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Constructing Quality of Service Indicators and Improvement Strategies for Medical Tourism in Taiwan

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ABSTRACT Aiming to establish the quality of service indicators and performance analysis for medical tourism industry, five dimensions of quality of service and 31 indicators for medical tourism are constructed through literature review and in-depth interviews with business representatives, experts, administrative organizations, and consumers. The consumer expectation and perception of medical tourism industry are collected and analyzed with artificial neural network and Mahalanobis Distance. The key improvement directions in the quality of service for medical tourism industry are sequenced as Service companies or hospitals present relevant certificates and certification, Appropriately keep secret of patients' medical records, Service providers (travel agents, treatment planners) can understand customer demands, Travel agents should present medical knowledge to provide customers with correct information, and Service providers (travel agents, treatment planners) could design a standard service procedure according to customer demands. The research results could provide the government, industry, and universities with reference of decision-making for medical tourism.

INTRODUCTION

It is estimated about 60 billion US dollars business opportunity in global medical tourism industry (MacReady 2007). Singh (2008) estimated that medical tourism would create more than 44 billion US dollars business opportunity in Thailand, Malaysia, and India in 2012. Medical tourism is currently one of the most rapidly developing industries in the world. A lot of countries are planning the relevant regulations and practical operation systems to strive for the business opportunity. Bookman and Bookman (2007) regarded the extremely potential business opportunity of international medical services in the global economy. Ramirez de Arellano (2007) indicated that investment in international medical services would result in balance of trade, enhance gross national product (GDP), and promote development of tourism. A lot of countries and regions, such as India, Malaysia, Singapore, Thailand, Brunei, Cuba, Hong Kong, Hungary, Israel, Jordan, Lithuania, Philippines, and Arab, therefore are aware of the business opportunity of medical tourism that they have become major medical tourism nations and regions (Heung et al. 2010; Pocock and Phua 2011). Other countries, like Colombia, Costa Rica, Mexico, Brazil, and Turkey, are also actively investing in the development of medical tourism, particularly the development of aesthetic medicine (Singh 2008). Such countries attract international customers mostly with the skillful medical techniques and advance equipment (Lunt and Carrera 2010). Although a lot of countries have been or are actively investing in medical tourism, Asia is still the major region for medical tourism (Connell 2006). The boom of medical tourism has quality of service become the major competitive strength internationally (Hall 2011). The past research on medical tourism focused more on medicine, technique, economy, marketing, and the relationship between supply and demand (Bookman and Bookman 2007; Connell 2006) as well as the construction of location selection model (Caballero-Danell and Mugomba 2007; Heung et al. 2010; Smith and Forgione 2007; Ye et al. 2008). However, quality of service for medical tourism has not been explored. For this reason, literature review and expert interviews are applied to establishing the quality of service indicators, and Back-Propagation Neural Network (BPNN) and Mahalanobis Distance (MD) are combined to continuously improve the quality of service.

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Literature Review

1. Quality of Medical Service

Lewis and Booms (1983) pointed out quality of service as providing good services to achieve customer expectation and delivery of quality service as providing consistent services to customer expectation based on stability. Lehtinen and Lehtinen (1982) also pointed out three dimensions for quality, including physical quality, referring to physical services (such as instrument and building), corporate quality, referring to corporate image and overall perception, and interaction quality, referring to the interaction between customers and staff or between customers. Darby and Karni (1973) further included credence properties, which might not be evaluated even when the customers paid for and used it (for example, appendicitis surgery). Parasuraman et al. (1988) developed Service Quality Scale (SERVQUAL Scale), covering the dimensions of reliability, responsiveness, tangibility, assurance, and empathy, in which assurance and empathy contained seven dimensions (communication, credibility, security, ability, politeness, understanding customers, and accessibility) out of the ten dimensions in the quality of service model developed by Parasuraman et al. (1985). The customers measured quality of service by comparing the gap between the perception and the expectation.

Zineldin (2000, 2006) proposed 5Qs to measure quality of medical service, in which some measuring indicators are covered. Such five dimensions could measure quality of medical service, and quality of medical service would affect patient satisfaction. The research expected good patients' satisfaction to further achieve the ultimate objective of recommending the hospital to the relatives and friends who looked for medical services. The 5Qs contained 1. Quality of object, technological quality, referring to the treatment itself, that is, the major factor in patients being in hospitals, 2. Quality of process, functional quality (how a health carer provided core service (skills), showing the healthcare activities being well practiced, 3. Quality of infrastructure, referring to the basic resources for healthcare services (such as internal abilities and skills, experiences, how-to-do, and technologies), 4. Quality of interaction, referring to the measurement of information exchange (for example, how much time a staff spent to understand patient demands, the ratio of patients being informed for back to the clinic), and 5. Quality of atmosphere, referring to the interaction between patients and staff (the relationship and interaction process between staff in specific environments, where the unfriendly atmosphere was a factor in bad healthcare quality in developing countries).

2. Medical Tourism

Aiming at the research on medical tourism, most theoretical models developed academically are the model for medical tourism consumers selecting locations. Smith and Forgione (2007) developed a two-phase model and pointed out the factors in patients choosing foreign medical services. In the first phase, the country or location for medical tourism was selected, where the factors included economic environment, political climate, and regulation policy. Selecting medical tourism institutes was the second phase, in which the factors contained cost and physician's trained medical quality and certification. Smith and Forgione (2007) mentioned that a consumer would first select the destination for medical tourism and then chose the institutes for the practice; however, the factors were not studied the weight when consumers making decisions. Ye et al. (2008) applied case study to explore the motive and obstacle of potential medical tourism consumers in Hong Kong and developed a hierarchical structure to explain the consumer motive for medical tourism from the aspects of Push and Pull. The research indicated that medical tourism consumers concern more about medical factors, rather than the selection of location. Besides, the research results showed the medical tourism marketing no longer focusing on low prices, but stressing on other characteristics. Medical tourism consumer motive model, proposed by Ye et al. (2008), covered four dimensions of Push, Pull, Promotion, and Other Concerns and 14 factors of improvement, reliability, privacy, attractive price, business reputation, medical facilities, word-of-mouth of relatives and friends, advertisement, physician's experiences, friends, family support, service attitudes and quality, time, and location.

Aiming at medical tourism, Henng et al. (2010) proposed a conceptual model establishing the interactive relationship between consumers and

businesses based on the ideas of supply and demand. The factors in medical tourism demand contained economic environment, political factors, regulations, properties, distance, aviation charges, cost, authentication, business reputation, doctor training, professional techniques, and recommendation, which would affect each other when consumers making decisions. Medical tourism supply was divided into the dimensions of building and facilities, marketing, quality, and communication with the factors of hospitals, clinics, private participation, public participation, market strategies, social communities, oversea promotion, international activities, certification and authentication, language, and network, which would interact with the factors in demand (Crooks et al. 2010).

Although such models presented primary research contributions, they remained in conceptual structure, which could not provide definite directions and strategies for the practical development of medical tourism. What is more, the past research did not discuss the completeness of such factors. For instance, insurance items, services and payment, convenience of relevant application, medical preparation and waiting, and follow-up treatment were not mentioned. The factors in consumers making decisions for medical tourism and the difference between the real perception and expectation after the medical tourism services were not discussed, either (Turner 2011). As a result, the establishment of quality of service indicators for medical tourism and the combination of Back-Propagation Neural Network and Mahalanobis Distance in this study reveal significant research value and contributions.

RESEARCH METHODOLOGY

Research Design

Medical tourism industry is currently divided into medical tourism, healthcare tourism, and health travel in Taiwan, but the establishment of quality of service indicators does not appear remarkable differences. The opinions of consumers, businesses, researchers, and officials (the government) about quality of service for medical tourism management are therefore analyzed. Literature Review, Focus Group, and In-Depth Interview are utilized for establishing the primary structure of quality of service in this study. Heung et al. (2010), Ho et al. (2012), and Neuman (2000) agreed that the above approach presented validity. The quality of service indicators organized by experts is used for developing the questionnaire, in which Likert's 7-point scale is utilized for the questions for each quality of service indicators. It tends to understand customer expectation and the perception after receiving the services so as to detect the actual quality of service performance of medical tourism industry.

The designed questionnaire is examined by experts, and the revised questionnaire is formally used for the questionnaire survey to collect the expectation and perception of medical tourism consumers. Back-Propagation Neural Network and Mahalanobis Distance are applied to analyzing the importance and gap for medical tourism businesses understanding the quality of service performance and formulating the development and improvement directions.

Proceeding Gap Analysis with Mahalanobis Distance

Traditionally, Euclidean distance, used for calculating the distance between two sample groups, merely measures the relative distance of center-of-gravity, but not considering the correlations, that is, the variables are assumed independent. Nevertheless, a system or product quality is presented by various characteristics, which might be correlated or mutually independent in various situations. Not considering the correlations might result in wrong decisions. Taguchi (2002) compared Mahalanobis Distance with other traditional statistics and indicated the advantages of (1) considering the mean, variance, and covariance, (2) considering the acceptance between variables, (3) considering the interaction between variables, and (4) being dimensionless (unit).

According to Taguchi (2001), Mahalanobis Distance is the square of distance. The equation is presented with a matrix and defined as below.

$$MD_j = D^2 = \frac{1}{k}\left(Z_{ij}^T C^{-1} Z_{ij}\right)$$

Deducting the Importance of Quality of Service with BPNN

BPNN is a broadly applied model in ANN. The BPNN structure is divided into an input layer,

one or several hidden layers, and an output layer. The built-in learning rate and the default value of the excited state provided by ANN could be applied to the computation of BPNN (Deng et al. 2008). Hush and Horne (1993) explained the three situations to terminate the network learning, (1) when the difference between the expected value of Mean Square Error (MSE) and the network output reduced down to the default value, (2) the default number of learning cycle times being achieved, and (3) when the valid samples for MSE were increasing.

A lot of researchers applied statistics to deducting the implicit importance of quality (Dolinsky and Caputo 1991; Matzler and Sauerwein 2002; Matzler et al. 2004a; O'Leary and Adams 1982; Simpson et al. 2002). Although the deducted importance was superior to the importance of self-representation, such statistics still appeared different normality, linearity, and independence from the real situation to cause wrong results. However, BPNN could avoid such problems. Three steps are applied to evaluating the implicit importance with BPNN.

(1) The susceptibility of quality and the overall customer satisfaction are used as the input variable in the input layer and the output variable of the output layer of BPNN.
(2) When BPNN is established, the target value is trained and tested. Mean Absolute Percentage Error (MAPE) and Goodness-of-fit (R^2) are the indicators evaluating the target performance of BPNN. When R^2 of the tested data approaches 1, Goodness-of-fit of BPNN is favorable. When MAPE of the tested data approaches 0, BPNN presents excellent prediction ability. When the above conditions are shown, such BPNN could be used for further analyses and applications.
(3) The relative importance I_i of the input variable is first calculated. The weight of BPNN after the training is acquired by summing the quality i being input to the connecting path of artificial neurons. The weight could be a negative value that the absolute value is used for presenting the effects of quality i.
The importance I_i of the input variable calculated with the trained BPNN could be regarded as the estimated value of importance to modify the traditional Gap Analysis.

RESULTS

Based on the dimensions for quality of service proposed by Parasuraman et al. (1988), the evaluation items in this study were designed by referring to medical tourism and quality of service constructed in literatures. With qualitative research of in-depth interviews, eight experts, including 3 males and 5 females, were interviewed about 40min each. The interviewees were divided into researchers, governmental units, tourism businesses, and medical units, in which the interviewees answered the questions with the professional knowledge. The dimensions and indicators of quality of service for medical tourism industry were organized in Table 1.

The questionnaire was designed according to the dimensions and indicators of quality of service and was examined by eight experts in order to ensure the validity. The medical tourism consumers were selected as the research subjects. The questionnaires were distributed and collected in March-June, 2013. The medical tourism businesses in various regions were randomly sampled proportionally. Total 200 copies of questionnaires were distributed, and 148 copies were retrieved, with the retrieval rate 74%. Having deducted 15 invalid copies, the valid samples appeared 133, 66.5%. The retrieved questionnaires were proceeded reliability and validity analyses. The Cronbach's α of the expectancy of 31 questions appeared 0.981, showing high reliability above 0.7 (Nunnally 1967). The question expectancy presented high consistency. Similarly, the Cronbach's α of the susceptibility of 31 questions revealed 0.980, showing the high reliability above 0.7 (Nunnally 1967). The question susceptibility appeared high consistency.

Mahalanobis Distance was applied to analyzing the gap of quality of service for medical tourism and the differences in expectation and perception. Since expectation and perception presented correlations and Mahalanobis Distance could consider the covariance and the correlation coefficient of two variables, the evaluated gap was more reasonable. Equations (1)-(6) were used for calculating the mean, standard deviation, correlation coefficient, and Mahalanobis Distance of expectancy and susceptibility of the 31 questions in order to analyze the gap of quality of service for medical tourism (Table 2).

Table 1: Quality of service indicators of medical tourism in Taiwan

Dimension		*Indicator*
Tangibility	1.	Service providers (travel agents, treatment planners) present advance service equipment (for example, medical equipment, advance technology, and online itinerary arrangement platform).
	2.	The manufacturing locations or the functions of service providers' (travel agents, treatment planners) equipment are attractive.
	3.	Service staff of service providers (travel agents, treatment planners) is well dressed.
	4.	The hardware, appearance, and service property of service providers (travel agents, treatment planners) are attractive.
	5.	The facilities and the services of service providers (travel agents, treatment planners) are well matched.
	6.	Service providers present sufficient language ability and are able to communicate with customers.
	7.	Service providers present special window or online platform.
Responsiveness	8.	The provided medical services conform to customer expectation.
	9.	The provided tourism services conform to customer expectation.
	10.	Service providers (travel agents, treatment planners) can understand customer demands.
	11.	Service providers (travel agents, treatment planners) are willing to help customers and provide instant services.
	12.	Customers can instantaneously find the service providers (for example,travel agents, treatment planners).
	13.	Service providers present professional knowledge to solve customers' problems.
Reliability	14.	Service providers (travel agents, treatment planners) would try to reduce unnecessary waiting time.
	15.	Service providers (travel agents, treatment planners) are trustable.
	16.	Service providers (travel agents, treatment planners) could respect to customer privacy.
	17.	Service providers (travel agents, treatment planners) could reliably and accurately provide committed medical tourism services.
	18.	Service providers (travel agents, treatment planners) are patient of explaining customers' questions in detail.
	19.	Service providers (travel agents, treatment planners) could accurately and well keep customers' itinerary/medical records.
	20.	Travel agents should present medical knowledge to provide customers with correct information.
Assurance	21.	Physicians would carefully explain the symptoms and patiently listen to the patients about the conditions.
	22.	Appropriately keep secret of patients' medical records.
	23.	Medical (nursing) staff in hospitals shows professional abilities.
	24.	Service providers (travel agents, treatment planners) present friendly and polite attitudes and can be trusted by customers.
	25.	Service companies or hospitals present relevant certificates and certification.
Empathy	26.	Service providers (travel agents, treatment planners) could provide customers with individual care.
	27.	Service providers (travel agents, treatment planners) emphasize customers' rights.
	28.	Service providers (travel agents, treatment planners) could design a standard service procedure according to customer demands.
	29.	Service providers (travel agents, treatment planners) remember customers' concerns.
	30.	The opening hours of service providers (travel agents, treatment planners) conform to customer demands.
	31.	Service providing hospitals could continuously and actively track the situation of customers after the treatment.

The satisfaction with the susceptibility of quality of service for medical tourism was further analyzed with BPNN. After the training and cross-authentication, RMSE=0.03839, MAPE = 0%, and R^2=0.8385 were acquired with equations (7)-(9), showing the acceptable Goodness-of-fit. The weight of quality of service for medical tourism was calculated with equation (9), and the perceived quality performance was organized in Table 2.

Table 2: Gap analysis and sequence after Mahalanobis Distance and weighted BPNN

No. of question	*Expectancy (E)*	*Perception (P)*	*Correlation coefficient*	*Mahalanobis distance*	*Absolute weight*	*Gap*	*Sequency*
1	5.90	5.73	0.48	0.73	0.09	0.02	22
2	5.86	5.63	0.49	0.82	0.07	0.02	23
3	5.90	5.77	0.57	1.30	0.04	0.02	24
4	5.95	5.71	0.40	0.84	0.10	0.03	15
5	6.07	5.75	0.32	0.93	0.14	0.04	13
6	6.07	5.83	0.42	1.12	0.06	0.02	20
7	6.05	5.81	0.45	1.17	0.06	0.02	18
8	5.83	5.77	0.41	0.99	0.02	0.01	30
9	5.84	5.74	0.35	0.79	0.14	0.03	14
10	5.99	5.77	0.35	0.86	0.31	0.08	3
11	5.97	5.80	0.38	0.91	0.08	0.02	21
12	5.97	5.66	0.39	0.81	0.03	0.01	27
13	6.11	5.78	0.37	1.04	0.13	0.04	11
14	6.08	5.57	0.42	0.85	0.03	0.01	26
15	6.15	5.75	0.36	1.07	0.12	0.04	12
16	6.24	5.87	0.42	1.28	0.06	0.02	19
17	6.17	5.83	0.23	0.88	0.03	0.01	28
18	6.21	5.85	0.38	1.31	0.12	0.05	6
19	6.17	5.92	0.29	1.01	0.08	0.03	17
20	6.07	5.83	0.47	1.01	0.18	0.06	4
21	6.14	5.89	0.41	1.15	0.07	0.03	16
22	6.19	5.93	0.44	1.38	0.23	0.10	2
23	6.23	5.93	0.35	1.17	0.12	0.04	10
24	6.08	5.83	0.36	1.17	0.12	0.05	8
25	6.26	5.92	0.40	1.53	0.22	0.11	1
26	6.03	5.74	0.38	0.87	0.04	0.01	25
27	6.07	5.82	0.39	1.21	0.00	0.00	31
28	6.03	5.72	0.48	1.03	0.17	0.06	5
29	6.02	5.73	0.49	0.98	0.02	0.01	29
30	5.94	5.61	0.62	1.16	0.13	0.05	7
31	6.02	5.71	0.57	1.16	0.12	0.04	9

According to Regression Analysis of BPNN, the top five factors in customer satisfaction with quality of service showed Service providers (travel agents, treatment planners) can understand customer demands, Appropriately keep secret of patients' medical records, Service companies or hospitals present relevant certificates and certification, Travel agents should present medical knowledge to provide customers with correct information, and Service providers (travel agents, treatment planners) could design a standard service procedure according to customer demands. The large gap of quality of service revealed the large difference between customer expectation and the real perception. From Table 2, the top five indicators with large gap were service companies or hospitals present relevant certificates and certification, Appropriately keep secret of patients' medical records, Service providers (travel agents, treatment planners) can understand customer demands, Travel agents should present medical knowledge to provide customers with correct information, and Service providers (travel agents, treatment planners) could design a standard service procedure according to customer demands.

CONCLUSION

Two major contributions are contained in this study. The literature analysis results and the opinions of government-industry-university experts and direct customers could be organized the establishment of quality of service indicators for medical tourism. The benefits and contributions are described as follows.

1. The complete quality of service indicators exclusively for medical tourism in Taiwan are constructed in this study.

2. The objectivity and value of the research contents are enhanced through literature analyses and the opinions of government-industry-university experts and consumers.
3. Regarding the emphasis of medical tourism development, it is just the beginning stage in Taiwan; but, the overall output value would greatly contribute to the entire economy.
4. The formulation of quality of service indicators allows medical tourism businesses inspecting the performance and enhancing the self-control behaviors so as to promote the management and quality of service for medical tourism industry.
5. An objective quality of service standard which could be followed by consumers, businesses, and governmental units should be established for medical tourism.

In regard to the development and continuous improvement of quality of service for medical tourism industry, the integration of SERVQUAL, BPNN, and MD allows definitely analyzing quality of service for medical tourism, and the analysis results could be applied to developing market strategies for medical tourism so as to continuously enhance the quality of service and find out the service innovation direction. Applying the integration of BPNN and MD to analyzing quality of service for medical tourism industry, the benefits for industrial development and continuous improvement are described as follows.

1. SERVQUAL could completely analyze the expectation and perception of medical tourism consumers and assist medical tourism businesses in understanding the perceived expectation and real perception of customers.
2. Back-Propagation Neural Network (BPNN) could definitely analyze Regression Analysis of quality of service for medical tourism to evaluate perceived implicit importance of customers, find out the key factors in quality of service for medical tourism businesses, assist medical tourism businesses in understanding the key quality of service affecting consumer satisfaction, and promote the quality of service with the least investment.
3. Replacing traditional method of the mean distance between two variables with Mahalanobis Distance (MD), the prior quality of service items are discovered as the market strategies for developing medical tourism and provided the government and businesses developing medical tourism.
4. By integrating SERVQUAL, BPNN, and MD, various types of consumers are proceeded Gap Analysis to assist medical tourism businesses in establishing the competitive advantages and the basis for sustainable management.

RECOMMENDATIONS

The improvement items for medical tourism industry are ordered as service companies or hospitals present relevant certificates and certification, Appropriately keep secret of patients' medical records, service providers (travel agents, treatment planners) can understand customer demands, travel agents should present medical knowledge to provide customers with correct information, and service providers (travel agents, treatment planners) could design a standard service procedure according to customer demands. Such a result provides the important reference for government-industry-university promoting medical tourism. In terms of service companies or hospitals present relevant certificates and certification, the combination of medical industry and tourism industry is the popular service model in Asian areas. The governmental units are also actively developing medical tourism industry. Nevertheless, the governmental institutes for medical businesses and tourism businesses are different. It is therefore suggested that the governmental institutes, central or local, should be integrated for the planning or coordinated measures should be offered for the regulations and restrictions. The governmental institutes should actively integrate the perception differences between hospitals and travel agents so that travel agents present medical knowledge and negotiate the relative institutes in the governmental sectors (such as Ministry of Health and Welfare, Tourism Bureau, Construction Bureau, and local governments) to confirm the supervising institute for medical tourism industry. In regard to Service providers (travel agents, treatment planners) can understand customer demands, it is suggested to investigate the expectation and

perception of patients towards medical tourism services so as to improve the quality of service for medical institutes as well as expand the blue ocean market of international medical services in Taiwan.

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