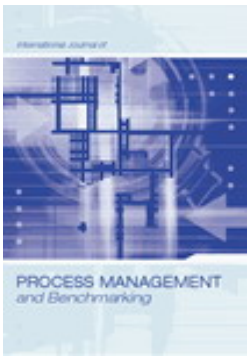

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Abstract: Today, service quality provided to patients is one of the most important criteria for obtaining patient satisfaction in medical and healthcare centres. A review of the work done in the field of quality improvement in healthcare centres shows the attention of researchers to provide quality in healthcare centres. In our research, we first identified the needs of patients, which was determined using a standard questionnaire, then using the Kano

model and its evaluation table to classify the needs of patients into three categories: functional, basic and exciting, so by using QFD tool and goal programming, we examined the current situation of the hospital and compared it with other competitors and identified the elements that are considered as high priority. This method helps us to examine our position as a service unit in front of patients and in comparison with competitors, as well as the extent of our success in achieving the goal with little data. Therefore, during the process of technical language and operationalisation of these parameters, we have a safe way to improve patient satisfaction.

Keywords: quality function deployment; QFD; Kano model; goal programming model; new service development; emergency department healthcare.

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1 Introduction

The basic determinant of success in any industry is the customers' discernment of the items and administrations advertised (Ahmadizadeh-Tourzani et al., 2018). Subsequently, associations centre on client fulfilment for benefit quality enhancement, trade development, and maintainability (Smith and Offodil, 2016). In spite of the fact that the Kano has been utilised broadly to inspire customers' benefit quality prerequisites and move forward client fulfilment, the execution of the Kano show in healthcare remains in its earliest stages and there's uncertainty in client needs related to healthcare administrations (Materla et al., 2019). Some researchers agree with Kano in various ways of their idea to weight the patient needs to express how they impact on patient satisfaction. Therefore, according to the patient's expectations, first, identify his needs. One way to understand the patients' needs is quality tool QFD, the current state of the

organisation as well as compared to other competitors examined and elements of attention and high priority to improving the quality of services provided are identified (Haber et al., 2020). It helps us position ourselves as a serving unit to the patients and compare the organisation with competitors, and examine the success rate in reaching the target with quantitative data. Then this research focus on categorising paintings needs in three dimensions according to the Kano model and by using quality function deployment (QFD) translate the voice of patients' needs into action by the weights that obtained and at the end by using goal programming we optimise Performance requirements of the study.

This paper is structured as follows: Section 2 presents a literature review. In Section 3, the proposed method is provided generally. Section 4 discussed the case study, in Section 5 discuss the results of the selected case study. Finally, in Section 6 the conclusion will be delivered.

2 Literature review

In research by Mao et al. (2019) illustrated that critical infrastructure systems (CISs), progressively enduring from different risks in later decades, are in critical require of progressing their flexibility. So distant few approaches for CISs strength advancement have recognised for changing flexibility enhancement prerequisites into facilitated and implementable measures. The current consider proposes a quality work arrangement-based system for fortifying the versatility of CISs. The proposed system includes diverse stages of the CISs lifecycle and takes into thought the relationships between flexibility change endeavours at these stages. The comes about of the case think about appeared that the proposed system might distinguish the trade-offs between strength enhancement endeavours at distinctive stages of the CISs lifecycle, and take under consideration their connections with flexibility criteria and the relationships among them to work out optimised arrangements for moved forward CISs versatility.

Apornak et al. (2020) in this research use genetic algorithm in order to optimise human resources in hospital emergency. In this regard, they first determine the needs of patient in quality manner and the quantity of resources in emergency department, then by genetic algorithm found the best solution of human resource allocation in relation between quality and quantity approach.

Liao et al. (2019) in their research with title Hospital performance evaluation by a hesitant fuzzy linguistic best worst method with inconsistency repairing illustrated that Hospital performance evaluation, as an important issue in hospital management, helps to know the status of a hospital and it can be implemented based on different criteria. This paper aims to propose a multiple criteria decision-making method with hesitant fuzzy linguistic information based on the original best worst method. In this study, the procedure of the hesitant fuzzy linguistic best worst method is proposed in stepwise to derive the weights of criteria and the priorities of alternatives. Furthermore, the cognitive preference information in the form of hesitation fuzzy linguistic term sets can express the qualitative preferences of decision-makers flexibly, and it aligns people's cognitions much closer than traditional linguistic representation models. In the results of this paper, a novel inconsistency repairing method developed. A case study concerning the hospital

performance evaluation is implemented by the proposed hesitant fuzzy linguistic best worst method to illustrate the practicality and validity of the proposed method.

In research by Ketabi et al. (2018) investigated the efficiency measurement of emergency departments in Isfahan, Iran. The purpose of this study is evaluating the performance of emergency departments. In this paper, by considering the aspects of efficiency beyond the traditional evaluation of the checklist. The factors which have been chosen are divided into two subsets: first, input factors consisting of active beds, physicians, nurses, and medical equipment and second, output factors including discharge, percentage of revival, average waiting time and patient satisfaction. For evaluating the performance they applied data envelopment analysis (DEA) technique in order to evaluate and compare 24 EDs of hospitals in Isfahan. The results revealed that 37% of them are inefficient. The results may be then used to suggest improvement strategies based on the input factors.

In research by Ahmadizadeh-Tourzani et al. (2018) illustrated that supplier selection is the most fundamental decision in the purchase management phase. Purchase is the most functional activity among several activities in a supply chain. A proper supplier selection supports a company's long-term strategies and its competitive position. Due to the presence of ambiguities and uncertainties in the decision making process for selecting suppliers, fuzzy techniques could provide a more reliable and flexible decision of supplier selection problem. In such techniques, customer needs and engineering requirements are weighted by the method of fuzzy analytic network process and relationship matrix of quality function deployment in a fuzzy environment of their importance degree, respectively. Using a mathematical model would integrate the number of cost components and objective factor measures. The integrated method was applied to a case study in a reputable Iranian automotive company. The results showed the efficiency of the method by considering the viewpoint of decision-makers and their dependence on each other.

Xu et al. (2018) in their research investigated the development of a validation and qualification process for the manufacturing of medical devices in a case study based on cross-sector benchmarking, this paper presented a case study concerning validation and qualification process for medical devices in a UK-based medical device manufacturer. The work aimed to develop an efficient and highly reliable procedure for the validation of medical devices. A benchmarking study has been performed to identify the best practices in product validation. The existing practices inside the case consider producer have been looked into to recognise openings for approval change. Unused hones have been proposed for the case ponder producer, and rules for actualising the proposed approval methods have moreover been created.

In a research by Apornak (2017) investigated customer satisfaction measurement using SERVQUAL model, integration Kano and QFD approach in an educational institution, in this research illustrated that Customer satisfaction measurement as a competitive advantage in organisations lead satisfactory of customers, in order to this measurement QFD is an instrument with descriptive information and experts advice for analysing customers' demands and translating them into their required productions. Identify customers' needs is one of the most important things in gaining customer satisfaction. Kano model can divide needs into three categories that are named 'must be, attractive and dimensional'. This research integrated QFD and Kano for identifying customers' needs. The results illustrated that the teachings method had the most important relative weight toward the others and in technical requirements; using

experienced teachers that were arranged it into a basic need in the Kano model was the most important customers' needs than the others.

Damron et al. (2016) in their research investigated collaborative and ethical consideration in the vendor selection process, they illustrated that both supply chain management and inventory management are critical to operations efficiency and global competitiveness. On the other hand, lean production principles may fail to synchronise with customer demand when companies need to develop long-term supplier relationships. Underpinning these relations is an expectation of socially and ethically responsible behaviour on the part of suppliers. Using a qualitative case-study method, the present study explored the importance of supplier relationships with H.J. Heinz and American Eagle Outfitters, as both firms have worked with their partners to ensure social and ethical responsibility.

In a research by Kamvysi et al. (2014) identified and prioritised the needs of students in order to design courses using FAHP And linear programming in QFD, in this paper, according to the needs of customers as an important factor in the design of products and services, the QFD has been used as an alternative framework to classify students' needs. This framework analysis process based on a fuzzy analytical hierarchy process and linear programming method based on data envelopment analysis at the QFD matrix In order to better judge is embedded. Also, this approach provided a sensitivity analysis to verify the priority needs of the students have been used, among the advantages of the proposed framework in this paper, it can be mentioned two advantages:

1 using the analytic hierarchy process fuzzy approach for the potential uncertainty of subjective judgment

2 using data envelopment analysis based on linear programming and easily solved by using a linear programming model to point out the importance weights).

In a research by Dai and Blackhurst (2012) investigated a four-phase approach to AHP-QFD in assessing the stability of supplier due to the increasing awareness for companies in terms of sustainability that considered in the economic, social and environmental efficiency, in this article looking for an integrated approach AHP and QFD to provide voice of shareholders to act. With regard to the development of a sustainable procurement strategy, AHP-QFD approach that consists of four phase's hierarchical relationship to customer needs with the company's sustainability strategy, priority sustainable competitive procurement, sustainable development of the total evaluation criteria and evaluation at the end of the total users. And then, demonstrate an example to illustrate the use of this approach has been suggested.

Lee et al. (2010), illustrated that an assessment framework to product planning by using FANP and QFD as an innovator in technology and creating customer needs satisfaction as the main factors in the global competition for enterprises, especially for high-tech companies and given that a new product could meet a wide range of customer expectations, this study is in two phases, In the first phase method QFD matrix and integrating with ANP method recognised the most important customer needs and voice of the customer to give a product recall, and then in the second phase of the multi-objective goal programming searched other objective that organisation wants to achieve it such as cost and the ability to produce; in this research with a case study on the design of transistors, light design display industry in Taiwan was investigated and then a functional framework is proposed.

In research by Avikal et al. (2014) used an integrated Kano model, fuzzy-AHP, and M-TOPSIS-based technique to find the optimal result according to reuse components and reduce undesirable of a disassembly process that can impact on the environment. The tasks are assigned to the disassembly workstations according to their priority rank that can originate from the Kano model and precedence relations. The proposed technique has been illustrated with an example and the results show improvements in the performance in comparison with other techniques.

In research by Lin et al. (2015) introduced a framework of Kano's model and FQFD applied to Taiwanese Ban-Doh banquet services. Kano's model with fuzzy sets was used and integrated into the Fuzzy QFD method to illustrate the relation between service attributes and customer responses by using Kano's model categorised service attributes into three major groups: basic, performance and exciting requirements, the findings of a case study involved six senior Ban-Doh chefs and 80 guests who attended Ban-Doh banquets are presented; this study enables service providers to determine the find that which services that can attract customers and where are company strengths and weaknesses.

Azizi and Aikhuele (2015) stated in their research a decision-making model in order to develop for the evaluation and selection of lean production tools for the implementation of the lean technique in a product assembly environment by using integration quality function deployment (QFD) and Kano model. The combined Kano model and QFD method were tested and applied in a simulated multiple decision-making problems with numerical examples. The proposed model in this study enables companies to work more economically by using their manufacturing skills, time, space, money, and other manufacturing influencing factors more efficiently and effectively.

In our research by introducing the integration between Kano and quality function deployment in healthcare will find the voice of patients and technical requirements in hospital as our case study, the difference between this study by the similar studies that use similar methods is in using multi-objective programming in recognising the most important needs and technical requirements in respect to the value of the objective functions and constraints in our case study.

3 Proposed method

In this paper, an incipient QFD optimisation approach is suggested combining multi-objective programming (MOP) and Kano model, this approach is originated from researches as a model proposed by Lai et al. (2004). The present study suggests the incipient approach to obtain the optimised solution from an inhibited number of alternatives of customer needs and technical requirements the values of which can be discrete because, inauthentic world applications, the values of customer needs are often discrete instead of continuous. According to this discussion, dynamic programming is proposed to solve this type of optimisation problem where values of the customers' needs and technical requirements are discrete and also we want to optimise the problem at different levels simultaneously.

The steps of this approach are stated as follows:

1 First focuses on understanding the patients' needs, for this paper, patients' needs were determined from asking from our experts and patients in the case study.

2 Second step technical requirements are very important for QFD analysis; it can help engineers in order to consider these requirements in order to cover patients' needs.

3 After determining the technical requirements, experts specify the relationships between patients' expectations and technical requirements keeping in mind the importance of ratings and direction of improvement that were important points for QFD analysis. This information was evaluated and determined by experts.

4 Experts of our study defined which customer needs related to which technical requirement.

5 The purpose of this step is to recognise all patients' needs by gathering the voice of the patients, after understanding all patients' needs and expectations must recognise the most relationship between these customer needs and technical requirements.

6 In this step, experts calculated the technical importance degree of each requirement. These values are calculated for each technical requirement as a summation of the importance degree of patients expectation which has a relationship with the technical requirement multiplied with the weight of the relationship.

7 However, at this stage with regard to identifying the needs of patients by using questionnaires and determine the degree of importance and satisfaction of the needs of patients through the questionnaire is to improve the overall (IR_i) and then calculated according to the results, the improved modified (IR_{adj}). The recovery ratio is adjusted according to the needs of Kano in three categories, K is determined for a fundamental and exciting approach to deal with due to the dramatic demands of $K = 2$, $K = 1$ and for performance demands $K = 1/2$ defined.

$$IR_i = \frac{T}{C} \tag{1}$$

$$IR_{adj} = (IR_i)^{(1/k)} \tag{2}$$

8 In this step in order to calculate the weight of patients' needs the values are calculated for each need in the formula as equation (3):

$$W\left(CR_1\right) = \frac{d_i * IR_{adj}}{\sum_{i=1}^{I} IR_{adj}} \tag{3}$$

9 The house of quality matrix illustrates which technical characteristic has a positive or strongly positive relationship with other technical requirements.

10 This approach helps to identify the minimum set of technical requirements of the institution to meet the various customer needs, in turn leading to a cost-effective means of improving quality as perceived by the customers.

11 Then by using goal programming in addition to customer satisfaction, cost and technical difficulties in implementing the engineering design specifications are considered as the other two goals. The fuzzy approach is used to solve multi-objective programming (MOP).

3.1 Case study

This research-based on the Kano model of customer satisfaction, and therefore acquires the customer needs by using QFD. Products and services with good quality, in order to resolve customer expectations and satisfaction levels, should be increased by this method. The model is used to design and develop innovative products by using the Kano model then the method of quality functional deployment (QFD) is proposed.

Kano model help to project team members to diagnose a variety of customer needs to understand the basic needs of creative reach. The careful analysis of patients' needs in the QFD process used to work through the product managers and team projects for creation and understanding of the work process of a new product or new version of a product. The results of the analysis according to the Kano model and QFD between patients' needs and technical correlation matrix has significant positive effects on product quality and innovation in an attractive manner for customers in producing the product.

4 Data analysis

First information extracted from the questionnaire analysed, the results according to specific objectives, the community hospital patients are examined, and then data from the questionnaires is gathered by distributed questionnaire between 142 patriates, the number of votes given to each of the requirements according to the two aspects of satisfaction (C) and the degree of importance (T) according to the choices (very poor, poor, average, good and very good) have been identified, and at the end most associated with any of the requirements according to the number of answers to each of the options is given. Then the Kano model classified patients' needs into three dimensions according to the Kano questionnaire that has been dispersed among expert persons in this research.

Table 1 Requirements categories based on Kano

Needs of patients	*Categorised based on Kano model*
Waiting time for admission	●●
Quiet area hospital	●
The presence of doctors	●●
Doctors skills	●●
Speed filing	●●
Health and hospital cleanliness	●●
Nursing skills	●●
Coordination between medical staff and nurses	●●
Availability of medicines and medical supplies in hospitals	○
Received hospital costs	○

Notes: ○: performance needs; ●: exciting needs; ●●: basic needs.

According to the results in Table 1, the needs 1, 3, 4, 5, 6, 7, 8 are categorised in basic needs numbers 9 and 10 as well as being categorised as performance requirements and

patients need number 2 categorised as exciting needs according to performance and non-performance questionnaires and Kano evaluation table.

At this stage with regard to identifying the needs of customers using questionnaires and determine the degree of importance and satisfaction of the needs of patients through the questionnaire is to improve the overall (IR_i) and then calculated according to the results, the improved modified (IR_{adj}). These calculations are determined according to step 7 in Section 3.

Then overall improvement of the degree of importance to the satisfaction according to results obtained from the questionnaire, the results states in Table 2.

Table 2 Overall improvement values

$IR_1 = \frac{T}{C} = \frac{5}{3} = 1.66$	$IR_4 = \frac{T}{C} = \frac{5}{2} = 2.5$	$IR_7 = \frac{T}{C} = \frac{5}{3} = 1.66$	$IR_{10} = \frac{T}{C} = \frac{4}{3} = 1.33$
$IR_2 = \frac{T}{C} = \frac{1}{1} = 1$	$IR_5 = \frac{T}{C} = \frac{3}{2} = 1.5$	$IR_8 = \frac{T}{C} = \frac{4}{2} = 2$	
$IR_3 = \frac{T}{C} = \frac{5}{3} = 1.66$	$IR_6 = \frac{T}{C} = \frac{4}{3} = 1.33$	$IR_9 = \frac{T}{C} = \frac{3}{3} = 1$	

According to the table above to obtain an overall improvement in any of the patients' needs are classified according to the Kano model, and then Modified ratio improvements according to *K* indexes in Kano categorisation demonstrate in Table 3.

Table 3 Modified ratio improvements

$IR_{adj1} = (1.66)^2 = 2.75$	$IR_{adj4} = (2.5)^2 = 2.65$	$IR_{adj7} = (1.66)^2 = 2.75$	$IR_{adj10} = (1.33)^1 = 1.33$
$IR_{adj2} = (1)^{1/2} = 1$	$IR_{adj5} = (1.5)^2 = 2.25$	$IR_{adj8} = (2)^2 = 4$	
$IR_{adj3} = (1.66)^2 = 2.75$	$IR_{adj6} = (1.33)^2 = 1.76$	$IR_{adj9} = (1)^1 = 1$	

With regards to the issue of the weight (importance) of each need according to the equation (3), that (IR_{adj}) modified ratio improvements that calculations demonstrate in Table 4, and also d_i is the degree of importance that originated from Table 4 then the weights calculated as follows in Table 4.

Table 4 The weights of patients' needs

Needs of patients	*Weights*
Waiting time for admission	$W(CR1) = 0.123$
Quiet area hospital	$W(CR2) = 0.008$
The presence of doctors	$W(CR3) = 0.123$
Doctors skills	$W(CR4) = 0.279$
Speed filing	$W(CR5) = 0.060$
Health and hospital cleanliness	$W(CR6) = 0.063$
Nursing skills	$W(CR7) = 0.123$
Coordination between medical staff and nurses	$W(CR1) = 0.143$
Availability of medicines and medical supplies in hospitals	$W(CR9) = 0.026$
Received hospital costs	$W(CR10) = 0.047$

Each of the above equations determines the importance of patients' needs, by doing these calculations, we able to turn patients' needs to fuzzy Kano approach, and use in the house of quality in order to integration Kano and QFD.

Relative weights according to the formula is stated in house of quality, however, according to experts examined the relationship between the needs of patients and each of technical specifications, the purpose of the sign ● to a strong correlation between patients' needs and technical requirements and of symbols ○ to communicate the average between the needs of patients and the technical requirements and the mark ∇ to poor communication between each of needs and technical requirements, that correlation between technical requirements and patients need value is 9, 3 and 1 that illustrated strong, average and poor correlation, respectively.

Figure 1 House of quality

Technical requirements	Most Relation in Row	How to get hospital services	Hospital staff respect the patient	Daily cleaning of rooms	Skills hospitals	Create a doctors prescription	Teamwork	Hospital approved budget	Nursing skills	Hospital location	Important factor	The relative weight
Waiting time for admission	9	●	○		○	○	○	●	▽	▽	123	0.123
Peace silence Hospital Campus	9	○	○					○		●	8	0.008
The presence of doctors	9	●	▽		▽	▽	○	●		○	123	0.123
Create a doctors prescription	9	○			○	●	○	●	▽	▽	279	0.280
Speed up patient records	9	●	▽		○	○	●	○	▽	▽	60	0.060
Health and hospital cleanliness	9	●		●	○		▽	●		▽	63	0.063
Nursing skills	9	▽	▽	▽	○		●	●	●	○	123	0.123
Coordination between medical staff and nurses	9	○			○	●	●	●	○	▽	143	0.143
Availability of medicines and medical supplies in hospitals	9	●			▽	○	○	●	▽	▽	26	0.026
Received hospital costs	9	●	○	●	○	○	○	●	○	●	47	0.047
Most Relation in column		9	9	9	9	9	9	9	9	9		
Important factor		5.394	0.84	1.113	2.525	4.698	4.794	8.556	2.166	1.928		
The relative weight		0.168	0.026	0.034	0.078	0.146	0.149	0.267	0.067	0.060		

And then identify the most relevant in each row to determine the relative weight of each factor and calculated the importance of the technical requirements in order to identify the overall impact of technical specifications on each of the patients' needs.

That the results of each of them are shown in the row of down-house of quality in order to build a house of quality matrix.

In order to model the formation of the objective function and constraints with regard to the approach discussed the ideal plan, specifications considered as a variables decision that we want each variable to determine the optimum amount in order to minimise the level of success in achieving the desired goals of our own objective functions:

The variables used in the model:

y_1 how to receive services at the hospital

y_2 hardware required by patients in hospital

y_3 daily cleaning of rooms

y_4 skills hospitals

y_5 create a doctor's prescription

y_6 teamwork

y_7 hospital approved budget

y_8 nursing skills

y_9 access to hospital location.

The goal is to determine each objective, the objectives that are used in goal programming include patient satisfaction (W), costs (C) and technical shortcomings (T), to solve the model for the first goal of customer satisfaction (W_j) is obtained from the relative weights of house of quality originated from integration QFD and Kano, we use quality, the cost for objective function (C_j) and technical difficulty (T_j) are adapted to each variable. According to experts decision in order to determine the importance of each data used 0 to 10, that in order to normalise their data divided by 100, However, the target functions that is goals of the research are identified, to identify constraints the minimum level of success determine according to the experts decision and consider the needs of the patient.

Table 5 Related to weight the importance of satisfying the patient's needs

Patients satisfaction	W_9	W_8	W_7	W_6	W_5	W_4	W_3	W_2	W_1
W_j	0.06	0.067	0.267	0.149	0.146	0.078	0.034	0.026	0.168

Table 6 Weight related to the cost of each patient's needs

Cost	C_9	C_8	C_7	C_6	C_5	C_4	C_3	C_2	C_1
C_j	0.09	0.08	0.09	0.07	0.08	0.07	0.07	0.05	0.07

Technical specifications for the minimum level of achievement in each of the needs of patients are shown in Table 8.

Table 7 Weight associated with the technical difficulties of each patient's needs

Technical difficulties	T_9	T_8	T_7	T_6	T_5	T_4	T_3	T_2	T_1
T_j	0.10	0.10	0.10	0.07	0.08	0.06	0.06	0.06	0.06

Table 8 The minimum levels of achievement in each of the needs of patients

Minimum level of success	D_9	D_8	D_7	D_6	D_5	D_4	D_3	D_2	D_1
D_j	0.1	0.7	0.8	0.8	0.9	0.6	0.7	0.5	0.8

Goal programming model are presented as follows:

$$Max\sum\left(W_jY_j\right)=0.168y_1+0.026y_2+0.034y_3+0.078y_4+0.146y_5 \\ +0.149y_6+0.267y_7+0.067y_8+0.060y_9$$

$$Mim\sum\left(C_jY_j\right)=0.07y_1+0.05y_2+0.07y_3+0.07y_4+0.08y_5 \\ +0.07y_6+0.09y_7+0.08y_8+0.09y_9$$

$$Min\sum\left(T_jY_j\right)=0.06y_1+0.06y_2+0.06y_3+0.06y_4+0.08y_5 \\ +0.07y_6+0.09y_7+0.07y_8+0.10y_9$$

St:

$y_1 \geq 0.8$

$y_2 \geq 0.5$

$y_3 \geq 0.7$

$y_4 \geq 0.6$

$y_5 \geq 0.9$

$y_6 \geq 0.8$

$y_7 \geq 0.8$

$y_8 \geq 0.7$

$y_9 \geq 0.1$

$y_i \leq 1$

The results of this modelling are present in next section.

5 Discussion

The results of the data analysis of this study are summarised in the following tables, which are addressed in the following commentary.

In Table 9 illustrated the maximum frequency of data of patients' needs according to the Likert-type scale.

In Table 10 according to the questionnaire and the evaluation of Kano the classification of needs are considered as follows in three categories.

The result of patients need from integration Kano model with quality function deployment (QFD) in house of quality is represented in Figure 2.

As well as for technical specifications which represents the relative weight of each technical specification is shown in Figure 3.

According to the Figure 3, it can be identified that the most important needs and technical requirements, according to the figures most important of these needs are properly prescribed by doctors, coordination and cooperation between medical staff and nurses who were in first and second in the importance and skills, the presence of doctors and waiting time for admission in the same priority and importance placed third. As for the technical requirements on how to categorise these requirements to determine priority focus on the requirements for that purpose (the budget approved by the hospital), the priority and priority services at the hospital on the second priority and the third priority group is also the most important requirements are technical.

Table 9 The maximum frequency of the data in the questionnaire

Needs	*Received hospital costs*	*Availability of medicines and medical supplies in hospitals*	*Coordination between medical staff and nurses*	*Nursing skills*	*Health and hospital cleanliness*
Level of satisfaction	Average	Average	Weak	Average	Average
Degree of importance	Good	Average	Good	Very good	Good
Needs	*Speed up patient records*	*Create a doctor's prescription*	*The presence of doctors*	*Quiet area hospital*	*Waiting time for admission*
Level of satisfaction	Weak	Weak	Average	Very weak	Average
Degree of importance	Average	Very good	Very good	Very weak	Very good

Table 10 Classification of needs according to the Kano model

Needs	*Received hospital costs*	*Availability of medicines and medical supplies in hospitals*	*Coordination between medical staff and nurses*	*Nursing skills*	*Health and hospital cleanliness*
Needs based in Kano model	Performance	Performance	Basic	Basic	Basic
Needs	*Speed up patient records*	*Create a doctor's prescription*	*The presence of doctors*	*Quiet area hospital*	*Waiting time for admission*
Needs based in Kano model	Basic	Basic	Basic	Exciting	Basic

According to the information can be obtained to improve the performance of the hospital in areas under the priority to third to identify needs and better understanding of customer needs and their transformation into practice, this means that with the further capitalise on the priority of utmost importance to better results can be obtained.

Also can identify the most important technical requirements and their effect on the patient needs, according to calculations that are: enacted budget hospital, how service delivery and teamwork in one to three priorities, respectively.

Goal programming model are as follows:

$$Max\sum\left(W_jY_j\right) = 0.168y_1 + 0.026y_2 + 0.034y_3 + 0.078y_4 + 0.146y_5 + 0.149y_6 + 0.267y_7 + 0.067y_8 + 0.060y_9$$

$$Mim\sum\left(C_jY_j\right) = 0.07y_1 + 0.05y_2 + 0.07y_3 + 0.07y_4 + 0.08y_5 + 0.07y_6 + 0.09y_7 + 0.08y_8 + 0.09y_9$$

$$Min\sum\left(T_jY_j\right) = 0.06y_1 + 0.06y_2 + 0.06y_3 + 0.06y_4 + 0.08y_5 + 0.07y_6 + 0.09y_7 + 0.07y_8 + 0.10y_9$$

St:

$y_1 \geq 0.8$

$y_2 \geq 0.5$

$y_3 \geq 0.7$

$y_4 \geq 0.6$

$y_5 \geq 0.9$

$y_6 \geq 0.8$

$y_7 \geq 0.8$

$y_8 \geq 0.7$

$y_9 \geq 0.1$

$y_i \leq 1$

Solving goal programming model according to LINGO software is that the results of which are as follows.

According to information obtained by solving the model, the most important needs and technical requirements to the value of the functions are showed in Table 11.

The overall objective function value is equal to –0.901, so according to the values of functions achieved 0.8519% of the target patient satisfaction, 0.483% of the target cost and the value 0.459% of technical difficulties.

According to the results of this important decision variables Y1, Y6, Y7 that the numerical value to be allocated 1 that indicates the minimum level of achievement should be more devoted to them to achieve the maximisation of satisfaction and minimisation of cost and technical shortcomings.

Figure 2 Weight the needs of the patient

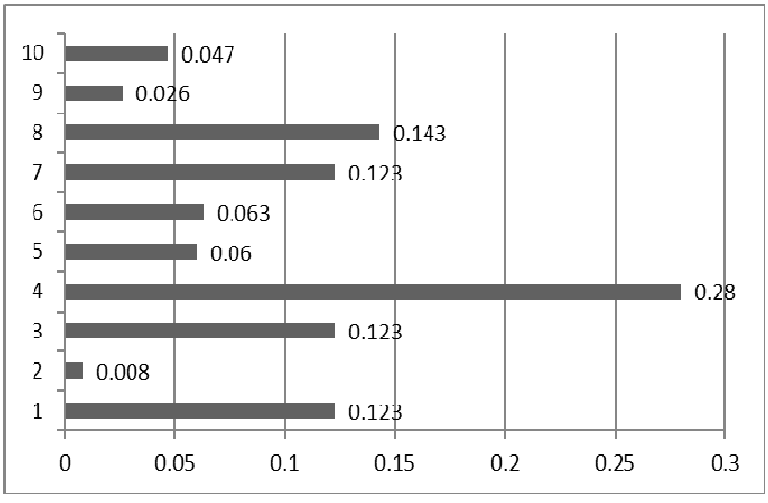

Figure 3 Weight technical requirements

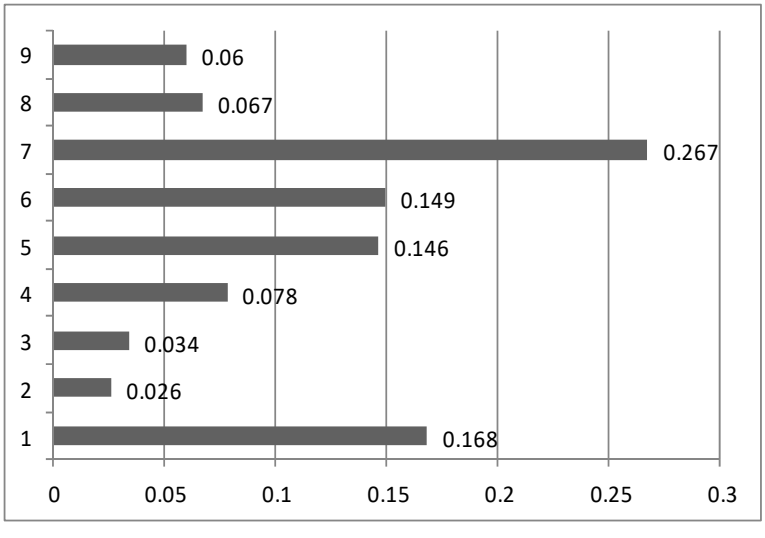

Table 11 Objective functions values of the problem

Amounts of objective function	*Objective function*
+0.8519	W
–0.483	C
–0.459	T

Table 12 The values of variables

Variables	*Values*
Y1	1
Y2	0.5
Y3	0.7
Y4	0.6
Y5	0.9
Y6	1
Y7	1
Y8	0.7
Y9	0.1

6 Conclusions

The aim of this research was modelling new service development using Kano, QFD, and Mathematical programming in an emergency department healthcare unit, therefore research presented in two phases have been able to review the issues addressed in the first phase of the problem consider and identify the needs of patients and the markets needs through the Kano model according to the concept of quality function deployment, the most important of these needs and expectations of patients regarding the level of services provided in this hospital and taking into account the technical requirements that are shared on the service in the hospital and hospitals with the other as the competitors and the relationship between each of the needs of patients with the technical requirements to invest and focus on more important and a step towards providing new services to address the shortcomings in our hospital. In the second phase for solving the problem more accurately and with modelling issues in favour of ideal planning approach and taking into account the aspirations of the technical requirements as the objective function consider the aspirations of three ideals included from the maximisation of patient satisfaction and minimise the costs and technical difficulties associated with each of the technical requirements, so that the results showed the overall objective function value is equal to –0.901, so according to the values of functions achieved 0.8519% of the target patient satisfaction, 0.483% of the target cost and the value 0.459% of technical difficulties. The results can be more comprehensive and concrete information regarding the limited purpose of the activities and functions that leads to providing better service in the case study.

The proposed method is a flexible method in which according to the capability can easily analyse the role of changes in various specialised factors, and the results of any analysis of the proposed workforce program. The limitation of this research is that this research investigates the results in a hospital in Tehran so other case studies have their own results. Also proposed method have ability to generalise for other units of the hospital in other hospitals after minor modifications.

According to the results in future study can use multi criteria decision making to prioritise factors affecting on patents needs. Also other research can use fuzzy method of

quality function deployment and compare the results by the presented model in this research.

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