Identification of patient requirements using Kano model and data mining

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Abstract:

Background:

Lean healthcare is one of new managing approaches putting the patient at the core of each change. The first step of Lean approach is to identify what the value is for the patient. In this perspective, this paper intends to identify requirements/expectations/needs of patient using Lean tools and then analyse results by data mining techniques for a better understanding of the patient perception of quality.

Purpose:

This paper represents an exploratory study to understand the perception of quality attributes within Moroccan public hospitals.

Materials and methods

This paper proposes an integrated methodology of lean healthcare and data mining in the aim of identifying patient's requirements. For that, a Kano-based questionnaire is firstly applied to identify patient needs. Then, questionnaire results are analysed using data mining tools to extract information.

Results

In the Moroccan context, the first priority concerns the availability of physicians and health products, reduction of waiting time and minimization of errors related to prescriptions and diagnostics.

Keywords: Healthcare service, Lean, Data mining, Kano model, questionnaire, public hospital.

1. Introduction

Today's challenging healthcare sector requires the use of new management approaches that place the patient at the core of each change. Satisfying the patient requires a good understanding of its requirements and expectations. The principal question is about the comprehension of the manner the quality is perceived among patients. for that, we interrogate patients on the importance that they attribute to different quality features in healthcare. Based on Kano model, this study aims to identify the most important quality attributes and classify them according to the patient point of view. This prioritization of attributes is essential to improving the quality of care since it helps improving the operational performance and guides the development phase of the improvement plans and assists even decision making of healthcare reforms. This paper is structured as follows: the first part represents the background of our study in the healthcare sector. The second part shows the interest of combining the two concepts. The third represents the integrated methodology. Results are then discussed and conclusions drawn.

2. Background of the study

In recent years, healthcare place high importance on services quality, which is recognized as the key determinant of patient's satisfaction [1]. Under constraints of limited resources, the healthcare sector requires a good governance of existing means to ensure a high quality of care. Lean approach is used in that context in the aim of reducing every activity that adds no value to the patient. The first step of every lean methodology is to identify what is the value is in the eye of the patient and what is necessary to create it [2]. A good determination of the patient needs is one of the cornerstones of success for a Lean methodology. Therefore, the value should be determined in a fairly high level [2].

The Kano model is one of the most powerful tools of Lean that helps identifying the patient needs. It's used to understand the relationship between quality features/attributes and patient satisfaction [3]. Research in the area of healthcare quality consider the patient-oriented service as a fundamental factor when establishing quality monitoring programs and sustainable strategies in healthcare [24], [25], [6]. The aim of this study is to identify the key drivers and provide guidance for enhancing quality of service using the Kano model. Previous research integrates Kano with other quality management instruments to impressive qualities of healthcare services as QFD (quality Function Development) [30], [5] in order to translate results into regular services planning [6], [7], FMEA [8], CKM (costumer knowledge management) [9]. Our paper proposes an integrated methodology gathering the Kano model and data mining techniques to a better understanding of the patient needs.

3. Methods and materials:

A Kano model-based questionnaire is used in Idrissi hospital at Kenitra. A total of 53 patients were questioned. The distribution of the sample is described in table 1. The results were analysed using data mining techniques. Satisfaction and dissatisfaction coefficients were calculated and the impact of personal criteria (age, gender, scholar level and salary) on patient requirements was studied.

3.1. presentation of the Kano model:

In the past, customer satisfaction was seen as a *one dimensional construction* [3]: The higher the quality of the attribute, the higher the customer's satisfaction and vice versa. This way of thinking changed with the introduction of Kano's theory of attractive quality [10]: The relationship between the objective performance and customer satisfaction of a service attribute depends on how customers evaluate the service [10], [11]. This theory divides service attributes into five distinct categories:

- Must be attributes (Basic): Customers take them for granted when they are fulfilled; if they are not fulfilled they may become very dissatisfied.
- One dimensional attributes (Performance): Result in customer satisfaction when fulfilled and dissatisfaction when not fulfilled.
- Attractive attributes (Excitement): Absence does not cause dissatisfaction, but achievement can lead to customer delight.
- Indifferent attributes: Absence and presence are alike and does not cause dis/satisfaction.
- Reverse attributes: Result in customer dissatisfaction when fulfilled and satisfaction when not fulfilled.

The Kano model explains that the relationship between customer satisfaction and performance of a service differs between the five categories [28]. Figure 1 provides a schema synthesizing all forms of customer requirements.

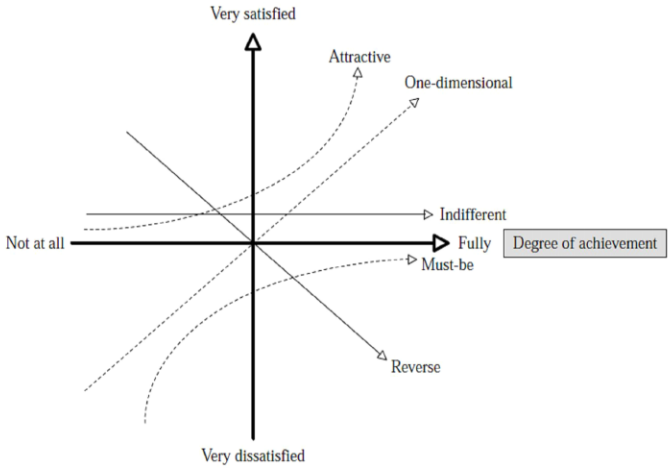

Figure1: Kano model [28]

3.2. application of the Kano method:

The questionnaire aims to identify the patient perception of quality attributes. A pair of question is formulated for each quality attribute. The patient has the possibility to evaluate the question by one of the five following options:

- I like it that way
- It must be that way
- I'm neutral
- I can deal with it
- I dislike it that way

A recent study in healthcare quality attributes divides them into seven dimensions [13]:

- Tangibility (physical facilities, equipment and appearance of personnel)
- Reliability (ability to perform the expected service dependably and accurately)
- Responsiveness (willingness to provide prompt service)
- Assurance (courtesy displayed by staff and their ability to inspire trust and confidence)
- Empathy (caring, individualized attention provided to patients by physicians and staff)
- Core medical services (the central medical aspects of the service)
-Professionalism/Competence (Knowledge, technical expertise, training, experience)

Table1: participant characteristics

Characteristic	%
Revenue	
<2000dh	57
2000-5000dh	13
5000-9000dh	19
>9000dh	11
Education	
Bac-	28
Bac+1/bac+2	15
Bac+3/bac+4	23
Bac+5 & more	34
Gender	
Female	49
Male	51
Age	
< 24	23.6
25 to 44	38.7
45 to 59	38.7
60+	2

The survey questionnaire we used consists of 60 questions in which 8 are open questions. Questions are integrated into four sections containing all quality dimensions mentioned above:

- Administrative services (Mode of payment, administrative procedures)
- Staff (Expertise and empathy factors)
- Physical factors (order, property, calm, availability of health products, tranquillity)
- External factors (location, type of sector, prices.

The majority of attributes that are used for evaluating healthcare services concerns staff. Professional credibility, competence and communication are significant factors for patients in the evaluation of service [12] Physician reputation, honesty, personal attitude, courtesy of staff, careful listening of patient's problems by the physician are also seen as important factors which can influence the patient's perception of service quality [13]. Table 2 summarizes all quality attributes of the questionnaire for the evaluation of public healthcare services classified into the seven dimensions of quality [13].

4. Data treatment

The health care sector generates a very huge data which still unusable. Therefore, there is a need of a powerful process to extract important information from this huge data. This process is KDD (Knowledge discovery in Databases). Data mining is a particular step in this process that is defined as "the application of specific algorithms for extracting patterns from data [14]. KDD is the overall process including the selection of transformation of data and also the evaluation and interpretation of Data mining results. Data mining allows extracting implicit, previously unknown, and potentially useful information from data [15].

Lean is a very useful approach for processes reengineering, but it suffers from problems in data collection and poor measures of performance [11]. A good understanding of Data is necessary to be able to better understand patient preferences and needs and better respond to them. In that context, clustering is used to identify clusters of patients based on the cause of their disease among diabetics [21], their empowerment degree among cancer patients [16], or their health state among patients with ventricular arrhythmias [22]. In the goal of improving the quality and effectiveness of healthcare, over-the-counter (OTC) healthcare products were clustered based on their temporal trends is also studied in order to detect certain outbreaks of diseases [23] and act rashly to determine the adequate treatment and to eliminate its causes. Data mining is also introduced to improve recruitment process into clinical trials [26] to predict the heart disease before it occurs [17] or the occurrence of an acute renal injury in patients after cardiac surgery and so to minimize their risk of mortality [18]. Data mining techniques were also used for healthcare processes quality improvement in the area of prediction, real time control of defects [19], and treatment of causes and effects of processes defects identified by lean tools (AMDEC, 5M…) based on a Statistical Batch based Decision Tree Learning (SBDL) [20]. All those researches show the importance of data mining in quality improvement within the healthcare sector [27]. By gathering lean healthcare principles and data mining techniques in a unique continuous improvement methodology, we're about to gather operational efficiency and well-founded managerial decisions. Our objectives are:

- Classification of features into three categories: this classification is done based on frequencies of each type of response category for all questions.
- Calculation of satisfaction and dissatisfaction coefficients: The satisfaction coefficient is calculated by adding attractive to one dimensional attributes and dividing by the total of the four categories. The dissatisfaction coefficient is calculated by adding Must-be to one dimensional attributes and dividing by the total of the four categories.

5. Results and discussion:

Among the answers given by patients concerning what could really make them satisfied, courteous staff is one of the most cited, some express their surprise if there is "just a smile" in a public hospital. Others says that the only thing that could satisfy them in a public hospital is "leaving the hospital". Figure 2 summarises the perception of patients to some attributes.

- Waiting time:

Waiting time is also an important attribute for patients. The average time of waiting from which it become unbearable is 65 minutes. Responses are distributed between 4 hours and 15 minutes. In average, the optimal waiting time is 25 minutes. Responses are distributed between 5 minutes and 2 hours. Figure 3 summarises the answers of patients.

- Errors and unnecessary moves:

According to patients, unnecessary moves is about 56%. Table 3 summarizes the degree of tolerance of medical errors among patients and the hospital sector that they prefer.

	never	sometimes	always
Tolerate ME	55%	43%	2%
Prefer private hospital	9%	36%	55%

Table 3: perception of medical errors MS and hospital sectors.

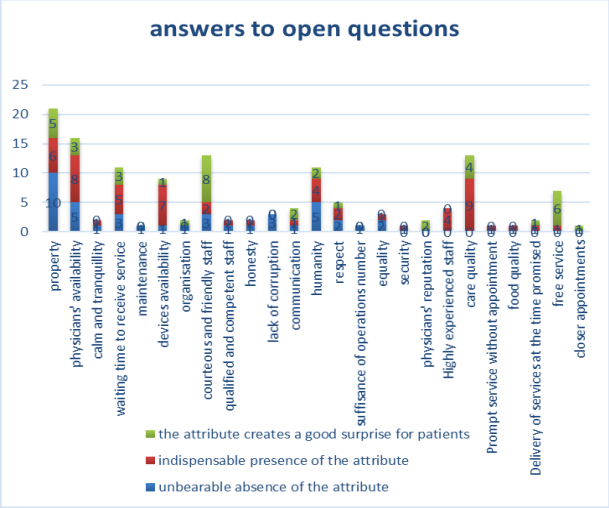

Figure 2: indispensable & unbearable attributes

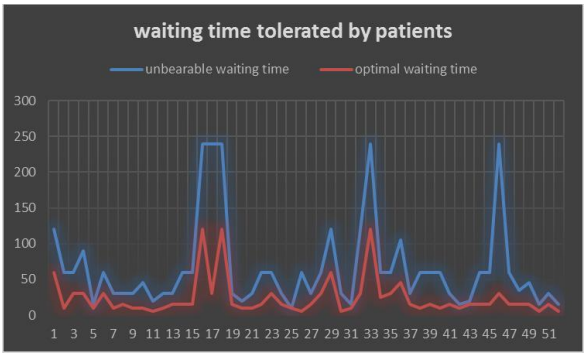

Figure3: optimal and unbearable waiting time

According to the patients' perception, the quality attributes chosen are classified into three categories based on their priority rate. Table 4 presents quality attributes categories within the Moroccan public hospital.

Table4: quality attributes categories

Categories	Quality attributes
Very important	- Elimination of medical errors - Availability of physicians - Availability of medical equipment - Closer appointments - Waiting time reduction - Availability of prescribed medicines at the HP
Less	- Property - Equipment technology

important	- Comfort - familiarity with latest advances - Physicians' appearance - courtesy
Not important at all	- Equipment attractiveness - Physicians' experience - Schedule of visits - Flexibility of admissions procedures - consultation duration

The priority rate is defined as the number of persons that consider it as Obligatory, Attractive or Proportional divided by the number of persons that are indifferent to its presence or that consider it with an opposite counter.

- Impact of personal data on the requirement degree of patients:

By clustering patient according to their degree of requirement as presented in figure 4, results obtained are:

The requirement degree is proportional to the level of studies and inversely proportional to age. Revenue and gender do not impact it.

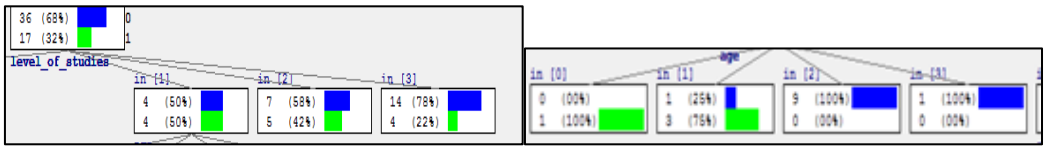

Figure4: clustering of patients

conclusion

Lean healthcare approach is important to patients only if it's based on a well-founded study of patients' priorities and requirements. Data mining techniques are very useful in questionnaire results analysis. It allows us understand what patients need from public hospitals and how they perceive healthcare quality attributes. Lean efforts must be focused on the very important category of quality attributes to meet patient requirements.

Table 2: quality dimensions and attributes of the questionnaire

Quality dimension	Attributes
TANGIBILITY	Calm and tranquillity
	Appealing materials such as brochures, magazines, newspapers, etc
	Professional appearance / dress of the staff
	Improvement of appointment made ways (on site into by phone)
	Property and order
	Quality and quantity of food
RELIABILITY	carful diagnosis of the patient's problems
	Technology of devices
	Correct diagnosis from the first time
	Maintaining accurate and neat records of the patient's medical history
	Devices availability
	Prescription of efficient, reliable and affordable medici-nes
	Physician's reputation

	Physician compliance with latest findings
	Consistency of fees and other charges
	Medical errors
Responsiveness	Closer appointments
	Delivery of services at the time promised
	Waiting time to receive service
	Prompt service without appointment
	Gap between time of getting an appointment and the appointment
	Availability of prescribed medicines at the pharmacy
ASSURANCE	Courteous and friendly staff
	Confidentiality of patient's information
	Ability of staff to inspire trust and confidence
	Thoroughness of explanation of medical condition and treatment
	Physicians making patients feel safe and relaxed in their transactions
	Honesty of physician
EMPATHY	Personal demeanour
	Taking time to listen
	Patience
CORE MEDICAL SERVICES	Availability of physicians
	Duration of consultations
PROFESSIONALISM/ SKILL/COMPETENCE	Qualified, skilled staff
	Highly experienced staff
	familiarity with latest advances in medical field
GENERAL CHARACTERISTICS	Flexibility of admissions treatment procedures
	Payment facilities and medical conventions
	Schedule of visits
	Hospital reputation
	Hospital rates
	Hospital location

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