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Measuring quality service: the use of fuzzy Kano model as an input for TOPSIS

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Abstract: The objective of this research is to propose an approach to assess the quality perceived by patients in a hospital. The approach deals with an integration of the Kano Model, the theory of fuzzy systems and TOPSIS technique to compare the distance from the service provided to the ideal service. The results show that the attributes closest to the ideal service are: cordiality and goodwill in attendance, attendance (information), modern equipment and commitment of the medical team. Those who have the greatest distance with the ideal solution are physical location, clean and pleasant facilities, employee appearance and clothing and efficient medical explanation. From the study of the ordering of the categories, it was possible to observe that the laboratory exams category was the service closest to the ideal service and the infrastructure category was the one that obtained the greatest distance from the ideal service.

Keywords: Kano model; fuzzy systems theory; TOPSIS technique; service industries; healthcare.

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1 Introduction

Currently, the market is becoming increasingly competitive (Carvalho et al., 2019; Kiumarsi et al., 2020; Matkovski et al., 2021; Jiang et al., 2021; Di Tommaso and Angelino, 2021). To stand out in the face of this scenario, organisations need to invest in the quality of their services to exceed customer expectations, as their permanence in the market depends on it (Guimarães et al., 2015; Senn et al., 2019; Melo and Medeiros 2021; Srivastava, 2021). In other words, organisations seek to provide the best service to their customers to remain in the market (Batista and Medeiros, 2014; Pramanik, 2016; Prihadyanti 2019; Verma and Awasthi, 2020).

According to Ma and Zhao (2012), Wahab et al. (2017) and Guimarães Junior et al. (2020), assessing quality in the service sector is a task with a certain level of complexity, related to the characteristics of service activities, since customer satisfaction can be determined, in most cases, by intangible and subjective factors. When it comes to quality of service in the public health system, the relevance of such sector stands out, due to the limitations of investments in infrastructure that are not financed by the government and the particularities of its target audience (Tontini et al., 2012; Abdolmaleki et al., 2020). Thus, hospitals need quality assessment approaches that identify the needs of their patients, aiming to satisfy their expectations and consequently the organisation's strategic objectives.

Lacerda et al. (2021) state that the use of a quality assessment tool in the public health service is necessary to prioritise areas for improvement. Thus, the following research problem is proposed: How do users of the public health service assess the perceived quality of the service provided by hospitals? Thus, this paper aims to propose an approach to evaluate the quality perceived by patients in a hospital located in

Northeastern Brazil, using the Kano model integrated with the fuzzy systems theory and the TOPSIS technique. The proposed approach stands out for its originality about the collection instrument, which, unlike traditional approaches, this search halves the number of questions in the collection instrument since only functional questions are used.

To identify the attributes of the service, in relation to how they can satisfy the needs of customers, the Kano model was used (Kano et al. 1984). However, alone, it does not consider the peculiarities of the characteristics of the evaluation of quality in service. For this reason, the Kano model will be worked together with the Theory of fuzzy systems (Zadeh, 1965) in order to approach human judgment, in which everything is a matter of point of view (Simões and Shaw, 2007). Finally, the TOPSIS technique (Hwang and Yoon, 1981) will be used to compare the distance from the service provided to the ideal service (Silva et al., 2021). That is, how much the organisation needs to improve to have a perfect service (Avikal et al., 2020).

This research is original because identify and analyse the important attributes for customers in the provision of services using fuzzy systems theory, to reduce the subjectivity of the customer's perception with the TOPSIS technique, to compare the distance from the service provided to the ideal service. As result as, achieving a competitive advantage in the market and customer satisfaction.

To highlight the relevance and innovation of the theme, a search was carried out in two databases, the Web of Science (WoS) and Scopus (on December 10, 2021) using the keywords 'fuzzy Kano model' and 'TOPSIS' (technique for order performance by similarity to ideal solution). In the Scopus database for the keyword 'fuzzy Kano model', 89 scientific productions were found since 2007, with fluctuations over the period. The highest number of 13 publications on the subject occurred in 2020, in the first year of restrictions imposed by COVID-19, followed by 2019, with 12 publications. China is the country at the top of publications, with 35, followed by Taiwan with 14, India with 11 publications and Iran with 11 and Hungary, Japan, and Turkey with 3 publications. Among the most cited papers, Lee et al. (2008) (116 citations), Lee and Huang (2009) (111 citations), Ayodele et al., (2018) (98 citations), Chen and Ko (2009) (85 citations), Chen and Ko (2008) (66 citations). It was possible to observe that papers published in the last five years have a considered number of citations as in Shokoohyar et al. (2021) (2 citations), Jain and Singh (2020), (39 citations), Beheshtinia and Azad (2019) (24 citations), Ayodele et al. (2018) (98 citations) and Ilbahar and Cebi (2017) (26 citations).

The same survey was carried out on WoS. The survey provided 113 documents since 2007, some in common with Scopus. The numbers regarding the publication were close to those found in the Scopus database, 24 publications on the subject occurred in 2020, followed by the year 2019, with 15 publications. The number of publications by country was like that found in Scopus (China: 45 publications, Taiwan: 17 publications, Iran: 11 publications, India: 11 publications and Hungary, Italy, Japan, and Turkey: 5 publications each). Among the most cited papers, Li et al. (2009) (86 citations), Lee et al. (2008) (85 citations), Llinares and Page (2011) (82 citations), Lee and Huang (2009) (78 citations), Ayodele et al., (2018) (77 citations). It was possible to observe that paper published in the last five years have a considered number of citations as in Violante and Vezzetti (2017) (43 citations), Ayodele et al. (2018) (77 citations), Beheshtinia and Azad (2019) (23 citations), Jain and Singh (2020) (34 citations) and Li and Zhang (2021) (2 citations).

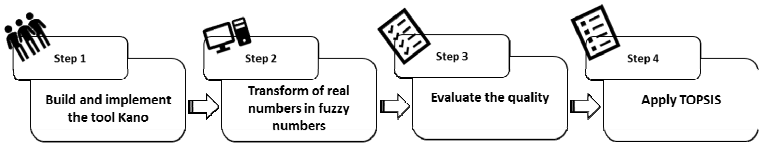
Searching for the keyword 'TOPSIS' involves a large amount of research (10,662 publications in the WoS database and 11,977 publications in the Scopus database). Mainly from 2008, when the technique began to be widely used. In this way, from the

analysis of the database, it is possible to infer that the proposed approach is somewhat innovative about its research topic. Analysing the citations, we see that there is a growth over time until 2020, showing the interest that this subject has aroused in other areas of analysis, and accentuating the innovative power of research.

2 Methods

This approach assesses the quality of the service based on the results obtained by the functional issues of the Kano model, through the diffuse operators. After the quality assessment, the TOPSIS technique will be used to organise the categories of attributes in relation to the ideal service. Figure 1 shows the research steps, from the construction of the approach to the ordering of the attribute categories.

Figure 1: Proposed approach



The steps of the proposed approach for assessing quality in services are described below.

2.1 Step 1: Build and implement the tool Kano

The Kano model aims to classify the attributes of quality, from the intersection of functional and dysfunctional issues (Avikal et al., 2020). In this work, we sought to work only on the model's functional issues to identify customer satisfaction for a given attribute present in the service.

2.2 Step 2: Transform of real numbers in fuzzy numbers

This step consists of two phases, as described below:

- Phase 1 – Transformation of linguistic terms into a fuzzy number

  After data collection, a triangular fuzzy number is proposed for each linguistic term, identified in the survey as 'very satisfied', 'I would like it to improve a little more', 'indifferent', 'I can accept that it is this way' and 'dissatisfied ', according to Table 1.

  The fuzzy numbers must be based on the scalar assessment in which it would best represent the range of each linguistic term, these in turn are described in the questionnaire responses defined through the reference set. In this approach, the triangular fuzzy number was chosen since the number has a better representation of customer preferences in each linguistic term and degree of relevance in the range of [0.1].

- Phase 2 – Use of fuzzy operators in attribute data and quality assessment.

  After the collection, the data referring to the linguistic variables will be fuzzified, for that purpose it is necessary to use three aggregation properties according to the equations (1, 2 and 3).

$$X*(a,b,c)=(X*a;X*b;X*c) \tag{1}$$

$$(a,b,c)+(a_1,b_1,c_1)=(a+a_1,b+b_1,c+c_1) \tag{2}$$

$$\frac{a,b,c}{X}=\left(\frac{a}{X},\frac{b}{X},\frac{c}{X}\right) \tag{3}$$

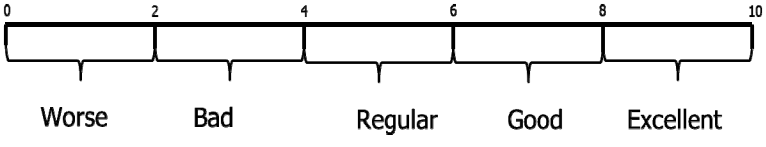
Table 1 Linguistic terms in the fuzzy environment adopted in the proposed approach

Linguistic term 1	*Scale*	*Fuzzy*
Number		
Dissatisfied	1	(0; 1; 3)
I can accept that it is that way	2	(1; 3; 5)
Indifferent	3	(3;5;7)
I would like it to improve a little more	4	(5;7;9)
Very satisfied	5	(7;9;10)

2.3 Step 3: Evaluate the quality

As described, the triangular fuzzy number is represented by (a, b, c) this being the values of the linguistic terms and X the number of individuals of each linguistic variable by category of attribute. To assess the quality figures obtained from the fuzzification, a scale was developed considering the parameter b according to Figure 2.

Figure 2 Quality assessment scale by parameter b



- If parameter ‘b’ is between 0 and 2.0 the quality assessment is considered to be terrible, the customer is dissatisfied with the service provided
- If parameter ‘b’ is between 2.1 and 4.0, the quality assessment is considered to be bad, although the quality is considered bad, the customer accepts that the service is provided in this way
- If parameter ‘b’ is between 4.1 and 6.0 the evaluation is considered to be regular, the customer is indifferent with the service provided
- If parameter ‘b’ is between 6.1 and 8.0 the quality assessment is considered good, however the customer wants the service provided to be improved a little more

- If parameter 'b' is between 8.1 and 10.0 the quality assessment is considered excellent, the customer is very satisfied.

2.4 Step 4: Apply TOPSIS

After the fuzzification process and consequently the quality assessment process in a fuzzy environment, it is necessary to apply the TOPSIS technique in a fuzzy environment to discover the real situation of the provision of the evaluated service in relation to an ideal performance service and independently evaluate each alternative. Therefore, it is necessary to follow four phases.

- Phase 1 – Ordering of categories: at this stage it is necessary to assign to all linguistic variables the optimal solution (A+) and the negative solution (A–). For A+, will be assigned the linguistic term with the highest value and for A– it will be assigned the linguistic term with the lowest value as shown below.

$$\begin{cases} A^{+} = (7,9,10) \\ A^{-} = (0,1,3) \end{cases}$$

- Phase 2 – Calculate the Euclidean distances of the service provided in relation to the ideal service ($d^{+}(V_{ij};\ A_j^{+})$) and the negative solution($d^{-}(V_{ij};\ A_j^{-})$) for each criterion *j*. This distance according to Chen and Tsai (2000), Wang and Lee (2007) and Silva et al. (2021), can be calculated by equation (4) below.

$$\begin{cases} d^{+}(V_{ij};A_j^{+}) = \sqrt{\frac{1}{3}\left[\left(a_1^{+}-a_1\right)^2+\right)\left(a_2^{+}-a_2\right)^2+\left(a_3^{+}-a_3\right)^2\right]} \\ d^{-}(V_{ij};A_j^{-}) = \sqrt{\frac{1}{3}\left[\left(a_1^{-}-a_1\right)^2+\right)\left(a_2^{-}-a_2\right)^2+\left(a_3^{-}-a_3\right)^2\right]} \end{cases} \tag{4}$$

When finding the Euclidean distance it is possible to visualise how far the linguistic variable is from the optimal solution and the negative solution.

- Phase 3 – Calculate the sum of these linguistic variables: this sum is given by the sum of all the linguistic variables of each category of the attribute in order to discover the global evaluation of that category and by the sum of all variables to find the global evaluation of the service. Therefore, it is necessary to use the equation (5).

$$\begin{cases} S^{+} = \sum_{j=1}^{n} d^{+}\left(V_{ij};A_j^{+}\right) \\ S^{-} = \sum_{j=1}^{n} d^{-}\left(V_{ij};A_j^{-}\right) \end{cases} \tag{5}$$

- Phase 4 – Calculate the ordering (C_i): to determine the real situation of the evaluated service in relation to an optimal performance service. These values must be in the range (0.1), where the closer to 0, the farther from the ideal solution the service will be and the closer to 1, the closer to the ideal solution the service will be. The ordering calculation can be performed from equation (6) below.

$$C_i = \frac{S_i^-}{S_i^+ + S_i^-} \tag{6}$$

Thus, it is possible to know the distance that each linguistic variable is from the ideal service and which categories of attributes are best placed in the ranking.

The use of the TOPSIS technique linked to the Kano model in a fuzzy environment has already been applied in several works such as Shafia and Abdollahzadeh (2014), Wang and Lee (2007), Chien and Tsai (2000), Chen and Lin (2012) and Avikal et al. (2014).

3 Results and discussion

Currently, Brazil has one of the largest public health systems in the world. This system ranges from the simple outpatient care service to organ transplant surgery services, where the service is guaranteed to be provided in a comprehensive, universal and free manner for all citizens of the country (Ministry of Health, 2015).

Thus, to validate the proposed approach, this research was carried out at Hospital Getúlio Vargas (HGV), a reference institution in the state in the sector of Orthopedics. This hospital is a member of SUS in Brazil and offers various services such as outpatient, urgent, emergency, transplants, surgeries and hospitalisations. HGV has 2,555 employees, attending approximately 2,000 emergency cases and 800 surgeries per month. The Hospital has 476 beds, 17 rooms in the operating room.

3.1 Step 1: Build and implement the tool Kano

The Kano model aims to classify the attributes of quality in five dimensions such as Must-be (M), Attractive (A), One-dimensional (O), Indifferent (I) and Reverse (R), using the functional and dysfunctional issues. In this work, the proposed approach aims to evaluate the quality of the service provided and not to classify the quality attributes. In this way, functional questions will be used to assess customer satisfaction when a given attribute is present in the service.

In Phase 1, an interview was conducted with managers of the HGV Medical Clinic sector, to identify the attributes that should be worked on in the research. Given these interviews, the researchers identified the necessary attributes to assess the perception of quality of each respondent, as shown in Table 2.

The interview with managers in the HGV medical clinic sector identified four categories of attributes, which are: Attendance, Infrastructure, Laboratory exams and Aspect of hospitalisation.

In Phase 2, a questionnaire divided into two parts was prepared. In the first one, we tried to identify the sociodemographic profile of the researched. Based on the attributes identified in the first phase, the second part of the questionnaire was elaborated, containing 20 functional questions adapted from the Kano model. In this second phase, the questions were formulated indicating the respondent's feeling about the provision of the service. In order to facilitate the respondents' understanding of the response alternatives, Interval Scales ranging from 1 to 5 were used. The five points were ordered as follows:

1 Dissatisfied

2 I can accept that it is this way

3 Indifferent

4 I would like it to improve a little more

5 Very satisfied.

Phase 3 corresponds to the application of the questionnaire at HGV. In order to resolve any doubts regarding the completion of the questionnaires, the interviews were conducted directly by the researchers of this research. The sample consisted of 40 people who were receiving the service in the medical clinic sector at HGV.

Table 2 HGV categories and attributes

Categories	*Attributes*
Attendance	Attendance (information)
	Time between arrival and attendance
	Attention to patients
	Clear guidance on hospitalisation
	Everyone's involvement
Infrastructure	Clean and pleasant facilities
	Ease of hospital facilities
	Employee appearance and clothing
	Physical location
	Sufficient numbers of doctors
	Modern equipments
	Adequate infrastructure
laboratory exams	Cortez attendance
	Performing exams quickly
	Performing exams without rework
	Cordiality and goodwill in attendance
Aspects of Hospitalisation	Efficient medical explanation
	Medication provided
	Commitment of the medical team
	Patients aware of their health problems

3.2 Step 2: Transform of real numbers in fuzzy numbers

With the results of the application of the questionnaires carried out among 40 patients interviewed at the HGV, the proposed approach was started. The process of applying the approach begins with the transformation of linguistic terms into fuzzy numbers. It follows with the transformation of the real numbers obtained from the respondents' responses to the fuzzy environment, the fuzzy numbers for such linguistic terms can be

seen in Table 1. Then the questionnaire responses were transformed using the fuzzy operators in the attribute data according to Table 3.

3.3 Step 3: Evaluate the quality

In this step, the evaluation is performed using the data referring to the attributes by means of the fuzzy triangular numbers, according to Table 3.

First, the five attributes of the service category will be analysed. The information from the satisfaction assessment in terms of fuzzy numbers, showed that the attribute Attendance (information) presented the triangular number (6.9; 8.9; 9.9). For this attribute, it is possible to conclude that the quality evaluation of the studied attribute is considered excellent since the parameter 'b' of the fuzzy triangular number is very close to the linguistic term 'I can accept that it is that way'.

Table 3 Transform of real numbers in fuzzy numbers

Categories	*Attributes*	*Fuzzy triangle*			*Attribute evaluation*
		a	*b*	*c*	
Attendance	Attendance (information)	6.9	8.9	9.95	Excellent
	Time between arrival and attendance	6.4	8.4	9.7	Excellent
	Attention to patients	6.15	8.15	9,575	Excellent
	Clear guidance on hospitalisation	6.5	8.5	9.75	Excellent
	Everyone's involvement	6.75	8.75	9,875	Excellent
Infrastructure	Clean and pleasant facilities	5.75	7.75	9.35	Good
	Ease of hospital facilities	6.6	8.6	9.75	Excellent
	Employee appearance and clothing	5.975	7.95	9.4	Good
	Physical location	5.75	7.75	9.05	Good
	Sufficient numbers of doctors	6.55	8.55	9,775	Excellent
	Modern equipments	6.85	8.85	9,925	Excellent
	Adequate infrastructure	6.4	8.4	9.65	Excellent
Laboratory exams	Cortez attendance	6.8	8.8	9.9	Excellent
	Performing exams quickly	6.7	8.7	9.85	Excellent
	Performing exams without rework	6.95	8.95	9,975	Excellent
	Cordiality and goodwill in attendance	6.75	8.75	9.85	Excellent
Aspects of hospitalisation	Efficient medical explanation	5.95	7.95	9,425	Good
	Medication provided	6.15	8.15	9,575	Excellent
	Commitment of the medical team	6.85	8.85	9,925	Excellent
	Patients aware of their health problems	6.4	8.4	9,675	Excellent

The attribute 'time between arrival and attendance' presented a fuzzy triangular number (6.4; 8.4; 9.7) and was rated as excellent. The attribute 'attention to patients', represented by the fuzzy number (6.15; 8.15; 9.57), was considered to be excellent since the parameter 'b' is between 8.1–10.0. Regarding the assessment of the quality of care in relation to the attribute 'clear guidance on hospitalisation' (6.5; 8.5; 9.75), the attribute was rated as excellent. The attribute 'everyone's involvement' whose fuzzy triangular number is (6.75; 8.75; 9.87) was considered excellent.

All the attributes of the attendance category were considered to be excellent, which analysed their degree of order in relation to the other categories in the next chapter. The next seven attributes studied are part of the infrastructure category. The attribute 'clean and pleasant facilities' was rated as good. The quality assessment for the attribute 'ease of hospital facilities' (6.6; 8.6; 9.75) was considered excellent.

The quality assessment according to the study of parameter 'b' for the attribute 'Employee appearance and clothing' (5,975; 7.95; 9.4) was considered good. According to the central parameter of the attribute 'Physical location' (5.75; 7.75; 9.05), the quality assessment for the studied attribute was considered good. The quality assessment in relation to the attribute 'sufficient numbers of doctors' represented by the fuzzy triangular number (6.55; 8.55; 9.775) was considered excellent. The evaluation of the attribute modern equipments (6.85; 8.85; 9.925), was considered excellent.

As for the quality assessment of the attribute 'Adequate infrastructure', represented by the fuzzy triangular number (6.4; 8.4; 9.65), as excellent. In the 'infrastructure' category, three attributes were considered good among them: 'clean and pleasant facilities', 'employee appearance and clothing' and 'physical location' and the remaining four were rated as excellent. The global quality index for this category will be applied in the next topic.

The laboratory exams category was studied using four attributes that will be described below. For the attribute 'Cortez attendance', whose fuzzy number is represented by (6.8; 8.8; 9.9) the central parameter was evaluated as excellent. For the attribute 'Performing exams quickly', represented by the fuzzy number (6.7; 8.7; 9.8), the quality assessment according to parameter 'b' is excellent. The attribute 'Performing exams without rework' (6.9; 8.9; 10) was considered excellent. As for the quality evaluation of the attribute 'Cordiality and goodwill in attendance', represented by the fuzzy triangular number (6.75; 8.75; 9.85), it was considered as excellent. In the laboratory exams category, all attributes were classified as excellent.

The last category to be studied is the aspects of hospitalisation, in which it was divided into 4 attributes studied below. The first attribute studied was the 'efficient medical explanation', represented by the fuzzy triangular number (5.95; 7.95; 9.425). For this attribute, the quality assessment was considered good. The quality assessment related to the attribute 'medication provided', whose fuzzy triangular number (6.1; 8.1; 9.6), was considered excellent.

The quality assessment referring to the attribute 'commitment of the medical team', being represented by the fuzzy triangular number (6.85; 8.85; 9.925) was considered excellent. The evaluation of the last attribute 'patients aware of their health problems', was considered as excellent, this variable can be represented by the fuzzy triangular number (6.4; 8.4; 9.675). It is worth mentioning that in the aspects of hospitalisation, only the attribute 'efficient medical explanation' was considered good, the other three had an excellent evaluation. To complete the application of the model, it is necessary to

determine the distance between the service provided and the perfect service that can be viewed in the next step.

Table 4 Euclidean distances of the HGV linguistic variables

Categories	*Attributes*	$d^+ (V_{ij}. A_j^+)$	$d^- (V_{ij}. A_j^-)$
Attendance	Attendance (information)	0.0866025	7.264583
	Time between arrival and attendance	0.5196152	6.8461668
	Attention to patients	0.7361216	6.6376609
	Clear guidance on hospitalisation	0.4330127	6.9297066
	Everyone's involvement	0.2165064	7.1388754
Infrastructure	Clean and pleasant facilities	1.0874282	6.2967584
	Ease of hospital facilities	0.3570714	6.9972018
	Employee appearance and clothing	0.9152641	6.4540201
	Physical location	1.158663	6.1975129
	Sufficient numbers of doctors	0.3897114	6.9715045
	Modern equipments	0.1299038	7.222664
	Adequate infrastructure	0.5299371	6.8298975
Laboratory exams	Cortez attendance	0.1732051	7.1807613
	Performing exams quickly	0.2598076	7.0970064
	Performing exams without rework	0.0433013	7.3065182
	Cordiality and goodwill in attendance	0.2217356	7.1308602
Aspects of hospitalisation	Efficient medical explanation	0.9193521	6.4546011
	Medication provided	0.7361216	6.6376609
	Commitment of the medical team	0.1299038	7.222664
	Patients aware of their health problems	0.524603	6.8380218

3.4 Step 4: Apply TOPSIS

After assessing the quality of the service provided by the fuzzy operators, an attempt was made to determine the distance between the service provided, the worst service (d^-) and the ideal service (d^+), by ordering the categories of attributes using the technique TOPSIS. They were considered an ideal solution (A^+) the parameters attributed to the linguistic term 'Very satisfied', that is, the fuzzy triangular number (7; 9; 10) and as a negative solution (A^-) to the parameter assigned to the term 'dissatisfied' whose identification of the triangular number is (0,1,3).

Then equation (4) was used to calculate the values of Euclidean distances, using fuzzy triangular numbers for linguistic variables, thus finding the distance of the service provided in relation to the ideal solution ($d^+ (V_{ij}, A_j^+)$) and the negative solution ($d^- (V_{ij}, A_j^-)$) in each linguistic variable 'j' used to assess the quality of the service provided at HGV. Table 4 shows the distances calculated for each linguistic variable in the HGV.

In the analysis of the values of Euclidean distances d+ e d- the shortest distance to the ideal solution can be concluded is 0.0433013 and the longest distance is 7.3065182. The attributes that are closest to the ideal service are:

1 cordiality and goodwill in attendance in the laboratory exams category

2 attendance (information) in the attendance category

3 modern equipments in the infrastructure category

4 commitment of the medical team in the category aspects of hospitalisation.

Still analysing the attributes, those who have the greatest distance with the ideal solution are:

1 physical location in the Infrastructure category

2 clean and pleasant facilities in the Infrastructure category

3 employee appearance and clothing in the Infrastructure category

4 efficient medical explanation in the aspects of hospitalisation category.

After calculating the Euclidean distances of the linguistic variables, it is necessary to use equation (5), in order to find the sum of the distances of the S and S- linguistic variables, that is, the global assessment of the service provided. The values found for S = 9.5678676 and S- = 137.65465.

The last step in the ordering process using the TOPSIS technique corresponds to the ordering calculation itself. This calculation can be performed using equation (6). In Table 5 it is possible to view the ordering of the linguistic variables studied.

Table 5 Ordering of attribute categories

Categories	*Ordering value*	*IGQ*
Attendance	0.945886	0.935011
Infrastructure	0.911366	
Laboratory exams	0.976267	
Aspects of hospitalisation	0.921597	

The ordering of attributes is given by the distance from the studied variable to the ideal service, it is worth noting that this distance varies in the range of 0 to 1 and the closer to 1, the closer to the ideal service will be the studied variable. From the study of the ordering of the categories of the attributes it was possible to observe that the category laboratory exams (0.976267) was the service closest to the ideal service and the category Infrastructure (0.911366) was the one that obtained the greatest distance from the ideal service. The categories attendance (0.945886) and aspects of hospitalisation (0.921597) obtained better results than the Infrastructure category and worse than the laboratory exams category, thus ranking 2 and 3 respectively in the ordering of the categories using the TOPSIS technique. The IGQ for the evaluation of HGV was around (0.935011) with a maximum value of 1. Through the three steps performed, it was possible to establish the ordering between the categories studied based on the degree of approximation of the alternatives with the ideal positive solution and the ideal negative solution.

These results converge with the results of the work developed by Souza et al. (2020), which aimed to assess the quality of services provided by basic health units in northeastern Brazil. The authors found that aspects related to tangibility and reliability, items assessed in the infrastructure and aspects of hospitalisation category, are the ones

that most needed to be prioritised. Barbosa Junior et al. (2018) and Andrade et al. (2019) confirm that the reliability dimension stands out as a critical priority.

The studies carried out by Smith and Smith (2018) and Gama et al. (2019) agreed with the results obtained in this research. For the respective authors, the dimension of responsiveness, items evaluated in the laboratory exams and attendance category, stands out as a critical priority, different from the results obtained in this research, where the categories were very well evaluated. According to Lacerda et al. (2021) the perception of the quality of service provided by the health sector has dynamic changeability, due to the user's own situation. Thus, it is necessary that the evaluation of the quality of the service provided by the sector is constantly carried out.

4 Conclusions

Over time, organisations in general have become concerned only with their costs and the factors that surround them as the main source of their efforts to reduce it. As a result, the objective is to increase your profits and guarantee your survival and permanence in the market. However, it is a limited thought to address separate costs of quality since cost is also considered an attribute of quality. In the context of hospital services, it could not be different.

It is evident the importance of providing services provided in hospitals as it is a complex task because it meets each specific type of service with its pre-defined standards and procedures. In addition, it becomes an even more difficult activity as it is inserted in a scenario with limited spending and investments.

The quality of services in hospitals should be measured through the people who directly benefit from the service (patients), and those who handle and apply the service (employees). The difficulty lies precisely in measuring the quality of these services.

Measuring quality in service is an arduous activity, due to the close relationship with consumer satisfaction. This satisfaction is subjective, varying as to the opinion of each patient due to a series of factors intrinsic to the service provided and even to the patient himself.

Given the context, this research applied an approach to assess the quality perceived by patients in a hospital located in northeastern Brazil and could see interesting results, seen in the previous chapter, that help the organisation in improving the service provided.

In addition, the research also set out to try to find the distance between the service provided and the service that would be ideal. Through the results of this approach, the managerial implications may unfold in understanding, through patients' assessment, the context in which their service is embedded and consequently devising strategic plans to reduce the gap between the actual performance of their service and the ideal service.

Among the strategic plans, some:

- Reorganisation of internal processes to improve their logistics.
- Implementation of tools that assist in decision making, ensuring greater accuracy and speed in the service provided.
- Faster and more effective assistance with the help of reducing bureaucratic policies.
- More personalised care according to each patient, linked to a more complete follow-up that makes the patient feel safer and more comfortable.

There is a range of strategic plans, subtle or not, that can be drawn up by organisations in general, in the case of the study by hospitals, to improve their services with the aim also of maintaining a good image in the market. For the implementation of improvements, hospitals need to develop integration and motivation tools to involve all employees, at all hierarchical levels.

In this environment, the proposed approach had the main function of directing the hospital to meet its demand. It is also necessary to have an internal policy related to quality management to strengthen the ties in the relationship between its patients, as well as the permanent and systematic exchange of information to capture the real expectations, suggestions for improvement, defects and/or failures with the patients. patients being treated.

Finally, it was observed that the approach proposed by the research is easy to put into practice, since it is already known the main attributes that satisfy the customer and what they expect from an ideal service. This approach directs and guides managers to achieve improvements, which can be incremental or not, in the short, medium, and long terms. Therefore, the search for quality of service must be a primary guideline for managing a hospital efficiently and effectively.

The present study brought some of the contributions of the academic literature on the investigated theme. It was considered relevant and current studies that brought a significant contribution to the advancement of this research and innovations within the context, assisting in the discussions and adding value to the work. The results allowed to help better understand consumer behaviour to improve the service provided in organisations considering the attributes that are most relevant to users.

Within the limitations and difficulties of this work, one can consider a gap in the literature with the use of this integrated approach for improving the service provided in organisations that deal with users' health. In addition, it is interesting to report that the study is applicable to any region and organisation, so it would be interesting to expand the sample to other locations and institutions. With this, there is one more limitation and, at the same time, a proposal for future work.

The suggestions for future research aim at continuing the studies to enhance the discussions in theory and practice, understanding and analysing the different perspectives of the results. The application of this study in other sectors and regions in order to evaluate the viability of changes and improvements that can be made can be some of the suggestions for further work.

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