Original Article

Application of Structural Equation Model to Evaluate the Perception of Service Quality of Medical Staffs of Infectious Disease Department in Chinese Hospitals

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Objective To enhance the quality of medical service for Chinese patients through research of service quality from Chinese medical personnel.

Methods ServQual scale was used for infection medical staffs randomly by sampling questionnaire in Beijing, Shanghai, Chengdu, Chongqing, Guangzhou and Nanning. The data collected were entered and analyzed using SPSS 20.0. Statistical methods included frequency, factor analysis, reliability analysis, correlation analysis, independent samples *t* test, one-way analyses of variance, simultaneous regression analysis and structural equation model analysis.

Results The *Kaiser-Meyer-Olkin* value for the factor analysis of the scale was 0.970. The *Cronbach's α* for the reliability analysis was 0.975. The Pearson correlation coefficients were 0.624-0.874 and statistically significant. Undergraduates felt good, PhD students felt bad; the doctors felt bad; managers felt good. Standard 5 dimensions of the regression coefficients were positive, including empathy ($\beta = 0.288$), reliability ($\beta = 0.241$) impacting on perceived service quality mostly. The control ability and stability of the standard error of perceived service quality directly effected value were 0.646 and 0.382, respectively.

Conclusions Medical staffs of infectious disease department have poor perception of service quality. Hospitals should improve awareness and of clinicians and deepen the reform of the medical care system.

Key words: Structural equation models; Infectious disease department; Perception of service quality

The ServQual scale is widely used in the field of the world service¹⁻⁷ and medical service quality evaluation of hospital.⁸⁻¹² Its reliability and validity are accepted by service quality research scholars.¹³ The satisfaction of medical personnel was improved each 3 percentage corresponding to improve customer satisfaction by 5 percentage.¹⁴ In 2014, the research of Li and

associates showed that patients at a hospital in

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Shanghai had higher levels of satisfaction with service quality than the clinicians; the first-line medical staff's perceived satisfaction with the service quality was particularly low.¹⁵⁻¹⁷ So the improvement of medical service should improve the service of medical staff. Therefore, the ServQual scale was used for infection of medical staff in Beijing, Shanghai, Chengdu, Chongqing, Guangzhou and Nanjing. The structural equation model was used in analysis of the factors influencing of medical staff perceived service quality and countermeasures was put forward, and then the references to the management of health and hospitals will be provided.

MATERIAL AND METHODS

Questionnaire designs and methods

Questionnaire designs

According to the definition of the 5 dimensions of ServQual and Chinese medical and health fields characteristics, we designed “evaluation of medical staff and perceived service quality questionnaire” including personal information and the content of the questionnaire.

Pre-questionnaire

The questionnaire was pre-tested in the medical staffs, community medical personnels, patients and the questionnaire’s validity and reliability were analysed.

Formal questionnaire

Medical staffs in infectious disease hospital were surveyed from September to December in 2013. Total of 404 medical staff questionnaires were recovered. Finally 392 valid questionnaires were retained after removing those containing logic errors or missing values more than 5% of the questionnaire. The effective recovery rate was 97.03%. Total remainings were: Chengdu, 19; Shanghai, 39; Chongqing, 150; Beijing, 97; Nanning, 87 and Guangzhou, 12.

Code

(1) The personal information of subjects: Gender: 1 for male, 2 for female; Age: 1 for those equal or less than 29 years, 2 for 30-39 years old, 3 for 40-49 years old, 4 for 50-59 years old, 5 for those equal and over 60 years old. Education: 1 for junior college and below, 2 for undergraduate students, 3 for graduate students, 4 for doctoral students. Occupation: 1 for doctors, 2 for nurses, 3 for technicians, 4 for research personnel, 5 for management staff, 6 for support staff. (2) The questionnaire content: there were 22 questions assessing positivity to 5 dimensions. Tangible questions were T1-4, those for reliability were L5-9, for Response S10-13, for Assurance A14-17, and for Empathy E18-22. Response to each question was scored using a Likert-type scale 5 point method. The questionnaire content: tangibles was T1-4, reliability was L5-9, response was S10-13, assurance was A14-17, empathy was E18-22. 1 was very dissatisfied, 2 was not satisfied, 3 was general, 4 was satisfied, 5 was

very satisfied after each question. All 22 questions are positive problems. So 392 questionnaires were coded from 1 to 392.

Statistical analysis

SPSS 20.0 was used for statistical analysis. Frequency analyses were computed using the respondent information and the 22 items of the ServQual scale. The respondents were divided into high and low groups based on the critical ratio (CR) of the means of the versions of the ServQual scale. Then independent-sample *t*-tests, reliability analyses and validity analyses were performed on the 22 items in each ServQual scale. Product moment correlations (Pearson correlation analyses) were conducted on the means of the five dimensions in each version of the ServQual scale. Independent-sample *t*-tests were performed using gender. One-way analysis of variance were performed on the mean values of the five dimensions with age, level of education and occupation. Simultaneous regression analysis were performed on the mean values of the ServQual scale with the mean values of the five dimensions as predictors. Structural Equation Models analysis was performed on the mean values of the ServQual scale with the mean values of the controllable errors and the stability error.

RESULTS

Analysis of pre-questionnaire reliability and validity

The *Cronbach's Alpha* value of “The questionnaire of evaluation of medical staff perceived service quality” 5 dimensions was 0.910. The questionnaire was effective.

Descriptive statistics

Subjects information

Gender: males were 175 (44.6%), females were 53.6 (53.6%). Age: up to and including 29 years were 88 (22.4%), 30-39 years old were 156 (39.8%), 40-49 years were 113 (28.8%), equal and over 50 years old were 32 (8.2%) and 1-4 codes followed. Education: junior colleges and below were 33 (8.4%),

undergraduate students were 175 (44.6%), graduate students were 142 (36.2%), doctoral students were 40 (10.2%). Occupation: doctors were 167 (42.6%), nurses were 38 (9.7%), medical technology staff (25) and scientific research staff (36) were 61 (15.6%), management staff (117) and 2 support staff (2) were 119 (30.3%), and 1-4 codes followed.

Analysis of 22 items in the 5 dimensions of the ServQual scale of frequency

The average value of the 5 dimensions of the ServQual scale were 3.355-3.928, indicating that overall the influencing of medical staffs felt a low degree of satisfaction with the quality of service (Table 1).

Determination value-critical ratio

First calculation of the total mean ServQual scale with 22 items, critical ratio before 27% and after 27% were 3.23 and 4, respectively. After dividing the low group and high group, respectively, *t* test patients group 22 items and level are 0 significant level ($P = 0$, $P < 0.05$). The questionnaire was valid.

Factor and reliability analysis

Kaiser-Meyer-Olkin Measure of Sampling Adequacy was 0.970, *Cronbach's Alpha* was 0.975. The formal questionnaire reliability and validity were effective.

Scores for the 5 dimensions showed highly significant positive correlation with each other

From Table 2, a highly positive correlation was between 1 and 5 dimensions from Table 1, moderate positive correlation was tangible and 4 dimensions. The remaining 4 dimensions were a highly positive correlation.

Samples *T* test and one-way analysis of variance

There were no significant differences in independent samples *T* test of 5 dimensions and the gender, and no significant differences in One-way ANOVA of age. In independent samples *t* test of 5 dimensions and the gender, and no significant differences in One-way ANOVA of age. One way analysis of variance

education and occupation analysis is significant differences, the results were in Table 3.

From Table 3, undergraduate students felt good, doctoral students felt bad in reliability, responsiveness, assurance and empathy. Doctors felt lower than managers in five dimensions of perceived service quality. Technician felt worse than managers in reliability, responsiveness of perceived service quality. The doctor felt the worst, then technician, experience times, managers felt better.

Simultaneous regression analysis

Five dimensions of ServQual scale of Quality service with simultaneous regression analysis, the results were shown in Table 4. The standardized regression model as follows: ©Service quality = $0.171 \times \text{Tangibles} + 0.241 \times \text{Reliability} + 0.201 \times \text{Responsiveness} + 0.192 \times \text{Assurance} + 0.288 \times \text{Empathy}$.

It can be found that the variable of the ServQual scale of 5 dimensions and the service quality criterion variable (multiple correlation coefficient) had a value of 1 in Table 4, indicating a high quality of correlation. The standard regression coefficients of 5 variables were positive, the criterion variables are positive, empathy and reliability impacted the criterion variable bigger than tangible.

Structural equation model analysis

Perceived service quality path were established according to the theory of ServQual model scale. Results were shown in Figure 1.

From Figure 1, the direct effects of exogenous variables on endogenous variables can be learned: based on the variables of the standard regression. The effect value of controllability and stability error on the perceived service quality (referred to as the direct effect of value) were 0.646 and 0.382, respectively. The effect of value of responsiveness S10-13 error on controllability were 0.256, 0.290, 0.319, 0.177, respectively. The total effect values were 0.165, 0.187, 0.206 and 0.114, respectively.

Table 1. ServQual scale of 22 items of descriptive statistics

	T1: A clean and comfortable work environment	T2: Modern and advanced work equipments	T3: Office area clearly marked	T4: Staff with neat and professional appearance	L5: The staff working time and intensity are appropriate
N	392	392	392	388	389
Mean	3.916	3.694	3.903	3.879	3.401
SD	0.850	0.869	0.806	0.746	1.010

	S12: The hospital can timely process the staff's complaints	S13: The hospital can process the staff's major and unexpected events actively	A14: The hospital is reliable	A15: The staff feel comfortable at work	A16: The staff are friendly and polite to each other
N	390	391	389	390	392
Mean	3.592	3.928	3.810	3.495	3.918
SD	0.951	0.853	0.941	0.969	0.749

	L6: The hospital is interested in solving the problems at work	L7: The hospital is reliable	L8: The working processes are clear and concise	L9: The welfare benefits promised by the hospital can be realized	S10: The hospital can satisfy the staff's working needs	S11: The hospital is willing to help the staff to solve working problems
N	389	389	391	391	390	391
Mean	3.465	3.851	3.560	3.535	3.526	3.573
SD	0.967	0.849	0.912	0.997	0.894	0.919

Table 2. The ServQual scale of 5 dimensions of Pearson correlation matrix

Dimension	Tangibles	Reliability	Responsiveness	Assurance	Empathy
Tangibles	1				
Reliability	0.681* ($R^2=0.463$)	1			
Responsiveness	0.631* ($R^2=0.398$)	0.874* ($R^2=0.764$)	1		
Assurance	0.660* ($R^2=0.435$)	0.857* ($R^2=0.735$)	0.846* ($R^2=0.716$)	1	
Empathy	0.624* ($R^2=0.389$)	0.870* ($R^2=0.757$)	0.867* ($R^2=0.751$)	0.854* ($R^2=0.730$)	1

* $P < 0.01$; correlations is significant at the 0.01 level (2-tailed)

The effect of value of tangibility T-4 error on stability were 0.352, 0.255, 0.136 and 0.310, respectively. The total effect values were 0.134, 0.097, 0.052 and 0.118, respectively. The 10 paths coefficient of structural equation model in the graph were statistical significance.

DISCUSSION

Doctors are the first productivity in hospital

Medical service quality and medical level is directly related to patients. Doctors are one of the most important people to improve the medical service

Table 3. The multiple comparison of tangibles, reliability, responsiveness, assurance and empathy (Scheffe)

The dependent variable	Factor	N	Mean	Std. Deviation		SS	df	MS	F	HSD	Scheffe	LSD
Tangibles	Junior college and below (A)	33	3.826	0.645	Between Groups	3.484	3	1.161	2.446 n.s.			
	Undergraduate students (B)	175	3.936	0.648	within Groups	183.288	386	0.475				
	Graduate students (C)	142	3.796	0.682	Total	186.773	389			n.s.	n.s.	B>D
	Doctoral students (D)	40	3.64	0.896								
Reliability	Junior college and below (A)	33	3.612	0.691	Between Groups	10.61	3	3.537	5.716*			A>D
	Undergraduate students (B)	175	3.698	0.765	within Groups	238.824	386	0.619				B>C
	Graduate students (C)	142	3.489	0.774	Total	249.434	389			B>D	B>D	B>D
	Doctoral students (D)	40	3.158	0.975								
Responsiveness	Junior college and below (A)	33	3.545	0.649	Between Groups	8.727	3	2.909	4.455*			B>C
	Undergraduate students (B)	175	3.799	0.812	within Groups	252.041	386	0.653				B>D
	Graduate students (C)	142	3.592	0.8	Total	260.769	389			B>D	B>D	
	Doctoral students (D)	40	3.333	0.929								
Assurance	Junior college and below (A)	33	3.72	0.681	Between Groups	9.367	3	3.122	5.267*			B>C
	Undergraduate students (B)	175	3.901	0.743	within Groups	228.802	386	0.593			B>D	B>D
	Graduate students (C)	142	3.695	0.773	Total	238.168	389			B>D		C>D
	Doctoral students (D)	40	3.398	0.93								
Empathy	Junior college and below (A)	33	3.345	0.874	Between Groups	14.89	3	4.963	5.913*	B>C	B>C	B>C
	Undergraduate students (B)	175	3.574	0.894	within Groups	324.029	386	0.839		B>D	B>D	B>D
	Graduate students (C)	142	3.275	0.91	Total	338.919	389					
	Doctoral students (D)	40	2.97	1.06								
Tangibles	Doctor (A)	167	3.713	0.66	Between Groups	8.237	3	2.746	5.877*			D>A
	Nurse (B)	38	3.836	0.64	within Groups	178.007	381	0.467			D>A	D>C
	Technician (C)	61	3.787	0.773	Total	186.243	384			D>A		
	Management staff (D)	119	4.053	0.681								
Reliability	Doctor (A)	167	3.362	0.817	Between Groups	17.908	3	5.969	9.941***	D>A	D>A	D>A
	Nurse (B)	38	3.647	0.679	within Groups	228.784	381	0.6		D>C	D>C	D>C
	Technician (C)	61	3.426	0.778	Total	246.692	384					
	Management staff (D)	119	3.85	0.74								

Continued

Responsiveness	Doctor (A)	167	3.485	0.81	Between Groups	24.543	3	8.181	13.371***	D>A	D>A	D>A
	Nurse (B)	38	3.632	0.686	within Groups	233.114	381	0.612		D>B	D>C	D>B
	Technician (C)	61	3.402	0.837	Total	257.656	384			D>C		D>C
	Management staff (D)	119	4.019	0.74								
Assurance	Doctor (A)	167	3.583	0.799	Between Groups	13.786	3	4.595	7.851***	D>A		D>A
	Nurse (B)	38	3.829	0.645	within Groups	223.008	381	0.585		D>C		D>C
	Technician (C)	61	3.69	0.732	Total	236.793	384				D>A	
	Management staff (D)	119	4.02	0.768								
Empathy	Doctor (A)	167	3.179	0.934	Between Groups	31.353	3	10.451	13.097***	D>A	D>A	B>C
	Nurse (B)	38	3.489	0.769	within Groups	304.031	381	0.798		D>C	D>C	D>A
	Technician (C)	61	3.095	0.873	Total	335.384	384					D>C
	Management staff (D)	119	3.782	0.881								

Table 4. Multiple regression analysis summary of perceived service quality of tangibility, reliability, responsiveness, assurance and empathy

Model	Unstandardized Coefficients		Standardized Coefficients	<i>t</i>
	B	Std. Error	Beta	
(Constant)	-0.001	0.002		-.491
Tangibles	0.183	0.001	0.171	282.725***
Reliability	0.224	0.001	0.241	221.096***
Responsiveness	0.182	0.001	0.201	195.120***
Assurance	0.182	0.001	0.192	196.920***
Empathy	0.229	0.001	0.288	278.845***

$R = 1.000$ $R^2 = 1.000$ after adjusting $R^2 = 1.000$ $F = 057540.775^{***}$

to the clinical treatment process.

Although most Chinese hospitals are public hospitals, they are still affected by market economy so that medical dispute cases are rising. And doctors don't get the corresponding respect and rewards according to their contribution. In China, firstly, the doctor's degree of perceived service quality is not high, secondly, PhD students do not have a high level of feeling in four dimensions lead to high turnover doctor rate.¹³

Technicians and managers should play some role

Medical technology departments include inspection

department, department of pharmacy, department of radiology and so on. They support the clinical work, and provide some references for the accurate diagnosis of doctors. Technicians have neither doctors' technical advantages nor managers' administrative advantages, so they have poor feeling of hospital perceived service quality. Managers have poor feeling of hospital perceived service quality. Through conducting patient satisfaction assessment management means to focus on patients by managers, the patients' perceived service quality may be improved and the loyalty to hospitals.¹⁹⁻²⁰

Figure 1. Path diagram of perceived service quality.

Improvement of response and tangibility is to enhance the effective means of perceived service quality of medical personnel. Despite the large effect of transference and reliability to perceived service quality, the main concern of Chinese hospitals is to improve service quality for patients,¹⁸ less concern how to improve the quality of medical service of medical staff. Actually, we know from the structural equation model, Chinese medical staff do not have high degree of requirements. It is an effective method to improve perceived service quality of medical personnel if hospital managers handle employees complaints timely, including processing medical staff's complaints timely, processing medical staff and patients' disputes timely. The aims are not only to protect the interests of the patients objectively and reasonably, but also respect the knowledge and labor of medical staff. That is to say, the difficulties of medical staff should be solved. Another effective way is to provide medical staff a clean and comfortable working environment. There are so many patients in China, but not enough room for patients and medical staff. So the environments of doctors work are not good.

Professionalization of hospital management

With the development of tertiary industries in China,²¹ the demand for services are increasing constantly.

Quality management requires the participation and efforts from the hospital and personnel at various levels of the medical facilities,²² as well as the improvement of organizational capacities, hiring and retaining high quality clinicians, rewarding outstanding employees and providing appropriate training. The hospitals' capacity for serving the clinicians should be strengthened. The clinician's capacity for serving patients should be strengthened.²³ Medical and health industry is a special industry compared to other industries. Chinese doctors need years of professional education to the first-line clinical work. Medical and health service is a career to engaged in human's healing and rescuing. Chinese hospital should establish a positive, professional image for medical staff and deserve the respect of the whole society.

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Conflict of interest

All authors declare all funds have no conflicts of interest.

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