



Modeling the Quality and Reliability Dependent Customer Satisfaction in Healthcare

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ABSTRACT

The importance of Customer Satisfaction is quite evident to any business or organization mainly because it plays a vital role in any industry. But unfortunately when it comes to health care and more specifically, hospitals, clinics and health systems, enormous rate of failure related to quality and reliability of services which is consequently followed by customer dissatisfaction is reported[1, 2]. And that's because hospital "customers" are very different than those in any other industry for one important reason, they don't want to be there. This paper aims to investigate the failure data related to Customer Satisfaction on account of quality and reliability. Number of failures and severity were used to model the quality related satisfaction, while reliability related satisfaction is modeled based upon number of visits to hospital (including its clinic), delays before receiving treatments and time interval between visits. Eventually the model is constructed on basis of quality and reliability related satisfaction values.

1. Introduction

Customers are as the matter of fact the true bosses of any Business or Organization[3]. With this concept in mind, firms came to conclusion that if they don't win the satisfaction of their customer, they will lose them to their competitors sooner or later. As a result, there has been dramatic increase in improving the customer and customer satisfaction related performance and processes[4, 5]. In this regards, companies try to gather information about customer satisfaction by launching and conducting customer satisfaction surveys[6-8]. These surveys generally try to measure the subjective experience of customer with a product or a service[9]. That means the output is an attitudinal reaction to perception of service; and is in fact a subjective evaluation rather than an objective measure which is based upon cognition and affected by emotions, values, beliefs and expectations. In spite of the fact that many critics believe that these surveys do not reflect the real thoughts and feelings of customer's experience, this method is yet the best and most applied technique for measuring, assessing and analyzing the customer satisfaction[10, 11].

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The controversial fact in health care, within past few decades, is that the customer satisfaction and related methodologies such as CRM were taken as a luxury rather than necessity for an organization but gradually according to the failure data, firms have realized that patient's perception is exactly in contrary to their beliefs. In the long run and after all tardiness, customer satisfaction techniques were applied to improve the quality and reliability of offered services. In recent years interest in measuring satisfaction with healthcare has considerably grown. The argument is that business approaches like general customer satisfaction methodologies neglect the important aspects which are unique to health care. Because of restricted health care resources and permanent rising expectations of patients, it's important to provide and supply cost effective technologies and treatments. Patient perception is one of the most important factors in assessment of performance in this domain[12].

2. Related work

Several different models have been developed to conceptualize and define the quality from customer's viewpoint and in terms of customer satisfaction[13-15]. On the other hand, several approaches have been used to identify the contributing factors related to satisfaction with health care[16-19]. However the fact is that very restricted and limited scientific based literatures have been published to demonstrate the quantification of customer satisfaction[20]. Only few works has mainly concentrated on assessment of customer satisfaction in healthcare[21]. But reliability assessment of services in healthcare sector is further scarce. There is no reported work on conceptualization of reliability, nor structured model for appraisal of quality and reliability in healthcare domain. There is consensus amongst critics that an exhaustive study which can definitively conceptualize the satisfaction with healthcare remains to be established. In this manner, understanding the stages and processes by which a user become satisfied or dissatisfied is partial and rather unaccomplished. Therefore this paper uniquely scrutinizes the assessment of quality and reliability related customer satisfaction in health care.

3. Holistic Model

Holistic approach provides a comprehensive framework for exploring the interactions between variables that affect consumer's evaluation. (Figure. 1)

This model explains that how the consumer will iterate the experience of mentioned factors. As a result consumer will be influenced not only by the whole system but also by the aspect of each factor. That means that the satisfaction is a multi-dimensional concept based upon the varied features of the care experience. Healthcare experience is associated with physical environment, appearance of human resources and finally organizational aspects of care[22,23].

Individual Characteristics are essentially sociopolitical values created by healthcare system which dramatically affect individual values, beliefs and expectations.

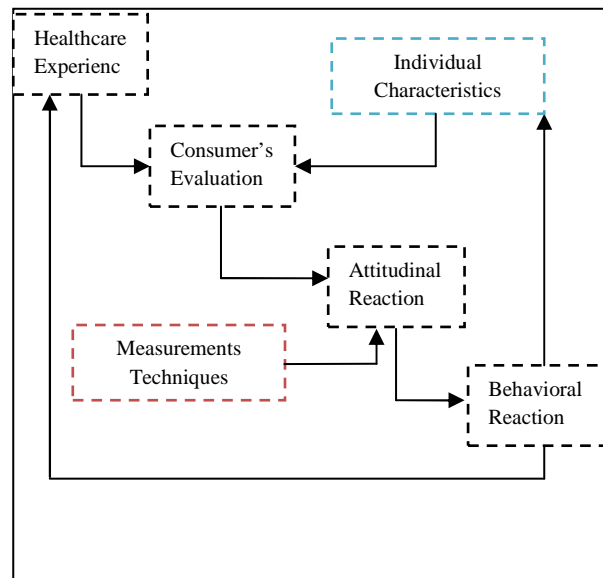


Figure 1. Holistic model of satisfaction with healthcare
(adapted from Strasser and Davis, 1991 and Strasser et al., 1993)

Besides personality of consumers, sociodemographic variables play major roles in shaping individual characteristics.

Authors believe that a new aspect which is unique to this study should be included in this model. This aspect which will be called as “Psychocultural Factor” is considerably regional based. This index indicates that the complex interaction between psychological and cultural factors in individual’s characteristic can cause great discrepancy in consumer perception of service. The major problem encountered during measurement of this index is that the consumer does not exactly know why the cultural background interfere with decision-making process and therefore this incommensurable feeling make it hard to measure and to judge this index.

Attitudinal reactions are linked to the feeling that will make consumer to express the understanding of the services as satisfaction or dissatisfaction.

One of The important outcome of the behavioral reaction phase is that consumer learns from experience which is articulated through feedback mechanisms and behavioral responses which can cause the change of healthcare provider. This means that individual attitudes are mainly altered by experiences, which consequently modify expectation and value judgments. Another important outcome of this stage is the consumer related feedback which addresses the consumer as an activist.

Compendiously, the holistic approach is an endogenous model which contains a dynamic process for determination of satisfaction. This dynamic process itself involves two feedback mechanisms.

4. Determination of satisfaction

The model applies the structural framework which is represented in Figure 1. This model characterizes the satisfaction affecting factors in three major groups:

- Individual Characteristics including: Experiences, beliefs, values, expectations, health status, sociodemographic and psychocultural factors.
- Health service delivery stimuli, including: the physical care environment; and the organizational aspects of care, the activities, attitudes, behavior and appearance of human resources.
- Quality and reliability of offered services.

Figure. 2 manifests the satisfaction factors. Factors related to quality and reliability are the most important factors affecting customer perception and satisfaction and contribute more than 45% in shaping or substituting the behavior of consumers.

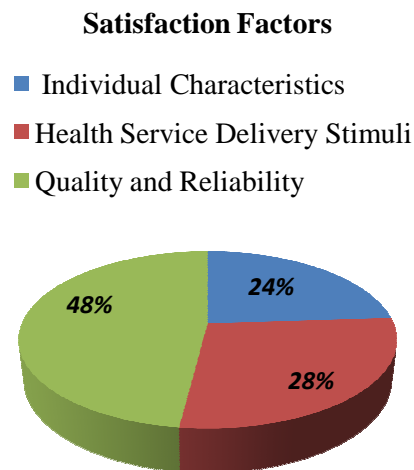


Figure 2. Factors affecting satisfaction

5. Model Structure

A. Data Collection Methodologies

To determine the level of satisfaction, secondary data were studied to extract necessary data from previous researches. Approximately 46% of these researches were found in medical journals, 32% in health services journals and 22% in social science journals. The result indicates that these studies were particularly conducted for three different purposes: by academic researcher examining an empirical related issue or for methodological studies with a theoretical basis, or by managers looking for a significant satisfaction assessment to support their decision-making procedure[24-89]. Table 1 shows the number of analysis of available data (secondary data) done in each context.

Primary data were collected through mode of survey administration and by different channels. These channels include wide range of tools and techniques. Table 2 shows the

number data collected by each method. Mixed methods imply that more than one method was applied to extract the required data.

B. Quality and Reliability Terms

In this section we focus on modeling quality and reliability satisfaction. These will be expressed in terms of Quality Satisfaction (QS) and Reliability Satisfaction (RS). Aggregation of these two indices has resulted in establishment of new index called Quality and Reliability Satisfaction (QRS).

Table 1. Secondary data analysis by context

Context	n (%)
Theoretical	18 (16)
Empirical	84 (75)
Pragmatic	10 (9)
Total	112 (100)

Table 2. Primary data collection method

Method	n (%)
Interview	20 (19)
Telephone	14 (13)
Questionnaire	36 (34)
Mail	28 (27)
Mixed	7 (7)
Total	105 (100)

To model the customer satisfaction, fuzzy logic approach was applied which is out of the scope of this article and would not be particularized. Between all different types of deterministic and stochastic approaches, the Grid search techniques have been chosen to regulate and tune different parameters in satisfaction model. The main purpose of parameter adjustment is to reach the optimal level of satisfaction values. Although, non of stochastic methods are efficient enough to be compared to Gradient Descent method, but as this study does not involve too many parameters which need to be tuned, therefore the Grid Search Algorithm is the best choice[90]. In this approach, failure data were applied to model customer satisfaction, and then a model was constructed to evaluate, predict and measure the Customer Satisfaction Index (CSI).

C. Data Sets

In this study patients are categorized in two different groups:

- *Inpatient* who occupies a bed in hospital or clinic for at least one night in the course of treatment, examination, or observation.

- *Outpatient* who is admitted to a hospital or clinic for treatment that does not require an overnight stay.

This was done because the important care delivery factors contributing to satisfaction may vary by type of care. It's remarkable that two other issues were addressed in domain: perception and evaluation of patient-doctor relationship, and the structure of system which deliver care. Studies related to these issues were analysed and examined separately.

Number of visits may vary according to the nature of required services. Revisits (caused by dissatisfaction) mainly occur when received cares and treatments does not meet the expected prerequisites. In this case, time interval between visit and revisit is a determining parameter. Based on reason of visit and the concern that a patient has, doctor begin predefined procedure in order to diagnose and treat patient. It has been proved that age and health status affect consumers' perception of care and services. Information related to patient including age, gender and health status, date and time of visit, previous records of illness, doctor involved and prescribed medicines are stored in clinic and hospital database. In this manner dissatisfaction (failure) data reported by patients can be inferred from the hospital database. By scrutinizing the database following attribute values are recognized:

- Number of visits to clinic or hospital.
- Time Interval between arrival time and treatment (hospital delays).
- Time interval between visits.

Moreover, severity ratings have been assigned to doctor's diagnosis. Aforementioned attributes were added to customer satisfaction model to assess Quality and reliability related satisfaction for each customer.

D. Perception of Quality and Reliability

Customer's evaluation of quality and reliability normally takes place in comparison context[91, 92]. That's because quality and reliability are mainly perceptual, conditional and subjective attributes and maybe understood differently by different people[93,94]. The characteristics of a service that bear on its ability to satisfy stated or implied needs. Fig. 3 describes how a patient perceives healthcare services. The perception process is a complex and multimodal process which pictures a coherent image of healthcare. In this article, quality related satisfaction has been modeled based on dissatisfaction incidences and the severity of incidences, whereas the severity of dissatisfaction has been defined based on intenseness. The severity rate shows the intensity of dissatisfaction which can be measured as a minor dissatisfaction or major one depending on the inconvenience they cause. Table 3 shows the classification and severity of factors which lead o dissatisfaction. Low levels of severity are mostly related to staff's attitude toward patients, experience of doctors and cycle of routine paperwork, where mid-level severities are mainly because of high treatment cost.

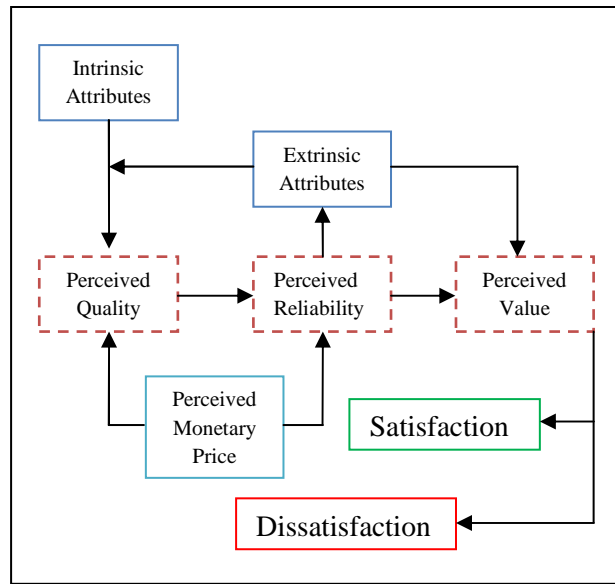


Figure 3. Patient’s perception of quality, reliability and value of services

Table 3. Dissatisfaction classification & severity

Category	Severity
Misdiagnosis or delayed diagnosis	5
Waiting for at least an hour to visit the doctor or to receive medical treatments	4
High treatment costs	3
Staff behavior	2
Routine paperwork	1

Major dissatisfactions occur when a patient has to wait more than an hour to visit the doctor or receive medical treatments or even worse when the patient condition is undiagnosed or misdiagnosed and treated for the wrong condition. The rates of severity depending on the level of inconvenience they cause are classified from extremely inconvenient to a bit inconvenient.

6. Satisfaction model

By considering frequency and severity of failure, the number of dissatisfaction incidences has been converted into incidences equivalence (IEeq) to determine the quality related satisfaction.

$$IE_{eq} = \sum_{i=1}^j t_i s_i \tag{1}$$

Where, j is the number of different inconveniences that customer experience, t_i is the number of time incidence i experience by the patient and s_i is the severity of dissatisfaction.

If the patient is quite satisfied with healthcare services, that means the number of incidence equivalence would be less than a certain limit (IE_{min}) which lead to quality satisfaction value one. If the patient is quite dissatisfied, that means the number of incidence equivalence is beyond certain limits (IE_{max}) which lead to customer satisfaction value zero. For any other values of incidence equivalence, satisfaction value may vary from zero to one. Fig. 4 presents membership function of quality satisfaction .

$$D_1 = \begin{cases} 1 & \text{if } IE_{eq} \geq IE_{max} \\ 1 - \frac{IE_{max} - IE_{eq}}{IE_{min} - IE_{eq}} & \text{if } IE_{min} < IE_{eq} < IE_{max} \\ 0 & \text{if } IE_{eq} \leq IE_{min} \end{cases} \quad (2)$$

Where, D_1 indicates the level of quality related dissatisfaction, IE_{max} maximum number of IE that makes customer totally dissatisfied and IE_{min} minimum number of IE that customer can tolerate.

$$QSL = \text{Quality Satisfaction Level} = 1 - D_1$$

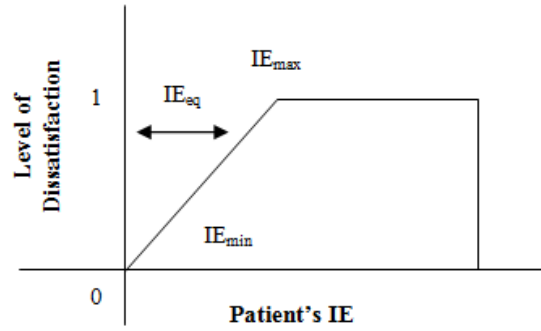


Figure 4. Membership function of quality satisfaction

Modeling of reliability related customer dissatisfaction is based on number of visits to hospital or clinic (v) and time interval between two consecutive visits (visit and revisit). Customer is dissatisfied, if time interval between visit and revisit (TI_{seq}) is less than certain value (TI_{min}). Then level of dissatisfaction would be zero if only the time interval is beyond certain (TI_{max}) (Figure. 5) Therefore the level of dissatisfaction caused by time interval between visit and revisit (ld_i) and number of visits (IR_{seq}) has been used to determine reliability satisfaction.

$$ld_i = \begin{cases} 1 & \text{if } 0 \leq TI_{seq} \leq TI_{min} \\ 1 - \frac{TI_{seq} - TI_{min}}{TI_{max} - TI_{min}} & \text{if } TI_{min} < TI_{seq} < TI_{max} \\ 0 & \text{if } TI_{seq} \geq TI_{max} \end{cases} \quad (3)$$

Equivalent number of visit will result as:

This equation determines reliability satisfaction level of a patient. Reliability values are

$$IR_{eq} = R_{seq} \left(1 + \frac{\sum_{i=1}^{v-1} ds_i}{v-1} \right) \tag{4}$$

calculated in the same way as quality values. That means the reliability satisfaction value would be one, if the equivalent number of visits (VNeq) is zero. Reliability satisfaction value is zero, if visit number is beyond certain value (VNmax). For any other values of VN the satisfaction may vary from zero to one. (Figure. 6)

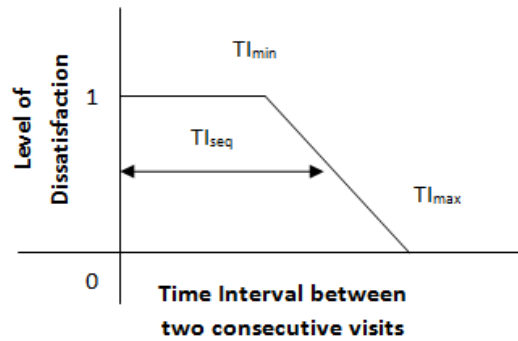


Figure 5. Membership function of reliability satisfaction

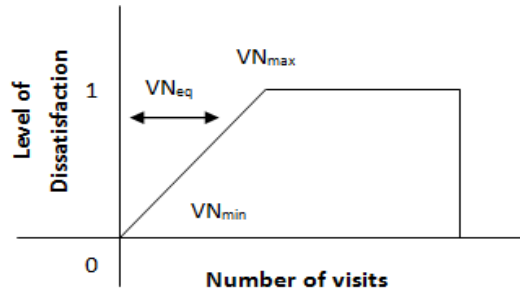


Figure 6. Membership function of reliability satisfaction

$$D_2 = \begin{cases} 1 & \text{if } VN_{eq} \geq VN_{max} \\ 1 - \frac{VN_{max} - VN_{eq}}{VN_{min} - VN_{eq}} & \text{if } VN_{min} < VN_{eq} < VN_{max} \\ 0 & \text{if } VN_{eq} \leq VN_{min} \end{cases} \tag{5}$$

Where, D₂ indicates the level of reliability related dissatisfaction, VN_{max} maximum number of visit causing the most dissatisfaction, VN_{min} minimum number of visits that customer can tolerate.

$$RSL = \text{Reliability Satisfaction Level} = 1 - D_2$$

The conclusive satisfaction level relating quality and reliability can be expressed as:

$$QRSL = QSL \times RSL$$

The equation indicates that the aggregated level of quality and reliability related customer satisfaction will only reach its maximum value, if quality and reliability values are at their own maximum rate.

7. Discussion and Conclusion

What is clear about customer satisfaction is that customers are becoming increasingly more demanding, less tolerant, and more critical when not having their expectations met. There was a time when customers were limited and literally obliged to choose specific service providers and had nowhere else to go[95]. That was mainly because the power belonged to the service providers. As a result customer satisfaction was not considered as a vital key to the process. Today customers have lots of choices on where to go, who and how to deal with. In other words the power has now shifted to the customer and companies should dispel the traditional notion that customers depend on them.

As preliminary investigations has revealed that about 48% of customer satisfaction in healthcare domain is related to the quality and reliability of received care. The holistic model was examined, altered and readjusted to assess and evaluate the perception of quality and reliability from customer's point of view. Related attributes are recognized and defined to measure the level of customer satisfaction. These values are then categorized in three different groups including (1) number of visits to hospital and its clinic; (2) Time Interval between arrival time and treatment (hospital delays); (3) Time interval between visits. An empirical model of patient's perception of quality, reliability and value of care is generated and minor and major dissatisfaction causing factors are quantified. Severity numbers describe the level of dissatisfactions caused by mentioned factors. Ultimately the model was structured by considering the frequency and severity of failure for quality satisfaction and number of visits to hospital or clinic and time interval between two consecutive visits for reliability satisfaction. The levels of quality and reliability satisfaction are then separately ascertained to determine the quality and reliability level of satisfaction.

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