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Applying the fuzzy analytical hierarchy process for classifying and prioritizing healthcare quality attributes

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Abstract. *In any country, the healthcare system is an important sector whose major goal is to provide high-quality medical services and goods to maximize patient satisfaction. The purpose of this research is to introduce an analytical approach for presenting and classifying healthcare quality aspects which might have an impact on patient satisfaction. Therefore, this perspective is achieved by implementing an integrated Kano and fuzzy analytical hierarchy process (FAHP) Model which will grant the support for creating better and improved business strategies, as well as an efficient resource allocation. Our contribution to the literature focuses on the advantage of using an integrated Kano Model and a fuzzy analytical hierarchy process in classifying patients' needs based on healthcare quality attributes regarding the healthcare staff and clinic's facility design. Furthermore, this contribution represents a base for further research and completes with the efficiency and sustainability of the fuzzy analytical hierarchy process applied to the healthcare system. The results suggest that healthcare providers should focus more on performance attributes, to increase patient satisfaction.*

Keywords: Analytical Hierarchy Process, decision-making, fuzzy, healthcare system, Kano, quality.

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Introduction

In today's world, every industry presents a constant dynamic, and the healthcare system is no exception. Patients' needs and requirements evolve, making the conventional healthcare system no longer tolerated by the patients, so the healthcare providers must adapt their improvement strategies to increase patients' satisfaction.

Allocating resources to improve processes without listening to patients' desires would result in a loss for clinics, and, ultimately, in a loss for the patient, who will change their loyalty to a better healthcare unit.

Despite all that, the Romanian medical service has not improved as much as the patients require. Moreover, the current patients' complaints are almost the same as they

were a few years ago, especially in the public healthcare system (Dobrin and Dinulescu, 2019).

To better determine patients' needs based on their perceptions and perspective, most studies recommend integrating patients in the process of creating medical products and services (Birader and Öztüren, 2019). This action can be completed by considering patients' direct and indirect inputs, as well as paying attention to their voices, respectively, the 'voice of the customer' (VOC) (Hsu et al., 2007; Gavurova & Kubak, 2021).

Among the most used and effective tools for listening to customers are focus groups, direct meetings, surveys, questionnaires, observations, etc. By implementing these techniques, healthcare providers can determine patients' needs and requirements and then develop proper improvement strategies.

To differentiate between patients' needs and patients' desires (wishes), the Kano Model categorizes their requirements into three fundamental classes: must-be attributes (if not fulfilled, patient's dissatisfaction will increase to the point of choosing another healthcare provider; basically, the medical product or service would lack functionality if these attributes were absent), performance attributes (if fulfilled, these attributes make the patients happier and, on the contrary, if not fulfilled, patients' dissatisfaction will increase), attractive attributes (actions or improvements not expected by the patients, which are meant to attain their loyalty).

Studies reveal that Romania has one of the lowest percentages of gross domestic product (GDP) assigned to the healthcare system, from all European countries, which results in a limited access to medical services, for patients; only 5.4% of the GDP represents healthcare expenses, less than the approximate average of 7% of the new members of the EU. Therefore, it is mandatory to have a sustainable alternative from the private environment that could help patients achieve quality medical services.

According to the National Institute of Statistics (NIS), the private medical infrastructure covers more than 75% of the total healthcare units in Romania, resulting in an increase of almost 300% compared to the last 15 years (NIS, 2019).

Also, since every multinational company offers private healthcare insurance, patients prefer to go to the private system, considering also that the medical services are more qualitative than those of the public healthcare system.

In the private healthcare system, the better the resources are allocated and used, the better the improvements and the outcomes. In other words, the most important quality attributes should be achieved with minimum effort. One way to allocate resources efficiently is to prioritize the service elements according to their significance and effects on patients' satisfaction. Thus, the Analytical Hierarchy Process (AHP) represents an efficient method used for classifying quality attributes based on a specific objective such as the patients' desires. Also, it ensures an analytical, yet easy to use, procedure for ranking options together with a scientific analysis regarding the consistency of the concluding results.

However, during the process, the element of uncertainty in the patients' preferences might appear. In this case, the fuzzy set theory will be assimilated with the traditional AHP.

As a result, the Fuzzy Analytical Hierarchy Process (FAHP) facilitates decision-makers when assessing their options among items along with linguistic attributes comparatively to crisp values (Büyüközkan et al., 2004).

In this context, the novelty of the current research consists in integrating the Kano Model with FAHP to present a methodical approach for categorizing and ranking the

healthcare quality characteristics relevant to healthcare staff, as well as the clinic's facility layout to ensure better improvement strategies meant to increase patients' satisfaction.

Thus, the purpose of this study is to go one step further by illustrating an extended framework of two different tools – the Kano Model and the Fuzzy Analytic Hierarchy Process - which aim to classify and prioritize the desired healthcare quality attributes, as illustrated by the patients. Accordingly, FAHP will help the healthcare managers and decision makers to focus on the selection criteria with greater weights of importance when developing various improvement strategies for their healthcare units.

Also, the proposed Kano-FAHP Model can be a basis for various types of multi-criteria decision-making approaches, as well as an important tool which will allow decision-makers to express their judgments.

Furthermore, by applying the proposed Model, the following theoretical and practical particularities derive from this study:

a) From a theoretical perspective, the integration of the Kano Model with the FAHP serves to derive healthcare priorities from a set of fuzzy judgments;
b) From a practical perspective, the Model is helpful for the healthcare practitioners, especially to rank the healthcare criteria according to the patients' preferences.

In summary, the paper will concentrate on the following main objectives:

O1. Determining patients' needs and requirements based on specific tools.
O2. Developing a systematical approach to classifying the healthcare quality attributes by implementing the FAHP.
O3. Ranking patients' preferences according to the absolute highest values.

Ultimately, this research applies the FAHP to ensure an overall framework for analyzing the private healthcare system. Likewise, the study aims to focus on addressing the knowledge gap in the research on healthcare quality attributes and patients' satisfaction.

In this study, we have proposed a different Model, based on the integration of the FAHP with the Kano Model. Thus, the paper will be divided into seven parts: The first part will be the Introduction followed by Section 2 which will introduce the theoretical aspects of the FAHP and Kano Model, Section 3 will represent an analytical and theoretical framework of the used coefficients, Section 4 will present the research methodology, while Section 5 will present the results and discussion issued from the previous section. Finally, the last two parts of the paper, Section 6 and 7, will show the limitations of the study, future directions, and conclusions.

Literature review

In the sphere of multi-criteria decision-making actions, the decision makers should adhere to the ethic of rationality when embracing the most proper alternative, that is, to determine a finite set of independent or dependent criteria (Chen, 2019; Roszko-Wójtowicz & Grzelak, 2021; Vavrek & Kovářová, 2021). For example, it can be considered as a multi-standard selection issue (Tong, 2019; Hashemkhani et al., 2021; Janovská, et al., 2021; Lustigová at al., 2021).

One of the most commonly used methods for analyzing the weight of different criteria is the Analytic Hierarchy Process tool (Dos Santos, 2019; Ho, 2018).

The Analytic Hierarchy Process (AHP) is mainly used because it represents an impressive decision-making process that can establish priorities and adopt the most suitable

decision when qualitative and quantitative aspects of a decision need to be taken into consideration (Saaty, 1980).

According to Nascimento and Leal (2020) and Nunes and Leal (2020), the AHP method has been not only applied, but also validated in different practical situations.

Furthermore, one of the most widely used and preferred decision-making technique, when a choice follows several criteria or sub-criteria, is AHP. The significant decision problem solving which AHP uses is established on the decomposition of the issue into a hierarchy structure that contains the goal, the criteria, sub-criteria, and alternatives. Furthermore, the AHP method helps decision-makers to formulate the critical conditions of a problem into a hierarchical structure comparable to a family tree (Zaim, 2012).

However, there were some theoretical and practical aspects of the AHP that were discussed (one example comes from a discussion in (Belton and Stewart, 2002)), but overall, it is widely used and accepted in practice (Vaidya and Kumar, 2006)), being one of the most applied methods for decision support. In addition to this, the AHP area has also been expanded from research on customer satisfaction (Medjoudj et al., 2015), to technological diversification process in the automotive industry (Muerza, 2014).

Nevertheless, the technique is defined by mathematical simplicity and ensures a reliable interpretation of the research, as well as being based on an additive weighting process, where certain relevant criteria are represented through their relative importance (Ghorbanzadeh et al., 2019). Another key point is that its applications are widely used for both individual-level and group decisions (Yuhua, 2004).

Even if the common AHP method does not involve assessing uncertainty in its own input, a series of extensions have been suggested to address this matter. As a result, several studies were conducted: by applying the fuzzy set theory (Boender et al., 1989; Buckley, 1985), arithmetic algorithms (Salo and Hämäläinen, 1995), numerous stochastic techniques (Hauser and Tadikamalla, 1996; Saaty and Vargas, 1987), maintaining strategies selection (Ge et al., 2017), selecting aircraft types (Dozic and Kalic, 2018), and environmental quality assessment (Xie et al., 2017).

In the healthcare industry, Adebanjo et al. (2016) presents the advantages of using the AHP for a better understanding of experts' perceptions regarding the prioritization of health care performance measures and their association with lean supply chain management.

One of the main advantages of the AHP method is represented by its use in a wide variety of application fields like: marketing (Wind and Saaty, 1980; Mark, 2001; Dima & Vasilache, 2016), energy (Pohekar and Ramachandran, 2004), medical and healthcare decision making (Liberatore and Nydick, 2008), project selection related to research and development (R & D) and the allocation of resources (Heidenberger and Stummer, 1999; Skvarciany et al., 2021).

Fuzzy analytical hierarchy process

Leung and Cao (2000) discussed the idea that one of the main reasons for having a low accuracy in the traditional AHP method for obtaining customers' reactions is because the person must assign a categorical value to the pairwise comparison based on his own perception. However, perceiving a phenomenon cannot be illustrated as a crisp score and a number interval can better present the perception of a person regarding the significance of a phenomenon in comparison with another phenomenon than a crisp number. Hence, the

FAHP can better replicate the decision-making process of the human mind than the traditional AHP.

What is more, Krejci (2017) considered that the FAHP is mandatory when the pairwise comparisons are imprecise, and AHP should be avoided in order not to mislead the results.

In 1983, Laarhoven and Pedrcyz used the FAHP for the first time by implementing the triangular fuzzy numbers.

However, sometimes to analyze imprecise and vague information, for which at least two sources of vagueness appear at the same time, the Modeling tools of ordinary fuzzy sets are offering limited results. Therefore, various generalizations and extensions of fuzzy sets have been created, like:

a) Fuzzy multisets (multisets that allow repeated items in the set);
b) Hesitant fuzzy sets (HFS, recently introduced, which try to operate the situation where several values are possible in the definition process of the membership of an item) (Torra, 2010);
c) MULTIMOORA method (a multi-criteria decision-making tool which has as output a ranking obtained from aggregating the results of the ternary ranking methods: Ratio System, Reference Point Approach, and Full Multiplicative Form).

In the traditional AHP, the decision-maker must compare two options with their crisp values for indicating his preference. The belief is that the person assuming the decisions is confident regarding his preferences (which might not always be the case). During the process, inaccurate decisions might be made, as the criteria become more difficult to approximate.

Therefore, to reduce the results of ambiguity in the decision-making process, the fuzzy analytical hierarchy process (FAHP) is used.

In the current research, the fuzzy set theory, along with its operations, is used with the regular AHP, as a decision-making method.

The theory of fuzzy numbers has its origin from the theory of fuzzy sets introduced by Zadeh (1965). The first to integrate the concept of fuzzy numbers into decision analysis were Bellman and Zadeh (1970).

The purpose of FAHP is to allow decision-makers to declare their ambiguous preferences and knowledge with linguistic variable values. Next, these values are converted into fuzzy membership functions which illustrate the uncertainty and fuzziness.

Table 1 presents the linguistic attributes along with the TFNs (Vahidnia et al., 2009). When utilized in FAHP the values have to ability to be converted and assessed to match with the fuzziness of the decision-maker.

Table 1. Triangular fuzzy number of linguistic variables

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

Source: Vahidnia et al., (2009).

Also, the relationships of the associated functions are illustrated in Figure 1.

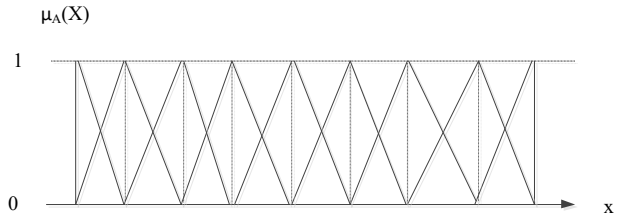


Figure 1. Triangular fuzzy numbers related to linguistic variables

Source: Momani et al., (2014).

Brief presentation of the Kano Model

The development of the Kano Model was made by a Japanese consultant, Noriaki Kano, relating to design characteristics for customer satisfaction (Cohen, 1995).

Additionally, the Kano Model represents an important tool being constantly recommended for the healthcare industry, as well as being considered a technique used to understand a product or a service lifecycle (Mikulić and Prebežac, 2011).

Moreover, the Model proposes a dynamical and theoretical methodology for identifying customer needs and perceptions by providing a visual representation of the relationship between the functional performance of quality attributes and the level of satisfaction attained (Kano et al. 1984; Berger et al. 1993; Robinson, 2009).

Kano Model Categories

The Kano Model divides the customer's requirements according to their response to satisfaction into five distinctive classes like (Berger et al. 1993; Kano et al. 1984):

- ✓ Must-be needs (basic needs) – patients expect to find attributes in a medical product or service as fundamental even if they are not clearly declared. In this case, patients will present a high dissatisfaction level when these basic quality items are missing or are not correctly fulfilled. However, the presence of these quality items does not increase patients' satisfaction even if they operate well;
- ✓ Performance needs (one-dimensional) – the quality items from this category will make the patients happier and will increase their satisfaction level if they are well illustrated in the medical service/product. Also, the satisfaction level will decrease if these attributes are not implemented properly. Thus, patient satisfaction is directly related to attribute performance;
- ✓ Attractive (delighter needs) – these are the quality attributes that are not expected by the patients. For instance, if a quality item is presented with no extra fee, patients will be delighted and thus, their devotion will increase. However, the absence of these attributes does not increase patients' dissatisfaction;
- ✓ Indifferent needs – patients are not normally interested in the existence of some quality attributes; they do not affect patients' satisfaction;
- ✓ Reverse needs – the presence of some quality attributes generates dissatisfaction for patients; their existence could be avoided.

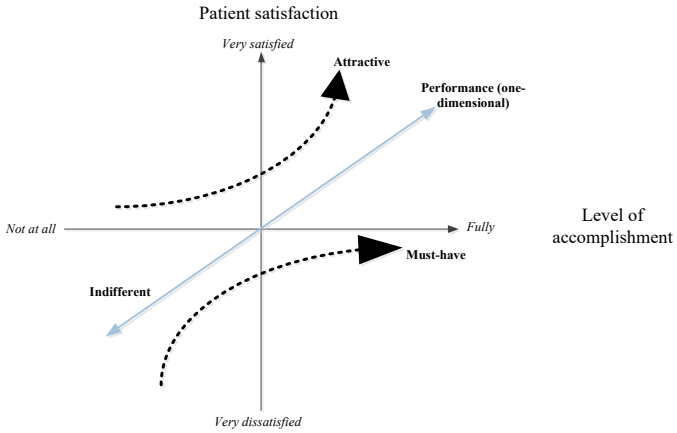


Figure 2. Kano Model

Source: Authors' work.

All attributes are part of one of the following categories of perceived quality as seen in Table 2.

Table 2. Kano's attributes

Code	Result
M	Must-Be
P	Perfomance
A	Attractive
I	Indifferent
R	Reverse
Q	Questionable

Source: Adapted from Matzler & Hinterhuber (1999).

Integrating FAHP with the Kano Model

In today's research, there are few analyses that integrate the Kano Model with FAHP to rank patients' needs and requirements. However, an empirical study, presented by Hemati and Ghorbanian (2011), illustrated the integrated Kano Model and FAHP for measuring and classifying customers' requirements in the field of transportation system.

Another research was in the field of electronic banking, developed by Alroaia and Ardekani (2012), who associated the Kano Model and FAHP to evaluate and prioritize the indicators that could affect customers' desires.

In our research, the Kano Model is used to express the ranking of decision-making issues based on multiple attributes, respectively, the healthcare quality characteristics and the way they affect patients' degree of satisfaction. Next, the healthcare quality attributes are classified by applying the FAHP. This last action has the role to mentor the healthcare providers in allocating resources for expressing improvement strategies.

Analytical and theoretical framework

Satisfaction and dissatisfaction coefficients

To precisely inspect patients' requirements and evaluate the impact of the presence and absence of a certain attribute on patient satisfaction, customer satisfaction (CS) and customer dissatisfaction (CD) coefficient must be computed for each attribute.

The CS coefficient illustrates the positive effects that appear if an attribute satisfies the customer, while the CD illustrates the negative impact if an attribute is missing or is unaccomplished (Matzler and Hinterhuber, 1998).

The CS coefficient is computed by segregating the amount of frequent values for the attractive and performance attributes (A+P) over the number of frequent values of the must-be, performance, attractive and indifferent attributes (M+P+A+I), as indicated in equation 1:

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

where:
CS – customer satisfaction;
M – must-be needs;
P – performance needs;
A – attractive needs;
I – indifferent needs.

The CD coefficient is computed by dividing the amount of frequent observations of the attractive and performance attributes (M+P) by the amount of frequent observations of the must-be, performance, attractive, and indifferent attributes (M+P+A+I), as illustrated in equation 2 (Bayraktaroglu and Özgen, 2008; Hsu et al. 2007; Zielke, 2008):

$$CD = \frac{M+P}{M+P+A+I} \quad (2)$$

where:
CD – customer dissatisfaction;
M – must-be needs;
P – performance needs;
A – attractive needs;
I – indifferent needs.

For which M, P, A, and I are the number of times an observation is designed in a must-be, performance, attractive, and indifferent category.

The absolute largest weight ranking technique

A method for ranking Kano attributes by assuming that the same importance must be given to achieving patients' satisfaction and preventing patients' dissatisfaction is the one proposed by Sireli et al. (2007) regarding the absolute largest CS and CD weights.

For this technique, only a certain part of satisfaction degree or dissatisfaction degree is considered, respectively, the one which has the largest weight.

In this case, the largest significance weights of CS and CD are the observation's weights when considering the next equations:

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

$$S_i = \frac{CS_i}{\sum_{i=1}^{m} CS_i} \quad (3)$$

$$D_i = \frac{CD_i}{\sum_{i=1}^{m} CD_i} \quad (4)$$

where:
S_i – satisfaction indicator;
D_i – dissatisfaction indicator;
w_i – observation's weight;
m – number of attributes.

Fuzzy Set Theory

According to Vahidnia et al. (2009), the fuzzy set theory represents a mathematical theory meant for Model fuzziness of the human cognitive process.

Practically, it represents a set of theories where there are no acute boundaries for the class.

The association function μA(X) illustrates the level for which any given item x from the field X belongs to a fuzzy number A.

Additionally, a triangular fuzzy number (TFN) A is characterized by a triplet (l, m, u) as seen in Figure 3 (Vahidnia et al. 2009).

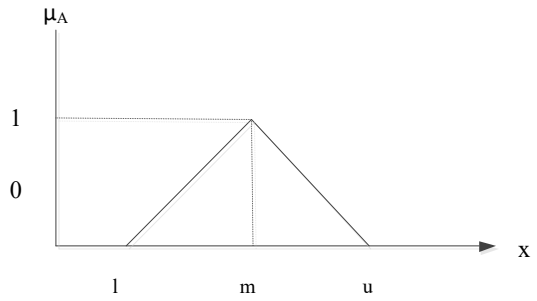


Figure 3. Triangular fuzzy number A

Source: Vahidnia et al., 2009.

In addition, the association function μ_A is represented as:

$$\mu_A(X) = \begin{cases} \frac{x-l}{m-l}, 1 \le x \le m \\ \frac{u-x}{u-m}, m \le x \le u \\ 0, otherwise \end{cases} \quad (5)$$

where:
l – lower value;
m – mode value;
u – upper value.

The triangular fuzzy functions are normally used to illustrate fuzzy numbers, being also suitable for fuzzy applications (Xu and Chen, 2007). Also, decision-makers found them easy to use and compute. Furthermore, the functions are a precise method for expressing decision issues where the present information is both subjective and imprecise. The TFNs usually use the real values scale between the closed interval of 0 and 1, even though there could be used also other scales depending on the fuzziness and ambiguity of the decision-makers, usually ranging between [1,9] in FAHP applications (Amiri, 2010; Dagdeviren et al., 2009).

Research methodology

Additionally, a large and growing body of literature has investigated the use of new management tools and advanced technologies with a positive influence on the healthcare units. For this reason, we decided to conduct a research on methods of evaluating complex decisions using mathematics and psychology (Dinulescu and Bugheanu, 2020).

The current research presents three main phases. In the first step, patients' needs and requirements regarding healthcare staff and clinic's facility design were collected using online and on-location quality surveys.

In the second step, with the help of the Kano Model, the patients' needs, and requirements gathered from phase one are distributed in four main classes: must-be, performance, attractive, and indifferent.

In the third step, the attributes in each class attained with the Kano hierarchy are ranked considering their relative importance, by using the FAHP.

By using the integrated Kano-FAHP approach, attributes' ranking will facilitate the creation of improvement strategies for healthcare services and will increase patients' satisfaction.

Step one – The identification of patients' requirements

To determine the healthcare quality attributes which present significant importance to the patients, the first step is to listen to the patients, more specifically, to listen to the 'voice of the customer' or 'voice of the patients', a procedure used to obtain characteristics that are important in the minds of patients (Lloyd, 2004). Thus, it is mandatory to examine their issues, difficulties, proposals, and suggestions, before, during, and after the delivery of medical services and treatments.

The attributes can be obtained from surveys, focus groups, interviews, feedbacks, questionnaires, etc. After achieving the patients' demands and needs, these are converted to healthcare quality attributes associated with healthcare staff and clinic's facility layout established on aggregate analysis which gathers attributes under the same dimension.

Step two – Kano Model classification

At this point, patients must express their feelings about the existence or absence of these attributes. After that, the classifications associated with the Kano Matrix are completed.

As already stated, the Kano Model is used to investigate the proposed dimensions for healthcare quality, related to healthcare staff and clinic's facility design. To obtain the patient's opinion on the attribute of an individual dimension, a group of paired questions is asked. The main inquiry has a positive structure (functional inquiry), where the patient is inquired regarding his perceptions if a certain healthcare quality value occurs, while the

second question takes a negative structure (dysfunctional inquiry), where the patient is inquired about his reaction if the same healthcare quality attribute is not realized.

Table 3. Example of a positive and negative question

Positive form of the question					
	Like	**Expect it**	**Do not care**	**Live with**	**Dislike**
How do you perceive if the clinic has modern medical equipment?					
Negative form of the question					
How do you perceive if the clinic does not have modern medical equipment?					

Source: Based on authors' study.

In this way, the patient is asked two antithetical questions to ensure that he accurately understands the question, to bypass the possible inconsistent answers.

The patient documents his reactions on a five-scale category, respectively, the one proposed by Berger et al. (1993); these categories are: like, expect it, do not care, live with, dislike.

When classifying the attributes, the Kano Evaluation Matrix is used to evaluate the result of functional, and dysfunctional questions.

Let us assume that the patient feels like the clinic should have modern medical equipment and he dislikes if the private clinic would not have modern equipment. In this situation, the attribute is categorized as a must-be attribute. If, on the other hand, the patient expects the clinic to have modern medical equipment, but they can accept the fact that the clinic does not have modern medical equipment, then this attribute would be classified as *indifferent*.

Table 4. Kano evaluation table

		Dysfunctional (X)			
Functional (Y)	**Like**	**Expect It**	**Do not care**	**Live With**	**Dislike**
Like	Q	A	A	A	P
Expect It	R	Q	I	I	M
Don't Care	R	I	I	I	M
Live With	R	I	I	Q	M
Dislike	R	R	R	R	Q

Source: Matzler & Hinterhuber (1999).

where:
Q – questionable need;
A – attractive need;
M – must- be need;
P – performance need;
I – indifferent need;
R – reversed need.

Statistically significant test

When performing a statistically significant test, this is performed to examine the accuracy of Kano's classes of attributes built on the statistical significance of the variation between the two highest frequency observations.

According to Sireli et al. (2007) two presumptions were created before operating the significance test:

1) The distribution of the responses to the Kano technique survey is binomial;
2) Taking into consideration the significant number of responses received, a normal distribution will be used to approximate the initial binomial distribution.

Based on the above assumptions, a hypothesis test is performed to determine the significance of Kano's answers from a statistical point of view, at a confidence level of 90% (Fong, 1996).

The next hypothesis, along with a specific condition, is adopted for exploring the statistical significance of the value distribution:

H0: a-b = 0 and H1: a-b>0

$$Z_{\alpha} = \frac{|a-b|}{\sqrt{\frac{(a+b)(2N-a-b)}{2N}}} \qquad (6)$$

For which:

a – main most recurrent;
b – secondary most recurrent;
N – overall number of observations;
α – confidence level;
Zα – standard normal value according to α −confidence level.

If condition (6) is validated (is true), then the null hypothesis will not be rejected. This kind of situation appears when the discrepancy among the two most persistent observations does not present a level of statistical significance. In other words, the item's category is ambiguous, and more information should be collected.

Step three – prioritization of healthcare quality attributes using FAHP

To compute the attributes' weights, the next steps of FAHP procedures must be followed:

- ✓ ***Phase 1*** – building the hierarchical structure of patients' needs depending on the impact of healthcare quality values and their classification through the Kano Model (Figure 5);

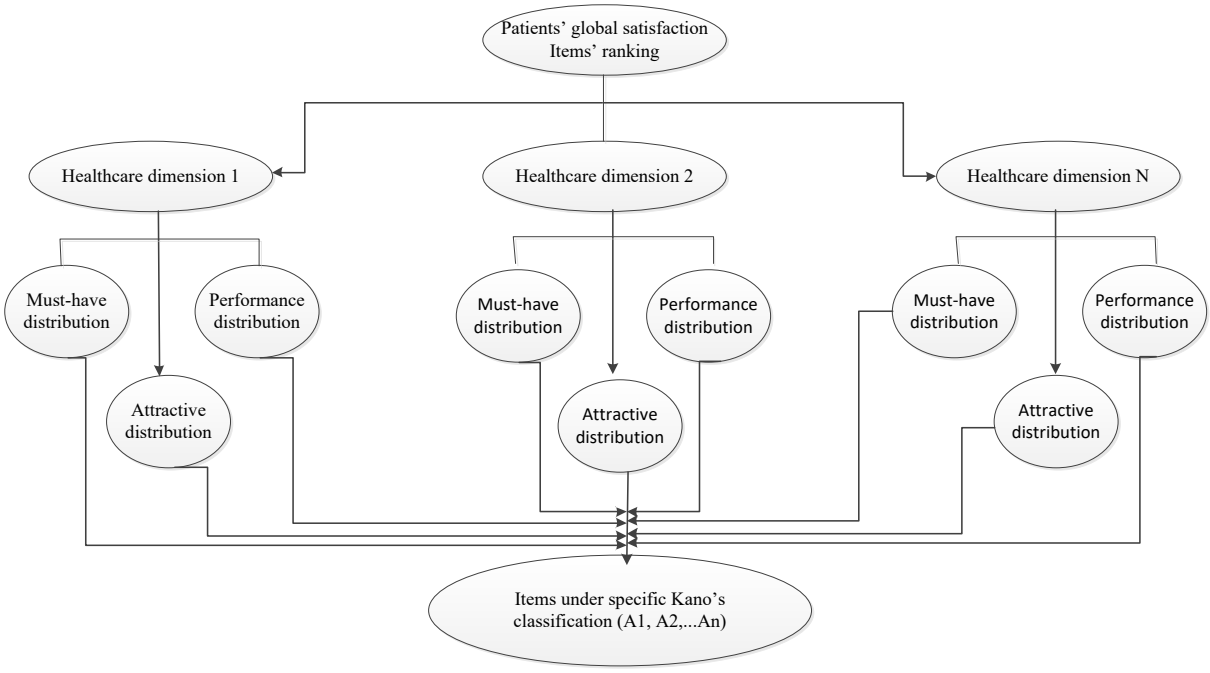


Figure 5. Kano Model classification aligned in a hierarchical manner

Source: Adapted from Momani (2014).

- ✓ ***Phase 2*** – fuzzy pairwise analogy matrices are built to define the FMCDM for prioritizing healthcare attributes related to clinic's facility design and administrative staff, along with relative linguistic importance values; Tables 6 to 14 present the comparison matrices of patients' choices with TFNs. The linguistic importance values used were equitably significant, slightly significant, significant, very significant, and absolutely significant.
- ✓ ***Phase 3*** – changing the relative linguistic importance observations into equivalent TFNs values. Table 5 presents the main linguistic importance values along with their TFNs, which are presented in values from 1 to 9 (Lee et al., 2008).

The changed FCM becomes a matrix, where n shows the number of comparisons taking into consideration the upper level:

$$\mathrm{FCM_j} = \begin{pmatrix} TFN_{11} & TFN_{12} & TFN_{13\ldots..} & TFN_{1n} \\ TFN_{21} & TFN_{22} & TFN_{23\ldots} & TFN_{2n} \\ TFN_{31}\ldots & TFN_{32} & TFN_{33\ldots} & TFN_{3n} \\ TFN_{n1} & TFN_{n2} & TFN_{n3} & TFN_{nn} \end{pmatrix} \quad (7)$$

- ✓ ***Step 4*** – the CR for every FCM is computed, according to equation (8), and ensures that all CRs are consistent (smaller than 0.1);

To obtain stable results, patients' desires and the significance weights among the values must be consistent, which means meaning that the consistency ratio (CR) is computed and then compared to 0.1. From this action, two options derived:

- Either the CR is *under 0.1*, in which case the matrix's evaluator is consistent;
- Or the CR is *greater than 0.1,* in which case the patient should rethink their choice.

The formula for the CR can be seen below (equation 8), where CI represents the consistency index, and RI illustrates the ration index established in Table 5 (Saaty, 1980).

$$CR = \frac{CI}{RI} \quad (8)$$

where,

$$CI = \frac{\Lambda_{max} - n}{n-1} \quad (9)$$

and

$$\Lambda = \frac{\frac{FCM_j - W_j^T}{W_j^T}}{n} \quad (10)$$

Practically, the CR should result in a value lower than 0.1, for the estimates of relative criteria's importance to be considered acceptable. On the contrary (for a value greater than 0.1), the causes of the inconsistencies must be explored.

Step 4 – the CS coefficients' weights and the absolute largest weight are computed; based on these values, the healthcare quality attributes' ranks will be illustrated. Thus, the clinic should direct its effort towards the first position attributes.

The next table (Table 5) presents on the upper row the order of the arbitrary Matrix, whilst on the lower row, the corresponding index of consistency for arbitrary judgments can be observed.

Table 5. Ratio index values related to the number of pairwise comparison elements

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
0.00	0.00	0.58	0.90	1.12	1.24	1.32	1.41	1.45	1.49	1.51	1.48	1.56	1.57	1.59

Source: Saaty (1980).

In his book, Saaty (1980) mentions that a CR > 0.1 illustrates that the representations might not be consistent (or are at the limit of consistency, although there are rare situations when a CR > 0.1 might be accepted). However, a high value of the CR (0.3, 0.4, etc.) means that the pairwise judgments are unreliable.

Results and discussions

For this part of the research, we have summarized and examined the studies and results to determine, classify, and rate the healthcare quality attributes associated with the administrative staff and healthcare facility dimension, which influence the patients' level of satisfaction from an analytical perspective.

The evidence was assembled from a private healthcare clinic located in Bucharest, Romania.

First stage: identifying the healthcare quality attributes

Considering the investigation of the voice of the patients, 28 attributes were examined – 18 related to the healthcare facility and 10 related to administrative staff.

Second stage: classifying healthcare quality attributes using the Kano Model

At this level, the importance of attributes and their impact on patients' degree of satisfaction is determined by using the Kano Model.

From a total of 162 questionnaires applied to respondents, with functional and dysfunctional inquiries for every 28 examined attributes, only 130 were valid, while 32 questionnaires were excluded due to incomplete responses regarding the Kano quality attribute questions; thus, there was a correct answer rate of 80.24% (Figure 6 presents the population of the study).

Count of Gender (f/m)	Column Labels										
	19-29		30-39		40-49		50-59		60-69		Grand Total
Row Labels	f	m	f	m	f	m	f	m	f	m	
bachelor degree	**6**	**12**	**5**	**8**	**12**	**6**	**10**	**7**	**1**	**4**	**71**
Cardiology	1	3	2	2		3	4	2		1	18
Dentistry				1	2		1	1		1	6
Endocrinology	1				1		1				3
Gynecology		1	1	1	3						6
Neurology	3	1		3	2		1				10
Oncology		1		1	3			1			6
Pediatrics	1	5	2		1	3	3	3	1	2	21
Physical Therapy		1									1
high-school degree	**1**		**3**	**1**	**4**	**6**	**5**	**4**	**2**	**1**	**27**
Cardiology					1	2	2				5
Dentistry				1					1	1	3
Endocrinology						1		1			2
Neurology	1					1	1	1	1		5
Oncology			1		1	1	1				4
Pediatrics			2		2		1	2			7
Physical Therapy						1					1
master degree	**4**	**2**	**4**	**5**	**4**	**5**	**2**	**3**	**3**		**32**
Cardiology	1		1	1		2			2		7
Dentistry					2	2					4
Gynecology	1	1	1					1			4
Neurology			1	3		1		1			6
Oncology		1			2						3
Pediatrics	1		1	1			1	1	1		6
Physical Therapy	1						1				2
Grand Total	**11**	**14**	**12**	**14**	**20**	**17**	**17**	**14**	**6**	**5**	**130**

Figure 6. Population of the study

Source: The authors.

The analysis made on the respondents' demographic shows that from a total of 130 patients, 54% had a bachelor's degree, while only 20% had finished high school. Additionally, the population was composed of both males and females, with ages ranging from 19 to 69. Of all the medical departments, the pediatrics and cardiology were the most visited.

The surveys were assigned to the patients to specify their feelings about the existence or absence of an item on the five-attitude scale already described.

Next, the surveys are evaluated in agreement with the Kano Matrix to present the classifications of attributes.

Finally, to check the reliability of the classifications, a statistical test was performed.

The statistical significance tests were performed based on Sireli et al. (2007) perceptions with a level of confidence of 90%.

Third stage: prioritizing healthcare quality attributes applying FAHP

At this stage, FAHP was utilized to prioritize healthcare quality values. These were based on patients' desires and attributes' importance.

Figure 7 presents a review of the resulting groups of each attribute, along with the outcome of the statistical significance test and the frequency of observations.

From this figure it can be noticed that, apart from the fact that all tests were statistically significant, the 28 service quality items were classified by the patients as follows:

- 7 must-haves attributes;
- 12 performance attributes;
- 7 attractive attributes;
- 1 indifferent attribute.

Nr.	Attribute	M	P	A	I	Final category	Category strength (%)	Total strength (%)	Statistical significance
Clinic's facility design									
1	Clinics' accessible location	38	49	34	9	**P**	8.46	93.08	significant
2	Internal appearance	24	51	36	19	**P**	11.54	92.50	significant
3	Internal cleanliness	29	70	21	10	**P**	31.54	100.00	significant
4	External cleanliness	35	35	36	24	**A**	1.30	88.33	significant
5	Existence of an waiting room	56	31	24	19	**M**	32.50	92.50	significant
6	Toilet cleanliness	39	54	21	16	**P**	19.50	95.00	significant
7	Cabinets' cleanliness	31	64	24	11	**P**	42.90	99.17	significant
8	Modern medical equipment	18	51	55	6	**A**	5.20	103.33	significant
9	Free internet access	26	47	26	31	**P**	20.80	82.50	significant
10	Parking available for the patients	15	43	47	25	**A**	5.20	87.50	significant
11	Comfort of movement within the facility	43	36	20	31	**M**	9.10	82.50	significant
12	Reception available	39	46	21	24	**P**	9.10	88.33	significant
13	Guidance available	37	39	36	18	**P**	2.60	93.33	significant
14	Disinfectant available at the entrance	78	24	23	5	**M**	70.20	104.17	significant
15	Cost of medical care	38	62	12	18	**P**	31.20	93.33	significant
16	Examination rooms' décor	20	19	51	40	**A**	14.30	75.00	significant
17	Diversity of specializations	36	57	30	7	**P**	27.30	102.50	significant
18	Working office hours	15	15	56	44	**A**	15.60	71.67	significant
Healthcare staff									
19	Medical staff training	46	40	26	18	**M**	7.80	93.33	significant
20	Medical staff friendliness	30	36	48	16	**A**	15.60	95.00	significant
21	Correct treatment	60	43	10	17	**M**	22.10	94.17	significant
22	Medical staff appearance	50	55	18	7	**P**	6.5	102.50	significant
23	Medical staff availability	63	30	16	21	**M**	42.9	90.83	significant
24	Medical staff respectfulness	42	33	45	10	**A**	3.9	100.00	significant
25	Administrative awareness	31	38	24	37	**P**	1.3	77.50	significant
26	Medical staff empathy	78	50	2	0	**M**	36.4	108.33	significant
27	Medical staff uniform	12	15	56	47	**A**	11.7	69.17	significant
28	Medical staff age	3	10	43	74	**I**	40.3	46.67	significant

Figure 7. Attributes' classification and their statistical significance

Source: Authors' computations.

In the following two figures (Figure 8 and 9) the attributes' division based on the administrative staff and clinic's quality characteristics can be observed.

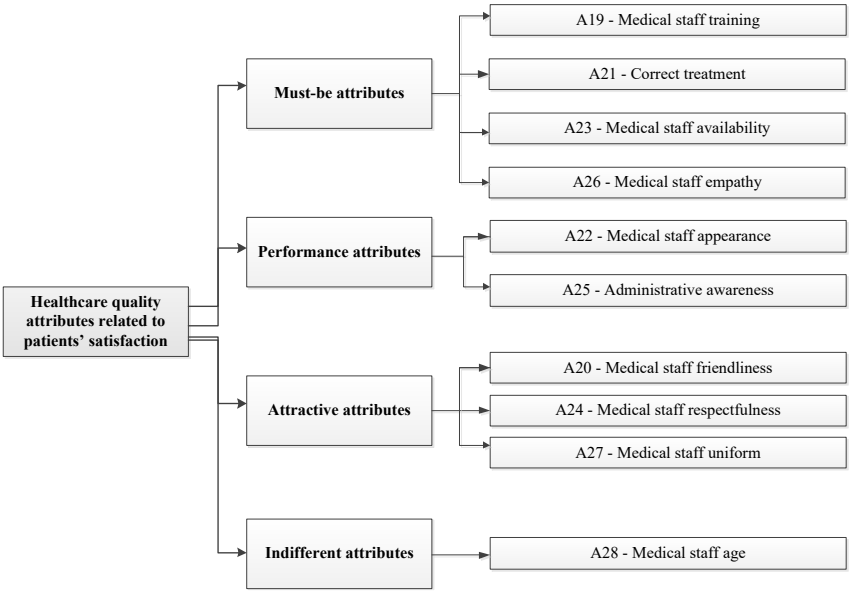


Figure 8. Hierarchical structure of patients' needs related to Administrative Staff
Source: Based on Authors' research.

For the administrative staff's quality characteristics there are all the four attributes (must-be, performance, attractive and indifferent), while for the clinic's facility design there are only three attributes (must-be, performance, and attractive).

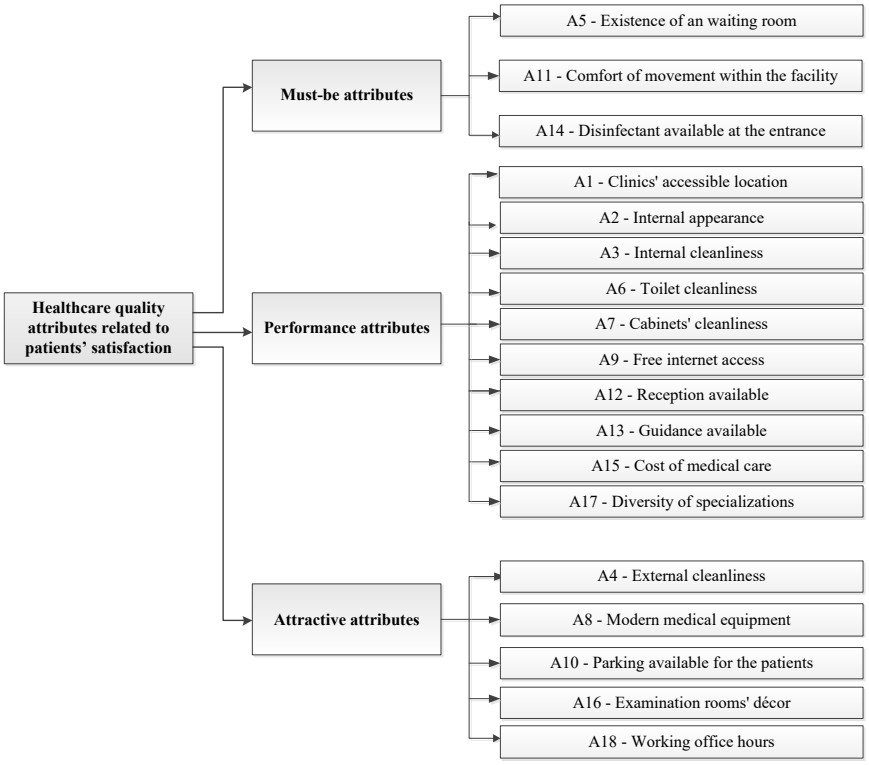


Figure 9. Hierarchical structure of patients' needs related to Clinic's facility design
Source: Based on Authors' research.

Tables (6-14) present the results for pairwise comparison triangle fuzzy number matrix related to healthcare staffs' attributes, as well as clinic's facility layout.

The results were obtained by using the Super Decisions software.

Table 6. Pairwise comparison triangle fuzzy number matrix (TFNM) for healthcare staff (HS) and clinic's facility design (CFD)

	HS	**CFD**
HS	(1,1,1)	(0.250, 0.333, 0.500)
CFD	(2,3,4)	(1,1,1)
	CR=0.071<0.1	

Source: Authors' computations.

Table 7. Pairwise comparison TFNM for must-be category, performance category and attractive category related to CFD

	CFD-M	**CFD-P**	**CFD-A**
CFD-M	(1,1,1)	(2,3,4)	(6,7,8)
CFD-P	(0.250, 0.333, 0.500)	(1,1,1)	(4,5,6)
CFD-A	(0.250, 0.333, 0.500)	(0.125, 0.143, 0.167)	(1,1,1)
	Λ_{max}=3.06 CI=0.03 RI=0.58 CR=0.05		

Source: Authors' computations.

Table 8. Pairwise comparison TFNM for must-be, performance, attractive and indifferent categories related to HS

	HS-M	**HS-P**	**HS-A**	**HS-I**
HS-M	(1,1,1)	(4,5,6)	(2,3,4)	(0.125,0.143,0.167)
HS-P	(0.167, 0.200, 0.250)	(1,1,1)	(1,1,2)	(0.5, 1, 1)
HS-A	(0.250, 0.333, 0.500)	(0.5,1,1)	(1,1,1)	(0.250,0.333,0.500)
HS-I	(6,7,8)	(1,1,2)	(2,3,4)	(1,1,1)
	Λ_{max}=4.01 CI=0.003 RI=0.9 CR=0.003			

Source: Authors' computations.

Table 9. Pairwise comparison TFNM for must-be healthcare attributes related to HS

	A19	**A21**	**A23**	**A26**
A19	(1,1,1)	(1,1,2)	(2,3,4)	(6,7,8)
A21	(0.5, 1, 1)	(1,1,1)	(0.250, 0.333, 0.500)	(4,5,6)
A23	(0.5, 1, 1)	(2,3,4)	(1,1,1)	(0.250, 0.333, 0.500)
A26	(0.125,0.143,0.167)	(0.167,0.200,0.250)	(2,3,4)	(1,1,1)
	Λ_{max}=4.07 CI=0.02 RI=0.9 **CR=0.02**			

Source: Authors' computations.

Table 10. Pairwise comparison TFNM for performance healthcare attributes related to HS

	A22	**A25**
A22	(1,1,1)	(4,5,6)
A25	(0.167, 0.200, 0.250)	(1,1,1)
	Λ_{max}=2 CR<=0.1	

Source: Authors' computations.

Table 11. Pairwise comparison TFNM for attractive healthcare attributes related to HS

	A20	A24	A27
A20	(1,1,1)	(2,3,4)	(0.167, 0.200, 0.250)
A24	(0.250, 0.333, 0.500)	(1,1,1)	(4,5,6)
A27	(4,5,6)	(0.167, 0.200, 0.250)	(1,1,1)
	Λ_{max}=3.08 CI=0.04 RI=0.58 CR=0.06		

Source: Authors' computations.

Table 12. Pairwise comparison TFNM for must-be healthcare attributes related to CFD

	A5	A11	A14
A5	(1,1,1)	(1,1,2)	(0.125,0.143,0.167)
A11	(0.5, 1, 1)	(1,1,1)	(6,7,8)
A14	(6,7,8)	(0.125,0.143,0.167)	(1,1,1)
	Λ_{max}=3.05 CI=0.02 RI=0.58 CR=0.04		

Source: Authors' computations.

Table 13. Pairwise comparison TFNM for performance healthcare values related to CFD

	A1	A2	A3	A6	A7	A9	A12	A13	A15	A17
A1	(1,1,1)	(1,1,2)	(2,3,4)	(1,1,2)	(2,3,4)	(1,1,2)	(1,1,2)	(2,3,4)	(2,3,4)	(2,3,4)
A2	(0.5,1,1)	(1,1,1)	(4,5,6)	(1,1,2)	(2,3,4)	(1,1,2)	(1,1,2)	(2,3,4)	(2,3,4)	(1,1,2)
A3	(0.250, 0.333, 0.500)	(0.167, 0.200, 0.250)	(1,1,1)	(4,5,6)	(4,5,6)	(6,7,8)	(6,7,8)	(6,7,8)	(1,1,2)	(2,3,4)
A6	(0.5,1,1)	(0.5,1,1)	(0.167, 0.200, 0.250)	(1,1,1)	(1,1,2)	(1,1,2)	(1,1,2)	(0.25, 0.333, 0.500)	(2,3,4)	(0.5,1,1)
A7	(0.250, 0.333, 0.500)	(0.250, 0.333, 0.500)	(0.167, 0.200, 0.250)	(0.5,1,1)	(1,1,1)	(2,3,4)	(0.250, 0.333, 0.500)	(4,5,6)	(1,1,2)	(1,1,2)
A9	(0.5,1,1)	(0.5,1,1)	(0.125, 0.143, 0.167)	(0.5,1,1)	(0.250, 0.333, 0.500)	(1,1,1)	(1,1,2)	(2,3,4)	(2,3,4)	(1,1,2)
A12	(0.5,1,1)	(0.5,1,1)	(0.125, 0.143, 0.167)	(0.5,1,1)	(2,3,4)	(0.5,1,1)	(1,1,1)	(1,1,2)	(0.250, 0.333, 0.500)	(1,1,2)
A13	(0.250, 0.333, 0.500)	(0.250, 0.333, 0.500)	(0.125, 0.143, 0.167)	(2,3,4)	(0.167, 0.200, 0.250)	(0.250, 0.333, 0.500)	(0.5,1,1)	(1,1,1)	(0.167, 0.200, 0.250)	(0.250, 0.333, 0.500)
A15	(0.250, 0.333, 0.500)	(0.250, 0.333, 0.500)	(0.5,1,1)	(0.250, 0.333, 0.500)	(0.5,1,1)	(0.250, 0.333, 0.500)	(2,3,4)	(4,5,6)	(1,1,1)	(1,1,2)
A17	(0.250, 0.333, 0.500)	(0.5,1,1)	(0.167, 0.200, 0.250)	(1,1,2)	(0.5,1,1)	(0.5,1,1)	(0.5,1,1)	(2,3,4)	(0.5,1,1)	(1,1,1)
	Λ_{max}=11.234 CI=0.13 RI=1.49 CR=0.08									

Source: Authors' computations.

Table 14. Pairwise comparison TFNM for attractive healthcare attributes related to CFD

	A4	A8	A10	A16	A18
A4	(1,1,1)	(4,5,6)	(0.250,0.333,0.500)	(2,3,4)	(4,5,6)
A8	(0.167,0.200,0.250)	(1,1,1)	(1,1,2)	(0.5, 1, 1)	(1,1,2)
A10	(2,3,4)	(0.5,1,1)	(1,1,1)	(1,1,2)	(2,3,4)
A16	(0.250,0.333,0.500)	(1,1,2)	(0.5,1,1)	(1,1,1)	(0.5,1,1)
A18	(0.167,0.200,0.250)	(0.5,1,1)	(0.250,0.333,0.500)	(1,1,2)	(1,1,1)
	Λ_{max}=5.13 CI=0.03 RI=1.12 CR=0.02				

Source: Authors' computations.

Based on the above-mentioned tables, it can be observed that all consistency ratios' values are under 0.1, which makes all the answers consistent.

Nonetheless, before using the fuzzy numbers for comparison, these must first be defuzzified. The defuzzification process considers the Best Non-fuzzy Performance value (BNP) respectively, the fuzzy weight of a criteria and then it computes the BNP value of the ultimate weight (Cebeci, 2009).

BNP represents a simple and efficient method without the necessity to emphasize the preferences of decision-makers. The BNP value of a fuzzy number $\widetilde{X}_i$ can be established by applying the following equation:

$$\mathrm{BNP_i} = \frac{[(uX_i - lX_i) + (mX_i - lX_i)]}{3} + lX_i \qquad (11)$$

According to the collective reactions and individual judgments of the patients, Figure 10 presents the ranking, BNP values of the criteria's importance, as well as BNP's normalized values.

FAHP was used for rankings' computations.

The attributes were ranked based on the BNP's normalized values, where the highest value was considered to have the highest impact.

Healthcare dimensions	Weights (TFN)	Kano items	Weights (TFN)	Quality item (attribute)	Weights (TFN)	Total weights (TFN)	BNP values	Normalized BNP	Rank
Clinic's facility design (CFD)	(0.733,0.750,0.733)	Must-be	(0.453,0.641,0.881)	A5	(0.132,0.152,0.243)	(0.043,0.073,0.156)	0.176	0.171	13
				A11	**(0.380,0.557,0.702)**	**(0.126,0.267,0.453)**	**0.546**	**0.531**	**2**
				A14	(0.239,0.291,0.386)	(0.079,0.139,0.249)	0.306	0.297	7
		Performance	(0.198,0.275,0.400)	A1	(0.093,0.155,0.306)	(0.013,0.031,0.089)	0.185	0.166	15
				A2	(0.087,0.146,0.277)	(0.012,0.03,0.081)	0.170	0.153	17
				A3	(0.116,0.188,0.309)	(0.016,0.038,0.09)	0.205	0.184	12
				A6	(0.042,0.076,0.133)	(0.006,0.015,0.038)	0.084	0.075	24
				A7	(0.047,0.084,0.149)	(0.006,0.017,0.043)	0.093	0.084	21
				A9	(0.043,0.082,0.137)	(0.006,0.016,0.04)	0.088	0.079	23
				A12	(0.038,0.074,0.119)	(0.005,0.015,0.034)	0.077	0.069	25
				A13	(0.022,0.038,0.064)	(0.003,0.007,0.018)	0.041	0.037	28
				A15	(0.038,0.068,0.121)	(0.005,0.014,0.035)	0.075	0.068	26
				A17	(0.043,0.089,0.143)	(0.006,0.018,0.041)	0.092	0.083	22
		Attractive	(0.062,0.084,0.121)	A4	(0.194,0.310,0.492)	(0.008,0.019,0.042)	0.332	0.307	6
				A8	(0.088,0.139,0.222)	(0.003,0.008,0.019)	0.150	0.138	18
				A10	(0.163,0.273,0.445)	(0.007,0.017,0.039)	0.293	0.272	9
				A16	(0.097,0.158,0.264)	(0.004,0.009,0.023)	0.173	0.160	16
				A18	(0.075,0.121,0.200)	(0.003,0.007,0.017)	0.132	0.122	19
Healthcare staff (HS)	(0.267,0.250,0.267)	Must-be	(0.464,0.659,0.098)	**A19**	**(0.311,0.444,0.732)**	**(0.03,0.0071,0.190)**	**0.496**	**0.467**	**3**
				A21	(0.140,0.235,0.340)	(0.017,0.038,0.089)	0.238	0.224	10
				A23	(0.118,0.207,0.308)	(0.014,0.034,0.043)	0.211	0.199	11
				A26	(0.075,0.112,0.165)	(0.009,0.018,0.043)	0.117	0.110	20
		Performance	(0.101,0.156,0.214)	**A22**	**(0.678,0.833,1.017)**	**(0.018,0.032,0.058)**	**0.843**	**0.831**	**1**
				A25	(0.139,0.167,0.208)	(0.003,0.006,0.011)	0.171	0.169	14
		Attractive	(0.116,0.185,0.270)	A20	(0.161,0.278,0.389)	(0.004,0.012,0.028)	0.276	0.277	8
				A24	**(0.231,0.391,0.562)**	**(0.007,0.018,0.04)**	**0.395**	**0.396**	**4**
				A27	(0.202,0.330,0.446)	(0.006,0.015,0.032)	0.326	0.327	5

Figure 10. Attributes' ranking based on total weights results and BNP normalized values

Source: Authors' computations.

As stated in Figure 10, a performance attribute (A22-medical staff appearance) has the highest rank, followed by a must-be attribute (A11-comfort of movement within the

facility). Thus, the improvement strategies should be formulated according to these two factors, to increase patients' satisfaction.

Ranking attributes using the Absolute Largest Weights Method

Next, for ranking the attributes categorized by Kano Model using as a method the absolute largest weights, the coefficients for patients' satisfaction and dissatisfaction are computed by applying the equations (1-4). Therefore, Figure 11 presents the degree of satisfaction and dissatisfaction level, satisfaction and dissatisfaction weight, absolute largest weight values, as well as the attributes rank.

	Attribute	CS	DS	Si	Di	Absolute largest weight	Rank
		Related to clinic's facility design					
1	Clinics' accessible location	0.64	0.67	0.041	0.040	0.0414	15
2	Internal appearance	0.67	0.58	0.043	0.034	0.0434	11
3	Internal cleanliness	0.70	0.76	0.045	0.046	0.0455	7
4	External cleanliness	0.55	0.54	0.035	0.032	0.0354	25
5	Existence of an waiting room	0.42	0.67	0.027	0.040	0.0400	16
6	Toilet cleanliness	0.58	0.72	0.037	0.043	0.0428	12
7	Cabinets' cleanliness	0.68	0.73	0.044	0.044	0.0439	9
8	**Modern medical equipment**	**0.82**	**0.53**	**0.053**	**0.032**	**0.0529**	**2**
9	Free internet access	0.56	0.56	0.036	0.034	0.0364	21
10	Parking available for the patients	0.69	0.45	0.045	0.027	0.0449	8
11	Comfort of movement within the facility	0.43	0.61	0.028	0.036	0.0363	22
12	Reception available	0.52	0.65	0.033	0.039	0.0391	18
13	Guidance available	0.58	0.58	0.037	0.035	0.0374	20
14	Disinfectant available at the entrance	0.36	0.78	0.023	0.047	0.0469	5
15	Cost of medical care	0.57	0.77	0.037	0.046	0.0460	6
16	Examination rooms' décor	0.54	0.30	0.035	0.018	0.0349	26
17	Diversity of specializations	0.67	0.72	0.043	0.043	0.0434	10
18	Working office hours	0.55	0.23	0.035	0.014	0.0354	24
		Related to healthcare staff					
19	Medical staff training	0.51	0.66	0.033	0.040	0.0395	17
20	Medical staff friendliness	0.65	0.51	0.042	0.030	0.0419	14
21	**Correct treatment**	**0.41**	**0.79**	**0.026**	**0.047**	**0.0474**	**4**
22	**Medical staff appearance**	**0.56**	**0.81**	**0.036**	**0.048**	**0.0483**	**3**
23	Medical staff availability	0.35	0.72	0.023	0.043	0.0428	13
24	Medical staff respectfulness	0.60	0.58	0.039	0.034	0.0389	19
25	Administrative awareness	0.48	0.53	0.031	0.032	0.0317	27
26	**Medical staff empathy**	**0.40**	**0.98**	**0.026**	**0.059**	**0.0589**	**1**
27	Medical staff uniform	0.55	0.21	0.035	0.012	0.0354	23
28	Medical staff age	0.41	0.10	0.026	0.006	0.0264	28

Figure 11. Healthcare quality attributes based on satisfaction and dissatisfaction coefficients, weights, and ranks

Source: Authors' computations.

Based on the absolute largest weight method, the four most important criteria for patients when it comes to qualitative healthcare services can be seen: Medical staff empathy (rank 1), modern medical equipment (rank 2), medical staff appearance (rank 3), correct treatment (rank 4).

Thus, the results illustrate that the performance attributes have the highest absolute largest weights, followed by the must-be attributes, and in the end, followed by the attractive attributes.

Limitations of the study and future research

Naturally, as most research papers, this study also has its limitations. For example, maybe one of the most significant limitations of the current paper is represented by the absence of previous research on the topic of integrated Kano Model and FAHP in the healthcare industry.

Another significant limitation associated with this research is the small sample size considered to behave as the 'voice of the customer' in the pairwise comparison of the selected criteria. In the future, a larger sample size could return more accurate results on the relative importance of the selected criteria.

Additionally, by recognizing the limitations of our research, we plan to formulate them in our future research. Thus, our intention will be to concentrate our knowledge on the ideas mentioned above, with the aim of upgrading the research and finally making an impact on the Romanian private healthcare system, as well as increasing patients' satisfaction.

Future research

As further directions for our research, our aim is to expand our study by developing an Analytic Network Process (ANP) Model related to decision making regarding the implementation of telemedicine in the Romanian private clinics. Furthermore, the ANP technique represents an upgrade of the AHP method, being also the most complete structure for the analysis of the decisions adopted at a superior level. Finally, we will document and evaluate the implementation phase.

In addition, to increase the long-term relevance of this study, the future research will focus on using another well-known multiple-criteria decision-making (MCDM), more precisely, the ELECTRE (Elimination and Choice Expressing Reality), which focuses on choosing the best action from a set of actions, being also applied to three main issues: choosing, ranking, and sorting.

Conclusions

According to the literature, the method used for our study, FAHP respectively, has a benefit when it comes to imprecise comparisons, being more relevant than the traditional AHP. Also, the method helps reducing the the results of ambiguity in the process of decision making, by granting decision-makers to declare their ambiguous preferences and knowledge with linguistic variable values.

The current research represents a comparison between two well-known methods for classifying and prioritizing attributes. However, the results demonstrated different ranking values for each attribute. Still, for a methodology based on a qualitative research, considering the patients' voice as well, the Kano-FAHP-BNP method is more accurate and appropriate for the study (than the Absolute Largest Weight) since it evaluates the patients' ambiguity in decision-making, the global satisfaction degree, including patients' satisfaction and dissatisfaction, comparatively to ranking attributes based only on satisfaction and dissatisfaction.

As a main conclusion, based on the received answers and the above computations, healthcare providers should firstly accomplish the performance attributes, by implementing improvement strategies which would increase patients' satisfaction.

After that, the must-be attributes must be fulfilled to ensure the minimum requirements, and lastly, the attractive attributes must be also prioritized to surprise and delight the patients.

The contribution of this study to the literature includes various aspects, as well as advantages.

First, the questionnaire results determine and categorize precise attributes that have an impact on the patients' satisfaction dimensions which are not completely covered in the literature, like healthcare staff and clinic's facility design.

Second, the presented integrated Kano-FAHP technique categorizes healthcare quality attributes from each Kano class. This process allows healthcare providers to formulate the most appropriate improvement strategies.

Third, the suggested Model allows healthcare providers to observe the ambiguity and confusion regarding the patients' preferences and their importance. Furthermore, the proposed technique allows decision-makers to organize and classify the items by considering global patients' satisfaction.

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