

## Application of Kano's Two-Dimensional Quality Model and QFD on a Gender-Friendly Environment of Hospital

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**Abstract**--With changes in economic development and market environment, people are paying more attention to service quality. Professional and medical conflicts are also increasing, and the quality of medical services has also come under increasing spotlight. Using the Kano two-dimensional quality model, this study proposed a priority list for constructing a gender-friendly environment. Combining the service experience engineering process, SERVQUAL scale and expert interviews, a questionnaire surveying the gender-friendliness of medical facilities is developed to determine patient needs.

Research results showed that in terms of the gender-friendliness of medical facilities, patients are mostly aware of must-be qualities even if there was significant room for improvement in the existing health care environment, such as needing plenty of and clearly marked childcare areas. Using Quality Function Deployment and House of Quality, a priority list for facility improvements are made for the references for management.

### I. INTRODUCTION

With changes in economic development and market environment, people are paying more attention to service quality. Due to direct contact with customers, the service industry must pay particular attention to customer satisfaction and service quality, especially in the medical industry [14]. Reference [23] pointed out that besides rapid growth in the health care sector, factors such as increase in living and educational standards, the stress of competition, medical breakthroughs, changes in cost structure, public scrutiny, and well-informed customers with increasing access to information all contribute to medical service providers feeling the stress of the emphasis on quality. To achieve a certain standard and satisfy or exceed customer needs, an ongoing customer oriented quality improvement strategy must be implemented.

Most traditional medical environments are centered on the medical staff and hospital administrators, with convenience for their medical staff as factor or decreased cost and increased efficiency as administrative goals. Few considerations are given to patient perspective. Patients go into an unfamiliar medical environment while feeling sick, and yet have to accommodate an inherently uncomfortable and uneasy process. In addition, their privacy, comfort and convenience are neglected. Furthermore, in a male-dominated medical system, the physical and psychological needs of female patients are even more neglected.

U.S. studies showed that females are primary consumers of medical industry. At the same time, they are also the family decision makers of medical behaviors [27]. Moreover, in terms of outpatient services, female patients are more attentive to service content and are more aware of doctor-patient relationship than male patients. Female patients are also more likely to go to a different hospital or doctor because of dissatisfaction with medical services [3].

Reference [16] indicated that integrating the Kano's model and Quality Function Deployment (QFD) can highlight the characteristics of different services. Moreover, literature review also shows that the integration of these tools can compensate for the inadequacy of QFD, thereby furthering understanding of the significance of different patient needs and the impact on their satisfaction.

There have no previous literature of integrating the two approaches to analyze the relationship of patients' gender, satisfaction and quality improvement priority. The main purpose of integrating Kano's model and QFD is help researcher and practitioners to find out customer's needs and to make improvements more efficiently. The combination of Kano's two-dimensional quality model and QFD can not only to thoroughly examine patient perception toward the gender-friendliness of medical facilities, but find the priority of quality improvement. Therefore, this integrated QFD model can help medical service process reengineering consist with both male and female's expectation.

In view of the abovementioned research motive, this study integrated the Kano's two-dimensional quality model and QFD to examine gender-friendliness in medical facilities. The study primarily focused on improvements in the services and spatial design of medical facilities to achieve the following goals:

1. Integrate patient satisfaction into the Kano's two-dimensional quality model to categorize the service elements of medical facilities according to quality elements.
2. Using customer satisfaction indicators, determine service elements in the Kano's two-dimensional quality model that increase customer satisfaction and eliminate those that decrease customer satisfaction, thereby providing reference for medical facility improvements.
3. Given limited funds and resources, use QFD to examine service quality function and management focus. Determine and prioritize service function elements required for medical facilities to build a gender-friendly environment, and make recommendations accordingly.

II. LITERATURE REVIEW

A. Gender and Patients' Satisfaction with Primary Care

Communication quality between clinician and patient is highly related to determinate the therapy procedure [30]. Physicians collect patients' information through verbal and non-verbal communication, palpation to inform patient compliant and treatment [18].

Recent research indicates the difference in clinician caring groups, physical environment, clinical specialties result in variation in communication patterns [10][19]. Communication quality is highly related to the degree to which patients' cooperation, and affect treatment outcome [12]. Both patients and medical facilities benefited from high quality of patient-physician communication, such as better blood sugar control among type II diabetics patients, fewer hospitalization days [13][21][20][31]. For this reason, improving communication quality could not only help clinicians gathering patients' information with less time consuming, but help patients understanding their physical or psychological condition, and leads to better therapy outcomes [4].

With the increased professional choice of women doctors, there has been a growing interest in gender, and try to discover the influences between both physicians and patients' genders on the quality of doctor-patient communication [28]. The empirical evidence shows in comparison with male physicians, female physicians are more empathic, less medical jargon, and provide more social-psychological information to reduce patients' anxiety. Also, the female physicians are more often to invite patients to join the treatment decision making [2][11][17].

B. Kano's Two-Dimensional Quality Model

Traditional viewpoints, also known as one-dimensional quality model, believe that satisfaction and quality are positively correlated, and that the better the quality, the

greater the customer satisfaction [14] [23]. Kano (1984) proposed a new two-dimensional quality model where the relationship between quality and satisfaction is defined as non-symmetrical and non-linear. In the Kano two-dimensional quality model, a product is divided into three types, and their impact on customer satisfaction differs. The horizontal axis represents quality elements while the vertical axis represents customer satisfaction. Points closer to the right indicate more quality elements and points closer to the top indicate greater customer satisfaction. In addition, quality is divided into Must-Be Quality Element, One-Dimensional Quality Element, Attractive Quality Element, Indifferent Quality Element and Reverse Quality Element (Fig. 1).

C. Quality Function Deployment

In Japanese, quality function deployment (QFD) is *hin shitsu ki no ten kai*, where *hin shitsu* means quality, defined as quality requirement goal, namely the House of Quality (HoQ); *ki no* means function or functionality, which is the functional requirement following a collection of customer voices and *ten kai* means extension, which refers to the integration of a series of processes, including conceptualization, design, production and services, before product or service quality can be achieved. Professor Yoji Akao believes that QFD is a broader or narrower general term. It is a customer-driven oriented tool frequently used in the development of a new product or service design [15][22][32], whereby the goal is to achieve maximum customer satisfaction [7][8].

The core idea behind QFD is to collect and transform customer requirements (CRs) into engineering characteristics (ECs), and subsequently develop part characteristics (PCs), process parameters (PPs) and production requirements (PRs). Using the HoQ (Fig.2), QFD core ideas can be expanded into four dimensions, product planning, process planning, component development and production planning [5][9].

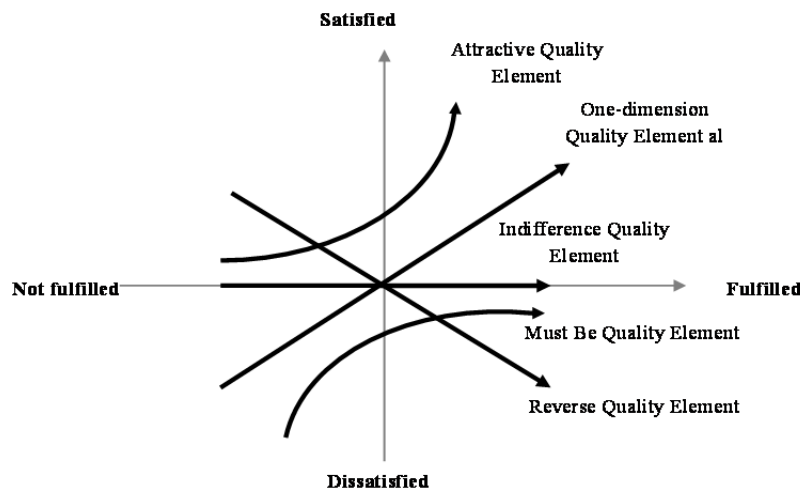


Fig. 1 Kano's two dimensional quality model

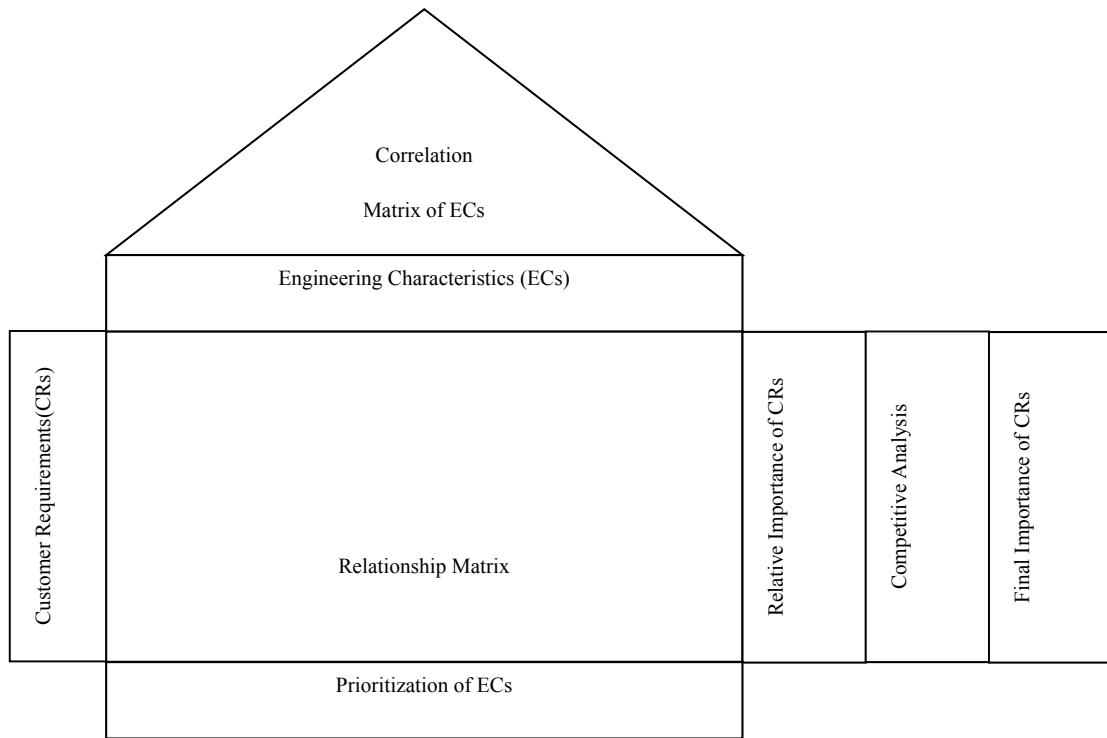


Fig. 2 The House of Quality (HoQ)

QFD enables managers to systematically gather comprehensive customer need information from the beginning to the completion of a project, thereby increasing customer satisfaction while enabling the organization to achieve a balance between customer need and organizational resources [26]. As a result, problems due to quality issues are significantly reduced, and therefore, many studies use QFD or integrate QFD with other tools to research quality improvement [1].

Quality Function Deployment is a tool for meeting customer needs, determining customer needs and then developing a series of transformations and integrations. Reference [29] delineated four advantages of using QFD: understand customer needs, reduce designing time, enhance team productivity, and provide information for product or service design. Reference [6] pointed out that QFD is technology based, but also integrates the degree of customer needs and customer satisfaction while at the same time analyzes and assesses cost.

### III. METHODOLOGY

#### A. Measurement

This research reviewed past studies on service experience engineering and gender-friendly medical facilities, compiled relevant gender and patient satisfaction indicators, used the service quality dimensions in the SERVQUAL scale, conducted expert interviews, and summarized quality

elements of gender-friendly environment in medical facilities to construct a questionnaire for surveying patient satisfaction and attention toward the various qualities of medical service. The Kano's two-dimensional quality model can enhance understanding of quality attributes, and if used together with quality function deployment (QFD) to include patient concerns into service design, the provision of needed patient services and the reduction of the gap between patient and medical service providers can be further enhanced. The questionnaire comprised two parts:

Part 1 comprised basic descriptive statistics:

This section includes demographic variables such as gender, age, education, marital status and other personal information, medical background such as most frequent hospital, treatment field and treatment reason to understand interviewee medical background.

Part 2 comprised importance and satisfaction level:

Using their 1985 measure of service quality based on the difference between customer actual knowledge of service standard and customer expectation of service standard, Parasuraman proposed the SERVQUAL scale, and consolidated its 10 key dimensions of service quality constructed into 5 key dimensions [25]

Questionnaire analysis is separated into three steps: first, consumer attention to and actual satisfaction with various quality elements were analyzed and classified using Kano's

two-dimensional quality model. Second, customer satisfaction coefficients for these quality element categories were then calculated (satisfaction index, SI & dissatisfaction index, DI) to examine the impact of quality element improvements on customer perception, and resulting important quality elements that were derived were then appropriately weighted. Combining the weightings with consumer expectation of and satisfaction with the quality of services offered by service providers, improvement ratio for various important quality elements was calculated and the weightings adjusted. The results of the Kano's two-dimensional quality model were integrated to construct the HoQ, and the QFD was applied to prioritize strategies for quality improvements last.

Satisfaction indicators range from 0 to 1, where a value closer to 1 indicates that the product or service has a greater impact on customer satisfaction. Dissatisfaction indicators range from 0 to -1, where a value closer to -1 indicates that the more the product or service fails to satisfy, the greater the customer dissatisfaction. In the dissatisfaction index formula, the negative sign highlights the negative impact on customer satisfaction if that element fails to satisfy.

*B. Statistical Analysis And Classifications*

This research used purposeful sampling and a structured questionnaire to survey patients who sought treatment at medical centers in central Taiwan between January-December 2012. Survey methods included paper and

electronic questionnaires. Paper questionnaire was administered to hospital staff, at seminars, lectures and waiting areas of the hospitals. Electronic questionnaire was posted on major relevant forums in the Taichung area. A total of 257 questionnaires were collected (including both paper and electronic copies), of which 100 copies were valid. Respondents comprised 38 males and 62 females, ages ranged from 20 to 39 years old, most were university graduates and about half were married. The most frequently visited field was internal medicine, and the main reason for visiting was convenient transportation. Demographic statistics was showed in Table 1.

Service attributes categories were derived from the questionnaire items and reverse items using relative majority ratio [24]. Qualities with the highest ratio were classified as service elements. For example, if a respondent indicated that "Medical staff is careful with diction during consultation, and is professional and empathetic", then the response to this positively phrased service element is "Like" while the response to the reverse item is "Of course", and subsequently classified as an Attractive Quality Element. Last, the percentages of all the types of responses were calculated, and the highest percentage was used to define the attribute of a particular service element. Results of the analysis showed that of the 24 service attributes, 20 were Must-Be Quality Elements, 2 were One-Dimensional Quality Elements, and 2 were Indifferent Quality Elements (Table 2).

TABLE 1 DEMOGRAPHIC STATISTICS

Item		Frequency	Ratio(%)
Gender	Male	38	38
	Female	62	62
Age	<19	2	2
	20-29	42	42
	30-39	30	30
	40-49	15	15
	>50	11	11
Education	Junior High and below	3	3
	Senior High	19	19
	Undergraduate	58	58
	Graduate and above	20	20
Marriage	Married	45	45
	Single	55	55
Department	Internal medicine	57	57
	Surgical department	17	17
	Obstetrics & Gynecology	2	2
	Ophthalmology & ENT department	21	21
	Other clinical departments	3	3
Reason for hospital selection	Relatives and friends' recommendations	28	19
	Service attitude	18	12
	Fine medical skills	21	14
	Fine medical facilities	21	14
	Reputation	19	13
	Convenient Transportation	39	26
	Others	4	3

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TABLE 2 CLASSIFICATION OF QUALITY ATTRIBUTES

Service Quality Attributes	KANO's classification of quality attributes (%)						classification
	A	O	M	I	R	Q	
1. Medical staff is careful with diction during consultation, and is professional and empathetic	4.26	36.17	45.74	13.83	0.00	0.00	M
2. Medical staff timely stops other patients from intruding	5.32	25.53	48.94	20.21	0.00	0.00	M
3. Medical staff closes the door during consultation	5.32	27.66	50.00	17.02	0.00	0.00	M
4. Palpitations should be conducted by medical personnel of the same gender as the patient	13.83	18.09	31.91	36.17	0.00	0.00	I
5. During medical treatment, the presence of nurse apprentices or interns should be avoided	8.51	22.34	23.40	45.74	0.00	0.00	I
6. During examinations, medical staff provides in a timely manner blinds or covers to block out irrelevant persons	5.32	28.72	53.19	12.77	0.00	0.00	M
7. Palpitations should be conducted by medical personnel of the same gender as the patient	6.38	26.6	56.38	10.64	0.00	0.00	M
8. Be examined as soon as possible after putting on the examination gown	19.15	24.47	34.04	22.34	0.00	0.00	M
9. Clear index of marks of floor and departments	8.51	26.6	42.55	22.34	0.00	0.00	M
10. Consultation rooms allow for personal privacy	2.13	35.11	51.06	11.70	0.00	0.00	M
11. Examination area allows for personal privacy	3.19	35.11	50.00	11.70	0.00	0.00	M
12. Examination gowns are Comfortable and feel secure	4.26	31.91	47.87	15.96	0.00	0.00	M
13. Washrooms generally allow for personal privacy	2.13	41.49	44.68	11.70	0.00	0.00	M
14. Washroom areas are safe	3.19	32.98	51.06	12.77	0.00	0.00	M
15. Plenty of treatment and Health education information	15.96	20.21	35.11	28.72	0.00	0.00	M
16. Convenient hospital transportation	10.64	32.98	29.79	26.60	0.00	0.00	O
17. Convenient hospital parking	9.57	31.91	29.79	28.72	0.00	0.00	O
18. Plenty of seats in waiting areas	19.15	26.6	28.72	25.53	0.00	0.00	M
19. Clean and complete treatment equipment	3.19	36.17	51.06	9.57	0.00	0.00	M
20. Changing rooms allow for personal privacy	2.13	31.91	54.26	11.70	0.00	0.00	M
21. Plenty of safe and convenient accessible facilities	6.38	21.28	44.68	27.66	0.00	0.00	M
22. Clearly marked accessible facilities	6.38	19.15	43.62	30.85	0.00	0.00	M
23. Plenty of childcare Areas	10.64	23.4	34.04	31.91	0.00	0.00	M
24. Clear signs in childcare Areas	11.70	21.28	34.04	32.98	0.00	0.00	M

Notes: O=One-dimensional; M=Must-be; I=Indifferent; R=Reverse; Q=Questionable.

In terms of service elements, there are statistically significant differences between “Palpations should be conducted by medical personnel of the same gender as the patient”, “be examined as soon as possible after putting on the examination gown”, “clear index of marks of floor and departments”, “plenty of treatment and health education

information”, “convenient hospital parking and transportation”, “plenty of seats in waiting areas”, “plenty of childcare areas (e.g. breastfeeding rooms) and clear signs” showed significant difference between male and female respondents, with males perceiving these service elements as indifferent quality element and most females perceiving them

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as Must-be quality element or One-dimensional quality element.

As shown in Table 3, paired t test analysis of service elements perceived as important to patients and their satisfaction indicated no significant difference for personal privacy and safety in washrooms, medical staff stopping other patients from intruding in a timely manner, medical staff closing the door during consultation, avoid having medical interns and other non-primary healthcare providers present during medical treatment, and after a patient visit, the medical staff avoid mentioning personal information, medical condition and treatment instruction of a patient in the presence of other patients. Other elements showed significant difference in patient perception of importance and their actual satisfaction, and therefore it is evident that the treatment environment of the current sample hospitals must be improved to increase patient satisfaction.

Corresponding interview and field observations with the questionnaire analysis results, environment and facility services currently provided by the sample hospitals can be organized, that is, the upper side of the QFD diagram.

The above results are summarized and integrated into a QFD, as shown in Table 4. According to the importance of each service need shown on the lower part of the table, and the calculated value of the relationship between service quality element and service function element, the priority list for improving service function in order to build a gender friendly environment can be determined. Specifically, the accuracy of health care workers in their execution of medical treatment or inquiry is the top priority, followed by consultation and examination rooms installed with curtains, public and accessible facilities in compliance with safety regulations, information marks leading the patients to the target department on each floor, and online information for hospital transportation, respectively.

**TABLE 3 PAIRED T-TEST BETWEEN IMPORTANCE AND SATISFACTION OF SERVICE FACTORS**

Dimension	Service Quality Attributes	Mean	Paired-t	P-value	
Tangibility	6. During examinations, medical staff provides in a timely manner blinds or covers to block out irrelevant persons	importance	4.26	2.73	0.008
		satisfaction	3.98		
	9. Clear index of marks of floor and departments	importance	4.29	2.97	0.004
		satisfaction	3.99		
	10. Consultation rooms allow for personal privacy	importance	4.41	3.342	0.001
		satisfaction	4.07		
	11. Examination area allows for personal privacy	importance	4.38	4.296	0.000
		satisfaction	3.97		
	12. Examination gowns are Comfortable and feel secure	importance	4.31	3.886	0.000
		satisfaction	3.86		
	13. Washrooms generally allow for personal privacy	importance	4.28	1.149	0.253
		satisfaction	4.18		
	14. Washroom areas are safe	importance	4.36	1.956	0.053
		satisfaction	4.17		
	16. Convenient hospital transportation	importance	4.07	1.459	0.011
		satisfaction	3.89		
	17. Convenient hospital parking	importance	4.04	3.655	0.000
		satisfaction	3.60		
18. Plenty of seats in waiting areas	importance	4.11	3.773	0.000	
	satisfaction	3.72			
19. Clean and complete treatment equipment	importance	4.40	2.43	0.017	
	satisfaction	4.18			

TABLE 4 THE INTEGRATED MODEL OF KANO'S TWO DIMENSION MODEL AND QFD

	Two dimension model	Perceived needs importance	Satisfaction of needs	Treatment process				Medical environment and facilities										Competitor's analysis				Base-Line	Import-ance (adjust)	Priority ranking
				Consultation and exam room layout	Number of clinicians	Clinicians' service quality	Accuracy of clinicians' clinical procedure	Medical service schedule	Patient Instructions	Clear index of marks of floor	Public and accessible facilities conform to the law	Facility cleaning and disinfection	Privacy urinals in male restroom	Medical Alert Restroom	Plenty of childcare areas	Separated male & female changing rooms	Comfortable examination gowns	Apply medical curtains	Online transportation information	Providing a parking area	Hospital A			
6. During examinations, medical staff provides in a timely manner blinds or covers to block out irrelevant persons	M	4.26	3.98	9														3.98	3.89	3.84	3.88	4.08	5.892	10
9. Clear index of marks of floor and departments	M	4.29	3.99						9	3								4.2	3.84	3.72	3.78	4.2	5.879	11
10. Consultation rooms allow for personal privacy	M	4.41	4.07												9			4.06	3.89	3.72	4.03	4.07	3.017	7
11. Examination area allows for personal privacy	M	4.38	3.97												9			4.14	3.91	3.66	4.06	4.14	6.219	4
12. Examination gowns are comfortable and feel secure	M	4.31	3.86												9			3.98	3.77	3.47	3.66	3.98	5.958	8
13. Washrooms generally allow for personal privacy	M	4.28	4.18								9	3						4.1	3.89	3.75	3.69	4.18	5.84	12
14. Washroom areas are safe	M	4.36	4.17							3	1	3	9					4.04	3.91	3.78	3.81	4.17	5.915	9
16. Convenient hospital transportation.	O	4.07	3.89							1						3	3	4.14	4.2	3.72	4.06	4.2	7.16	1
17. Convenient hospital parking	O	4.04	3.6							1						3	9	3.76	3.61	3.41	3.91	3.91	7.141	2
18. Plenty of seats in waiting areas	M	4.11	3.72							1								3.61	3.68	3.44	3.75	3.75	5.175	22
19. Clean and complete treatment equipment	M	4.4	4.18								9		1	1	3			4	3.91	4	4.13	4.18	6.021	6
20. Changing rooms allow for personal privacy	M	4.37	3.95										9					4.08	3.91	3.81	3.97	4.08	6.161	5
21. Plenty of safe and convenient accessible facilities	M	4.19	3.87						1	9							1	3.98	3.75	3.47	3.63	3.98	5.551	16
22. Clearly marked accessible facilities	M	4.12	3.75						3									3.96	3.55	3.56	3.53	3.96	5.549	17
23. Plenty of childcare Areas.	M	3.93	3.64										9					3.88	3.66	3.25	3.56	3.88	5.253	20
24. Clear signs in childcare Areas.	M	3.93	3.64															3.86	3.66	3.28	3.53	3.86	5.19	21
1. Medical staff is careful with diction during consultation, and is professional and empathetic	M	4.17	3.98						3									4	3.89	3.56	3.84	4	5.653	15
2. Medical staff timely stops other patients from intruding	M	3.97	3.87				6											3.92	3.75	4.03	3.88	4.03	5.461	19
15. Plenty of treatment and health education information	M	4.16	3.9													9		4.14	4	3.59	3.88	4.14	5.507	18
3. Medical staff closes the door during consultation	M	4.2	4.15				6											4.27	4.05	4.22	4.28	4.28	5.814	13
4. Palpitations should be conducted by medical personnel of the same gender as the patient	I	4.11	4.07				9	1										3.94	3.8	3.47	3.78	4.07	4.11	23
5. During medical treatment, the presence of	I	3.87	3.91				3	6	1									3.82	3.75	3.34	3.69	3.91	3.87	24

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IV. DISCUSSION

Analysis not only showed significant gender difference in perception, but also showed how each gender perceives service quality. For example, for females, service elements such as “Palpations should be conducted by medical personnel of the same gender as the patient”, “Be examined as soon as possible after putting on the examination gown”, “Clear signs or billboards in the hospital”, “Plenty of treatment and health education information and seats in waiting areas”, “Convenient hospital transportation and convenient hospital parking”, “There must be plenty of childcare areas (e.g. Breastfeeding Rooms) and clear signs” were perceived as Must-Be Quality Element or One-Dimensional Quality Element. However, for males, these service elements were perceived as Indifferent Quality Element, indicating that their presence or lack of would not affect satisfaction.

Empirical results showed that females perceived convenient hospital transportation and parking as One-Dimensional Quality Element while males perceived these elements as Indifferent Quality Element. Improving hospital convenience would significantly increase female satisfaction and enhance their perception of the hospital as a friendly treatment environment. The presence or lack of Indifferent Quality Element does not impact satisfaction. In the empirical results, “Palpations should be conducted by medical personnel of the same gender as the patient” and “During medical treatment, the presence of nurse apprentices or interns should be avoided” were Indifferent Quality Elements. Therefore it is evident most patients value the professionalism of the medical staff during treatment.

In this study, Attractive Quality Element was not found. However, analysis showed that “Be examined as soon as possible after putting on the examination gown” and “Plenty of seats in waiting areas” were classified as Attractive Quality Element by a high proportion of respondents. Although these two elements were not classified as Attractive Quality Element and had no impact on satisfaction, their improvement would enhance patient satisfaction.

This research showed that the quality of a service element should not be categorically classified. For example, 31.9% of the respondents perceived “Palpations should be conducted by medical personnel of the same gender as the patient” as a Must-Be Quality Element while 36.17% classified it as an Indifferent Quality Element; nevertheless, this service element should not be categorically classified as an Indifferent Quality Element because the classification result could be due to sampling error. Therefore, in future application of the Kano two-dimensional quality model, the number of samples could be increased to reduce error so that the results could more accurately classify the quality attributes of service elements.

V. CONCLUSIONS

With the increasing focus of patients’ satisfaction and quality of care in today’s health care industry, patients and their relatives can acquire and share their medical service experience rapidly through information technology. This phenomenon has had hospital managers’ attention about the medical service process. Patients’ satisfaction is highly related to hospital’s performance which necessitates service diagnosis approaches to satisfy patients’ needs. This paper focuses on investigating new approaches to evaluate medical service gap between current service state and customer expectations by integrating Kano and QFD methods.

The results of this study suggest several implications of redesigning medical service process for practitioners. First, it showed the gaps of each medical service contents between patients perceived and expected. The case hospital is weak in tangible medical service such as “Clear index of marks of floor and departments” and patients’ privacy. Second, in Kano’s model, put an effort on one-dimension criteria can create better patients’ satisfaction. The analytical result of Kano model indicate that redesign hospital transportation and parking area can increase patients’ satisfaction highly. Third, The QFD model showed the most important three medical service quality attributes were hospital transportation, medical staff’s manner while examinations, block out irrelevant persons, patients’ privacy.

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