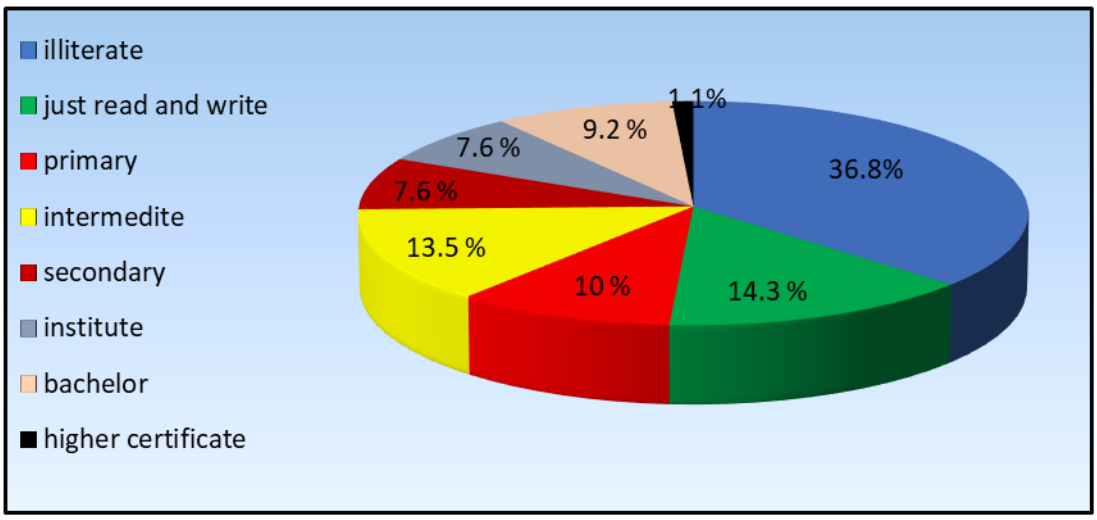

Figure 6. Education of respondents

2.1.7. Respondents of hospital type

Figure 7 shows the contribution of the patients in the hospital type. A total of 370 patients that (50.8%) 188 of the patients in public hospital and (49.2%) 182 of the patients in private hospital.

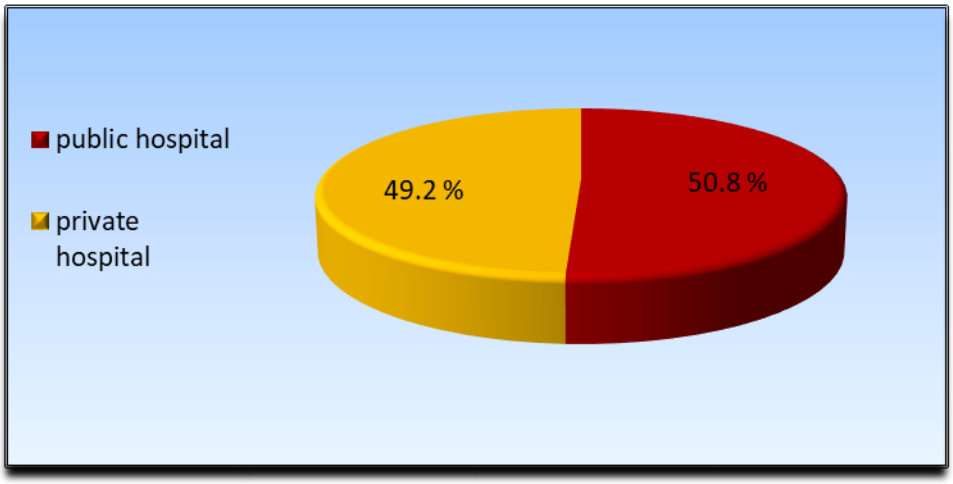

Figure 7. Contribution of the patients in the hospitals.

2.1.8. Respondents divided by hospitals

Figure 8 shows patients that are divided by eleven hospitals. A total of 370 patients that (14.6%) 54 patients in Rizgare Teaching Hospital, (9.5%) 35 patients in West Emergency Hospital, (13.2%) 49 patients in Erbil Teaching Hospital, (13.5%) 50 patients in East Emergency Hospital, (10.5%) 39 patients in Zheen Hospital, (10.5%) 39 patients in CMC Hospital, (8.1%) 30 patients in Sardam Hospital, (8.1%) 30 patients in Paky Hospital, (3.8%) 14 patients in Zanko Hospital, (4.1%) 15 patients in Balsam Hospital, (4.1%) 15 patients in Hawler Hospital.

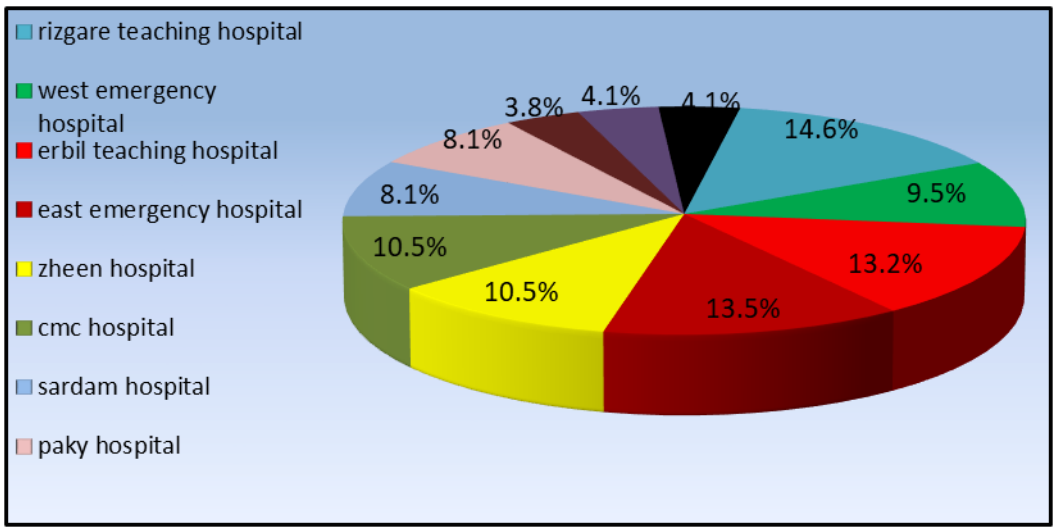

Figure 8. Patients divided by hospitals.

2.2. Reliability Test

Reliability is the degree to which the questionnaire, the evaluation, the assessment or any measurement technique generates the same results in a repeat test. In short, the stability or accuracy of scores over time or through raters (Bolarinwa, 2015). Reliability was tested using Cronbach's alpha (α), the Rasch version of Cronbach's α, except that it is measured from the person's logit scale estimates. (Andrich and Marais, 2019). It is suggested that $\alpha \geq 0.90$ = excellent, $0.90 > \alpha \geq 0.80$ = good, $0.8 > \alpha \geq 0.7$ = acceptable, $0.7 > \alpha \geq 0.6$ = questionable, $0.6 > \alpha \geq 0.5$ = poor, and $\alpha < 0.5$ = unacceptable (Hansen and Kjaersgaard, 2020). The reliability test for our data as shown in the following table:

Table 1. Reliability test

Cronbach's alpha	N of Items
0.788	22

Table 1 shows that total number of items is 22 items and Cronbach's alpha is 0.788 . Therefore, the data is acceptable to analyze.

2.3. Descriptive Statistics

Table 2 shows the descriptive statistics for all variables the mean and standard deviation, count and percent for Likert scale (strongly disagree, disagree, neutral, agree, strongly agree).

Table 2. Descriptive Statistics

Var	strongly disagree		disagree		neutral		agree		strongly agree			
	Count	%	Count	%	Count	%	Count	%	Count	%	Mean	S. D
X1	0	0.0	9	2.4	27	7.3	218	58.9	116	31.4	4.19	0.669
X2	2	0.5	13	3.5	29	7.8	261	70.5	65	17.6	4.01	0.667
X3	0	0.0	0	0.0	15	4.1	211	57.0	144	38.9	4.35	0.556
X4	0	0.0	15	4.1	136	36.8	174	47.0	45	12.2	3.67	0.739
X5	2	0.5	21	5.7	50	13.5	153	41.4	144	38.9	4.12	0.887
X6	0	0.0	7	1.9	22	5.9	211	57.0	130	35.1	4.25	0.650
X7	0	0.0	1	0.3	4	1.1	292	78.9	73	19.7	4.18	0.432
X8	0	0.0	3	0.8	14	3.8	238	64.3	115	31.1	4.26	0.562
X9	0	0.0	2	0.5	4	1.1	259	70.0	105	28.4	4.26	0.498
X10	0	0.0	1	0.3	6	1.6	227	61.4	136	36.8	4.35	0.525
X11	0	0.0	2	0.5	12	3.2	242	65.4	114	30.8	4.26	0.541
X12	0	0.0	0	0.0	9	2.4	300	81.1	61	16.5	4.14	0.412
X13	0	0.0	1	0.3	6	1.6	122	33.0	241	65.1	4.63	0.532

X14	1	0.3	4	1.1	19	5.1	248	67.0	98	26.5	4.18	0.592
X15	0	0.0	4	1.1	6	1.6	290	78.4	70	18.9	4.15	0.476
X16	0	0.0	54	14.6	37	10.0	238	64.3	41	11.1	3.72	0.847
X17	1	0.3	8	2.2	25	6.8	230	62.2	106	28.6	4.17	0.662
X18	0	0.0	6	1.6	19	5.1	216	58.4	129	34.9	4.26	0.629
X19	0	0.0	6	1.6	19	5.1	307	83.0	38	10.3	4.02	0.468
X20	0	0.0	8	2.2	23	6.2	253	68.4	86	23.2	4.13	0.605
X21	1	0.3	6	1.6	31	8.4	294	79.5	38	10.3	3.98	0.525
X22	0	0.0	19	5.1	40	10.8	258	69.7	53	14.3	3.93	0.673

2.4. Factor Analysis

Factors analysis used to describe the basic components that clarify the relationships between a numbers of variables. Furthermore, the study of the principal components is used to derive full variation from the data set for each component, reducing a large number of variables to a smaller number of components. (Tabachnick and Fidell, 2007).

The first step we used Kaiser-Meyer-Olkin (KMO) and Bartlett's test to know the data is suitable for factor analysis (Kaiser, 1974; George and Mallery, 2019). The KMO index ranges from 0 to 1, with 0.50 considered to be sufficient for factor analysis. The Bartlett Test Sphericity should be probability of value ($p<.05$) in order for the factor analysis to be sufficient.

The KMO and Bartlett's Test for our data summarized the results in the following table:

Table 3. KMO and Bartlett's Test – public hospital

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		0.748
Bartlett's Test of Sphericity	Approx. Chi-Square	168.749
	Df	171
	Sig	0.000

Table 3 shows that the Kaiser-Meyer-Olkin (KMO) measure is 0.748, Greater than 0.5, it indicates that sample is good for sampling. And Bartlett's test is significant at 0.000, less than 0.05 than the correlation matrix is significant, which indicates that the data is sufficient for factor analysis.

Table 4. Communalities

variable	Initial	Extraction
X1	1	0.548
X2	1	0.663
X3	1	0.531
X4	1	0.665

X5	1	0.616
X6	1	0.577
X7	1	0.652
X8	1	0.828
X9	1	0.557
X10	1	0.556
X11	1	0.838
X12	1	0.686
X13	1	0.661
X14	1	0.644
X15	1	0.628
X16	1	0.610
X18	1	0.593
X19	1	0.791
X20	1	0.600

Extraction Method: Principal Component Analysis.

The segment Communalities presents before rotation the communality of each component, the communality of a variable is 1 for all the variables, the entire initial communalities are higher than 0.50, which is good. We remove variables (X17, X21, X22) because their variance smaller than 0.5 and don't have effect on the analysis, Table 4 shows how much variation the extracted factors accounted for in the variables.

Table 5. Communalities

Component	Initial Eigenvalues			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	4.081	21.481	21.481	2.450	12.892	12.892
2	1.724	9.076	30.557	2.070	10.897	23.789
3	1.597	8.405	38.962	1.808	9.513	33.302
4	1.409	7.415	46.377	1.687	8.879	42.181
5	1.277	6.721	53.098	1.645	8.660	50.841
6	1.132	5.956	59.055	1.476	7.766	58.608
7	1.025	5.394	64.449	1.110	5.841	64.449
8	0.835	4.394	68.843			
9	0.780	4.104	72.947			

10	0.728	3.830	76.776
11	0.684	3.601	80.378
12	0.617	3.245	83.623
13	0.602	3.169	86.792
14	0.558	2.939	89.731
15	0.507	2.669	92.400
16	0.457	2.406	94.806
17	0.437	2.299	97.105
18	0.401	2.108	99.213
19	0.149	0.787	100.000

Extraction Method: Principal Component Analysis.

The total variance explained section presents how many components (factor) to extract. We used the criterion of retaining only factor with eigenvalue of 1 or greater, in Table 5 shows the first seven components eigenvalue greater than 1 will be retained for rotation. These thirteen components account for (12.892%, 10.892%, 9.513%, 8.879%, 8.660%, 7.766% and 5.841) of the total variance. These seven components explain a total 64.449 per cent of the variance. It can also be inferred these seven components have influenced people's satisfaction from public and private hospitals.

The scree test is another way of identifying the number of valuable components for public and private hospitals. In Figure 9, we can look at the change in shape of the plot there is quite clear break between second and third components. Component 1 explains much of the variance than the other components. After that there is also another little break after seventh component, explains the first seven components the eigenvalue above 1 explains much of the variance than the other components.

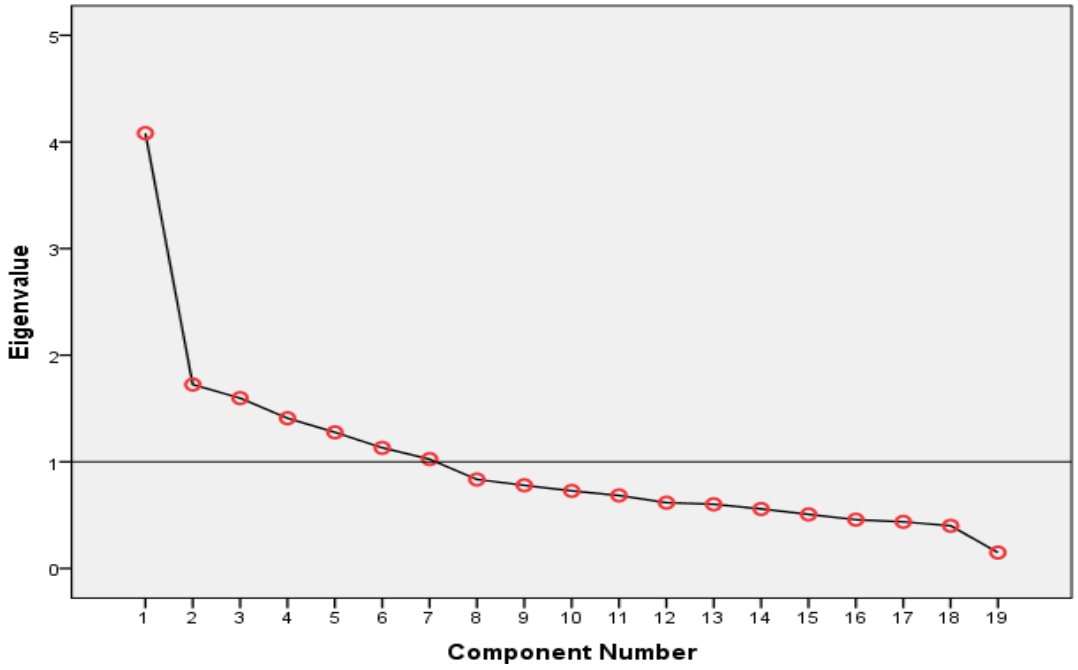

Figure 9. Scree plot

Table 6. Rotated component matrix

component	% of Variance	Factor Interpretation	Variables included in the factors	Loading
C1	12.895	Tangibility and Regularity of Services	The hospital staff provide prompt services.	0.899
			Providing timely services.	0.896
			Modern equipment in the hospital.	0.695
C2	10.897	Assurance of Services	Patients feel safe in the hospital.	0.769
			Hospital staff demeanor instils confidence.	0.749
			The hospital staff communicate to patients about service provision.	0.698
C3	9.513	Responsiveness	Medical staff willingness to help patients.	0.795
			The hospital staff get things done the first time.	0.771
C4	8.879	Reliability	The hospital staff provide promised services.	0.767
			The hospital staff insist on error free records.	0.615
C5	8.660	Empathy	Hospital attractiveness.	0.788
			Hospital staff give patients individual attention.	0.743
C6	7.766	flexibility service	Hospital staff are always courteous towards Patients.	0.751
			Hospital staff give patients personal attention.	0.598
			Medical staff never too busy to respond to patients request.	-0.526
C7	5.841	Time and materials	Hospital has convenient opening hours.	0.840
			Attractiveness of medical materials.	-0.565

After varimax rotation, the rotated component matrix shows the seven components. To determine what these components represent, it would be necessary to consider the variable loaded on each of the seven components. We used absolute value ($\pm$0.5) to identify high loadings. In Table 6 shows that the first component is more important than the second component and so on. Therefore, the need for the hour is for public and private hospitals to reflect on these variables in order to attract patients.

2.5. Discriminant Analysis

Before determining the discriminatory functions of the two groups (public and private), it is needed to do some tests that like the significance of the linear discriminating function and test the significance of the variables in the discriminatory function.

2.5.1. Test the significance of the linear discriminating function

When we want to discriminate between the two groups (public and private) is to be measured and the composition of statistically significant discriminatory functions is statistically significant, the two groups are equal to the mean by using the Wilks' Lambda tester to measure the importance of the linear discriminating feature:

$$\Lambda = \frac{SS\ withi\_group}{SS_{total}}.$$

Table 7. The significant test of the discriminatory function

Wilks' Lambda				
Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1	0.624	171.183	9	0.000

Table 7 shows that the probability values (sig $= 0.000$) smaller than 0.05, and that there is a significant difference between the two groups. This means that the linear discriminant function distinguishes between the two groups (public) and (private).

2.5.2. Test the significance of the variables in the discriminatory function

The significance of all variables is tested to find out the importance of each variable in the function, and its effect on the analysis of the results using the F test

Table 8. Testing the significance of F for each variable in the discriminant function

Variable	Wilks' Lambda	F	df1	df2	Sig.
X1	0.971	11.008	1	368	0.001
X2	0.928	28.537	1	368	0.000
X4	1.000	0.005	1	368	0.942
X5	0.993	2.563	1	368	0.110
X7	0.981	7.070	1	368	0.008
X8	1.000	0.102	1	368	0.749

X9	0.961	15.129	1	368	0.000
X10	0.996	1.432	1	368	0.232
X11	1.000	0.119	1	368	0.731
X12	0.995	1.986	1	368	0.160
X13	0.998	0.813	1	368	0.368
X14	0.996	1.324	1	368	0.251
X15	0.991	3.437	1	368	0.065
X16	0.862	58.982	1	368	0.000
X18	0.999	0.213	1	368	0.645
X19	0.992	2.832	1	368	0.093
X20	0.816	82.759	1	368	0.000

Table 8 shows that the variables (X1, X2, X7, X9, X16, X20.) their probability values (sig $\leq$ 0.05) are highly significant and have a great effect in terms of differentiating between the two groups, while the remainder of the variables have no significant effect.

2.5.3. Estimation of linear discriminatory functions

We used stepwise method for the most important 17 variables that we extracted at factor analysis from public and private hospitals and then we extract the most important 9 variable in the two groups, the results are shown in the following table:

Table 9. Canonical discriminant function coefficients

Variable	Function 1
X1	0.486
X2	0.601
X5	-0.285
X7	-0.852
X8	-0.417
X9	0.476
X16	0.654
X18	-0.340
X20	1.112
Constant	-5.532

Unstandardized coefficients

The relative value of independent variables in the prediction of dependent variables is shown in the Table 7 by canonical discriminant function coefficients. And unique predictor factors that are relevant in

distinguishing between public and private hospitals. Coefficients with higher absolute value have a higher discriminating ability for the variable grouping. The discriminant function is:

Z = -5.532 + 0.486X1 + 0.601X2 – 0.285X5 – 0.852X7 – 0.417X8 + 0.476X9 + 0.654X16 – 0.340X18 + 1.112X20.

2.5.4. Differential function according to group means (cutoff point)

It can be observed that the linear discriminative function is assessed on the basis of the group averages as shown in the following table:

Table 10. Function at group centroids

Type hospital	Function 1
Public hospital	-0.761
Private hospital	0.786

To classify any term depending on the function (W), we substitute the values of the variables related to this term in the equation. If W> 0, then it returns to the first group (public), but if W <0, then the item returns to the second group (private), but if W = 0 there is not classify, that is:

$$CP = \frac{\bar{Z}_1 + \bar{Z}_2}{2}$$

$\therefore$ W = Z – CP.

2.5.5. Calculate the probability of correct classification

Table 11 shows the results of the probability of correct classification of hospitals. In public hospital 139 were classified correctly out of 188 cases at 73.9%, and in the private hospital 150 were classified correctly out of the 182 cases at 82.4%. And that the correct classification rate for the model was 78.1% out of 370 cases, and this means that the probability of classification error is 21.9%.

			Predicted Group Membership		
		Type hospital	Public hospital	Private hospital	Total
Original	Count	Public hospital	**139**	49	188
		Private hospital	32	**150**	182

%	Public hospital	73.9	26.1	100
	Private hospital	17.6	82.4	100

a.78.1 % of original grouped cases correctly classified.

Table 11. Classification results

2.6. Receiver operating characteristic (ROC) curves

The receiver operating characteristic (ROC) curve indicates the ability of a marker or diagnostic test to discriminant between two groups of subjects. Sensitivity and specificity are the basic metrics of diagnostic test accuracy; however, they rely on the cut-off point used to identify "positive" and "negative" test results. Sensitivity and specificity change as the cut point changes, and the plot of a test's sensitivity versus its false-positive rate for all possible cut points. The figure ROC curve for our models is:

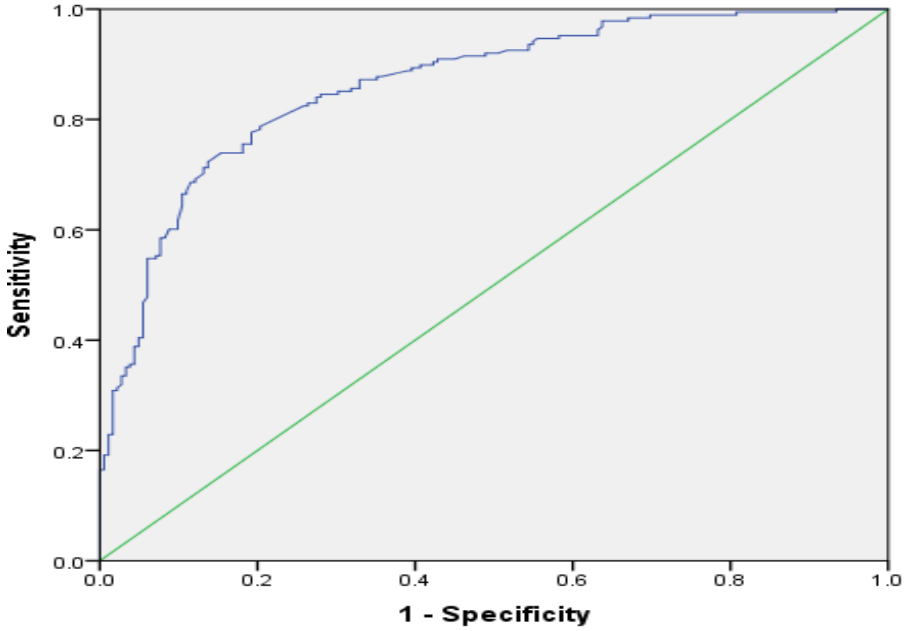

Figure 11. Receiver's operating characteristic curve demonstrating strong discriminatory strength

The area under the ROC curve (AUC) is generally accepted as an indicator of the discriminatory power of a diagnostic test. Table 10 blue shows that the probability of value (sig $\leq$ 0.05), there is a significant different from the random area and AUC = 0.863 means that the diagnostic test is excellent discrimination.

Table 12. Area under ROC curve

Area	Std. Error[a]	Asymptotic Sig.[b]	Asymptotic 95% Confidence Interval	
			Lower Bound	Upper Bound

0.863	0.019	0.000	0.827	0.900

a. Under the nonparametric assumption
b. Null hypothesis: true area = 0.5

2.7. Comparison between results of the factor analysis and the discriminant analysis

In factor analysis we selected the first three most important components explains much of the variance than the other components, containing 8 variables and stepwise discriminant analysis extract the most important 9 variables from both type of hospitals. A table was then developed to compare their findings. Thus the relation is shown in the following table.

Table 13. Comparison between results of the factor and discriminant analysis

Factor analysis variables	Discriminant analysis variables
X1, **X7**, **X8**, X10, X11, X12, X14, X15	**X1**, X2, X5, **X7**, **X8**, X9, X16, X18, X20

CONCLUSIONS

The mean of this study is to extract the most important variables to effect patient to choose which hospitals, classification and evaluation model of the quality health services between public and private hospitals by using factor and discriminant analysis with ROC curve, based on the results obtained.

In public and private hospitals the factor analysis identified seven components accounting for 64% of the total variance, the first component is most influential which explain the largest variance ratio containing three variables (tangibility and regularity of services) and the per cent of variance to this component is 12.892%. The second component containing three variables (assurance of services) and the per cent of variance to this component is 10.897%. The third component containing two variables (responsiveness services) and per cent of variance to this component is 9.513%. The fourth component containing two variables (reliability service) and the per cent of variance to this component is 8.879%. The fifth component containing two variables (empathy service) and per cent of variance to this component is 8.660%. The sixth component containing three variables (flexibility service) its rate

interpretation is 7.766%. The seventh component containing two variables (time and materials) its rate interpretation is 5.841%.

Discriminant analysis showed that the key variable associated with the selection of a hospital, we used stepwise method for the most important 17 variables that we extracted at factor analysis from public and private hospitals and then we extract the most important 9 variable in the two groups, and the correct classification rate for the discriminant analysis is 78.1% distinguish between public and private hospitals. We used ROC curve criterion to evaluate the discriminant model and area under the roc curve. AUC was 0.863 means that the diagnostic test is excellent discrimination.

A convergence and similarity exists between factor analysis and discriminant analysis, factor analysis from public and private hospitals we selected the first three most important components explains much of the variance than the other components, containing 8 variables and stepwise discriminant analysis extract the most important 9 variables from both type of hospitals. Additionally, the results show that the variables (X1: Modern equipment in the hospital, X7: The hospital staff get things done the first time and X8: Providing timely services) are the most important and influential variables between the factor analysis and discriminant analysis for the patient satisfaction. Therefore, the government should take much care of these three variables to increase the quality of health care in both types of private and public hospitals.

REFERENCES

Aghamolaei, T., Eftekhaari, T. E., Rafati, S., Kahnouji, K., Ahangari, S., Shahrzad, M. E., Hoseini, S. H., (2014). Service Quality Assessment of a Referral Hospital in Southern Iran with SERVQUAL Technique: Patients' Perspective. *BMC Health Services Research,* 14(1): 1-5.

Alijanzadeh, M., Zare, S. A. M., Rajaee, R., Fard, S. M. A. M., Asefzadeh, S., Alijanzadeh, M., Gholami, S., (2016). Comparison quality of health services between public and private providers: the Iranian people's perspective. *Electronic Physician,* 8(9): 2935–2941.

Alumran, A., Almutawa, H., Alzain, Z., Althumairi, A., Khalid, N., (2020). Comparing public and private hospitals' service quality. *Journal of Public Health,* 13: 1-7.

Amin, M., Nasharuddin, S. Z., (2013). Hospital service quality and its effects on patient satisfaction and behavioural intention. Clinical Governance: *An International Journal,* 18(3): 238-254.

Baltussen, R. M. P. M., Yé, Y., Haddad, S., Sauerborn, R. S., (2002). Perceived quality of care of primary health care services in Burkina Faso. *Health Policy and Planning,* 17(1): 42-48.

D'Cunha, S., Suresh, S., (2015). The measurement of service quality in healthcare: a study in a selected hospital. *International Journal of Health Sciences and Research,* 5(7): 333-345.

Douglas, L., Connor, R., (2003). Attitudes to service quality–the expectation gap. *Nutrition, Food Science,* 33(4): 165-172.

Eggleston, K., Lu, M., Li, C., Wang, J., Yang, Z., Zhang, J., Quan, H., (2010). Comparing Public and Private Hospitals in China: Evidence from Guangdong. *BMC Health Services Research,* 10(1): 1-11.

Eygü, H., Karaman, S. (2013). Uzaktan eğitim öğrencilerinin memnuniyet algıları üzerine bir araştırma. *Kırıkkale Üniversitesi Sosyal Bilimler Dergisi*, 3(1): 36-59.

Gaur, S. S., Xu, Y., Quazi, A., Nandi, S., (2011). Relational impact of service providers' interaction behavior in healthcare. Managing Service Quality*: An International Journal*, 21(1): 67-87.

George, D., Mallery, P., (2019). IBM SPSS Statistics 26 Step by Step: A simple Guide and Reference. Routledge.

Ibarra, L., Casas, E., Partida, A., (2014). SERVQUAL Method applied to Agencia Fiscal Del Estado de Sonora: an analysis about service quality. The 2nd International Conference on Strategic Innovative Marketing, México.

Irfan, S. M., Ijaz, A., (2011). Comparison of service quality between private and public hospitals: Empirical evidences from Pakistan. *Journal of Quality and Technology Management*, 7(1): 1-22.

Kaiser, H. F., (1974). Little Jiffy, Mark IV. *Educational and Psychological Measurement*, 34(1): 111-117.

Mensah, F., Asirifi, M. K., Sherif, M., (2016). Comparative Analysis of Patient Satisfaction between Private and Public Hospital. *American Based Research Journal*, 5(10): 2304-7151.

Mostafa, M.M., (2005). An empirical study of patients expectations and satisfactions in Egyptian hospitals, *International Journal of Health Care Quality Assurance*, 18 (7): 516-532.

Sohail, M.S., (2003). Service quality in hospitals: more favorable than you might think, *Managing Service Quality*, 13 (3): 197-206.

Tabachnick, B. G., Fidell, L. S., Ullman, J. B., (2007). Using Multivariate Statistics. Boston, MA: Pearson.

Taner, T., Antony, J., (2006). Comparing public and private hospital care service quality in Turkey. *Leadership in Health Services*, 19(1): 1366-0756.

Wiesniewski, M., Wiesniewski, H., (2005). Measuring service in a hospital colposcopy clinic, *International Journal of Health Care Quality Assurance*, 18 (3): 217-228.