

# Quality Perception - A Hierarchical Modelling Approach

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**Abstract:- SERVQUAL has been widely studied across various industries including health care sector by researchers world wide. Most of these studies have used general linear model to draw their findings. However using GLM to study service quality in various hospitals amounts to sheer violation of the basic assumption of independence of observations as the data are nested and clustering in data could be easily observed which was ignored by researchers. This study seeks to plug this loophole by using Hierarchical modeling on R software. Data from 250 patients was collected from Big and Small hospitals from the commercial capital of central India and analyzed. They showed the existence of 5 factors quiet in accordance with Parasuraman (1988) findings. There after hierarchical modeling was applied with these factors as dependent variables. Findings showed that on Tangibility there is no significant difference in perception across gender, age, annual income and education qualification. Findings further shows that Reliability, Assurance, Responsiveness and Empathy varies across gender.**

**Keywords:-** Servqual, Service, Quality, Health Care, Regression, Clustering, Hierarchical Modeling.

## I. INTRODUCTION

The gradual shift of economy from manufacturing to service base and the fight for survival in razor sharp competition all of a sudden brought quality of service in focus. In the seminal works of Parsuraman *et al.* (1985,1988) in the decades of 1980's service quality has been conceptualized, defined and measured using the gap model. Service quality gap is computed as the difference between percepti on and expectation. Servperf (Cronin & Taylor, 1992) is another such universal construct that measures the service quality in various service settings but unlike the Servqual gap model, this captures service quality perception only. Servqual and Servperf the two scales that dominate service quality researches, as they are simple and easy to administer and requires minor semantic modification to customize it to industry specific settings. Service quality has always been a fancy amongst the researchers and the literature has been replete with service quality frameworks, models, factors, constructs, antecedents, consequents, determinants etc. Research in the area of service quality has given important insights to managers for improving quality by judiciously using their resources. An obvious reason that

may be accrued to the systematic evolution of research in this area is the well established link between service quality and business performance

## II. LITERATURE REVIEW

Service quality is an assessment of how well the service delivered meets the client's expectation. It may mean the quality of deliverables to some, while to some others it may mean the human interactions involved at the service encounter yet to others it may mean the experience involved at the time of availing the service. The quality of service is thus a relative concept having different meaning at different times. With the advent of globalization service quality has all of a sudden caught attention of both researchers as well as practitioners (Abdullah, 2005). In order to survive in business, it is service quality alone that can give a competitive edge to business and thus ensure survival (Bitner, 1993). Services have its own idiosyncratic characteristics and are therefore difficult to design, measure and maintain. Services are heterogeneity, perishable intangibles and production & delivery of the services are concurrent. Moreover the outcome quality is contingent to the situational inputs. The quality of service is thus an abstruse concept that takes on different meaning depending on the inputs and the service partners.

The latent concept of service quality may be measured by measuring the factors or determinants of service quality. The determinants may be technical, functional, process related, human related, behavioral constructs, image, IT based, experiential and so on (Parsuraman *et al.*, 1985; Gronos, 1984; Cronin & Taylor, 1992; Mattson, 1992; Teas, 1993). The literature on service quality is flooded with various frameworks and models to asses service quality of various services like telecom, healthcare, hospitality, public services, aviation, education, tourism, banking etc. (Nwabueze and Mileski, 2008; Rhee and Rha, 2009; Shamdasani *et al.*, 2008; Sunindijo *et al.*, 2014; Kamakoty *et al.*, 2015). These models largely measure the service quality from the service user's perspective or service providers perspective and offers useful insights about enhancing service quality by judiciously using business resources. The most popular instruments used for measuring the service quality are Servqual and Servperf scale or customized variants of these scales. Table 1 given below summarizes Servqual based research on service quality.

Table 1 : Research in Service Quality ( Kamakoty &amp; Sohani, 2011)

Industry	SERVQUAL based Research work
Banking	Rahman, 2005; Balaji and Ganesan,2005 ; Davila <i>et al.</i> ,2010 , Newman, K. (2001)
Restaurant/Fast Food/ Hospitality	Balaji and Ganesan, 2005 , Chowdhary and Prakash,2007
Hospital/Health Care/Fitness Centres	(Nwabueze and Mileski,2008; Chowdhary and Prakash,2007
Consultancy	Viadiu <i>et al.</i> , 2002
Public Services	Foster and Newman,1998
Education	Balaji and Ganesan 2005
Airlines	Balaji and Ganesan 2005
IT/Telecomm.	Balaji and Ganesan 2005, Zhou <i>et al.</i> (2002)

Service quality is as important in health care industry as it is any where else. Quality of health services may be defined as the value that is being offered to the customer in terms of quality of life, life expectancy , cure, prevention etc. While quantitatively it can be measured in terms of counts, expectancies, reduction, risk factor etc ., researchers have occupied themselves in developing constructs to measure the qualitative aspects of services. There is a rich repository of literature where in one can find various scholarly work to frame, measure, factorize quality of services. The universal gap based Servqual model is by and large the most popular tool elicited in literature to measure the service quality of medical services, health centres, hospitals across various countries/ communities by students, medical staff, research scholars etc. Griffith (2002), Lehtinen and Lehtinen (1985),. John (1989), Reidenbasch and Sandifer (1990) Babakus and Glynn (1992), Bowers *et. al.* (1994), Youssef & Nel (1996), and Lim and Tang (2000) Jabnoun and Chaker (2003).

This paper attempts to study the service quality of hospitals of commercial capital of central India on the basis of size. The data has been collected from 250 pateints dispersed across big abd small hospital. The patients are nested in the hospital so hierarchical modeling had been used with patients at level at level 1 and hospital at level 2. Servqual perception only scale is used to capture the data across the dichotomy of big and small hospitals. The data is then subjected to analysis to develop important insights on health care services.

### III. RESEARCH METHODOLOGY

A through secondary research had been conducted to identify the gap in literature. Various journals, news, reports, conference papers had been studied to get useful insights on the existing body of knowledge on quality of medical services. Once the gap had been identified , It was decided to measure service quality across hospitals by employing Servqual perception only scale. Sevqual scale had been customized across health care setting to capture the data from patients. or their attendants on a seven point Likert scale (strongly disagree to strongly agree) along with demographic variables like age, income, gender etc . A pilot study was undertaken in order to determine whether the

questionnaire and the scaled were easily understood by responders who were either patients or their attendants.

The data was personally collected by the researchers with the help of well structured questionnaire after a detailed debriefing of the respondent patients/attendants' in hospitals. Five hospitals were selected for data collectiobn. The criteria for selection was as medical facilities offered, target segment and accessibility. A sample of 250 responses was collected using convenience sampling. Data analysis was done using R s/w. Intially the data was checked for anomalitie and missing values. Once the data was clean, it was put to factor analysis. The extracted factors were analyzed across demographic variables. The hospitals were classified into two categories Big and Small on the basis of Bed capacity. Two hospitals qualified in Big category out of 5. 't' test and anova analysis was applied to study the perception expectation gap in the five extracted service quality factors across gender, age, education, income . The findings were then reported along with managerial implications.

### IV. DATA ANALYSIS

Total sample size was 250, out of which 46 were missing values which were eventually imputed using regression method. Out of 250 respondents 52.8% were male and 47.2% were female. About 40% of the respondents were below 30 years, 17% between 30-40 years, 14.4% between 40-50 years and 28% were above 50 years. Qualification wise 62.4% were undergraduates, 31.6% were graduates and 6% were post graduates. On Income basis 58.8% were below 1 lacs, 36.4 were between 1 – 2.5 lacs, and only 4.8% were above 2.5 lacs per year.

Gender is coded as 1 for male and 2 for female. Age is coded as 1 for patients below 30 years of age, 2 for patients between 30 – 40 years, 3 for patients between 40 -50 years and 4 for patients above 50 years of age. Qualification is coded as 1 for undergraduates, 2 for Graduates and 3 for post graduates. Coding of annual income is 1 for income less than 1 lacs, 2 for income between 1 – 2.5 lacs and 3 for annual income above 2.5 lacs.

Before subjecting the data for Factor Analysis, Bartlett test was carried out to assess the factorability of the data.

The Kaiser-Meyer-Olkin Measure of Sampling Adequacy is a statistic that indicates the proportion of variance in your variables that might be caused by underlying factors. : KMO values between 0.8 and 1 indicate the sampling is adequate. KMO values less than 0.6 indicate the sampling is not adequate and that remedial action should be taken. Output showed Kaiser-Meyer-Olkin Measure of Sampling

Adequacy of 0.85 (Chi-Square of 2756.602) clearly indicating that data if fit for factorization.

Scree Plot shown below highlights that 5 factors explain most of the variance, which is in accordance with Parasuraman findings. These 5 factors accounts for 69.44% of variance in data.

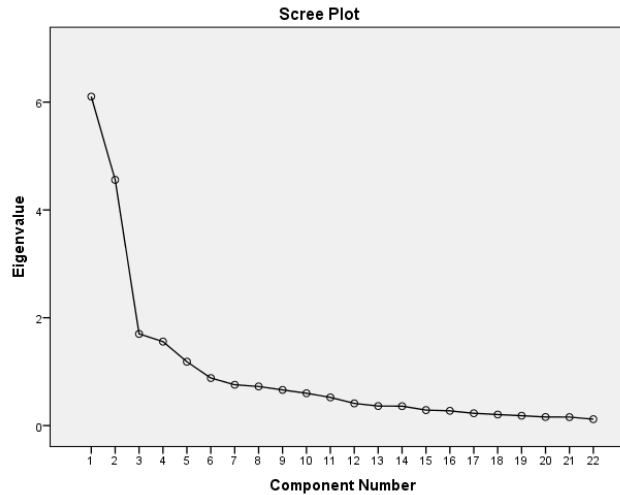


Fig.1 . Scree Plot

Table 2 :Variance of Factors Extracted

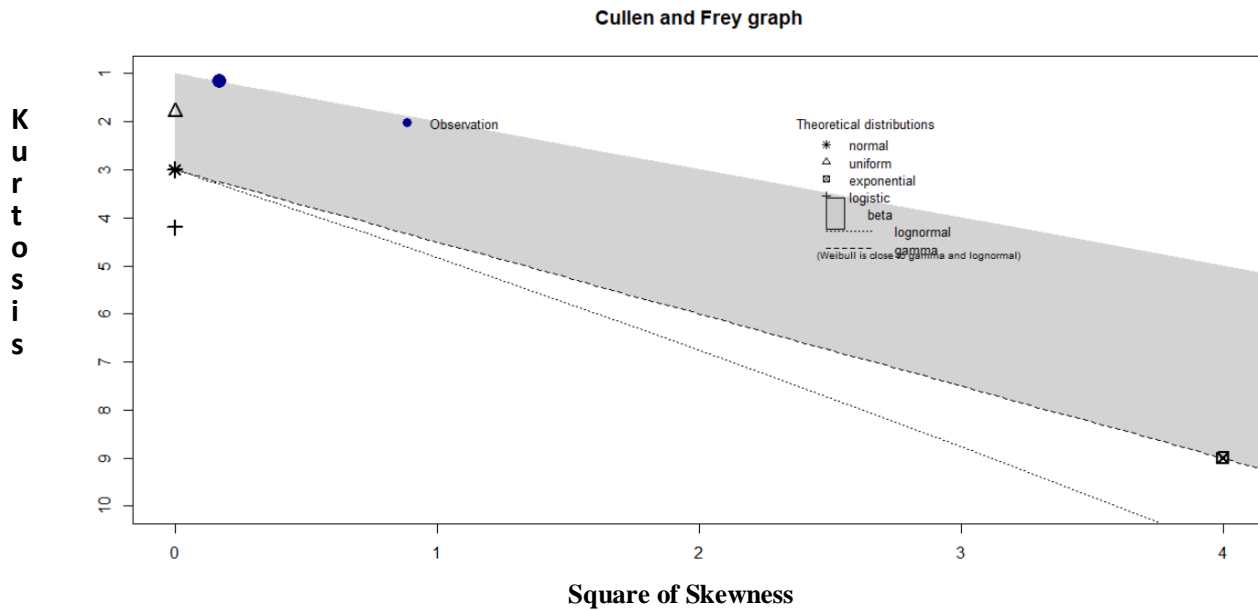
S. No	Factor	Extracted Variance %
1	Tangibility	25.8%
2	Reliability	22.5%
3	Responsiveness	8.09%
4	Assurance	7.34%
5	Empathy	5.60%
	Cummulative Variance Explained	69.44%

Factor Analysis showed that Item 1 through 4 loaded on Factor 1 referred to as Tangibility, items 5 through 9 loaded on Factor 2 referred to as Reliability, items 10 through 13 loaded on factor 3 referred as Responsiveness, item 14 through 17 loaded on factor 4 referred as Assurance and lastly items 18 through 22 loaded on 5<sup>th</sup> factor called as Empathy. Reliability analysis carried out showed all factors have Cronbach Alpha of above .70, which is quiet in keeping with international standards, therefore a summated scale was created for all Factors and named accordingly for both Perception and Expectation.

Table 3: Reliability of Factors Extracted

S. No	Factor	Cronbach Alpha
1	Tangibility	0.849
2	Reliability	0.829
3	Responsiveness	0.699
4	Assurance	0.840
5	Empathy	0.85

Gap was studied by taking the difference between Perception and Expectation summated scale. Positive value indicated patients perception about hospital services are higher than what they expected and negative value showed just the opposite. Thereafter descriptive statistics was carried out for the acquired factors as shown below in table. Output in the table clearly shows that data is normally distributed with Skewness near zero and Kurtosis well below 3.0 (with low standard errors)



**Fig 2: Showing distribution of dependent variable**

Above graph shows that the distribution of dependent variables (RATER) show Beta distribution

For data analysis, we have used Hierarchical Modeling using Generalized Linear Mixed Effect Model using R software using packages like ‘lmer4’, ‘merTools’ and ‘fitdistrplus’. The last one is used to assess distribution of dependent variables.

We have used various factors of SERVQUAL perception scale as dependent variable and demographic descriptors – age, gender, annual income, and education qualification as predictors. Further we have divided the hospitals as Big – Small depending on bed capacity and this has been used for capturing random effect.

On running the script for Empathy as a response variable the output showed the evidence of Inter Class Correlation of 0.07 which is evidence of clustering (though weak) in the data for Big and Small hospitals, thereby lending justification to the application of Hierarchical Modeling. The output for Random Effect is shown as below

**Random effects:**

Groups	Name	Variance	Std.Dev.
Big- Small	(Intercept)	0.01853	0.1361
Residual		1.74854	1.3223

For Fixed Effect Age ( $\beta = -0.165$ , t-value = -2.32) and Gender ( $\beta = -0.368$ , t-value = -2.214) have significant effect on empathy. Highly significant Intercept ( $\beta = 5.95$ , t-value = 13.72). Findings show that as the patients’ age goes up his perception goes down by 16% thus patients with higher age are more dissatisfied with the empathy of the hospital. On gender female perception is about 36% lesser than male, clearly

suggesting female are relatively more disgruntled with the hospital empathy than male.

On running the script for Tangibility as a response variable the output showed the evidence of Inter Class Correlation of 0.03 which is evidence of clustering (though weak) in the data for Big and Small hospitals, thereby lending justification to the application of Hierarchical Modeling. The output for Random Effect is shown as below

**Random effects:**

Groups	Name	Variance	Std.Dev.
Big- Small	(Intercept)	0.0069	0.0861
Residual		0.855	0.92

For Fixed Effect none of the values are significant at 5% significance level. Findings show that cutting across patients of all age, gender, education qualification and annual income there is no difference in the hospitals tangibility aspect.

On running the script for Responsiveness as a response variable the output showed the evidence of Inter Class Correlation of 0.11 which is strong evidence of clustering in the data for Big and Small hospitals, thereby lending full justification to the application of Hierarchical Modeling. The output for Random Effect is shown as below

**Random effects:**

Groups	Name	Variance	Std. Dev.
Big- Small	(Intercept)	0.07853	0.280
Residual		0.299	1.731

For Fixed Effect Gender ( $\beta = -0.553$ , t-value = -2.54) and annual income ( $\beta = -0.892$ , t-value = -3.62) have significant effect on Responsiveness and age in nearly significant A

ge ( $\beta = -0.187$ ,  $t\text{-value} = -2.00$ ). Findings show that female perception of responsiveness is 55% lower than male. Also as the patients income goes up his perception on hospitals responsiveness goes down by 89%. dissatisfied with the empathy of the hospital. On gender female perception is about 18% lesser than male (though marginally significant), clearly suggesting female are relatively more disgruntled with the hospital responsiveness than male.

On running the script for Assurance as a response variable the output showed the evidence of Inter Class Correlation of 0.12 which is strong evidence of clustering in the data for Big and Small hospitals, thereby lending full justification to the application of Hierarchical Modeling. The output for Random Effect is shown as below'

**Random effects:**

Groups	Name	Variance	Std. Dev.
Big- Small	(Intercept)	0.08	0.295
Residual		1.129	1.062

For Fixed Effect Age ( $\beta = -0.144$ ,  $t\text{-value} = -2.517$ ) other predictors are insignificant. Findings show that as the pati

ents age goes up his perception about hospitals assurance de creases by 14%. This shows that old patients find hospitals less assuring than younger counterparts.

On running the script for Reliability as a response variable the output showed the evidence of Inter Class Correlation of 0.22 which is strong evidence of clustering in the data for Big and Small hospitals, thereby lending full justification to the application of Hierarchical Modeling. The output for Random Effect is shown as below

**Random effects:**

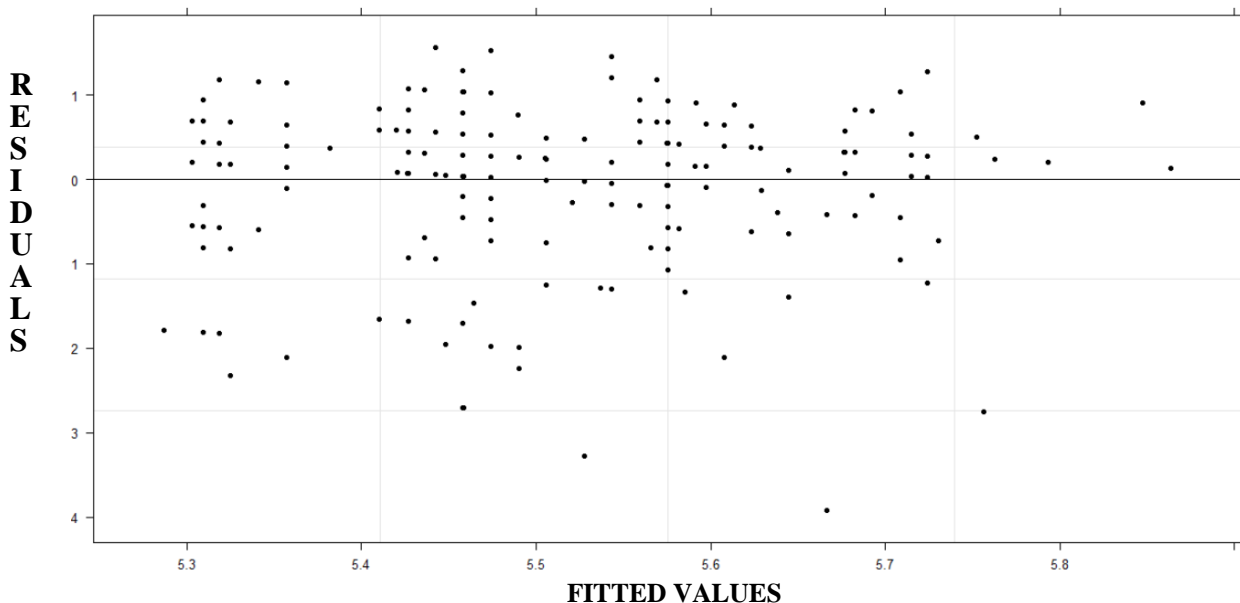
Groups	Name	Variance	Std. Dev.
Big- Small	(Intercept)	0.643	0.801
Residual		4.914	2.216

For Fixed Effect Age ( $\beta = 0.311$ ,  $t\text{-value} = -2.59$ ) other predictors are insignificant. Findings show that as the patient s age goes up his perception about hospitals reliability increa ses by 31%. This shows that young patients find hospitals less reliable than their younger counterparts.

**Table 4: Depicting Model fit**

S. No	Dependent Variable	AIC	BIC	LogLik	Deviance	$\chi^2$	P Value
1	Empathy	864.84	889.49	-425.42	850.84	-	-
2	Tangibility	685.2	710.37	-335.86	671.72	179.11	0
3	Responsiveness	1000.58	1025.23	-493.29	986.58	0.000	0
4	Assurance	758.59	783.24	-372.29	744.59	241.99	0
5	Responsiveness	1127.17	1151.82	-556.58	1113.17	0.00	0

Table above shows the model fit for various SERVQUAL factors. It can be clearly seen that model No 2 with Tangibility as dependent variable has lowest AIC (Akaike's Information Criteria) and BIC (Bayesian Information Criteria).



**Fig 3: Residual Plot**

Figure above shows the residual plot against the fitted values a random pattern which is clearly indicative of a good fit.

## V. DISCUSSION

Tangibility aspect of service quality is insignificant across age, income, qualification and gender implies that the customers look for higher level of tangibility aspects than what is offered by the hospitals. They know look beyond the basic medical infrastructure and expect improved hospitality. Increase in perception of Reliability with age implies that hospitals need to craft focused services for the patients of younger age. Assurance is an aspect of service quality to be built in the senior generations. This can be done by robust selection, training, induction of hospital staff and medicos. Additionally Assurance can be built through proper follow ups and courtesy calls. Empathy is seen to be effected by age. Senior patients are not very happy in this context. Healthcare providers should take a serious note of they represent the major chunk of their clientele. Empathy can be imbibed through proper communication and quick response to patients ailment & complains. It calls for sensitization of staff towards handling patients. This also applies for handling the female gender patients with more of sensitivity and patience as the evidences show that females rate the hospitals lower on this factor. Females are not happy on Responsiveness aspect of service quality of hospitals. They look for timely responses and prompt actions. The hospitals need to work on this aspect by ensuring the availability of staff, facilities and services as an when required. Similarly people of higher income brackets also have an urge for more Responsiveness.

## VI. CONCLUSION

It can be concluded from this study that hospital lack on certain aspects of service quality. Specially the senior patients and the female patients look for more of empathy, responsiveness and assurance. The hospitals should seriously craft solutions to cater to their requirements as these constitute the chunk of hospital clientele. Tangibility is another aspect that the hospitals have to look beyond the normal. Apart from robust medical infrastructure, the patients look for tangibilization of the service delivery process.

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