

# Classifying and Ranking Healthcare Quality Attributes Using Integrated Kano- Fuzzy Analytical Hierarchy Process Model

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## Abstract

Healthcare is a vital service sector that provides quality treatment services to patients aiming at achieving individual satisfaction. In order to improve the quality of the healthcare sector, patients should be involved in the improvement process. The aim of this study is to provide a systematic approach for determining and prioritizing healthcare quality attributes that affect patients' satisfaction. This is accomplished using an integrated Kano-FAHP model that would provide the basis for better improvement strategies and resource allocation. Based on Kano model principles the collected attributes are analyzed and classified into four main classes: must-be, performance, attractive, and indifferent needs. Statistical tests are performed to ensure the reliability of Kano classification. The classified healthcare quality attributes are structured in hierarchal form, and then prioritized by using FAHP method. Conventional AHP is integrated with fuzzy set theory to capture the uncertainty and ambiguity of patients while concluding judgments. Results indicate that must-be attributes gain the largest weights where "correct information given" and "employee friendless and respectfulness" are the first and second attributes with weights of 0.098 and 0.092, respectively.

**Keywords:** healthcare quality, patients' satisfaction, Kano model, fuzzy analytic hierarchy process

## 1. Introduction

Patients' satisfaction in healthcare is based on many attributes. In addition to medical expertise and the availability of technology, patients consider other dimensions of the care process to be important and necessary to enhance their experience at the healthcare facility. Raposo, Alves, and Duarte (2009) defined patients' satisfaction as the attitude resulting from both output and process perspectives. That is, patients' satisfaction is not only affected when the actual treatment is provided, but also patients' feelings and activities during time spent in a healthcare facility.

In past years and to stay competitive, healthcare providers invested in understanding the importance of each dimension of care for enhancing patients' satisfaction. Such dimensions include medical and administrative staff, facility location and design, procedures, compliance to regulations, local and international recognition (Raposo et al., 2009). Moreover these dimensions are represented by some attributes, which are not equally important to patients and have different impacts on their satisfaction (Kano, Seraku, Takahashi, & Tsuji, 1984). Hence, it is necessary to classify and rank these attributes to provide an insight to those that are most important so that healthcare providers can allocate and prioritize their resources to gain the highest customer satisfaction.

To identify customers' needs based on their perspective, studies recommend integrating customers in the design process of products and/or services through their direct and indirect inputs and listening to their voices; the voice of customer (VOC) (Y. Hsu, C. Hsu, & Bing, 2007). Direct meetings, focus groups, surveys and observations are most appropriate and effective tools used to listen to customers and identify their problems and their improvement recommendations.

To distinguish between needs and wishes, Kano model classifies customers' requirements to three main classifications: must be (dissatisfiers), performance (satisfiers) and attractive dimensions (delighters). Must-be represent the attributes that if not fulfilled, customers would be extremely dissatisfied and would simply move to another provider. In other words, the resulting product or service would not be functional if such attributes are missing. Performance attributes refer to dimensions that make the customer happier if they are fulfilled or

improved and dissatisfied if not fulfilled. Attractive attributes represent dimensions that are not expected by customers and are provided at no additional charge to achieve customer loyalty (Kano et al., 1984). This classification provides useful information regarding the critical to quality aspects that should be fulfilled to keep providers competitive and gives insight to future improvements that affect customer attitude and satisfaction.

Better improvements and outcomes result from better resource allocation and utilization which is achieved when the most important attributes and aspects are fulfilled first with least effort. One approach for better resources allocation is to prioritize service elements based on their importance and effects on customers' satisfaction. Analytical Hierarchy Process (AHP) is an effective tool that can be used for ranking attributes based on a certain objective such as customer preference. It provides a systematic and simple to use procedure for ranking alternatives in addition to a numerical check for the consistency of final results.

The large variation and uncertainty in patients' assessments of their needs and the degree of importance of each requirement, disperses improvement efforts and limits outcomes. To overcome the effects of uncertainty of patients' preferences, fuzzy set theory is integrated with conventional AHP. Fuzzy Analytical Hierarchy Process (FAHP) enables decision makers to evaluate their preferences between attributes via linguistic values rather than crisp values (Büyükozkan, Kahraman, & Ruan, 2004). FAHP has been applied by many researches in different fields either separately or integrally with other tools to solve decision making problems and determine the best strategies for improvement, better resource allocation, or to select the best alternative (Chan, Kumar, Tiwari, Lau, & Choy, 2008; Lee, Chen, & Chang, 2008; Singh & Sharma, 2011; Vahidnia, Alesheikh, & Alimohammadi, 2009)

In this research, Kano model is integrated with FAHP to provide a systematic approach to classify and rank healthcare quality attributes for better improvement strategies selection to enhance patients' satisfaction. To investigate the effectiveness of the proposed methodology in classifying and ranking attributes under uncertainty; healthcare quality attributes related to administrative staff and healthcare facility design are chosen for the study.

## 2. Literature Review

In this section a review of the previous work related to healthcare quality, patients' satisfaction, Kano model and FAHP is presented.

### 2.1 Healthcare Quality and Patients' Satisfaction

Many researchers have studied healthcare quality attributes that affect patients' satisfaction directly and indirectly. For example, Harteloh (2004) applied the semantic rule in medicine to explore how the meaning of quality could be mediated in medical practice. The semantic rule is used to translate the quality model; Deming cycle-sequences of plan, do, check, and act, to a structure of quality in medical practices. Raposo et al. (2009) focused on measuring patients' satisfaction levels as a measure of healthcare quality. The analysis showed that patient-doctor relationship, the quality of facilities, and the interaction with administrative staff have the most positive effects on patient satisfaction.

Song, Zhou, and Wang (2011) defined the meaning of patients' satisfaction. Also, they proposed several quality dimensions that should be given attention for improvement. These quality dimensions are cost, external environment, commitments and promises, and perceptions of payment. Yildirim, Kocoglu, Goksu, Gunay, and Savas (2005) stated that waiting time strongly affects patients' satisfaction. Jenkinson, Coulter, Bruster, Richards, and Chandola (2002) performed a study to identify the most important quality attributes that affect patients' satisfaction. A postal survey was designed and sent to more than 3000 patients. After analyzing the results of the survey using multiple regression analysis, it determined that physical comfort, emotional support, and respect for patient preferences are the most important attributes that affect patients' satisfaction. Nerney et al. (2001) proposed that patients' satisfaction is influenced by information or obvious answers received from medical staff, and by appropriate explanation of tests' results.

### 2.2 Kano Model

Kano model is a quality evaluation technique that could be utilized to prioritize customer needs depending on their effect on customer satisfaction. Previous research clearly stated its advantages, its capability to identify customer needs and their impact on customer satisfaction (Chiou & Cheng, 2008; Matzler & Hinterhuber, 1998; Zielke, 2008). Kano's theory has been applied widely in services and product development fields (Arefi, Heidari, & Zandi, 2012; Chen, 2012; Kuo, 2004; Lai, Xie, & Tan, 2004; Ting & Chen, 2002; Tontini, 2007; Witell & Fundin, 2005). For example, Hsu et al. (2007) captured the service requirements of passengers in the airline industry. Measurement indices for improvement have been determined by measuring the impact of service needs on passenger satisfaction and dissatisfaction. Bayraktaroglu and Özgen (2008) implemented Kano model to

categorize quality library services for users in details. The most important quality attributes were determined by an integrated Kano model, AHP and Quality Function Deployment (QFD) to determine the most strategically important requirements for better budget allocation, service arrangement and development of marketing strategies.

W. Chang and Y. Chang (2012) studied 30 dental care quality elements based on Kano's perspective. They found that physical characteristics of structural aspects and administration of process aspects are essential dimensions that affect patients' satisfaction in the dental care industry. They also have concluded that the opportunities for improvement rise with aspects of the lowest level of satisfaction. Chiou and Cheng (2008) presented an integrated methodology of Kano model and QFD as a systematic method of identifying patients' needs. They concluded that their approach can help healthcare providers develop improvement strategies. Sireli, Kauffmann, and Ozan (2007) combined Kano model and QFD in simultaneous multiple product design to determine the requirements of the cockpit weather information system (CWIS).

Xu et al. (2009) proposed an analytical Kano model to manage the disagreement that exists around the quality attributes classification using traditional Kano model. They concluded that the resultant categories of Kano model do not represent a true quantitative measure. Lee, Wang, and Lin (2012) modified the analytical Kano model to overcome its complexity in both practical applications and the scoring scheme used. In addition, they discussed how quality attributes could be prioritized for improvement, which was not discussed by Xu et al. (2009). The priority of improvements is based on quality attributes categories, attributes performance, and asymmetric impact of attributes performance on overall satisfaction.

Matzler, Fuchs, and Schubert (2004) investigated whether Kano model can also be applied to employee satisfaction by specifying their satisfaction attributes and classifying them. They found an asymmetric relationship between the satisfaction with different factors and overall employee satisfaction, thereby confirming Kano model in the context of employee satisfaction.

### *2.3 Fuzzy Analytical Hierarchy Process*

Singh and Sharma (2011) have identified performance indicators for global supplier and then evaluated them using FAHP model to select the best suppliers for a manufacturing firm. They concluded that FAHP has the ability to capture the vagueness of human thinking style and effectively solve Multi-Criteria Decision Making (MCDM) problems. Kahraman, Cebeci, and Ulukan (2003) utilized FAHP to select the best supplier based on criteria determined for a manufacturing company. Dağdeviren, Yavuz, and Kılınç (2009) showed the effectiveness and feasibility of using AHP and the technique for order of preference by similarity to ideal solution (TOPSIS) method with fuzzy improvement in the selection of the optimal weapon among many alternatives in MCDM problems. They constructed an evaluation model for weapon selection and selected the best weapon based on weights gained from fuzzy (TOPSIS).

Vahidnia et al. (2009) used FAHP to determine the optimal site for a new hospital. They used Geographical Information System (GIS) analysis to classify governing criteria in site selection. They then used FAHP to evaluate alternatives and determine the best site. Amiri (2010) used AHP and Fuzzy (TOPSIS) method for selection oil-field development projects. He used AHP to construct the structure of the project selection problem and determine criteria weights. Final ranking of alternative was obtained by fuzzy TOPSIS. He concluded that the alternatives' ranks could be changed by fuzzy preference evaluation.

Lee, Chen, and Chang (2008) utilized FAHP and balance scored card (BSC) to evaluate information technology departments in the manufacturing industry. The authors used BSC to identify the hierarchy of the problem based on four major perspectives of performance measures, which was then prioritized using FAHP to suggest the best improvement strategies. Büyüközkan, Kahraman, and Ruan (2004) applied FAHP in quality improvement of software development projects in which economic aspects and quality were evaluated and combined to obtain degree of importance associated with each project's strategy.

### *2.4 Integrated Kano Model and FAHP*

Very few researchers combined Kano model and FAHP to classify and rank customer's needs. For example, Hemati and Ghorbanian (2011) presented an empirical study based on integrated Kano model and FAHP to measure and rank customers' requirements in a transportation system. Alroaia and Ardekani (2012) combined Kano model and FAHP to analyze and prioritize indicators affecting customers' needs in electronic banking. The results indicated that services' security and assurance is the customers' first priority. Up to our knowledge, no research has been found that integrates Kano model and FAHP to classify and prioritize quality attributes in the healthcare industry such that patients' voice is represented.

In this research Kano model theory is first used to formulate the hierarchy of multi-attributes decision making problem, that represent the healthcare quality attributes based on their effects on patients' satisfaction. Then, these quality attributes are prioritized using FAHP to guide providers during resource allocation process and during formulating the improvement strategies.

### 3. Theoretical Background

#### 3.1 Kano Model Theory

Generally, quality attributes are not equally important for different populations. Therefore, some quality attributes could cause a product to be more satisfactory to the customer while others do not. Regarding the assumption of inequality of attributes effects on customer satisfaction, Kano model (Kano et al., 1984) guides providers of service or products to focus on two dimensions to gain the best satisfaction and predict future trends of customer needs. The two dimensions are:

- (1) Needs fulfillment, which evaluates the degree of customer requirement fulfillment.
- (2) Customer subjective response to fulfillment of the quality attributes.

These dimensions can be drawn on a graph with two axes, as shown in Figure 1. The x-axis represents need fulfillment, and the y-axis represents customer satisfaction. Figure 1 simply describes requirement fulfillment and customer satisfaction relationship based on the attributes category. That is, attractive attributes make customers more satisfied and never make them unsatisfied. Performance attributes make customers satisfied or unsatisfied depending on how they are fulfilled. Must-be requirements fulfillment prevent customers from being unsatisfied.

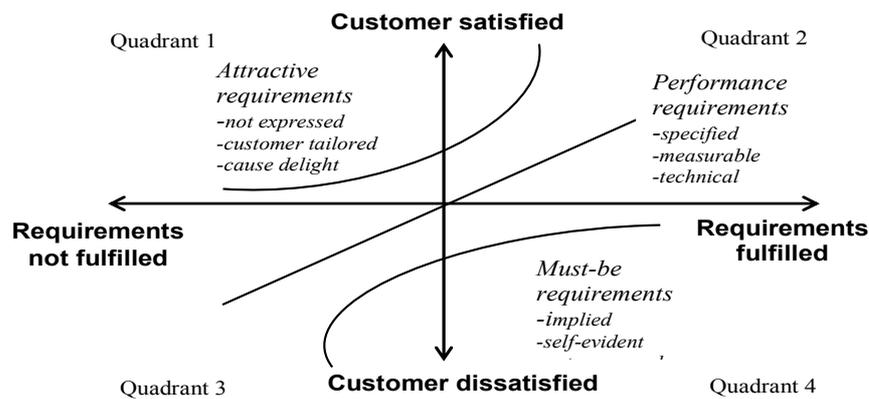


Figure 1. Kano model of customer satisfaction (Kano et al., 1984)

#### 3.2 Kano Model Categories

Kano model divides customer requirements based on their effect on satisfaction to five different categories as follows (Berger et al., 1993; Kano et al., 1984):

- Basic requirements/Must-be needs: customers expect to find some attributes and aspects in a product/ service as essential even though they are not expressed. Unfortunately, customers will be extremely dissatisfied if these basic quality attributes do not exist or are not properly fulfilled. Moreover, the existence of these quality attributes does not make customers more satisfied even if they perform well.
- One-dimensional/ Performance Needs: The quality attributes in this category will make customers happier and more satisfied if they are presented well in the product and dissatisfied if they are not properly fulfilled. In other words, customer satisfaction is linearly proportional to attribute performance.
- Attractive/ Delighter requirements: The quality attributes in this category are not expected by customers. If a quality attribute is presented without extra fees, customers will be surprised, delighted and their loyalty will increase. However, the absence of the same quality attribute does not make customers unsatisfied.
- Indifferent quality needs: customers are usually not interested in some quality attributes if they exist or not; they do not affect their satisfaction.
- Reverse quality attributes: The existence of some quality attributes make customers unsatisfied; they simply wish them to not exist.

#### 3.3 Satisfaction and Dissatisfaction Coefficients

Customer satisfaction (CS+) and dissatisfaction (CS-) coefficients for each attribute are calculated in order to

analyze patient requirements comprehensively and study the effect of the existence and absence of a specific attribute on patient satisfaction. The CS+ coefficient indicates the positive effects if an attribute is fulfilled on customer satisfaction and CS- indicates the negative effects if an attribute is not fulfilled (Matzler&Hinterhuber, 1998). CS+ coefficient is calculated by dividing the sum of frequent observations of the attractive and performance category over the sum of frequent observations of the must-be, performance, attractive and indifferent categories as indicated in equation (1). CS- coefficient is calculated by dividing the sum of frequent observations of the must-be and performance categories over the sum of frequent observations of the must-be, performance, attractive and indifferent categories as indicated in equation (2) (Bayraktaroglu&Özgen, 2008; Hsu et al., 2007; Zielke, 2008).

$$CS+ = \frac{A + P}{M + P + I} \quad (1)$$

$$CS- = \frac{M + P}{M + P + I} \quad (2)$$

Where:

M, P, A and I are the number of times an attribute is considered in a must-be, Performance, attractive and indifferent category, respectively.

### 3.4 The Absolute Largest Weight Ranking Method

Sireli et al. (2007) proposed the absolute largest CS+ and CS- weights to rank Kano attributes assuming that achieving customer's satisfaction and preventing customer's dissatisfaction are equally important. That is the largest importance weights of CS+ and CS- are considered as the attribute's weights according to the following equation:

$$w_i = \max(S_i, D_i) \quad (3)$$

Where:

$w_i$ : attribute's weight,

$$S_i = \frac{CS+_{i}}{\sum_{i=1}^m CS+_{i}},$$

$$D_i = \frac{CS-_{i}}{\sum_{i=1}^m CS-_{i}},$$

m: number of attributes.

This method considers only one side of satisfaction or dissatisfaction; the one with the largest weights.

### 3.5 Fuzzy Set Theory

Fuzzy set theory is "a mathematical theory designed to model fuzziness of human cognitive process" [Vahidnia et al., (2009), p. 3050]. It is basically a set theory where the class lacks sharp boundaries. The membership function  $\mu_A(x)$  represents the degree to which any given element x in the domain X belongs to the fuzzy number A. The following are basic definitions of fuzzy sets and triangle fuzzy numbers (Vahidnia et al., 2009):

Definition 1: A fuzzy set A in the universe of discourse X is characterized by a membership function. This membership function  $\mu_A$  which associates with each element x in X is a real number in the interval [0, 1]. The function value  $\mu_A$  is termed the grade of membership of x in A.

Definition 2: A triangular fuzzy number (TFN) A can be defined by a triplet (l, m, u) as shown in figure 2.

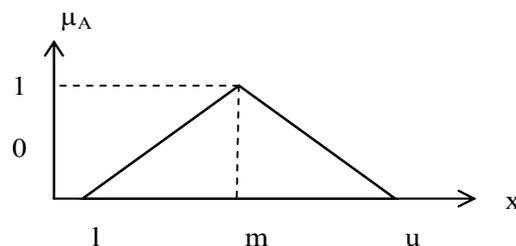


Figure 2. Triangular fuzzy number A

The membership function  $\mu_A$  is defined as:

$$\mu_A(x) = \begin{cases} \frac{x-l}{m-l}, & l \leq x \leq m \\ \frac{u-x}{u-m}, & m \leq x \leq u \\ 0, & \text{otherwise} \end{cases} \quad (4)$$

Where  $l, m, u$  are the lower, mode, and upper bounds of the triangular membership function.

Triangular fuzzy membership functions are generally used to represent fuzzy numbers and are very popular in fuzzy application (Xu & Chen, 2007). They are easy for decision makers to use and calculate and have proven to be an effective way for formulating decision problems where the information available is subjective and imprecise. TFNs generally operate over the range of real values in scale between [0,1], although any scale could be used depending on the decision makers' fuzziness and vagueness, and usually range between [1,9] in FAHP applications (Amiri, 2010; Dağdeviren et al., 2009).

To convert a fuzzy triangle number  $(l,m,u)$  to a crisp value many methods such as fuzzy extend analysis, center-of-area defuzzification and  $\alpha$ -cut methods can be used. Fuzzy extend analysis is the easiest to compute and correctly determines priorities. The  $\alpha$ -cut method is less controversial and takes into account decision makers' attitudes to risk (Amiri, 2010; Dağdeviren et al., 2009; Lee et al., 2008). In this study  $\alpha$ -cut method is used for converting healthcare quality attributes TFN weights gained by FAHP to crisp values based on the following formula:

$$C_\lambda = \lambda \times \alpha Right + (1 - \lambda) \times \alpha Left \quad (5)$$

and

$$\alpha Left = \alpha \times (m - l) + l \quad (6)$$

$$\alpha Right = u - \alpha \times (u - m) \quad (7)$$

Where  $C_\lambda$  represents the average crisp value and  $\lambda$  represents the degree of optimism, which ranges between [0, 1] (pessimistic, moderate, optimistic situations).

### 3.6 Fuzzy Analytical Hierarchy Process

In conventional AHP the decision maker is asked to compare two criteria with crisp values to indicate his/her preference. It is supposed that the decision maker is certain and confident about his/her preferences, which is not always the case. As the criteria become more complicated and difficult to estimate, misleading results and decisions will be concluded. Most decision makers prefer to give their preferences and pairwise comparisons using a wide range of values that express their imprecise judgment regarding fuzzy multi-criteria decision making problems (FMCDM). In order to reduce the effects of uncertainty and vagueness in decision making, FAHP approach is used, where Fuzzy set theory and its operations are integrated with the conventional AHP. FAHP is designed to allow decision makers express their uncertain judgments and preferences with linguistic variable values rather than crisp values that are used in conventional AHP. These linguistic variable values are transformed to fuzzy membership functions which represent fuzziness and uncertainty. The steps of constructing FAHP models are the same as in conventional AHP with the only difference being in using fuzzy membership values rather than crisp values for comparative purposes.

Table 1 represents the linguistic values and their TFNs (Vahidnia et al., 2009) used in FAHP these numbers can be changed and evaluated to fit with the decision maker's fuzziness. The membership functions' relationships are represented in Figure 2. The gained fuzzy values are normalized to a single crisp value using  $\alpha$ -cut method as described previously.

Table 1. Triangular fuzzy number of linguistic variable

Linguistic values	TFNs	Reciprocal TFNs
Equally important	(1,1,2)	(0.5,1,1)
Moderately important	(2,3,4)	(0.250,0.333,0.500)
Important	(4,5,6)	(0.167,0.200,0.250)
Very important	(6,7,8)	(0.125,0.143,0.167)
Absolutely important	(8,9,9)	(0.111,0.111,0.125)

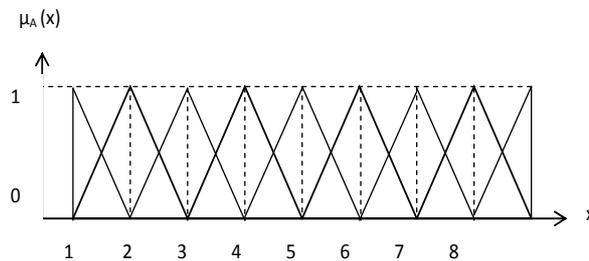


Figure 3. Triangular fuzzy numbers corresponding to linguistic variables

#### 4. Proposed Methodology

The current study consists of three phases. In phase I, patient requirements concerning the administrative staff and those concerning the healthcare facility design are identified by direct meetings with patients, focus groups, observations and patients' complaints and recommendations. In phase II, Kano model is used to classify requirements attained from listening to voice of patients into three major classes namely; must-be, performance and attractive. In phase III, FAHP is used to rank attributes within each class in the attained Kano hierarchy based on their relative importance. Figure 4 summarizes the proposed methodology to classify and rank healthcare quality attributes using an integrated Kano-FAHP approach. The ranking of attributes will facilitate directing the improvement strategies in the healthcare services by providers based on their importance and their effects on patients' satisfaction. The following sections describe the proposed model in details.

##### 4.1 Phase One: Patients' Requirements Identification

To identify the healthcare quality attributes that are important to patients, we first listen to patients themselves, listen to their problems and difficulties, their suggestions and recommendations before, during, and after delivery of services and treatments. The "voice of customer" or "the voice of patients" process is effectively used to capture attributes or aspects that are foremost in the mind of the patients (Lloyd, 2004). These attributes can be captured in a variety of ways such as surveys, focus groups, observations, personal interviews, compliance and recommendation boxes, feedbacks on websites and social networks. Then patients' requirements are translated to healthcare quality attributes related to administrative staff and healthcare facility design based on clustering analysis where the similar attributes are gathered under the same dimension.

##### 4.2 Phase Two: Kano Model Classification

In this phase, patients are asked about their feelings towards the existence or absence of these attributes. Classifications are then inferred based on Kano matrix.

##### Data Collection

Kano model is used to analyze the dimensions proposed for healthcare quality, which relate to administrative staff and healthcare facilities' design. In order to elicit patient opinion about a particular dimension's attributes, a set of paired questions are asked. The patient or the respondent is asked two opposite questions to ensure that he/she understand the question properly and to avoid inconsistency of answering these questions. The first question takes a positive form (functional question), where the patient is asked about his/her feeling if a specific healthcare quality attribute exists, and the second one takes a negative form (dysfunctional question) where the patient is asked about his/her feeling if the same healthcare quality attribute is not fulfilled. The respondent/patient record his/her feeling on a scale that has five categories. This scale has been proposed by Berger et al. (1993). The categories of this scale are: I like it that way, it must be that way, I am neutral, I can live with it that way, and I dislike it that way. A sample of a functional and dysfunctional question is shown in table 2.

##### Attributes Classification

In this step Kano Evaluation Matrix, shown in table 3, is used to analyze the outcome of functional and dysfunctional questions. Cross-matching for patients' answers to the pair of questions is performed to infer attributes' categories. For example, a patient is asked to evaluate the "employee appearance" attribute, the following questions are asked:

- How do you feel if employee appearance is tidy and stylish?
- How do you feel if employee appearance is not tidy and stylish?

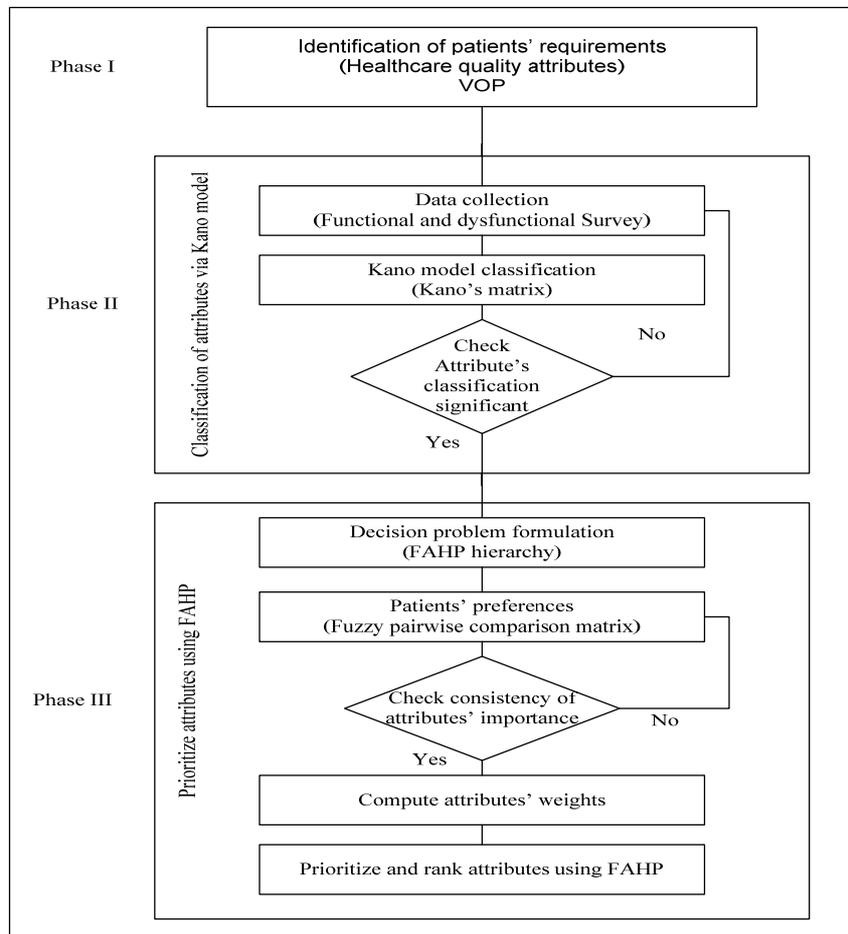


Figure 4. The proposed methodology for classifying and ranking healthcare quality attributes via integrated Kano-FAHP model

Table 2. Functional and dysfunctional question sample

	Functional form of the question	Dysfunctional form of the question
Quality attributes	How do you feel if employee appearance is tidy and stylish?	How do you feel if employee appearance is not tidy and stylish??
Employee appearance	<input type="checkbox"/> I like it that way <input type="checkbox"/> It must be that way <input type="checkbox"/> I am neutral <input type="checkbox"/> I can live with it that way <input type="checkbox"/> I dislike it that way	<input type="checkbox"/> I like it that way <input type="checkbox"/> It must be that way <input type="checkbox"/> I am neutral <input type="checkbox"/> I can live with it that way <input type="checkbox"/> I dislike it that way

Suppose that he/she feels that employees must appear tidy and wear stylish cloths, and he/she dislikes the appearance of the employees if they do not look tidy and their cloths are not stylish, then this attribute is classified as must-be attribute. While if he/she feels that employees must appear tidy and wear stylish cloths, and he/she is neutral toward the appearance of the employee if they do not look tidy or do not wear stylish clothes, then this attribute is classified as indifferent. The frequencies of attributes' categories gained from patients' answers are counted, and the highest category frequency gained for each attribute is deemed as that attribute's classification (Hsu et al., 2007). For instance the number of times “employee appearance” was classified as must-be, performance, attractive and indifferent were 45, 30, 25 and 10 respectively, then this attribute is classified as must be.

Table 3. Kano Evaluation Matrix (Berger et al., 1993)

		Negative form of question (dysfunctional )				
		I like it that way	It must be that way	I am neutral	I can live that way	I dislike it that way
Positive form of question ( functional )	I like it that way	Q	A	A	A	O
	It must be that way	R	I	I	I	M
	I am neutral	R	I	I	I	M
	I can live that way	R	I	I	I	M
	I dislike it that way	R	R	R	R	Q

Q: questionable result, A: Attractive needs, I: Indifferent needs, O: One-dimension needs, M: Must-be needs, R: Reversed requirements

### Statistical Significant Test

A statistical significant test is performed to examine the reliability of Kano's categories of attributes based on the statistical significance of the difference between the highest two of frequency observations. Sireli et al., (2007) made two assumptions before conducting the significance test: (1) Kano model survey answers are binomially distributed (2) normal distribution is used to approximate the binomial distribution as a result of the large number of answers received. According to these assumptions and based on (Fong, 1996) a hypothesis tests are conducted to determine the statistical significance of Kano responses at 90% confidence level. The following hypothesis is used to examine the statistical significance of attribute classification:

$$H_0 : a - b = 0$$

and

$$H_0 : a - b > 0$$

If condition (8) is true, then do not reject null hypothesis. This happens when the difference between the two most frequent observations is not statistically significant. This means that the attribute's category is inconclusive and more data should be collected.

$$|a - b| < Z_{\alpha} \sqrt{\frac{(a + b)(2N - a - b)}{2N}} \quad (8)$$

Where:

a: the first most frequent, and

b: the second most frequent, and

N: the total number of observations

$\alpha$ : the confidence level

$Z_{\alpha}$ : the standard normal number according to  $\alpha$ - confidence level.

### 4.3 Phase Three: Prioritizing Healthcare Quality Attributes Using FAHP

The following steps represent the FAHP procedures and calculations to compute the attributes weights:

#### Step 1: developing hierarchical structure of patients' requirements/ healthcare quality attributes

Hierarchical structure form is widely used to represent attributes or criteria, sub criteria and alternatives, in which pairwise comparisons are clearly defined. The hierarchal structure for ranking healthcare quality attributes based on Kano's classification consists of four levels as shown in figure 5:

- Level 1 represents the goal of the problem under study, for example: "healthcare quality attributes ranking based on overall patients' satisfaction".
- Level 2 represents healthcare quality dimensions such as administrative staff and healthcare facility design, etc.
- Level 3 represents Kano's classifications under each dimension; must-be, performance, and attractive.
- Level 4 represents healthcare quality attributes under each classification.

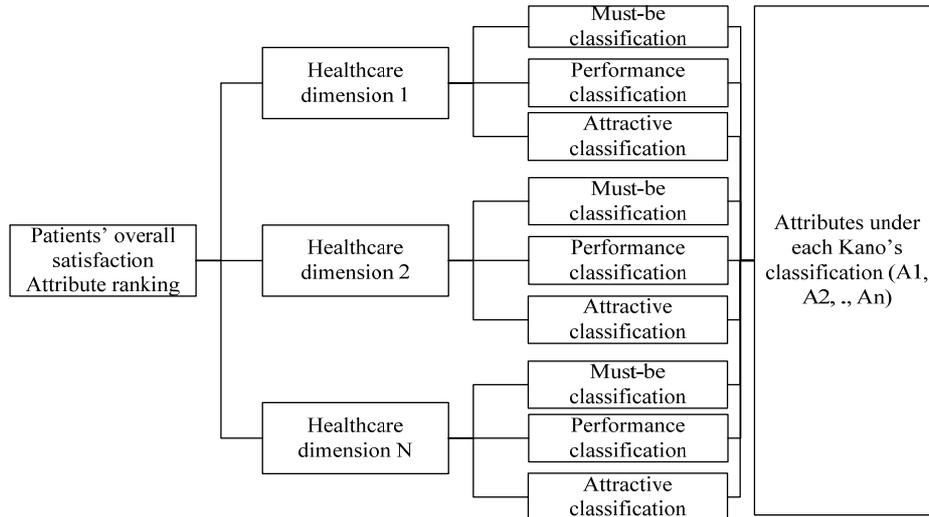


Figure 5. Hierarchical form of Kano model classification

*Step 2: Constructing fuzzy pairwise comparison matrices (FCM) and relative linguistic importance values*

Fuzzy pairwise comparison matrices (FCM) are constructed based on the hierarchy of the FMCDM problem in which all lower-level attributes are compared with each other with respect to the direct upper level in the hierarchy. The comparisons are performed by using linguistic importance values such as: equally important, moderately important, important, very important, or absolutely important.

*Step 3: Converting the relative linguistic importance values to TFNs values*

The relative linguistic importance values are converted to equivalent TFN values according to the scale adopted by the decision maker that best describes his/her fuzziness. Table 1 showed the most used linguistic importance values and their TFNs. In practical FAHP application, TFN values operate in the range [1-9] (Lee et al., 2008). The converted FCM results in the following  $n \times n$  matrix, where  $n$  represents the number of comparisons with respect to the upper level:

$$FCM_j = \begin{bmatrix} TFN_{11} & TFN_{12} & \dots & TFN_{1n} \\ TFN_{21} & TFN_{22} & \dots & TFN_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ TFN_{n1} & TFN_{n2} & \dots & TFN_{nn} \end{bmatrix}$$

*Step 4: Computing importance weights of patients' requirements based on fuzzy set theory calculations*

To compute the importance weights of the requirements; each column in the FCM is normalized then each row is averaged according the following equation:

$$\begin{aligned} \overline{FCM}_j &= \begin{bmatrix} TFN_{11} / \sum TFN_{i1} & TFN_{12} / \sum TFN_{i2} & \dots & TFN_{1n} / \sum TFN_{in} \\ TFN_{21} / \sum TFN_{i1} & TFN_{22} / \sum TFN_{i2} & \dots & TFN_{2n} / \sum TFN_{in} \\ \vdots & \vdots & \ddots & \vdots \\ TFN_{n1} / \sum TFN_{i1} & TFN_{n2} / \sum TFN_{i2} & \dots & TFN_{nn} / \sum TFN_{in} \end{bmatrix} \\ &= \begin{bmatrix} \overline{TFN}_{11} & \overline{TFN}_{12} & \dots & \overline{TFN}_{1n} \\ \overline{TFN}_{21} & \overline{TFN}_{22} & \dots & \overline{TFN}_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ \overline{TFN}_{n1} & \overline{TFN}_{n2} & \dots & \overline{TFN}_{nn} \end{bmatrix} \end{aligned} \tag{9}$$

$$W^T_j = \begin{bmatrix} w_1 \\ w_2 \\ \vdots \\ w_j \end{bmatrix} = \begin{bmatrix} \sum \overline{TFN}_{1i} / n \\ \sum \overline{TFN}_{2i} / n \\ \vdots \\ \sum \overline{TFN}_{ni} / n \end{bmatrix} \tag{10}$$

Where  $W_j^T$  is the attributes' weights.

*Step 5: Checking the consistency of patients' preferences*

Patients' preferences and importance weights between attributes should be consistent to provide reliable results and make strong decisions. For this purpose the consistency ratio (CR) is calculated and compared to 0.1 as in conventional AHP. If CR is less than 0.1 then the evaluator of the matrix is consistent, if CR is greater than 0.1 the patient should reevaluate his/her preferences. CR is calculated using equation (16) in which CI represents consistency index and RI represents the ratio index taken from table 4 (Saaty, 1980) based on the number of pairwise comparisons.

$$CR = \frac{CI}{RI} \quad (11)$$

Where

$$CI = \frac{\lambda_{\max} - n}{n - 1} \quad (12)$$

And

$$\lambda_{\max} = \frac{FCM_j - W_j^T}{n} \quad (13)$$

Table 4. Ratio index values according to the number of pairwise comparison elements (Saaty, 1980)

n	1	2	3	4	5	6	7	8	9
RI	0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45

*Step 6: Computing attributes' TFNs total weights*

The total weight of an attribute is calculated by multiplying the weight of the attribute by the weights of the upper levels in the hierarchy as follows:

$$\text{Attribute total weight} = \text{attribute wt} \times \text{classification wt} \times \text{dimension wt} \quad (14)$$

*Step 7: Converting total attributes' TFNs weights to crisp values*

The final step in FAHP calculation is to convert the obtained TFN weights to crisp value using  $\alpha$ -cut method.

*Step 8: Ranking healthcare quality attributes*

Healthcare quality attributes are prioritized according to their weights where larger weights have more priority improvement. Efforts should focus on these attributes.

## 5. Results and Discussions

In this section the analysis and results of identifying, classifying and ranking healthcare quality attributes related to administrative staff and healthcare facility design dimensions, which affect patients' satisfaction from process perspective, are summarized and discussed. Data was collected at a local primary healthcare center located in Jordan.

### 5.1 Phase one: Identification of Healthcare Quality Attributes

Based on the analysis of the voice of patients, 28 attributes are considered to be studied in this research. Eight attributes related to administrative staff and twenty related to healthcare facility are specified.

### 5.2 Phase Two: Classification of Healthcare Quality Attributes via Kano Model

In this phase, attributes' importance and their effects on patients' satisfaction are determined using Kano model. To infer attributes classification, 150 surveys in the form of functional and dysfunctional questions for each of the 28 attributes were distributed to patients to express their feeling if an attribute exists or not on the five attitude scale described previously. Then, they are analyzed according to Kano matrix to infer attributes' classifications. Finally, a statistical test was performed to check classifications' reliability. The statistical significance tests of the resulting healthcare quality attributes' classifications related to administrative staff and healthcare facility design were done based on Sireli et al. (2007) assumptions with 90% confidence level. Table 5 summarizes the resulting classes of each attribute, the frequency of observations, and the result of the statistical significance test. Results indicate that twelve attributes were classified as must-be, four, five and seven attributes

were classified as performance, attractive and indifferent, respectively. Moreover, all tests were statistically significant.

### 5.3 Phase Three: Prioritize Healthcare Quality Attributes Using FAHP

In this phase FAHP is used to prioritize the healthcare quality attributes based on patient's preference and importance of the attributes. The following steps describe the procedure to formulate healthcare quality attributes as FMCDM and FAHP calculations.

In step one, the hierarchical structure of patient's needs is built based on the effect of healthcare quality attributes on patient's satisfaction and their classification via Kano model as shown in figure 6. In step two, eight fuzzy pairwise comparison matrices are constructed to formulate the FMCDM to prioritize the healthcare quality attributes related to administrative staff and healthcare facility design. Tables 6 to 13 show these comparison matrices of patients' preferences with TFNs. In step three, importance weights of customer requirements based on fuzzy set theory calculations is computed. The column of the FCM is normalized then the row is averaged according to equations 9 and 10. TFN weights of the eight FCMs are computed and summarized in table 14. In step four, the consistency ratio (CR) for each FCM is calculated according to equations 11, 12 and 13 and assures that all are smaller than 0.1. CR for each FCM is presented in tables 6-13. The final step in FAHP calculation is to convert the obtained total attributes' TFN weights to crisp values. In this study  $\alpha$ -cut method is used, where  $\alpha=0.7$  and  $\lambda=0.8$ . Table 15 shows the total attributes TFNs weights, their crisp value, and their final overall ranks.

Table 5. Attribute's classification and their statistical significance

	Attributes	Frequency				Classification	Statistical Significance
		M	P	A	I		
<i>Attributes related to administrative staff</i>							
A1	Employee uniform	17	4	16	28	Indifferent	significant
A2	Employee appearance	48	20	7	12	Must-be	significant
A3	Employee friendliness and respectfulness	46	3	6	28	Must-be	significant
A4	Employee attention and care	23	60	4	7	Performance	significant
A5	Administrative awareness	13	10	23	38	Indifferent	significant
A6	Special employee to guide and direct patients	14	14	15	23	Indifferent	significant
A7	Transaction time	24	35	18	12	Performance	significant
A8	Correct information given	59	15	8	11	Must-be	significant
<i>Attributes related to healthcare facility design</i>							
A9	External appearance	16	8	27	16	Attractive	significant
A10	Internal decoration and services	19	12	32	21	Attractive	significant
A11	External and internal cleanliness	70	12	5	3	Must-be	significant
A12	Waiting room and WC cleanliness	50	15	8	13	Must-be	significant
A13	Internal temperature	38	15	20	19	Must-be	significant
A14	Waiting room location	3	2	8	68	Indifferent	significant
A15	Guidance sign simplicity and traceability	43	12	15	18	Must-be	significant
A16	Officehour of the healthcarefacility	20	34	23	18	Performance	significant
A17	Waiting room décor and services	51	9	17	18	Must-be	significant
A18	Ease of movement for people with special needs	34	22	23	12	Must-be	significant
A19	Parking availability and proximity to entrance	7	6	39	28	Attractive	significant
A20	Special waiting rooms for children	27	5	19	38	Indifferent	significant
A21	Cafeteria availability	48	14	16	10	Must-be	significant
A22	Rest andprayer room existence	24	12	18	30	Indifferent	significant
A23	Location and transportation availability	42	17	12	12	Must-be	significant
A24	Parks and green area availability within thehealthcarefacility	3	5	46	34	Attractive	significant
A25	Examination rooms space and décor	27	38	13	16	Performance	significant
A26	Closeness of managerial and accounting offices	20	20	32	18	Attractive	significant
A27	Ease of movement within the facility	43	30	11	10	Must-be	significant
A28	Healthcare facility design	6	3	25	37	Indifferent	significant

Table 6. Pairwise comparison triangle fuzzy number matrix for administrative staff and healthcare facility design

	AS	HFD
AS	(1,1,1)	(0.250,0.333,0.500)
HFD	(2,3,4)	(1,1,1)
CR=0.071 < 0.1		

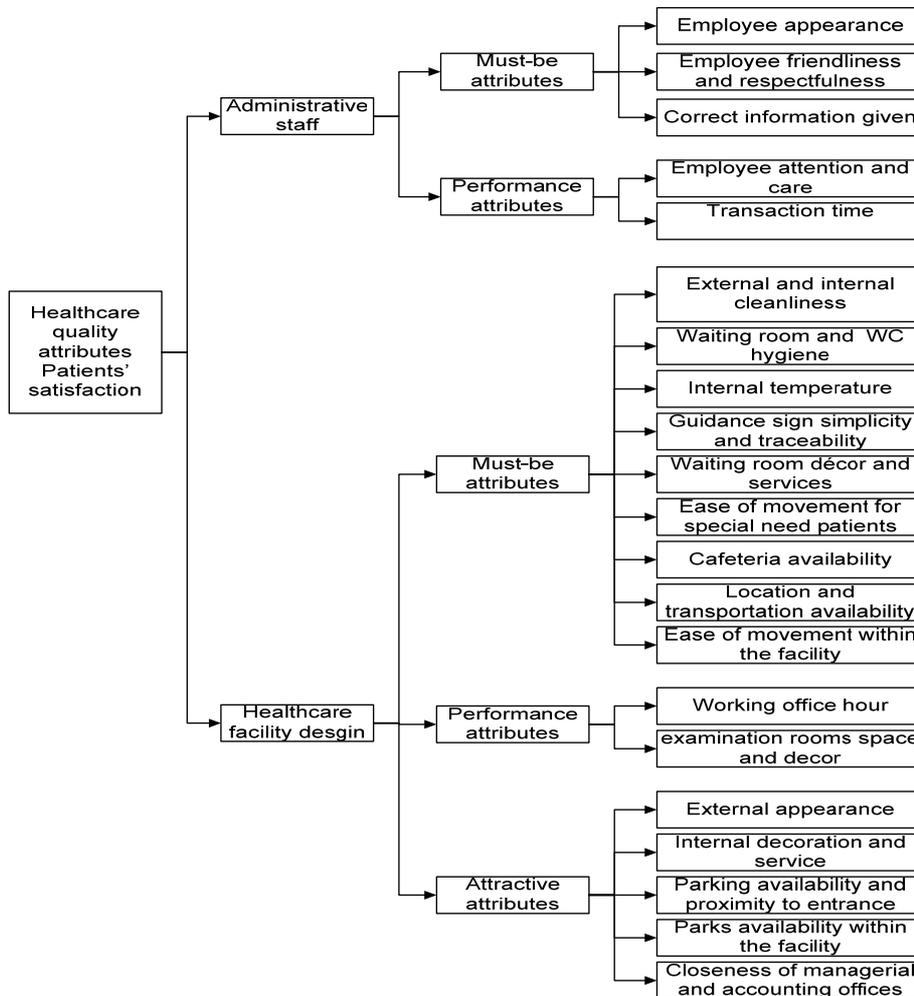


Figure 6. Healthcare quality attributes hierarchy as multi-attribute decision making problem

Table 7. Pairwise comparison triangle fuzzy number matrix for must-be, performance and attractive categories with respect to healthcare facility design

	HFD-M	HFD-P	HFD-A
HFD-M	(1,1,1)	(6,7,8)	(8,9,9)
HFD-P	(0.125,0.143,0.167)	(1,1,1)	(2,3,4)
HFD-A	(0.111,0.111,0.125)	(0.250,0.333,0.500)	(1,1,1)
AR=3.082	CI=0.041	RI=0.58	CR=0.071 < 0.1

Table 8. Pairwise comparison triangle fuzzy number matrix for must-be, performance and attractive categories with respect to administrative staff

	AS-M	AS-O
AS-M	(1,1,1)	(4,5,6)
AS-O	(0.167,0.200,0.250)	(1,1,1)
CR < 0.1		

Table 9. Pairwise comparison triangle fuzzy number matrix for must-be healthcare quality attributes with respect to administrative staff

	A2	A3	A8
A2	(1,1,1)	(0.250,0.333,0.500)	(0.167,0.200,0.250)
A3	(2,3,4)	(1,1,1)	(1,1,2)
A8	(4,5,6)	(0.5,1,1)	(1,1,1)
AR=3.029	CI=0.015	RI=0.58	CR=0.025 < 0.1

Table 10. Pairwise comparison triangle fuzzy number matrix for performance healthcare quality attributes with respect to administrative staff

	A4	A7
A4	(1,1,1)	(1,1,2)
A7	(0.5,1,1)	(1,1,1)
CR < 0.1		

Table 11. Pairwise comparison triangle fuzzy number matrix for attractive healthcare quality attributes with respect to healthcare facility design

	A9	A10	A19	A24	A26
A9	(1,1,1)	(0.250,0.333,0.500)	(0.250,0.333,0.500)	(1,1,2)	(0.250,0.333,0.500)
A10	(2,3,4)	(1,1,1)	(0.250,0.333,0.500)	(2,3,4)	(1,1,2)
A19	(2,3,4)	(2,3,4)	(1,1,1)	(2,3,4)	(1,1,2)
A24	(0.5,1,1)	(0.250,0.333,0.500)	(0.250,0.333,0.500)	(1,1,1)	(0.250,0.333,0.500)
A26	(2,3,4)	(0.5,1,1)	(0.5,1,1)	(2,3,4)	(1,1,1)
AR=5.15	CI=0.037	RI=1.12	CR=0.033 < 0.1		

Table 12. Pairwise comparison triangle fuzzy number matrix for performance healthcare quality attributes with respect to healthcare facility design

	A16	A25
A16	(1,1,1)	(1,1,2)
A25	(0.5,1,1)	(1,1,1)
CR < 0.1		

Table 13. Pairwise comparison triangle fuzzy matrix for must-be healthcare quality attributes with respect to healthcare facility design

	A11	A12	A13	A15	A17	A18	A21	A23	A27
A11	(1,1,1)	(1,1,2)	(1,1,2)	(1,1,2)	(2,3,4)	(1,1,2)	(2,3,4)	(1,1,2)	(1,1,2)
A12	(0.5,1,1)	(1,1,1)	(2,3,4)	(1,1,2)	(1,1,2)	(1,1,2)	(2,3,4)	(1,1,2)	(1,1,2)
A13	(0.5,1,1)	(0.25,0.33,0.50)	(1,1,1)	(1,1,2)	(2,3,4)	(1,1,2)	(2,3,4)	(1,1,2)	(1,1,2)
A15	(0.5,1,1)	(0.5,1,1)	(0.5,1,1)	(1,1,1)	(2,3,4)	(1,1,2)	(2,3,4)	(1,1,2)	(1,1,2)
A17	(0.25,0.33,0.50)	(0.5,1,1)	(0.25,0.33,0.50)	(0.25,0.33,0.50)	(1,1,1)	(0.25,0.33,0.50)	(2,3,4)	(0.25,0.33,0.50)	(0.25,0.33,0.50)
A18	(0.5,1,1)	(0.5,1,1)	(0.5,1,1)	(0.5,1,1)	(2,3,4)	(1,1,1)	(2,3,4)	(1,1,2)	(1,1,2)
A21	(0.25,0.33,0.50)	(0.25,0.33,0.50)	(0.25,0.33,0.50)	(0.25,0.33,0.50)	(0.25,0.33,0.50)	(0.25,0.33,0.50)	(1,1,1)	(1,1,2)	(1,1,2)
A23	(0.5,1,1)	(0.5,1,1)	(0.5,1,1)	(0.5,1,1)	(2,3,4)	(0.5,1,1)	(0.5,1,1)	(1,1,1)	(2,3,4)
A27	(0.5,1,1)	(0.5,1,1)	(0.5,1,1)	(0.5,1,1)	(2,3,4)	(0.5,1,1)	(0.5,1,1)	(0.25,0.33,0.50)	(1,1,1)
AR=9.56	CI=0.07	RI=0.145	CR=0.048						

Table 14. Weights of healthcare dimensions, Kano classes, and healthcare quality attributes as TFNs

Healthcare Dimension	Weights (TFNs)	Kano classes	Weights (TFNs)	Quality attributes	Weights (TFNs)	Total Weights (TFNs)						
Administrative staff	(0.267,0.250,0.267)	Performance	(0.138,0.167,0.207)	A4	(0.417,0.500,0.833)	(0.015,0.021,0.046)						
				A7	(0.292,0.500,0.583)	(0.011,0.021,0.032)						
		Must-be	(0.686,0.833,1.029)	A2	(0.081,0.115,0.181)	(0.015,0.024,0.050)						
				A3	(0.297,0.405,0.689)	(0.054,0.084,0.189)						
Facility design	(0.733,0.750,0.733)	Performance	(0.140,0.155,0.173)	A16	(0.417,0.500,0.833)	(0.043,0.058,0.106)						
				A25	(0.292,0.500,0.583)	(0.030,0.058,0.074)						
				A8	(0.290,0.480,0.630)	(0.053,0.100,0.173)						
		Attractive	(0.072,0.069,0.074)	A9	(0.058,0.090,0.181)	A9	(0.058,0.090,0.181)	(0.003,0.005,0.009)				
						A10	(0.117,0.206,0.400)	(0.007,0.011,0.022)				
						A19	(0.201,0.339,0.620)	(0.011,0.017,0.033)				
						A24	(0.053,0.096,0.177)	(0.003,0.005,0.008)				
						A26	(0.132,0.270,0.416)	(0.007,0.014,0.022)				
						Must-be	(0.788,0.777,0.753)	A11	(0.075,0.121,0.299)	A11	(0.075,0.121,0.299)	(0.050,0.075,0.163)
										A12	(0.069,0.127,0.287)	(0.049,0.082,0.162)
		A13	(0.062,0.114,0.258)	(0.040,0.069,0.136)								
						A15	(0.059,0.121,0.240)	(0.039,0.075,0.132)				
						A17	(0.031,0.068,0.152)	(0.017,0.034,0.060)				
A18	(0.064,0.134,0.245)					(0.036,0.075,0.122)						
				A21	(0.037,0.068,0.170)	(0.019,0.033,0.068)						
				A23	(0.051,0.132,0.207)	(0.030,0.075,0.107)						
				A27	(0.046,0.113,0.180)	(0.027,0.064,0.092)						

According to the FAHP weights of attributes, table 15, it is concluded that must-be attributes have the largest weights and have the first priority in ranking, which indicates that healthcare providers should give more attention to these attributes to eliminate patients' dissatisfaction, and maintain their competitiveness in the healthcare industry. The second rank is for performance healthcare quality attributes and third rank is for attractive attributes with the least weights.

Must-be healthcare quality attributes have the highest weights where "A8: Correct information given" was the first attribute with 0.098, and "A3: employee friendless and respectfulness" and "A12: waiting room and WC cleanliness" were second and third attributes, in must-be classifications, with 0.092 and 0.085, respectively, as shown in table 16. Performance healthcare quality attributes have intermediate weights where "A16: office hour" and "A25: examination rooms space and décor" were first and second attribute, in performance classifications, with 0.059 and 0.052, respectively, as shown in table 17. Attractive healthcare quality attributes have the least weights where "A19: parking availability and proximity to entrance" and "A26: closeness of managerial and accounting office" were first and second attributes, in attractive classifications, with 0.018 and 0.013, respectively as shown in table 18.

As a consequence, healthcare providers should fulfill the must-be attributes first with conservative improvement strategy to achieve the minimum requirements, and to prevent patients move to another competitor. After that performance attributes should be fulfilled for better patients' satisfaction. The third priority should go to attractive attributes to delight and surprise the patients.

Table 15. Healthcare quality attributes' weights and rank using FAHP

Healthcare Dimension	Kano classes	Quality attributes	TFNs	Crisp value	Normalized crisp value	Rank	
Administrative staff	Performance	A4	(0.015,0.021,0.046)	0.021	0.022	16	
		A7	(0.011,0.021,0.032)	0.019	0.020	15	
	Must-be	A2	(0.015,0.024,0.050)	0.023	0.025	14	
		A3	(0.054,0.084,0.189)	0.083	0.089	2	
Facility design	Performance	A8	(0.053,0.100,0.173)	0.093	0.099	1	
		A16	(0.043,0.058,0.106)	0.057	0.061	9	
		A25	(0.030,0.058,0.074)	0.052	0.056	11	
		A9	(0.003,0.005,0.009)	0.004	0.005	21	
	Attractive	A10	(0.007,0.011,0.022)	0.011	0.012	19	
		A19	(0.011,0.017,0.033)	0.017	0.018	17	
		A24	(0.003,0.005,0.008)	0.004	0.005	20	
		A26	(0.007,0.014,0.022)	0.013	0.013	18	
		Must-be	A11	(0.050,0.075,0.163)	0.074	0.079	4
			A12	(0.049,0.082,0.162)	0.079	0.084	3
			A13	(0.040,0.069,0.136)	0.066	0.070	7
			A15	(0.039,0.075,0.132)	0.070	0.074	5
			A17	(0.017,0.034,0.060)	0.031	0.033	13
			A18	(0.036,0.075,0.122)	0.068	0.073	6
		A21	(0.019,0.033,0.068)	0.032	0.034	12	
		A23	(0.030,0.075,0.107)	0.066	0.070	8	
		A27	(0.027,0.064,0.092)	0.057	0.060	10	

Table 16. Ranks of attributes within must-be category

Must-be attributes	Crisp weight	Normalized weight	Rank
A2 Employee appearance	0.025	0.032	12
A3 Employee friendliness and respectfulness	0.092	0.116	2
A8 Correct information given	0.098	0.123	1
A11 External and internal cleanliness	0.081	0.102	4
A12 Waiting room and WC cleanliness	0.085	0.107	3
A13 Internal temperature	0.071	0.090	7
A15 Guidance sign simplicity and traceability	0.074	0.093	5
A17 Waiting room décor and services	0.033	0.042	11
A18 Ease of movement for people with special needs	0.072	0.090	6
A21 Cafeteria availability	0.035	0.044	10
A23 Location and transportation availability	0.069	0.086	8
A27 Ease of movement within the facility	0.059	0.074	9
Total	0.795	1	

Table 17. Ranks of attributes within Performance category

Performance attributes	Crisp weight	Normalized weight	Rank
A4 Employee attention and care	0.023	0.149	3
A7 Transaction time	0.020	0.129	4
A16 Officehour of the healthcarefacility	0.059	0.385	1
A25 Examination rooms space and décor	0.052	0.338	2
Total	0.153	1	

Table 18. Ranks of attributes within attractive category

Attractive attributes	Crisp weight	Normalized weight	Rank
A9 Healthcare facility external appearance	0.005	0.093	4
A10 Healthcare facility interiorand décor	0.012	0.227	3
A19 Parking availability and proximity to entrance	0.018	0.341	1
A24 Parks availability within thehealthcarefacility	0.005	0.087	5
A26 Closeness of managerial and accounting offices	0.013	0.251	2
Total	0.052	1	

#### 5.4 Comparing Integrated Kano-FAHP with Absolute Largest Weights

The ranking of Healthcare quality attributes computed by integrated Kano-FAHP method is compared with the absolute largest weights method suggested by Sireli et al., (2007) to investigate the difference between them and the effect of including uncertainty in the preference of patients in decision problems.

##### 5.4.1 Attributes Ranking Using Absolute Largest Weights

In order to rank attributes classified by Kano model using absolute largest weights, customers' satisfaction and dissatisfaction coefficients are calculated using equations (1&2). Table 19 shows extent of satisfaction and dissatisfaction, satisfaction weight and dissatisfaction weight, absolute largest weight and attributes rank.

##### 5.4.2 Absolute Largest Weights Method and Integrated Kano-FAHP Rank Comparison

Healthcare quality attributes ranking using Kano-FAHP and largest absolute weights are summarized in table 20. For example "A2: Employee appearance" decreased in priority from having a rank of 9 in absolute largest weights method to having a rank of 14 using the Kano-FAHP. Table 20 presents the ranking changes within the same classification.

The proposed methodology for ranking the attributes, Kano-FAHP, is more accurate than the absolute largest weights method because (1) the proposed model take into account the uncertainty of patients in decision making (2) the overall satisfaction level, which includes both satisfaction and dissatisfaction of patients, is considered to prioritize attributes rather than ranking them based on satisfaction or dissatisfaction alone.

Table 19. Healthcare quality attributes CS coefficients' weights and ranks

Attributes	CS+	CS-	S <sub>i</sub>	D <sub>i</sub>	Absolute largest weight	Rank
Attributes related to administrative staff						
<i>Must be</i>						
A2 Employee appearance	0.31	-0.78	0.035	0.062	0.062	9
A3 Employee friendliness and respectfulness	0.11	-0.59	0.012	0.046	0.046	20
A8 Correct information given	0.25	-0.80	0.028	0.063	0.063	8
<i>Performance</i>						
A4 Employee attention and care	0.68	-0.88	0.077	0.069	0.077	1
A7 Transaction time	0.60	-0.66	0.067	0.052	0.067	4
Attributes related to healthcare facility design						
<i>Must be</i>						
A11 External and internal cleanliness	0.19	-0.91	0.021	0.072	0.072	2
A12 Waiting room and WC cleanliness	0.27	-0.76	0.030	0.059	0.059	12
A13 Internal temperature	0.38	-0.58	0.043	0.045	0.045	21
A15 Guidance sign simplicity and traceability	0.31	-0.63	0.035	0.049	0.049	19
A17 Waiting room décor and services	0.27	-0.63	0.031	0.050	0.050	18
A18 Ease of movement for people with special needs	0.49	-0.62	0.056	0.048	0.056	16
A21 Cafeteria availability	0.34	-0.70	0.038	0.055	0.055	17
A23 Location and transportation availability	0.35	-0.71	0.039	0.056	0.056	15
A27 Ease of movement within the facility	0.44	-0.78	0.049	0.061	0.061	10
<i>Performance</i>						
A16 Officehour of the healthcarefacility	0.60	-0.57	0.067	0.045	0.067	3
A25 Examination rooms space and décor	0.54	-0.69	0.061	0.054	0.061	11
<i>Attractive (delighters)</i>						
A9 External appearance	0.52	-0.36	0.059	0.028	0.059	14
A10 Internal decoration and services	0.52	-0.37	0.059	0.029	0.059	13
A19 Parking availability and proximity to entrance	0.56	-0.16	0.063	0.013	0.063	7
A24 Parks and green area availability within thehealthcarefacility	0.58	-0.09	0.065	0.007	0.065	5
A26 Closeness of managerial and accounting offices	0.58	-0.44	0.065	0.035	0.065	6

Table 20. Rank of healthcare attributes using absolute largest weights and FAHP

Healthcare quality attribute	Rank		Remark
	Absolutelargest weight	Integrated Kano-FAHP	
Administrative staff quality attributes			
<i>Must-be attributes</i>			
A2	9	14	↓
A3	20	2	↑
A8	8	1	↑
<i>Performance attributes</i>			
A4	1	16	↓
A7	4	15	↓
Healthcare facility design quality attributes			
<i>Must-be attributes</i>			
A11	2	4	↓
A12	12	3	↑
A13	21	7	↑
A15	19	5	↑
A17	18	13	↑
A18	16	6	↑
A21	17	12	↑
A23	15	8	↓
A27	10	10	□
<i>Performance attributes</i>			
A16	3	9	↓
A25	11	11	□
<i>Attractive attributes</i>			
A9	14	21	↓
A10	13	19	↓
A19	7	17	↓
A24	5	20	↓
A26	6	18	↓

↑ ascended, ↓ descended, □ unchanged

## 6. Concluding Remarks

In this research Kano model is applied to classify healthcare quality attributes into four main categories based on their effects on patients' satisfaction. They are then prioritized using FAHP. The results show that must-be attributes gain the largest weights followed by performance attributes and finally attractive attributes. The contribution of this research to the literature includes several points. First, the survey results identifies and classifies specific attributes that affect patient's satisfaction in dimensions that are not thoroughly covered in the literature such as administrative staff and healthcare facilities design. Second, the proposed integrated Kano-FAHP model prioritizes healthcare quality attributes within each Kano class. This investigation gives insights to providers to select the most appropriate improvement strategies. Third, the proposed model enables healthcare providers to capture the uncertainty and ambiguity in representing patients' preferences and importance. Moreover, Kano-FAHP model enables decision makers to classify and rank attributes taking into account the overall patients' satisfaction rather than ranking them based on satisfaction or dissatisfaction alone.

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