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Full Length Research Paper

Determining medical service improvement priority by integrating the refined Kano model, Quality function deployment and Fuzzy integrals

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In recent years, owing to the rise in consumers' consciousness with regard to health care quality, hospitals are constructively probing into the factors affecting patients' satisfaction. This is to enable them identify technical items of medical services and to see it as a priority to utilize these items. Using quality function deployment (QFD) with the Refined Kano model, this study aims to prioritize above all the use of various medical service technical items as an improvement directed towards hospitals' competitiveness. With the outpatient services of a hospital as the empirical case study, this study first collected the service requirements of the patients and classified them using the Refined Kano model to decide the weights of each patient's service requirements, then found out the different medical service technical items which the hospital provided to satisfy the service requirements, and utilized the Fuzzy Integral approach to calculate the improvement index of each medical service technical item in order to determine the priority of improvement. With the Refined Kano model analysis it is found that there are three high value-added qualities, seven critical qualities, five necessary qualities, another five highly attractive qualities, four less attractive qualities, and two care-free qualities. Further analysis of the QFD proposed the primary medical service technical items as staff training, facility safety, hospital location, cordial service, equipment maintenance, and advanced medical equipment. This study presents a simple and feasible approach for hospitals to confirm the service demands of patients, to determine the improvement sequence corresponding with patients' demands under limited resources, focus on the most attractive demands and the priority items for improvement, in order to enhance competitiveness in an efficient and effective way.

Key words: Medical service quality, refined Kano model, quality function deployment, Fuzzy integral.

INTRODUCTION

Both service and manufacturing industries place high importance on quality, which can affect customers' satisfaction and thus the willingness to make a purchase (Oliver, 1980). Quality is a key determinant of consumers' satisfaction (Gremler et al., 2001; Omar and Schiffman, 1995; Radwin, 2000), and it has also been recognized as a strategic tool for attaining operational efficiency and improving business performance (Jain and Gupta, 2004). Although the medical industry is different from general service industries, the high service quality is still a key success factor. In addition, scholars have indicated that patients and their family members should be considered as consumers for medical service providers (Milakovich, 1995). It is also important to manage consumers' perceptions of medical service quality, as higher appraisals are closely related to satisfaction, and will thus influence the intention to use a service again in the future, a fact that is ultimately reflected in the financial performance of medical organizations (De Man et al., 2002). As a consequence, promoting medical service quality to satisfy patients' demands is a primary aim for hospitals that seek to be more successful.

In the past, patients went to hospitals simply for medical treatment, so that such institutions emphasized their

professional medical techniques. Nevertheless, with the enhancement of living standards and increase in the public general medical knowledge and demands, patients pay more attention to their health and expect higher quality medical services, and their assessments of quality of hospitals are no longer limited to medical techniques. Leinonen et al. (2001) indicate that service quality, from the patients' viewpoint, requires that medical staff express respect, empathy, and concern, as well as more traditional items, such as professional skills and service attitude. In addition, patients will trust and rely on a hospital more once they experience satisfactory medical service, and will continue to go to it for future medical treatments. Nonetheless, certain differences exist in the cognition of medical service quality held by hospitals and patients (Arasli et al., 2008). It is thus necessary to develop a systematic approach to find out the real requirement of patients, as this lead to greater customer's satisfaction and ultimately make the hospital more successful (Fu and Chang, 2002).

Identifying patients' opinions is critical for the evaluation of medical service systems (Polluste et al., 2000). This study thus aims at understanding patients' requirement and classifying these into different types of quality based on the Refined Kano model. Patients' opinions can serve as references for the enhancement of medical service quality and the general improvement of hospitals. Previous studies examined items for improvement independently. This study combines QFD and the Fuzzy Integral approach to calculate the weights of technical items of medical service which hospitals provide to meet patients' demands, in order to sequence the improvements and propose specific directions for such actions.

LITERATURE REVIEW

Medical service quality

In the relevant literature, medical service quality simply focused on the professional techniques of doctors and nurses. However, the concept of medical service quality has gradually evolved to include the views of patients. Shih (1978) regards medical service quality as containing the perceived quality of medical service techniques and the perceived quality of medical service management. Quality of techniques includes the quality of diagnoses and treatments. The quality of management refers to the quality of communication and discussion between doctors/nurses and patients, and patients' cooperation. Hyde (1986) indicated that medical service quality includes understanding and satisfying patients' demands, reliability, zero defect service, appropriate environmental packaging, clear and definite instruction manuals, good-efficiency performance, punctuality, and effective service feedback. Fisher (1990) evaluated and divided medical service quality attributes into three items: (1) a solid environment, including the evaluation of outpatient waiting rooms, seats, stores, and lounges, as well as patients' satisfaction with waiting and doctors' diagnosis time; (2) attitude to medical service, including whether or not patients were able to see the same doctor, willingness to see a different doctor, being treated by interns, being able to communicate the disease condition with doctors, attitude of medical personnel, and if doctors were careless; and (3) general attitude of doctors, including doctors being willing to spend time in understanding patients' disease condition and explaining it to them, and whether patients trust doctors' professional abilities. In addition, Bowers et al. (1994) considered five factors which patients use to evaluate medical service quality, as follows: empathy, reliability, reaction, communication, and concern.

In studies of medical service quality, Chang (2006) found that medical personnel were more concerned with their professional abilities, while patients emphasized more displays of concern and good interpersonal interaction. Westaway et al. (2003) also discovered that patients considered interpersonal interaction as very important, including medical personnel being able to listen to, encourage, assist and support patients, and treating them in considerate and friendly ways, as well as stressing the importance of the facilities and equipment in hospitals such as the toilets in waiting areas, general cleanliness, and seats in lounges.

Shoshanna et al. (2005) reported that patients emphasized the communication with medical personnel, and specifically the medical staff being able to react to their demands, as well as the cleanliness of wards and bathrooms in hospitals. Rao et al. (2006) presented the priority of patients' demands as the doctor's behavior and attitude, the effectiveness of medicine, the medical personnel's behavior, and the supply of medical information.

According to the previous studies outlined above, medical service quality can be evaluated from three aspects, as follows: professional medical techniques, staff attitudes, and the environment. In addition, patients pay more attention to the feelings that arise in the service process, as well as to the provision and condition of medical facilities and equipment. Consequently, hospitals cannot merely focus on medical techniques, but must also take service quality and medical equipment and facilities into consideration, so that they can improve patients' satisfaction.

Kano model and refined Kano model

Kano Model, presented by Kano et al. (1984), presumes that satisfaction does not necessarily occur when all the relevant qualities are possessed, and that is possible for customers to experience dissatisfaction or no feeling at all.

The Kano Model, initially applied in product development in the manufacturing industry, classifies quality into five

attributes, as follows: (1) attractive quality attributes, which customers are satisfied with if present, but not dissatisfied if absent; (2) one-dimensional quality attributes, which are positively and linearly related to customers' satisfaction—that is, the greater the degree of fulfillment of the attribute, the greater the degree of customers' satisfaction; (3) must-be quality attributes, which absence will result in customers' dissatisfaction, but presence does not significantly contribute to customers' satisfaction; (4) indifferent quality attributes, the presence or absence of which results in neither satisfaction or dissatisfaction; (5) reverse quality attributes, which presence causes customers' dissatisfaction, and whose absence results in customers' satisfaction. In Kano Model, the horizontal coordinate represents the degree to which the quality attribute is sufficiently fulfilled. The more it approaches the left, where the quality attribute becomes insufficient, the higher the degree of deficiency is; while the more it approaches the right, the higher the degree of fulfillment is. The vertical axis indicates the satisfaction that customers feel with regard to the quality attributes. The higher it is, the more satisfaction shown; while the lower it is, the more dissatisfaction shown.

Based on Kano Model, Yang (2005) developed the Refined Kano Model, as shown in Figure 1, categorizing quality into eight elements, as follows: 1. attractive qualities, including highly attractive qualities which are the best tool to achieving greater market competitiveness, and low attractive qualities, which have less ability to attract customers, so that firms can decide on the importance of providing them based on the cost; 2. one-dimensional qualities, including high value-added qualities, which make a high contribution to customers' satisfaction, and which promote the overall service quality, so that firms should provide as many items with these attributes as possible, and low value-added qualities which cannot be ignored by firms, because of their contribution being less aiming to prevent customers' dissatisfaction caused by insufficient service standard; 3. must-be qualities, including critical qualities whose related items should be sufficiently provided because of their importance to customers, and necessary qualities that firms should provide to a certain service standard to prevent customers from being dissatisfied; and 4. indifferent qualities, including potential qualities whose items can become strategic weapons for firms to attract customers, and care-free qualities, which are not taken into account in cost considerations, in order to effectively deal with limited resources.

Previous scholars applied Kano Model to various service contexts, like banks, laundries, supermarkets, restaurants, tourism and so on (Schvaneveldt et al., 1991; Sa Moura and Saraiva, 2001). This study will examine hospital service quality using a questionnaire survey and Kano Model, adopting majority decisions to classify attributes and to gather patients' perceptions as to whether or not attributes are fulfilled as references for the service quality improvement in hospitals. In case the importance of quality items and the characteristics of attribute classification are not effectively sequenced as items for improvement, the Refined Kano Model (Figure 1), presented by Yang (2005), is applied to modify the importance ranking and quality item classification.

Quality function deployment, QFD

Quality Function Deployment (QFD) is a systematic approach that integrates customers's voice into the product development process, and Bossert (1991) considered that it can transform patients' requirements into technique to meet customers' expectation. Chen and Weng (2006) approved the use of QFD to achieve high customers' satisfaction, through the stages of product planning, engineering, and manufacturing, thus transforming customer's voice into the final product. A quality house, as the basic tool of QFD proposed by Bossert in 1991, and shown in Figure 2, primarily includes: 1. Customers' expectations, which are also called customers' thoughts, demand attributes, or the voice of customers (VOC), which are placed on the left side of the quality house and are mainly used to describe customers' demands and expectations; 2. Technical specifications, also called the voice of engineering (VOE), located in the ceiling of the quality house, and this is the strategies or technical services drawn up by relevant departments in the enterprise with mutual coordination and communication; 3.The relationship between customers' wants and technical specifications, which is the body of the quality house, is used to illustrate the degree of the relationships among customers' demands and engineering technology; 4. Competitive analysis as done by customers, which is in the right side of quality house, and is mainly used to calculate the weights of customers' demands through customers' emphasis degree, and marketing key with regard to each demand item, so as to understand the priority of customer demands; 5. The correlation between technical specifications, which is located in the roof of the quality house, is mainly used to explain the relationship between various engineering technologies; 6.Technical specification priorities, at the bottom of the quality house, finds the primary demand items for improvement, after calculating and sequencing the importance of customers expectations, and can be regarded as a tool to decide on the introduction of techniques and the allocation of resources.

In recent years, QFD has been widely applied in many studies, such as Costa et al. (2000) applied it to food industry to find the advantages and disadvantages of improving ketchup, ultimately improving the latter. Gonzalez et al. (2004) focused on the importance of bank service quality and customers' satisfaction while exploring internal and external management and applying QFD to the development of innovative services. Dikmen et al.

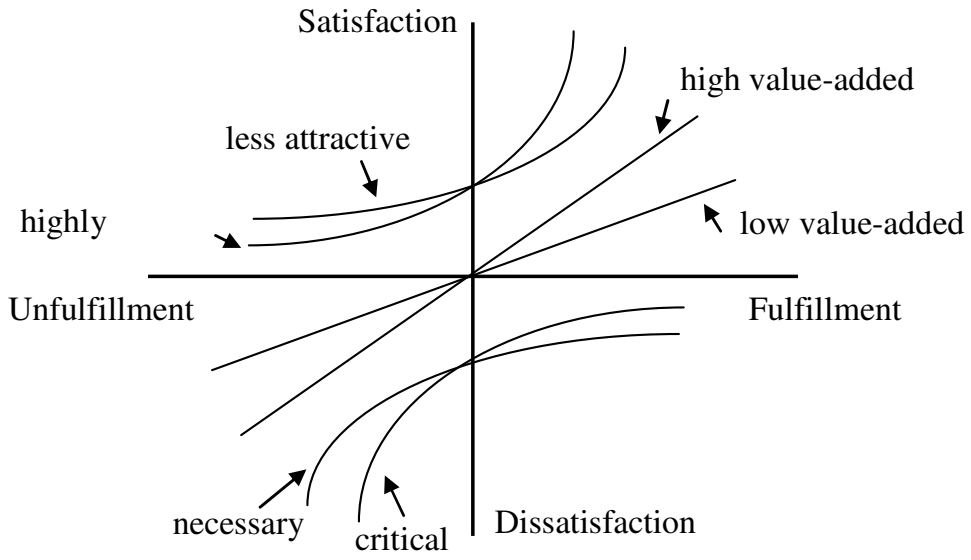

Figure 1. The Refined Kano model.

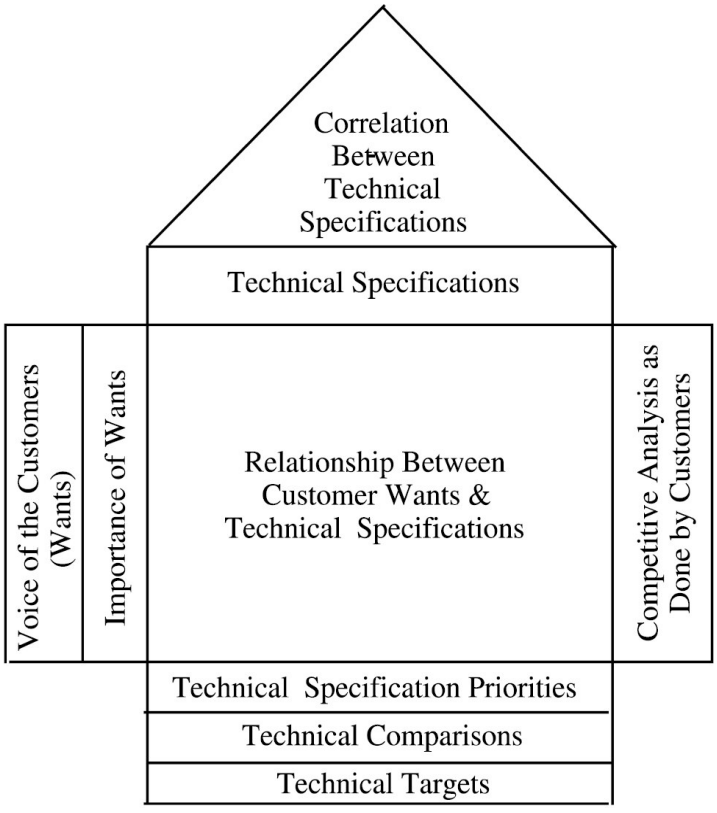

Figure 2. Quality house model.

(2005) applied QFD in the construction industry and took the items that customers stated they really needed into the consideration of housing design, so as to reduce the waste of resources on invalid items as well as to raise customers' satisfaction. Finally, Utne (2008) utilized QFD in a study on improving the catch of fish in Norway. The current study intends to weigh the priority sequence of improvement items through using a questionnaire survey

in hospitals, combined with QFD to develop practical suggestions to improve patients' satisfaction.

Fuzzy integral

The Fuzzy integral approach can be used in a comprehensive evaluation approach without presuming the independence of evaluation items (Lee et al., 2000), and can be applied to assess the relationships among items to deal with evaluation problems with subjective values. Before proceeding with the use of the Fuzzy Integral approach, appropriate Fuzzy measure needs to be selected to understand the relation among various evaluation items. Ishii and Sugeno (1985) and Asai (1995) considered Fuzzy measure as an approach with non-additional evaluation, as it transforms the general basis probability theory of weighing tasks into probability theory, and then takes the relation of evaluation items into account. Sugeno (1974) presented the λ Fuzzy measure to state the degree of the parameter λ being a measure limited by λ as the weight value of evaluation items. Previous scholars have applied the Fuzzy Integral approach to various fields of studies. Chiou and Tzeng (2002) used it to define Fuzzy measures and evaluate the green engineering strategy of fishery product processing industry development using the non-additional Fuzzy Integral approach. Chen et al. (2002) examined the relation between public opinion and governmental policies with Fuzzy measures and the Fuzzy Integral approach and took the policy of Taipei City Government with regard to gas-powered taxis as topic for empirical research. Bosc et al. (2003) blurred SQLf with the Sugeno Fuzzy Integral approach combined with the SQL database. Patricia et al. (2007) predicted the time array sequence of consumptive tomato price in American market by combining a mimic neural network and Sugeno Fuzzy Integrals. Yan et al. (2009) applied a combination of the Fuzzy Integral approach with Innovative Product Concept Strategy Technology in the study of mobile phone designs.

Since subjective opinions are collected, the questionnaire survey used in this study, the acquired priority sequence and weights combined with QFD can not be reflected in quality items accurately. According to the above studies, the Fuzzy Integral method can eliminate the weaknesses of the Linear Model Theory and match the spirit of independent points to acquire more accurate values for the importance of quality attributes in Fuzzy Theory. This study, therefore, will proceed with the evaluation using the Fuzzy Integral approach and calculate the importance of medical service techniques with the λ Fuzzy measure.

RESEARCH METHODOLOGY

Research model

This study uses a quality house in QFD as the analysis model and interviews medical experts about the research topic in order to modify the original items in the quality house into patient service demands, medical service techniques, a relation matrix of patient service demands and medical service technical items, and the importance of medical service techniques (improvement sequence) for subsequent analysis.

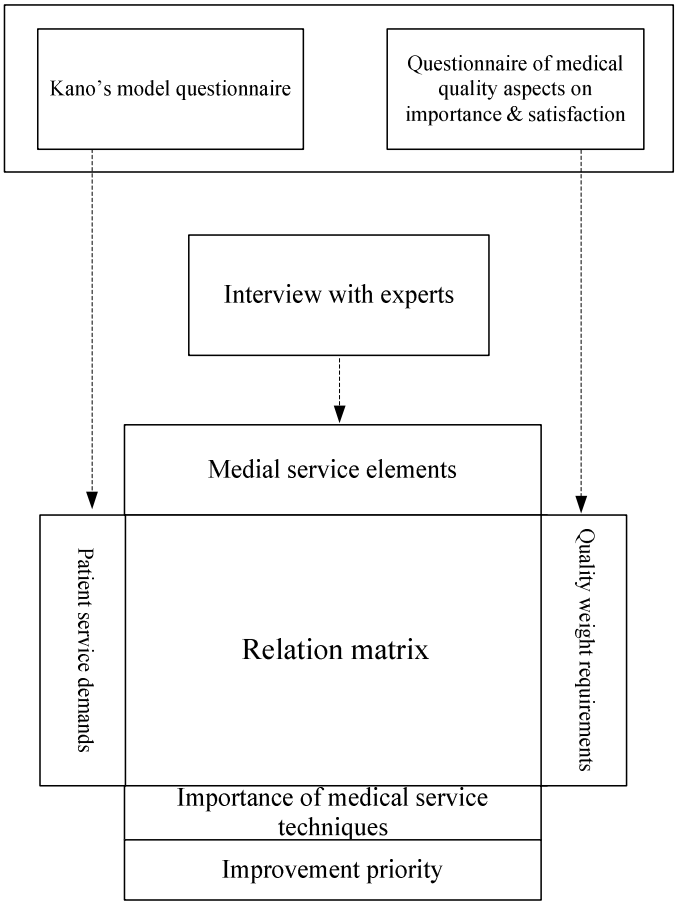

Figure 3. Research model.

This study first classifies patient service demands with the Kano Model and determines their weight based on customers' value, then invites experts to analyze the relationship between patient service demands and medical service techniques, and finally calculates the sequence of medical service techniques by introducing the Fuzzy Integral approach into the quality house calculation. The research model is shown in Figure 3.

Samples and questionnaire design

Patient service demands in this study are adapted from the medical service quality demand aspects designed by Carey and Seibert (1993); they include environment and equipment, comfort and cleanliness, staff service attitude, medical care, complaints, and service results.

Based on the six aspects with the questionnaire design principle in the Kano Model and adopting a Likert five-point scale, this study designs positive and negative attitude questions to understand the respondents' reactions when some quality attribute is fulfilled or not. In order to clarify for patients the meanings contained in the Kano Model, this study modifies the classifications of Matzler and

Table 1. Two-dimensional quality attribute classification table.

Positive \ Negative	Very satisfied	Satisfied	Fair	Dissatisfied	Very dissatisfied
Very satisfied	Invalid appraisal	Attractive quality	Attractive quality	Attractive quality	One-dimensional quality
Satisfied	Reverse quality	Indifferent quality	Indifferent quality	Indifferent quality	Must-be quality
Fair	Reverse quality	Indifferent quality	Indifferent quality	Indifferent quality	Must-be quality
Dissatisfied	Reverse quality	Indifferent quality	Indifferent quality	Indifferent quality	Must-be quality
Very dissatisfied	Reverse quality	Reverse quality	Reverse quality	Reverse quality	Invalid appraisal

Hinterhuber's (1998) two-dimensional quality attributes into five levels, as follows: very satisfied, satisfied, fair, dissatisfied, and very dissatisfied (Table 1). Importance is divided into very unimportant, unimportant, fair, important, and very important, scores of 1 to 5. Satisfaction is divided into: very dissatisfied, dissatisfied, fair, satisfied, and very satisfied, also with scores of 1 to 5, respectively. Demographic data gathered in the questionnaire included sex, education, occupation, monthly salary, and division. The questionnaire subjects were the outpatients in a regional teaching hospital; a total of 150 questionnaires were distributed, and 137 valid responses were returned, giving a total response rate of 91.33%.

Quality house model

Having understood patients' satisfaction and importance ratings with regard to medical services, the improvements and the improvement sequence of medical service techniques are obtained by using a quality house with the following procedures.

Step 1: Define patient demands for medical services. Located in the left side of quality house, patient demand items, which patients consider more important, are found through the introduction of the required quality items into QFD.
Step 2: Decide the weights of the quality attributes that patients demand. With the importance and satisfaction of patients with regard to each service demand thus obtained, the following quality characteristic sequence is transformed into standardized weights as the weights of the demand items.

1. Data transformation between importance and satisfaction. Using the results of the calculated questionnaire data, transform it into divisions based on zero. First deduct three from the importance and satisfaction value as the new evaluation standard value, and then sequence the data. The data range of importance and satisfaction is transformed from the previous division (1 to 5) into the division (-2 to 2).
2. Satisfaction and difference index: With the previous transformed importance and satisfaction values, calculate the satisfaction and difference index of patients' requirement items. The satisfactory attitude is the product of patient s' importance multiplied by satisfaction after being transformed, while the difference index represents the differences between the patients' importance and satisfaction sequences. The satisfactory attitude actually means the weighted sum of satisfaction; and difference index is the difference between the actual performance of hospital service quality characteristics and the quality standard required by patients. With the evaluation of the index, the priority sequence of patients' requirements can be determined, and this can assist in the planning of service improvement. The quality characteristics sequence evaluation which determines the priority sequence of patient requirements is based on the following two criteria.

(1) When the difference between different kinds of quality, particularly in negative values, becomes smaller, these qualities need prior improvement.
(2) If the difference indexes of quality varieties equal each other, the one with smaller satisfactory attitude, especially with a negative value, is the priority improvement object. The smaller the last difference index is, the earlier it becomes the initial priority, and further through the reverse sequence of initial priority becomes the initial weight. The standardized weight (SD) is therefore obtained by summing up the initial weight divided by the initial priority.
Step 3: Develop technical specifications for medical services, which are also called the service elements in this study. Located in the ceiling of the quality house, and based on discussions with hospital experts, five medical service technologies are classified as follows: overall environment, hardware equipment, medical service, perception attribute, and administration, from which twenty medical service technique items are designed.
Step 4: Develop the association matrix of patient demand items and medical service elements. Having interviewed and evaluated with hospital experts, the association degrees are quantified as nine high relation points (◎), three medium relation points (○), or one low relation point (△). The relationship degree between medical service techniques and patient service requirements is filled in by experts.
Step 5: Calculate and determine the improvement priority. With the advantage of conforming to human Fuzzy judgments, the Fuzzy Integral approach is adopted to weigh the medical service techniques in this study. With regard to the calculation and procedures, and using the standardized weight obtained in step 2, the calculation of medical service technique importance through the Fuzzy Integral approach is as follows.

(1) All relation degrees of the required qualities and medical service techniques are sequenced.
(2) All relation degrees of the required qualities and medical service techniques are transformed into [0,1] values, where x_i stands for the relation strength of the relative matrix. Relation strength is divided into nine high relation, three medium relation, and one low relation point. Since the highest relation degree is 9, it can be made $h(x_i) = x_i / 9$.
(3) Through standardized weights (SD) in the priority sequence, all quality requirements are transformed into [0,1] values, as SDx10 as g^i makes the items easier to compare.
(4) According to the Fuzzy Integral approach, $\lambda = -0.9999$ is obtained.
(5) Substitute λ, g^i and $g_\lambda(H_{i-1})$ for $g_\lambda(H_i) = g^i + g_\lambda(h_i) + \lambda(g^i)[g_\lambda(H_{i-1})]$ to get $g_\lambda(H_i)$
(6) Pick the smallest values of $h(x_i)$ and $g_\lambda(H_i)$ from each demand quality item.

(7) Find out medical service technical item from the biggest value of $h(x_i) \wedge g_\lambda(H_i)$ as the relation weight of the medical service technical aspect. Get the weight of each medical service technique with the Fuzzy Integral approach and the important weight number. The bigger the weight number is, the more priority it has, and this information can be used by managers when planning improvements in hospital service quality.

DATA ANALYSIS

Sampling and sample structure

To investigate patient's expectations and requirement with regard to medical service quality and their corresponding weights, the requirement items were adopted from Carey and Seibert (1993). According to respondents' answers for satisfaction and the perceived importance of service requirements, the requirements can be classified into six categories: attractive, reverse, indifferent, invalid, one-dimensional or must-be, based on the Kano Quality Model. We can also classify the service demand into critical, care-free, highly attractive, low attractive, necessary or high-value added groups based on the Refined Kano Model.

A statistical analysis of basic statements shows that 74(54%) of the respondents were males, while there were 63(46%) females of the respondents. 43 of the respondents were aged between 21 to 30 (31.4%), and 38 of respondents aged between 31 to 40 (27.7%). 52 of the respondents only had senior high school education (38%), while the next degree is college education (29.9%). There were 72 respondents married (52.6%), and 65 single ones (47.4%). 118 of the respondents had a monthly salary of sixty thousand NTD or below (86%), and 19 (14%) more than this. 19 (14%) respondents were surgical outpatients, with 16 each being ophthalmology and rehabilitation outpatients (11.7% each).

Reliability and validity analyses

Reliability, related to the accuracy and precision of a measuring tool, indicates the coincidence and stability of findings. This study adopts the α coefficient value presented by Cuieford (1965) to stand for reliability, with a Cronbach's α value of 0.7 or above representing high reliability. The results show that the reliability of the overall Kano quality attributes is 0.924, and non-possessed 0.926, and the reliability of overall importance and overall satisfaction are 0.936 and 0.923, respectively, showing that this research has high reliability.

Validity assesses whether the questionnaire examines what it is intended to. When q questionnaire is based on theory and refers to questionnaire items used in similar studies, it is considered as having acceptable content validity. In this case, this study refers to the questionnaire dimensions designed by Carey and Seibert (1993) aimed at examining the medical service quality dimensions, with some appropriate changes made before the questionnaires were distributed. These were based on focus groups, interviews and evaluations by five hospital experts who are in charge of daily hospital operations. The validity of this questionnaire should therefore be above the necessary standard.

Analysis of Kano model

The questionnaires collected in this study were categorized with data codes representing the 26 topics in Kano Model for the different service qualities to obtain the classified attribute analysis.

Within the 26 quality items in this study, nine are attractive qualities, 12 must-be qualities, three one-dimensional qualities and two indifferent qualities, as shown in Table 2.

(1) Attractive qualities, which patients are satisfied with when hospitals provide the service, but their satisfaction is not affected if not provided, contain nine service quality attributes which are as follows: "Clear directions for each department in a hospital", "Hospital provides computerized service", "Hospital provides obstacle-free facilities", "Empathetic service attitude of nursing staff ", "Empathetic service attitude of hospital volunteers", "Doctors can explain the disease and its treatment in detail ", "Hospital provides a complete complaint channel ", "Hospital provides detailed information about hygiene education", and "Side effects do not occur when patients take medicine"; (2) Must-be qualities, which patients consider as natural and right when the hospital provides the service, but are dissatisfied if not provided, include 12 service quality attributes, as follows: "Hospital provides perfect medical equipment", "Hospital provides perfect escape equipment", "Good hospital sanitation", "Hospital washrooms properly cleaned", "Appropriate temperature from air conditioning system", "Empathetic service attitude of hospital administrators", Nursing staff are concerned with and listen to patients' demands", "Skillful techniques of nursing staff ", "Nursing staff can handle and react to emergencies", "Patients recover after treatment", "Convenient hospital parking", and "Hospital can quickly make improvements based on patients' suggestions". (3) One-dimensional qualities, for which customers are satisfied when the hospital provides the service while dissatisfied if not provided, contain three service quality attributes, as follows: "Empathetic attitude of doctors", "Doctors can patiently listen to details of patients' conditions", and "Hospital guarantees the confidentiality of patients' personal information". (4) Indifferent qualities, which do not affect patients' satisfaction whether or not hospital provides the services, include two items, namely "Convenient hospital transportation" and whether the hospital can promptly reply to patients complaints.

Refined Kano model analysis

This study further analyzed the data with the Refined Kano Model, as shown in Table 2. The analysis shows three high value-added quality items, including “Doctors can patiently listen to details of the patients’ condition”, “Hospital guarantees the confidentiality of patients’ personal information”, and “Empathetic attitude of doctors”. In addition, there are seven critical qualities, including: “Hospital provides perfect medical equipment”, “Hospital provides perfect escape equipment”, “Convenient hospital parking”, “Nursing staff are concerned with and listen to patients’ demands”, “Skillful technique of nursing staff ”, “Nursing staff can handle and react to emergencies”, “Patients recover after treatment”. There are also five necessary qualities, as follows: “Good hospital sanitation”, “Hospital washrooms properly cleaned”, “Appropriate temperature from air conditioning system”, “Empathetic service attitude of hospital administrators”, and “Hospital can quickly make improvements based on the patients’ suggestions”. In addition, there are five highly attractive qualities, which are: “Clear directions for each department in the hospital”, “Empathetic service attitude of nursing staff”, “Empathetic service attitude of hospital volunteers”, “Doctors can explain the disease and its treatment in detail”, and “Side effects do not occur when patients take medicine”. Finally, there are four low attractive qualities, as follows: “Hospital provides computerized service”, “Hospital provides obstacle-free facilities”, “Hospital provides a complete complaint channel”, and “Hospital provides detailed information about hygiene education”, as well as two care-free qualities, “Convenient hospital transportation” and “Hospital can promptly reply to patients’ complaints”.

Quality house deployment of medical service element items

This study uses a quality house model, calculates the weights of patient service demands, and uses the Fuzzy Integral method to assess the importance of each medical service element by taking the 20 medical service elements obtained from interviews with experts. Table 3 shows Quality Function Deployment of the medical service elements.

Having introduced Quality Function Deployment into the calculations of each medical service element’s importance, the top ten improvement elements are sequenced, as follows: staff training with the highest importance of 0.841, safety of hospital design (0.803), convenience of hospital (0.785), empathetic service (0.734), equipment maintenance and medical-used equipment (both 0.714), cleanness of hospital (0.7), coordinated service and emphasizing patients’ rights (both 0.629), and professional service (0.584).

According to the above findings, patients are concerned that the hospital environment should be well cleaned and maintained, such as keeping washroom clean, to avoid the risk of elderly patients sliding and falling due to a wet or slippery floor. Moreover, service staff should be more actively concerned about patients to see if they are in need of any assistance, so that the overall level of satisfaction with the hospital can be effectively increased.

DISCUSSION AND CONCLUSIONS

With rising patients’s consciousness with regard to health, hospitals now need to pay more attention to satisfying the demands of patients. For this reason, the promotion of quality is an important competitive strategy in the medical industry. How to advance service quality and patients’ satisfaction is thus not only the ultimate goal of the collective efforts of medical organizations, but it is also the primary management policy. It is therefore important for the medical industry to realize the actual demands (requirements) of patients so as to be better able to focus resources on the most important items.

This study used data codes and the 26 topics in Kano Model to find 12 must-be qualities, three one-dimensional qualities, nine attractive qualities, and two indifferent qualities. Must-be qualities are the priority attributes for hospitals, as patients consider that hospitals should essentially possess a safe environment or provide high-quality medical care. One-dimensional qualities are the second most important items, showing that patients’ perceptions when discussing their problems with doctors will affect their satisfaction, and hospitals should protect patients’ personal information to maintain trust in the organization. Attractive qualities, the most competitive attributes for hospitals, can enhance patient satisfaction, but do not increase dissatisfaction if they are absent, as patients do not consider them important. Finally, applying the Refined Kano Model combined with the average of importance for re-modification, medical service quality is subdivided to achieve more accurate results, and thus the high value-added quality items induced from the research findings that have a high contribution to hospitals are considered as the most important quality items that hospitals should provide. Critical quality refers to the important quality items that hospitals should provide. Necessary quality should be maintained on certain services to prevent patients from being dissatisfied. Highly attractive quality items should also be a focus. Low attractive quality items can be neglected when considering the numerous other items and the limited resources in hospitals. Care-free quality items, which can be effectively handled with limited resources, are not taken in to consideration because of the relatively low costs involved.

This study adopts Quality Function Deployment Integrated with the Fuzzy Integral approach to obtain the priority improvement sequence as follows: staff training, safety of hospital design, convenience of hospital, empathetic service, equipment maintenance, and medical-used equipment. Therefore, this study suggests

Table 2. Classification of service requirements in Kano and Refined Kano models.

Service requirements	Importance average	Satisfaction average	Kano quality classification	Refined Kano model
Hospital provides perfect medical equipment	4.08	2.88	Must-be quality	Critical quality
Convenient hospital transportation	3.91	2.84	Indifferent quality	Care-free quality
Convenient hospital parking	4.05	2.81	Must-be quality	Critical quality
Hospital provides perfect escape equipment	4.06	2.91	Must-be quality	Critical quality
Clear directions for each department in the hospital	3.96	2.86	Attractive quality	High attractive quality
Hospital provides computerized service	3.88	2.82	Attractive quality	Low attractive quality
Hospital provides obstacle-free facilities	3.82	2.82	Attractive quality	Low attractive quality
Good hospital sanitation	3.80	2.77	Must-be quality	Necessary quality
Hospital washrooms properly cleaned	3.77	2.81	Must-be quality	Necessary quality
Appropriate temperature from air conditioning system	3.75	2.77	Must-be quality	Necessary quality
Empathetic attitude of doctors	3.93	2.90	One-dimensional quality	High value-added quality
Empathetic service attitude of nursing staff	3.96	2.99	Attractive quality	High attractive quality
Empathetic service attitude of hospital administrators	3.89	2.91	Must-be quality	Necessary quality
Empathetic service attitude of hospital volunteers	3.99	3.00	Attractive quality	High attractive quality
Nursing staff are concerned with and listen to patients' demands	4.02	3.08	Must-be quality	Critical quality
Skillful techniques of nursing staff	3.98	2.95	Must-be quality	Critical quality
Nursing staff can handle and react to emergencies	3.94	3.04	Must-be quality	Critical quality
Doctors can explain the disease and its treatment in detail	4.00	2.96	Attractive quality	High attractive quality
Doctors can patiently listen to details of the patients' conditions	3.93	3.02	One-dimensional quality	High value-added quality
Hospital provides a complete complaint channel	3.89	2.92	Attractive quality	Low attractive quality
Hospital can promptly reply to patients' complaints	3.90	2.93	Indifferent quality	Care-free quality
Hospital can quickly make improvements based on patients' suggestions	3.85	2.91	Must-be quality	Necessary quality
Hospital provides detailed information about hygiene education	3.72	2.83	Attractive quality	Low attractive quality
Hospital guarantees the confidentiality of patients' personal information	3.96	3.01	One-dimensional quality	High value-added quality
Patients recover after treatment	3.96	3.01	Must-be quality	Critical quality
Side effects do not occur when patients take medicine	3.96	2.97	Attractive quality	High attractive quality
Overall average	3.92	2.91		

Table 3. Quality function deployment.

	Medical service techniques																				
	Demand quality weight	Closeness of hospital	Convenience of hospital	Safety of hospital design	Cleanness of hospital	Medical-used equipment	Public facility in hospital	Equipment maintenance	Coordinative service	Empathetic service	Service reaction ability	Professional service	Efficiency of medical service	Environmental comfort	Emphasize patients' rights	Effectiveness of medication	Sufficient personnel	Patient complaint handling	Personnel administration	Staff training	Instant information
Hospital provides perfect medical equipment	0.071					◎		◎													
Convenience of hospital transportation	0.06	△	△																		
Convenience of hospital parking	0.074	△	○																		
Hospital provides perfect escape equipment	0.069		△	◎			○	○													
Clear marks of directions to each department in hospital	0.066		◎				△	△													
Hospital provides computerized service	0.049		○			△		△													○
Hospital provides obstacle-free facility	0.037		◎	◎			◎	○													
Hospital sanitation	0.054				◎									○					△		
Hospital washroom duly cleaned	0.034				◎		△							○					△		
Appropriate temperature form air conditioner in hospital	0.046				○		△	△						◎							
Empathetic attitude of hospital doctors	0.051									◎							△		△	○	
Empathetic service attitude of hospital nursing staff	0.031		△							◎							△		△	○	
Empathetic service attitude of hospital administrators	0.02		△							◎									△	○	
Empathetic service attitude of hospital volunteers	0.04		○							○										○	
Nursing staff being able to concern and listen to patients' demands	0.029						○							○			△ △		△ △	△	

Table 3. Cont'd.

Skillful techniques of nursing staff	0.057									△	◎	◎						◎		
Nursing staff with emergency handling and reacting ability	0.003									◎	◎	○						○	△	
Doctors can explain the disease and its treatment in details	0.063							◎			△			◎	△			◎		
Doctors can patiently listen to patients' sickness condition	0.006							○						○			△			
Hospital provides complete complaint channel	0.014		○				○							△		△			△	
Hospital can promptly reply to patients complaints	0.011									◎		△		△		◎			△	
Hospital can quickly make improvements to patients' suggestions	0.009											△		△		○			△	
Hospital provides detailed information of Hygiene education	0.017						○				△			△			△		○	△
Hospital guarantees the privacy of patients' personal information	0.023						○							○						
Patients' sick condition improved after doctor's treatment	0.023														○					
Side effect does not happen during patients taking medicine	0.043														◎					
Medical service technique weights		0.111	0.785	0.803	0.7	0.714	0.371	0.714	0.627	0.734	0.140	0.584	0.571	0.457	0.629	0.429	0.111	0.333	0.111	0.841	0.333
Medical service technique importance		18	3	2	7	5	14	5	8	4	17	10	11	12	8	13	18	15	18	1	15

Relation symbols: ◎ = 9 Highly relative, ○ = 3 Medium relative, △ = 1 Lowly relative.

that hospitals should enhance empathetic staff service and the professional abilities of medical personnel in staff trainings regularly and improve obstacle-free facilities and fire-fighting equipment, as well as increase the number of parking spaces around the hospital for patients, or increase the number of volunteers to assist patients with regard to hospital safety. What is more, patients think that hospitals must purchase new medical equipment and regularly maintain it.

According to the above analysis of patient requirements, by using Quality Function Deployment to find out which quality items need most urgent improvement, hospitals, operating with limited resources, can achieve the highest levels of patients' satisfaction to promote their reputations as well as enhance their competitiveness.

REFERENCES

Arasli H, Ekiz EH, Katircioglu ST (2008). "Gearing service quality into public and private hospitals in small islands: empirical evidence from Cyprus". Int. J. Healthcare Qual. Assur., 21(1): 8-23.

Asai K (1995). "Fuzzy System for Management." ISO Press. Netherlands. pp. 49–54.

Bosc P, Lietard L, Pivert O (2003). "Sugeno Fuzzy Integral as a basis for the interpretation of flexible queries involving monotonic aggregates." Info. Process. Manage., 39(2): 287-306.

Bossert JL (1991). "Quality Function Deployment-A Practitioner's Approach." ASQC Quality Press Inc. New York.

Bowers MR, Swan JE, Koehler WF (1994). "What attributes determine quality and satisfaction with health care delivery?" Health Care Manage. Rev., 19(4): 49-55.

Carey RG, Seibert JH (1993). "A patient survey system to measure quality improvement questionnaire reliability and validity." Medical Care, 31(9): 834-845.

Chang CL (2006). "Application of quality function deployment launches to enhancing nursing home service quality." Total Quality Manage. Business Excellence, (17): 287-302.

Chen LH, Weng MC (2006). "An evaluation approach to engineering design in QFD processes using fuzzy goal programming models." Eur. J. Oper. Res., 172(1): 230-248.

Chen TY, Chang HL, Tzeng GH (2002). "Using fuzzy measures and habitual domains to analyze the public attitude and apply to the gas taxi policy." Eur. J. Oper. Res., 137(1): 145-161.

Chiou HK, Tzeng GH (2002). "Fuzzy multiple-criteria decision-making approach for industrial green engineering." Environ. Manage., 30(6): 816-830.

Costa AIA, Dekker M, Jongen WMF (2000). "Quality function deployment in the food industry: a review." Trends Food Sci. Technol., 11(9-10): 306-314.

Cuieford JP (1965). "Fundamental Statistics in Psychology and Education." New York: McGraw-Hill.

De Man S, Gemmel P, Vlerick P, Rijk PV, Dierckx R (2002)."Patients' and personnel's perceptions of service quality and patient satisfaction in nuclear medicine." Eur. J. Nuclear Med. Mole. Imaging, 29(9): 1109-17.

Dikmen I, Birgonul MT, Kiziltas S (2005). "Strategic use of quality function deployment (QFD) in the construction industry." Building Environ., 40(2): 245-255.

Fisher CM, Anderson CJ (1990). "Hospital advertising: does it influence consumers." J. Health Care Mark, 10(4): 40-46.

Fu CJ, Chang HH (2002). "An empirical study of the satisfaction level of medicare services quality in Taiwan." Taiwan Acad. Manage. J., 1(2): 317-339.

Gonzalez ME, Quesada G, Picado F, Eckelman CA (2004). "Customer satisfaction using QFD: an e-banking case." Managing Serv. Qual., 14(4): 317-330.

Gremler DD, Gwinner KP, Brown SW (2001). "Generating positive word-of-mouth communication through consumer-employee relationships." Int. J. Serv. Ind. Manage., 12(1): 44-59.

Hyde PC (1986). "Setting standards in health care." Qual. Assur., 12(2): 57-59.

Ishii K, Sugeno M (1985). "A model of human evaluation process using fuzzy measure." Int. J. Man-Machine Stud., 22(1): 19-38.

Jain SK, Gupta G (2004). "Measuring Service Quality: SERVQUAL vs. SERVPERF Scales". J. Decision Makers, 29(2): 25-37.

Kano N, Seraku N, Takahashi F, Tsuji S (1984). "Attractive quality and must-be quality." J. Japanese Society Quality Control, 14(4): 39-48.

Leinonen T, Leino KH, Stahlberg M, Lertola K (2001). "The quality of perioperative care: Development of a tool for the perceptions of patients." J. Adv. Nurs., 35(2): 294-306.

Matzler K, Hinterhuber HH (1998). "How to make product development projects more successful by integrating Kano's model of customer satisfaction into quality function deployment." Technovation, 18(1): 25-38.

Milakovich ME (1995). "Improving service quality: achieving high performance in the public and private sectors." St. Lucie Press, Delray Beach, FL.

Oliver RL (1980). "A Cognitive model of the antecedents and consequence of satisfaction decision." J. Mark. Res., 17(11): 460-469.

Omar MA, Schiffman RF (1995). "Pregnant women's perceptions of prenatal care. Maternal-Child Nurs. J., 23(4): 132-142.

Patricia M, Alejandra M, Miguel L, Olivia M (2007). "A hybrid modular neural network architecture with fuzzy Sugeno integration for time series forecasting." Appl. Soft Comput., 7(4): 1217-1226.

Polluste K, Kalda R, Lember M (2000). "Primary health care system in transition: the patient's experience." Int. J. Qual. Health Care. 12(6): 503-9.

Radwin L (2000). "Oncology patients' perceptions of quality nursing care." Res. Nurs. Health. 23(3): 179-190.

Rao KD, Peters DH, Bandeen RK (2006). "Towards patient-centered health services in India - a scale to measure patient perceptions of quality." Int. J. Qual. Health Care, 18(6): 414-421.

Sa Moura P, Saraiva P (2001). The development of an ideal kindergarten through concept engineering/quality function deployment, Total Qual. Manage., 12(3): 365-372.

Schvaneveldt SJ, Takao E, Masami DD (1991). "Consumer evaluation perspectives of service quality: evaluation factors and two-way model of quality", Total Qual. Manage., 2(2): 149-161.

Shih YT (1978). "The evolution of healthcare quality." J. Hosp., 11(2): 106-109.

Shoshanna S, Christine C, Elizabeth G, Elizabeth H, Jenny C (2005). "What do consumers want to know about the quality of care in hospital." Health Serv. Res., 40(6): 2018–2036.

Sugeno M (1974). "Theory of fuzzy integrals and its applications." Unpublished Doctoral Dissertation, Tokyo, Tokyo Institute of Technology.

Utne IB (2008). "Improving the environmental performance of the fishing fleet by use of Quality Function Deployment (QFD)." J. Cleaner Prod., 17(8): 724-731.

Westaway MS, Rheeder P, VanZyl DG, Seager JR (2003). "Interpersonal and organizational dimensions of patient satisfaction: the moderating effects of health status." Int. J. Qual. Health Care, 15(4): 337–344.

Yan W, Chen CH, Chang D, Chong YT (2009). "A stakeholder-oriented innovative product conceptualization strategy based on fuzzy integrals." Advanced Engineering Informatics. 23(2):201–209.

Yang CC (2005). "The Refined Kano's model and its application." Total Quality Manage. Business Excellence., 16(10): 1127-1137.