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Research Article

HYBRID MODEL OF THE KANO MODEL, ANALYTICAL HIERARCHY PROCESS AND ASSOCIATION RULES TO IDENTIFY AND PRIORITIZE NEEDS, EXPLORE PATIENT'S BEHAVIORAL RULES AND INCREASE PATIENT SATISFACTION (CASE STUDY: SAADAT ABAD SURGERY CENTER)

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ABSTRACT
The purpose of this paper is to present a hybrid model of the Kano model, analytical hierarchy process and association rules to classify patient's needs, prioritize them and discover patient's behavioral rules. The statistical population of the research is the ward and surgery department's visitors of the Saadat Abad surgery center, that after a random sample, 119 questionnaires were acceptable and were used for data analysis. Initially the patient's needs were classified by Kano model into four categories and 9 needs was introduced as a key requirement and base on key requirements, second questionnaire were designed. In second stage, by using 132 acceptable questionnaires and AHP, patient's key requirements were prioritized. Also in this research, by association rules technique in data mining, the relationship between the customer demographic characteristics and the Kano model's result is specified. The results show that the patient's demographic characteristics are influential on their needs. The result of this research help surgery center to identify patient's needs, segment them and develop appropriate strategy to increase patient's satisfaction.

Keywords: *Patient Satisfaction, Kano Model, Analytical Hierarchy Process, Data Mining, Association Rules*

INTRODUCTION
Today involving customers in the process of product and service designing is considered as a significant, inevitable and essential element in organizations' achievements (Svendsen *et al.,* 2011). Customer-centeredness has not only been considered as a priority in industry but also in governmental-service and service-welfare organizations. Juran defined quality as the amount of product success in providing consumer's desire and purpose (Sauerwein *et al.,* 1996). Hospitals _as service organizations_ require an accurate management of their customers or patients. Patients' satisfaction was started to absorb attention in the1950s.

At that time, sociologists such as Eszas and Parsonz performed researches about patient-doctor relationships (Kumbar, 2010). Patient's satisfaction is considered as an important purpose of group therapy which has a significant influence on patient's health improvement. Offered services must be coordinated with patients' needs to satisfy them. Customer's satisfaction is a critical tool in measuring the quality of services represented by health systems (Becker, 2007). As satisfaction is an inner feeling, it should be transformed into quantitative parameters to determine its amount and degree (Hinterhuber, 1998).

Therefore, identifying elements which influence on patients' satisfaction is important and unavoidable. However, the more significant issue is to adopt models and techniques for classifying and prioritizing the mentioned elements and be able to codify the most beneficial strategies and succeed in the competitive environment.

The Kano algorithm and analytical hierarchy process are two strong measures for identifying and prioritizing customers' needs (Jaeng, 2011). Recent studies regarding customer' satisfaction recommend

us to classify product's features in three categories of mandatory, uni-dimensional and attractive. All these elements influence on customers' satisfaction or dissatisfaction (Nilsson Witell and Fundin, 2005). These factors originate from the Kano model which is applied for identifying and classifying customers' needs (Bilgili *et al.*, 2011).

The Kano model_ as a prevalent model of quality measurement _enables researches to reach a more profound comprehension of customers' preferences through analyzing their perceptions of services' and products' features (Sharif Ullah, 2011). Given the possible conditions in each decision, adopting a patient's needs classification approach has stimulated many researchers to compare different multi-elements decision making methods under similar conditions. However, among multi-element decision making methods, the analytical hierarchy process is comprehensively applied for analyzing priorities in complex and multi-indicator management issues. This model is based on the independence of criteria (JI and Jiang, 2003).

Beside the existing concerns regarding providing and applying appropriate tools for evaluating the level of satisfaction, many previous researchers studied factors influencing on service customers' satisfaction and considered numerous elements including variables of demographic characteristics and hospitalization history. However, different results have been achieved regarding elements influencing on the satisfaction amount (Quintana *et al.*, 2006).

Most of the researches performed by the Kano model limited themselves to classifying customers' needs and did not study the effect of customers' demographic characteristics on the results (Zhu *et al.*, 2010), although consumer's behavior is affected by his personal characteristics and decision making process. Personal characteristics consist of four elements: cultural, social, personal and psychological (Fleissner, 2008). So customers may have various behaviors and preferences as a result of their different beliefs (Nagai *et al.*, 2009).

Among the best approaches of extracting customers' behavioral models are data mining techniques. Data mining is an artificial intelligence technique developed to analyze data for exploring significant rules and models (Liao *et al.*, 2012).

Data mining may be comprehensively applied in marketing decisions (Hand, 2007). Apriori is one of the main algorithms for exploring association rules in data mining which has specifically been developed for large datasets (Young *et al.*, 2008).

A literature review shows no research applying the Kano model, analytical hierarchy process and data mining algorithms simultaneously for identifying and prioritizing customers' needs and the influence of demographic characteristics on types of their needs. Although, many studies have considered the relationship between demographic characteristics and customers' satisfaction and expectations, the association rules have not been studied. A research studied the relationships between demographic characteristics and customers' expectations of service quality and the amount of customers' satisfaction regarding electronic banking in India.

This study proved the influence of demographic characteristics on customers' satisfaction and recommended banks and their service designers to consider customers' needs from different age, education, specialization and income groups in order to develop (Kumbar, 2010). Given the influence of demographic characteristics such as sex, age and marriage, hospital managers are recommended to consider social characteristics including education, job and financial income, too.

The first step toward patients' satisfaction is to identify their personal characteristics (Fleissner, 2008). Besides the above-mentioned variables, patient's type of illness, health condition (Young *et al.*, 2008), and hospitalization history (John, 1992) influence on his satisfaction. In a research performed in the Iranian military hospitals' clinics, the demographic characteristics-customer satisfaction relationship was studied. 600 hospitalized patients from 6 military hospitals around the country were randomly sampled. At the time of discharge, a checklist including demographic characteristics and a satisfaction measurement questionnaire was distributed among patients.

The questionnaire consisted of eight parts including: medical services, nursing services, nurses' behaviors, nutrition status, welfare facilities, reception services, discharge and billing. This research

indicated no significant relationship among elements such as age, education, hospitalization history, and patients' satisfaction. However, sex and insurance coverage were identified as two influential variables (Amerion *et al.*, 2010).

In another research, the multi-variable variance technique was applied to study the effect of demographic characteristics on customers' expectations from the quality of hostelry industry services. In this research the influence of demographic characteristics of 168 hotel visitors including age, sex, marriage, job and education on their expectation from the type and quality of services were studied. Age was the only element effecting customers' expectations (Amin Bidokhti and Roohipour, 2013). The influence of demographic variables on the Kano model's results_ as one of the models for measuring customers' satisfaction_ in Saderat Bank of Isfahan was studied.

This study included 100 samples gathered from customers of the Saderat Bank of Isfahan. Customers' needs were classified by the Kano model, variance analysis and also mean comparison test of the two populations.

The study concluded that elements such as sex, age, education and income influenced on the results of Kano model (Shahin and Alipour, 2008). Also in another evaluative research studying the quality of customers' satisfaction, 330 samples of digital users were included. In this research customers' needs were classified by Kano model and then an operation-importance analysis was performed. The results indicated that five demographic characteristics including sex, age, education, job and income had a significant influence on results of the Kano model (Zhu *et al.*, 2010). These studies only elaborated on the effects of demographic characteristics on customers' satisfaction and also results of Kano model and the relationships among them.

What kind of relationship is it? How do customers with different demographic characteristics classify their needs by Kano model? How do hospitals and health centers _as service organizations imposing direct influence on patients' health_ identify the needs and expectations of patients from different groups? Given various demographic characteristics of patients, in which Kano categories are their needs located? To answer these questions, we may explore association rules among demographic variables and classified needs in the Kano model by applying accurate data mining measures.

After analyzing the theoretical foundations of Kano model, analytical hierarchy process and data mining, the proposed model was represented. Finally, the proposed model was performed in the Saadat Abad surgery center of Tehran.

The Kano Model

Professor Nuriaki_ the professor of Rika University and a well-known specialist in the field of quality science_ and *et al.,* (1984) introduced a model entitled *customer satisfaction Kano model*. This model can classify needs of a product or service affecting customer's satisfaction into three categories (Bilgili *et al.*, 2011). This model has mainly originated from the Herzberg animating-health theory (Sharif Ullah, 2011). The mentioned three kinds of needs follow:

1. Mandatory needs: they are related to main characteristics that a product or service must possess. Customer will be greatly annoyed unless these needs are satisfied. Compensating these needs will not increase customer's satisfaction. Customers consider them as mandatory requirements of products and services and subsequently demand them inexplicitly. Mandatory needs are absolute competitive elements.
2. Uni-dimensional needs: customers' satisfaction has a direct relationship with need provide providence. In other words an increase in need providence leads to an increase in customers' satisfaction and vice versa. These needs are explicitly demanded by customers. Uni-dimensional or operational needs preserves an organization in market.
3. Attractive needs: they have the most influence on customers' satisfaction and greatly increase it. They are not explicitly requested by customers and never expected by them, too. However, a complete satisfaction of these needs increase satisfaction. However, if customers are not provided by this kind of needs, they will not be dissatisfied. Satisfying attractive or animating needs establishes an organization as a market leader (Bilgili *et al.*, 2011).

Another three qualitative features extracted from this model include:

4. Indifference needs: customers do not like these needs and completely ignore them. So, customers will not pay anything for this characteristic. In fact, this kind of need neither lead to satisfaction nor to dissatisfaction.
5. Reverse needs: it means that not only these needs are not interesting for customers but also annoying. In other words the absence of such needs creates more satisfaction. In a research done in a restaurant based on the Kano model, managers understood that a television set inside restaurant not only did not make customers happy but also dissatisfied them.
6. Questionable needs: naturally they should not be selected. It means that the responsive has not comprehended the intention of question or the question has not been clearly posed.

Kano created a more accurate and sophisticated approach for defining quality through putting together the operational parameters of quality and customer's satisfaction in a two-dimensional graph (Mehrgan and Ghasemi, 2002).

In the Kano model, a pair of question is represented per each identified characteristic asking the amount of satisfaction in two conditions: the presence and absence of the target characteristic. Choices include: satisfied, mandatory, indifferent, tolerable and dissatisfied.

Questionnaires are then evaluated according to the Kano evaluation matrix. So the absence or presence of the target need determines its type.

Table 1: The Kano Evaluation Matrix (Nilsson Witell and Fundin, 2005)

Non-Operational Questions (The Absence of Target Element)				**Customers' Needs**
dissatisfied	tolerable	indifferent	mandatory	satisfied operational questions
functional	animating	animating	animating	questionable
satisfied	(the presence of			
basic	indifference	indifference	indifference	reverse
indifference	target element)			
basic	indifference	indifference	indifference	reverse
tolerable	questionable	reverse	reverse	reverse
reverse	dissatisfied			

Analytical Hierarchy Process

Analytical hierarchy process is one of the most comprehensive multi-element decision making systems which was first introduced by Thomas L saati (1980). This technique is based on paired comparisons and is able to involve qualitative and quantitative standards. An analytical hierarchy process consists of three following steps:

1. Hierarchy construction: creates a graphical representation of issue which displays aim, standards and choices.
2. Weighting: elements located in each level are compared with their corresponding elements located in upper levels and then weighted. They are called relative weights. Finally combining relative weights leads to ultimate weights called absolute.

3. System compatibility computation: one of the benefits of analytical hierarchy process is controlling the compatibility of decision. In other words we may judge about being good or bad or acceptance and non-acceptance.

Data Mining

Data mining means extracting or adopting knowledge from a very comprehensive data set. In other words, data mining as a process applies intelligent techniques to extract knowledge from a data set which a simple statistical analysis fails. Data mining uses very complex mathematical algorithms to classify data and predict events (Shahrabi and Shokour Niaz, 2008). In modern organizations, a data mining user is growingly achieving importance. Given the increasing competition, now companies need to understand the knowledge implied in their data more than before (Liao *et al.,* 2012). Data mining has two main applications: prediction and description which mean exploring unknown relations and models of known elements and describing a large database, respectively (Liao *et al.,* 2012). Five kinds of data mining techniques consist of: classification, regression, association rules, segmentation and deviation detection.

Classification and regression are beneficial for predicting, while segmentation and deviation detection are appropriate for describing the existing models implied in data (Liao *et al.,* 2012). Exploring association rules or extracting corresponding rules is a kind of data mining which aims to find a relationship among characteristics in a data set.

This technique is preferred to tree because of its standard decision making and increased rules extraction. Three algorithms of GRI, Apriori and CARMA are used in this technique. In the current research we applied the Apriori algorithm (Alizadeh and Malek Mohammadi, 2013).

Apriori Algorithm

In this research, we aimed to explore association rules to identify patients' behavioral models regarding their demographic characteristics.

Therefore, an appropriate algorithm must be adopted to explore association rules. Apriori is a main algorithm used for identifying association rules designed for large data sets (Hand, 2007). Apriori was created by Chang in 1996 which was considered as one of the most significant discoveries in the history of association rules' extraction. As an advantage, this technique works faster in large-scale big data and has no limitation regarding the number of rules' extraction and can also achieve 32 prerequisites. Each data set possesses a number of items named transaction. This approach is sometimes called shopping cart analysis. Apriori output consists of a set of rules which explain the quality of item coverage in a data set (Alizadeh and Malek Mohammadi, 2013).

MATERIALS AND METHODS

Research Methodology

Type of research was theoretical-practical and descriptive- survey regarding the purpose and type, respectively and was performed sectionally in the surgery center of Saadat Abad. 169 questionnaires were used for gathering field data and simple random sampling was done. The research population consisted of patients visiting the surgery and ward department of Saadat Abad. Number of samples was calculated by Cochran formula for the average of ten visitors per day (average of 300 visitors per month) and the error level of 5%.

Case Studies

Given the proposed model, a case study was performed in Saadat Abad surgery center. The surgery center of Saadat Abad started its activity as a limited surgery center in 2004. This center consisted of skin, hair, and laser clinic, obesity clinic and fitness, cardiology clinic, surgical center limited, radiology and ultrasound department, ward department, pediatric clinic, clinic of neurosurgery and spine, kidney and urinary clinic, general surgery clinic, laboratory and pathology, surgery, urgency, psychiatric clinic and psychiatric counseling, pharmacy, acupuncture, endoscopy, audiology and eye examination. The current research was performed in ward and surgery department. Regarding hospitalization and surgery process, patients were moved to surgery room after reception, then to the ward section hospitalized for some hours or at most one night. According to the proposed model, phases of the study consisted of:

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Classifying Patients' Needs Using the Kano Model

Patients' needs were determined based on previous literature and interviewing specialists and quality experts of the surgery center. First a list of needs mentioned in previous studies and interviews with surgery center patients were provided and represented to experts. A group of experts including quality experts of surgery center and the manager of surgery department's nurses emitted needs unrelated to the surgery center and added related needs to the list. Gathering lists from experts followed by preparing the second list which was re-administered to the group. Finally 44 needs were determined as the patients' needs visiting Saadat Abad surgery center (see chart 2). Three following needs added by the quality experts of surgery center: no congestion in the reception and discharge section, ward and surgery department and attractiveness of building decoration and the surgery center facilities.

The Research Proposed Model

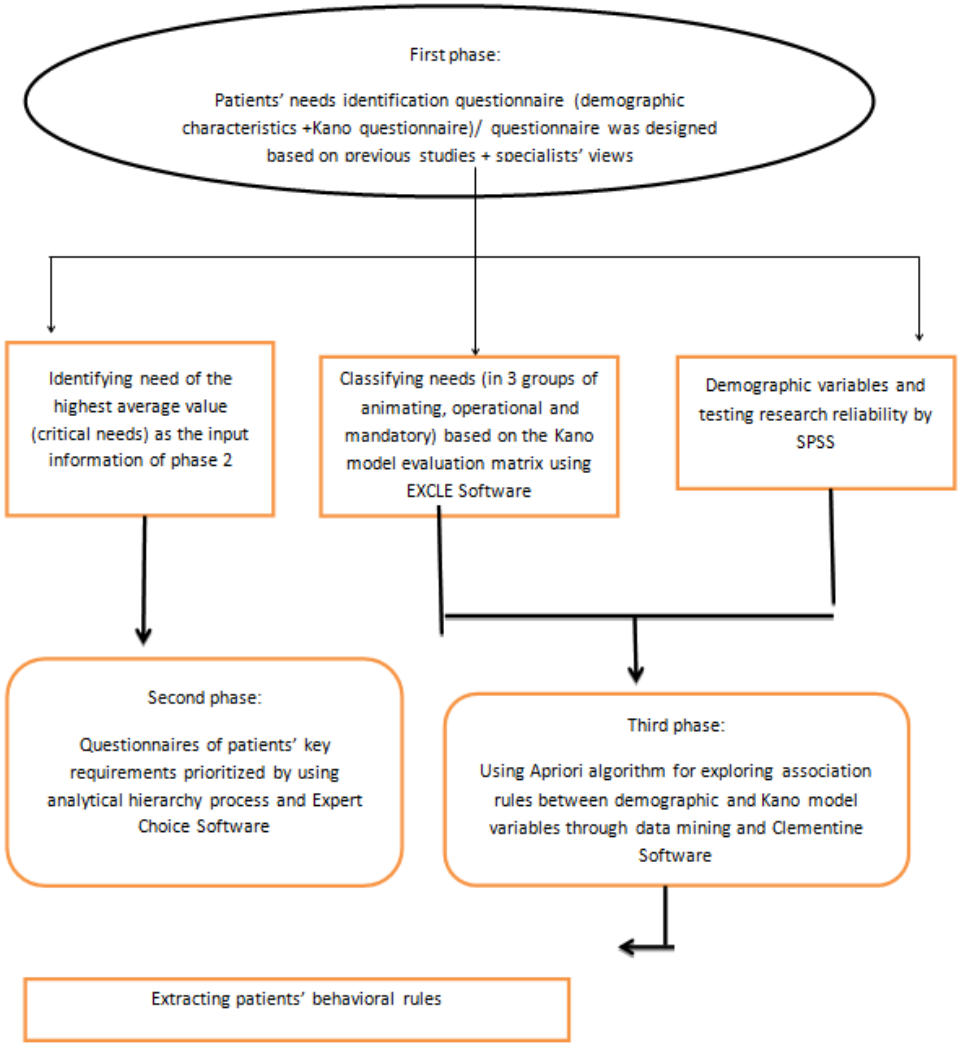

Figure 1: Proposed Algorithm

Table 2: List of Patients' Needs

1. Good deal of guards and security	2. Good deal of reception personnel	3. Speed of personnel in patient's reception	4. Elegant appearance of surgery room personnel
5. Similar behavior of nurses in dealing with visitors	6. On time service Providing by nurses	7. Hospitality and responsibility of nurses	8. Nurses' appropriate technical skills
9. Doctors' good skill in curing patients	10. Doctor's attention to patient during reception, hospitalization and discharge	11. Personnel's honesty in respecting patients privacy	12. Pure attempt of personnel in solving patients problems
13. Appropriate location of health center	14. Public wealth facilities such as: parking, lobby, chapel, air conditioning and lightning systems	15. Necessary facilities in lobby: furniture, cooler and…	16. An accurate guidance for visitors
17. Silence and order observance in health center	18. Silence, order, and peace in surgery room	19. Using equipment related to services and modern and neat medical equipment	20. General cleanliness, bathroom and sanitary services
21. Sufficient wealth facilities, appropriate beds, medical equipment	22. Cleanliness of clothing, bed sheet and blanket	23. The quality of food and its serving manner	24. Entertainment facilities for patients such as: TV, book and etc.
25. Phone reception	26. No congestion in reception and discharge departments	27. No congestion of visitors in ward and surgery departments	28. Quick service and short waiting period
29. Sufficient number of personnel	30. Up-to-date services	31. Reasonable cost payments	32. Having a complaint unit and the manner of responding to suggestions, complaints and criticisms
33. On time informing and pre-surgery preparations	34. Efficiency of , imaging, ultrasound and CT scan department	35. Appropriate laboratory services	36. Counseling services in the center
37. Representing appropriate nursing instructions	38. Continuing cure after discharge	39. Attractiveness of center's exterior	40. Attractive decoration and surgery center facilities
41. Signposts	42. Appropriate environmental condition of center	43. Security during entrance and exist	44. Confidence in the health center and its successful records

According to previous studies and expert's opinions, 8 features were identified as demographic characteristics of patients: sex, age, marriage, education, job, visit and hospitalization. Surgeon's name was also added to the list by the quality experts of hospital. The first questionnaire (phase 1) was designed to prioritize needs and identify patients' critical needs by using the Likert scale. Then it was applied (phase 2) as the primary information of second questionnaire and patients' needs classification (phase 3). After distributing 169 questionnaires in the ward and surgery department, 118 acceptable questionnaires were gathered.

The Cronbach alpha was used for the ultimate estimation of the questionnaire. 96.1 % and 84.4 % were calculated for the reliability of second phase (significance amount of needs) and third phase (the Kano model), respectively. After prioritizing needs based on the Likert scale, we introduced 9 key requirements to perform paired comparisons in the second phase. We needed 36 pairs to do paired comparison which is a sensible number given the time restrictions and visitors' patience. So the second phase results follows:

Table 3: Key Requirements

Priority	**Need Type**
1.	Appropriate skill of doctor
2.	General cleanliness, tidiness of room, bathroom and sanitary services
3.	Silence, order and peace in surgery
4.	Good quality and cleanness of clothing, bedsheet and blanket
5.	On time informing and pre-surgery preparations
6.	Appropriate environmental condition of surgery center such as: light, temperature, noise and…
7.	Quietness and order in the health center
8.	Reasonable cost payments comparing services
9.	Confidence in the health center and its successful records

Needs of patients visiting the surgery center were classified by the Excel Software in the third part of the questionnaire (the Kano questionnaire). See table 4

Prioritizing Patients' Needs by Analytical Hierarchy Process

The second questionnaire was designed through analytical hierarchy process to prioritize 9 key needs determined by the first questionnaire. In this questionnaire, patients were asked to compare key requirements with each other and determine their importance value toward other factors. Importance value was scaled as quite more important, greatly more important, more important, a little more important and equal which were marked by numbers 9, 7, 5, 3 and 1, respectively. In other words, respondents wrote down the related number from the right of each need in the related row according to the importance value.

From 169 administered questionnaires, 132 acceptable questionnaires were gathered. The Cronbach Alfa calculated the reliability of the questionnaire as 78.8%. According to the previous literature, to synthesize 132 matrices obtained from paired comparisons, the geometric average was used to perform paired comparison in Excel. Including the synthesized matrix in Expert Choice Software, the identified key requirements were prioritized through analytical hierarchy process:

1. Doctor's good skill (39.5%)
2. Quietness, order and peace in surgery (22.6%)
3. On time information and pre-surgery preparations (11.1%)
4. Good quality of clothing, bedsheet and blanket (7.5%)
5. General cleanliness, tidiness of room, bathroom and sanitary services (5.9%)
6. Quietness and order in the health center (5.1%)
7. Appropriate environmental conditions of surgery: temperature, light, noise and smell (4.4%)
8. Confidence in the health center and its prosperous records (2.4%)
9. Reasonable cost payments comparing provided services (1.7%)

Table 4: Classifying Needs by the Kano Model

Main Needs	Operational Needs	Animating Needs	Indifference Needs
Doctor's good skill	Good quality and cleanness of clothing, bed sheet and blanket	No congestion in reception department	Having a unit for complaints and the manner of responding
General cleanness, tidiness of room, bathroom and sanitary services	Reasonable cost payments comparing services	Efficient guidance for visitors	
Quietness, order and peace in surgery (room)	Confidence in the health center and its records	Recommending and guidance signposts	
On time information and pre-surgery preparations	Using modern medical equipment	Quality of food and its serving	
Appropriate environmental conditions	Continuing cure after discharge	Representing counseling services at the center	
Quietness and order in the health center	Personnel's honesty regarding patients privacy	Having necessary facilities in lobby	
Nurses' appropriate technical skills	Honest affaire of personnel in solving patients' problems	Doctor's attention to patients during reception and hospitalization	
On time service provided by nurses	Quick servicing and short waiting period	Appropriate location of the health center	
Having necessary welfare facilities	Responsibility and good	Non-presence reception	

in rooms	temperedness of nurses	
Quickness of personnel in patients' reception	Up-to-date services	Elegant appearance of nurses and personnel of surgery
Security in entrance and exit time	Appropriate laboratory services	Attractiveness of interior decoration and surgery equipment
	Appropriate radiology department	Attractiveness of center's exterior
	Non congestion of visitors in the surgery and ward department	Good facilities for patient's attendant
	Representing efficient nursing instructions and trainings	Necessary facilities in lobby
	Appropriate and respectful behavior of reception and cash personnel	
	Sufficient number of personnel	
	Similar behavior of nurses dealing with visitors	
	Public welfare facilities (parking)	
	Respectful and appropriate behavior of security and guards	

Research Article

Exploring the Association Factors of Patients' Behaviors through Data Mining

After classifying the types of services represented by the surgery center using the Kano model, we explored relationships among demographic characteristics of patients and results achieved by the Kano model based on the association rules. For this purpose, 8 demographic variables were considered as patients' classification criteria: sex, age, marriage, education, job, visit, name of surgeon, and hospitalization. Commensurability is done on variables after gathering patients' information:

1. Sex: Woman=A man=B
2. Age: A= under 18 B=18-24 C=25-34 D=35-44 E=45-54 F=55 or upper
3. Marriage: A=single B= married
4. Education: A=below diploma B= diploma and associate degree C= bachelor D=master and upper
5. Job: A=doctor B=engineer C= manager D=teacher E= employee F=retired G=housekeeper H=others
6. Visit: A=one B= two times C=three times D=more than three times
7. Surgeon
8. Hospitalization: A=one night B=without hospitalization

Needs were classified by the Kano model as: O=operational A= animating M= main I=indifference

After commensuration, the data related to patients' demographic characteristics and results of the Kano model were inserted in the Excel Software. These results were considered as the input of Clementine Software. We performed Apriori algorithm after pre-processing data. The results of Apriori algorithm have been represented in table 5. In this table 181 rules were identified having a confidence coefficient of upper 80%. For instance, if doctor's name in the first rule is Safaee, the 32nd need is 81.81 percent a indifference need (having a complaints units and manner of responsibility) or the 18th rule states that by 87.5 percent, people of 25-34 years old having diploma or associative degree and married who has visited the center for the first time see need 10 (attention of doctor to patients during reception and hospitalization) as an animating need. In the 58th rule, 87.5 percent of visitors who are manager consider the need 13 (appropriate location of the health center) as animating. In rule 118 we observe that need 16 (appropriate guidance for visitors) is an animating need for 80 percent of people having a master or upper degree.

Table 5: Patients behavior rules

Conclusion

In this paper, a model hybridized of three models of Kano, analytical hierarchy process and Apriori algorithm was represented. A case study was performed according to this model in the surgery center of Saadat Abad. This model enables us to develop appropriate strategies for patients' satisfaction besides market classification. Results indicated that the demographic characteristics influence on the type of needs. The results of this research were compatible with previous studies. This research has three implications for the surgery center:

1. Using research results for classifying needs based on the Kano model: providing all needs is not possible because of financial and technical constraints. Therefore, first personal needs should be considered and then operational and animating needs should be included given the limited facilities of the surgery center. Also considering the reliability of the proposed model, the current operational and animating needs will be transformed to main future needs. So, the surgery center should acquire long-term programs to satisfy these needs.
2. Using the results of prioritizing Likert scale and analytical hierarchy process: The health center is aware of patients' key requirements and initially focuses on the complete satisfaction of them. Results indicated that the most essential needs of patients are their main needs, too.
3. Using the rules resulted from association rules exploration: these rules help the surgery center to reach a better perception of market classification and develop appropriate strategies. If a health center has an appropriate background of its patients and knows what they really expect, it can provide them more efficiently and consequently obtain their satisfaction and royalty.

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