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Monitoring and Reducing Patient Dissatisfaction: A Case Study of an Iranian Public Hospital

Abstract: Patients' dissatisfaction with hospital services is a major indicator for the assessment of healthcare quality. This paper proposes an innovative framework to measure and decrease patient dissatisfaction with hospital services. First, a validated and verified SERVQUAL-based questionnaire is proposed to be distributed among patients. Then, according to the collected data, the level of dissatisfaction is monitored by deploying a p-chart and a Demerit chart. Finally, in order to identify long-term improvement opportunities, an improvement index and Pareto chart have been exploited. The usefulness of the proposed framework is illustrated by the application on a case study in a public hospital of Iran. The results revealed that both the Demerit chart and p-chart are quite competent in monitoring patients' dissatisfaction and alarming out-of-control situations. In the studied hospital, food service was found to be the critical challenge that required both immediate and long-term improvements. Nurses' criteria should receive immediate improvement while long- term efforts should be devoted to hospital environment and facilities.

Keywords: patient dissatisfaction; SERVQUAL questionnaire; public hospital service; control chart; p-chart; Demerit chart; Pareto chart; improvement index

1. Introduction

Measuring and improving the quality of hospital services is a critical issue as hospitals directly deal with public health and well being of people. Unlike manufacturing products that can be assessed based on particular quality characteristics, services are intangible and consumed at the moment offered. Hence, it is merely the perception of patients about the quality of received services that remains to make judgments (Büyüközkan *et al.*, 2011). Such perceptions appear in form of patient satisfaction and dissatisfaction which are known as the main indicators of healthcare quality (Vuori, 1988). This paper aims at improving the healthcare quality through reducing patient dissatisfaction. To this end, a framework consisted of SERVQUAL and statistical process control (SPC) tools is proposed and applied to a real world example.

Due to the nature of hospital services that interact with patient's private health and body, the feelings, especially negative ones, towards hospital and its services are stronger and more subjective than any other service. A disstatisfied patient experiences a sense of frustration and bitterness (Buskirk & Rothe, 1970) and feels that caregivers have not treated him the way he deserved or needed to be. This highlights the importance of studying patient dissatisfaction to improve the healthcare quality. Studies that directly address patient dissatisfaction, as an independent entity from satisfaction, in health sector are really scarce. Ogrodniczuk *et al.* (2007) have investigated patient dissatisfaction with their psychotherapist to examine the relationship between dissatisfaction and treatment outcome. The results indicated that in most of the cases, dissatisfaction hampers patients from taking benefit of their group therapy. Rogers *et al.* (2000) have used open-ended questions to examine the sources of dissatisfaction with hospital care. Scrutinizing the answers reveals that devoting more humane value as a part of a palliative care program can reduce patient dissatisfaction. In another study (Eriksson & Svedlund, 2007) personal narrative interviews with open-ended questions were performed with a few number of patients who had received care on a hospital ward in Sweden. The results provided several expository themes as the main causes of dissatisfaction like sense of distrust, feeling of being troublesome, and deficient or lacking information. Finally, Lee *et al.* (2010) have sought for the dissatisfaction domains in an academic medical center using telephone interview. Their study suggests that unmet expectations concerning safety, communication, respect, and wait time form the major priorities of patient dissatisfaction.

In order to evaluate service quality and deal with the intangibility and inseparability inherited in service nature, Parasuraman *et al.* (1985) have proposed SERVQUAL as a viable tool which offers a comprehensive set of service domains and measures the gap between costumers' perceptions and expectations in those domains. Owing to the high reliability and comprehensiveness of SERVQUAL, it has been applied in a variety of healthcare-related fields. Several examples of such applications are as follows: radiology (Hoe, 2007), preoperative clinic (Pakdil & Harwood, 2005), patients' satisfaction in private hospitals (Zarei *et al.*, 2012), differences in patients' satisfaction between public and private hospitals (Isik *et al.*, 2011), parental satisfaction with the services of an ear-nose-throat facility (Margaritis *et al.*, 2012), mutual perceptions of patients and nurses about the nursing services (Lee & Yom, 2007), using SERVQUAL together with multiple criteria decision making tools to prioritize the importance of

dimensions and alternatives (Büyüközkan *et al.*, 2011; Altuntas *et al.*, 2012; Büyüközkan & Çifçi, 2012), using SERVQUAL together with the theory of inventive problem solving (TRIZ) for healthcare quality improvement (Altuntas & Yener, 2012), and cultural differences in healthcare systems (Lonial *et al.*, 2010). These studies have also advocated the reliability, validity, and sufficiency of SERVQUAL model for the use in different healthcare domains.

In order to monitor the behavior of healthcare system and patients, statistical control charts are known to be great tools. They can signal problems with assignable causes and provide the opportunity to take preventive actions for avoiding the dissemination of problem. For gaining a basic background on the application of control charts to healthcare and practical implications, readers are directed to (Hantula, 1995; Benneyan *et al.*, 2003). These charts have been extensively applied to health domain for a variety of applications (Carey, 2000). Amongst these applications are: monitoring the level of radiation received by the patients under treatment (Waterhouse *et al.*, 2010), decreasing in-hospital mortality intensive care unit (Koetsier *et al.*, 2012), signaling the outbreak of post eye surgery infectious (Chiam & Feyi-Waboso, 2009), control charts for healthcare surveillance (Joner *et al.*, 2008; Jiang *et al.*, 2012), monitoring rare health events such as needle stick injury (Fatahi *et al.*, 2012), reducing patient turnaround time (Kao, 2012), controlling out-of-hospital cardiac arrest patient mortality (Chen *et al.*, 2011), medical records assembly process (Canel *et al.*, 2010), and applications in nursing practices (Polit & Chaboyer, 2012). Woodall (2006) reviewed different applications of control charts in healthcare based on the type of charts deployed. More recently, he extended his previous paper in form of a book chapter (Woodall *et al.*, 2012) by providing more discussion on the control chart selection and implementation issues in health care. Another systematic review of literature about the applications of SPC in healthcare improvement is presented in (Thor *et al.*, 2007).

Given the high importance of studying patient dissatisfaction in the health sector, dearth of such studies indicates a gap in the literature that calls for extensive research to monitor and obliterate patient dissatisfaction. On the other hand, despite the growing use of control charts in healthcare industry, little research has been conducted to apply these charts to the context of patient satisfaction or dissatisfaction. According to the review of Thor *et al.* (2007) out of 97 reviewed SPC variables in healthcare, merely 3 variables were concerned with patient satisfaction. Hence, this paper focuses on addressing the problem of monitoring patient dissatisfaction by a novel

application of statistical control charts and provides solutions to thwart or reduce dissatisfaction prevalence. The study is distinct from previous papers in three ways. Firstly, it draws special attention to reduce patient dissatisfaction instead of increasing satisfaction. This is more helpful especially for public and governmental hospitals which deal with too many dissatisfied patients and a high number of complaints. Secondly, as Demerit chart has not been previously used for monitoring hospital services, this paper contributes to the literature by providing a real world example of constructing and deploying this control chart in healthcare. Thirdly, when the data from the questionnaires are collected and weakness areas are unfolded, verbal suggestions for improvements would not suffice. We have adopted a systematic approach for improvement of current situation by using improvement index. This leads to a clear and precise statement of weaknesses and specifies that the attention for improvement must be drawn to which parts and how much.

The rest of this paper is as follows. In the next section, the concepts of satisfaction and dissatisfaction, their differences, and pertaining considerations are illuminated. In section 3 the methodology of the research is described precisely. Section 4 presents the practical implementation of the proposed approach on a case of a public hospital in Iran. Section 5 is devoted to the discussion on the findings of the study, research implications, and limitations. Finally, section 6 concludes the paper and provides suggestions for future research.

2. Satisfaction Vs. Dissatisfaction

The survey of literature shows that while many studies can be found that concentrate on customer satisfaction in service sector, little research has been done on dissatisfaction especially in healthcare. This probably originates from the misconception that these two terms, satisfaction and dissatisfaction, are two sides of the same coin; but they are not. Past research has stressed that they are two different and independent entities that can even coexist (Srijumpa *et al.*, 2007; Lee *et al.*, 2010; Chen *et al.*, 2013). According to the two-factor theory developed by Herzberg and Mausner (Herzberg & Mausner, 1959) satisfaction and dissatisfaction are two distinct concepts originated from different interactions of customer and product/service. Therefore, customer dissatisfaction is not simply the opposite of customer satisfaction and high level of

satisfaction is not synonymous to low level of dissatisfaction or vice versa. This means that service providers need to devise separate plans to measure and reduce customer dissatisfaction apart from their efforts to increase customer satisfaction. Such plans should consider the roots of problem and the responsible party, delineate possible actions to be taken, and propose ways to avoid the recurrence of the problem (Peetersa & Czapinski, 1990). A quality improvement program based on control charts can fully address these issues: The charts signal the out-of-control manners; according to the analysis of the out-of-control points, the causes of the problem are identified, and consequently appropriate corrective measures are taken.

Generally, measuring dissatisfaction can be preferable to measuring satisfaction due to some motives. First, a dissatisfied patient as a person who experienced the sense of bitterness and frustration (Buskirk & Rothe, 1970) always tries to take a more active role for assessing the service in order to let his/her voice be heard. Therefore, the results are regarded to have higher validity in comparison with the ones of a satisfied patient (Williams *et al.*, 1998; Coyle & Williams, 1999). Another advantage is that while satisfaction is often defined ambiguously, dissatisfaction tends to be more specific and focused (Mulcahy & Tritter, 1998). As the third reason, since a dissatisfied patient is promised more but has received less (Buskirk & Rothe, 1970), the negative experience will remain more consistently in his/her mind and will not fade through the time (Annandale & Hunt, 1998). Therefore, studying dissatisfaction provides a better understanding of the actual situation of healthcare system and can be more helpful for quality improvement (Coyle & Williams, 1999; Eriksson & Svedlund, 2007).

3. Proposed Methodology

The research exploits a systematic approach to monitor and eliminate the variability which leads to patient dissatisfaction within specific hospital processes and offers ways to improve the current service level. To this end, several tools have been applied throughout the survey. Fig. 1 illustrates the flowchart of the proposed approach. The framework consists of three successive phases and at each phase several steps are to be taken. The tools applied at each step are represented on the right hand side of the flowchart.

In the first phase, after determining the target patients, their needs, and the services being studied, a questionnaire is designed using the SERVQUAL model. SERVQUAL is a service

quality measurement scale that was first introduces by Parasuraman (Parasuraman *et al.*, 1988) in the mid-1980s to evaluate the performance of service organizations. The application of SERVQUAL in research and practice has become widespread soon after its inception. It encompasses five major dimensions pertaining to the services providers, namely *Tangibles*, *Reliability*, *Responsiveness*, *Assurance*, and *Empathy*. Tangibles pertain to the physical facilities, equipment and appearance of personnel. Reliability is ability to perform the promised service in a reliable and accurate manner. Responsiveness indicates the willingness to help customers and provide prompt service. Assurance is the knowledge and courtesy of employees and their ability to inspire trust and confidence, and Empathy is caring and the individualized attention the firm provides its customers (Parasuraman *et al.*, 1988). Each dimension can be used for designing a number of questions aiming to measure the performance of service quality under that dimension.

The questionnaire should be designed in such a way that respondents can comprehend and answer the questions easily and in a reasonable amount of time. In order to achieve coherent outcomes to be interpreted, Likert scale can be used for designing the answer choices as a popular and reliable tool. The scale can be labeled depending on what is being measured (Li, 2013). Therefore, the objective of study, whether it is evaluating satisfaction or dissatisfaction, is more characterized by the measurement scale rather than the items in SERVQUAL questionnaire. In order to have a full range of answers for patient satisfaction and dissatisfaction, the following labels are proposed: 1-strongly dissatisfied (SD), 2- dissatisfied (D), 3- neither dissatisfied nor satisfied (NN), 4- satisfied (S), and 5- strongly satisfied (SS); where SD and D pertain to dissatisfaction and the rest are indicators of satisfaction or being indifferent. Devising a wider range of scales into the questionnaire provides future opportunities for further analysis of collected data, even though the current objective is focused on measuring dissatisfaction.

Prior to distributing the questionnaires, checking the reliability and verification are crucial considerations to be done. Reliability is the ability of measuring a concept such as the questions of a questionnaire in a consistent manner. One prominent way to assess reliability is examining the internal consistency (Spiliotopoulou, 2009). In this paper, we have measured internal consistency by applying Cronbach's alpha scale. It is a statistic proposed by Cronbach in 1951 to examine the consistency in response to the items of a measure or test scores (Schweizer, 2011). For developing questionnaires to measure patient satisfaction, application of Cronbach's alpha

has been advocated as a reliable tool since early stages of introduction (Bland & Altman, 1997). If questions measure the same thing (e.g. patient dissatisfaction), Cronbach's alpha will be equal to one. As the variance among the questions increases, alpha tends to zero. Therefore, closer values to one indicate higher reliability (Hinton, 2004). Having checked the reliability, the questions should be verified. Verification ensures that the constructed model is error-free and behaves according to the expectations (Nikakhtar *et al.*, 2011). In order to verify the designed questionnaire, a group of ideas gathered from experts should be used. For hospital services, the group can include physicians and/or nurses. According to the ideas of experts, the questionnaire should be revised by changing or omitting the questions which require amendment.

The second phase of the proposed approach is data collection. In this phase, the size of sample size should be determined based on the estimation of whole statistical society. Moreover, the details of data collection such as the type (e.g. electronic questionnaires, paper-and-pencil, etc.), timing, and the number of rounds should be specified. When these parameters are adjusted, the data can be gathered and stored.

The third phase is data analysis and improvement of the current situation. Initially, the data should be purified and prepared for the analysis by eliminating outlier and incomplete data. After that, the prevalence of dissatisfaction among patients should be assessed. We have used statistical control charts for this end. These charts are originally designed to control the variability within industrial processes (Montgomery, 2008). However, they can be also deployed to measure and control the variability and monitoring the processes in service sector. In this study, two types of control charts, Demerit chart and p-chart, are proposed to measure the patient dissatisfaction. When the charts are drawn, out-of-control points indicate that there is a specific reason, other than random variations, which caused the patients' dissatisfaction to be above or below the allowed threshold or control limits. Besides, no meaningful pattern must be observed throughout the charts. Once such points or patterns are observed, the services offered at the time of observation should be investigated and appropriate action plans should be adopted to prevent such biases for future. This phase provides valuable information about the current performance of service dimensions. Areas with higher number of out-of-control signals require to be immediately improved.

Next step is ranking the services according to their need for improvement from the perspective of patient dissatisfaction. The ranking should consider both the dissatisfaction level with each service offered and the importance or weight of that specific service with respect to overall dissatisfaction. In order to take both criteria into account, we have developed a novel improvement index which is gained from multiplication of dissatisfied patients' percentage by the Spearman's rank correlation coefficient (the dependence between each service criteria and overall dissatisfaction level). Pareto chart is a useful statistical tool to visualize the obtained ranking scores. Whilst previous phase provides on-sight information on the vulnerable areas, the results of this phase can be use to devise strategic actions for longer horizon improvement plans. The methodology ends up with the investigation of improvement opportunities in the service dimensions that are realized critical based on the Pareto chart.

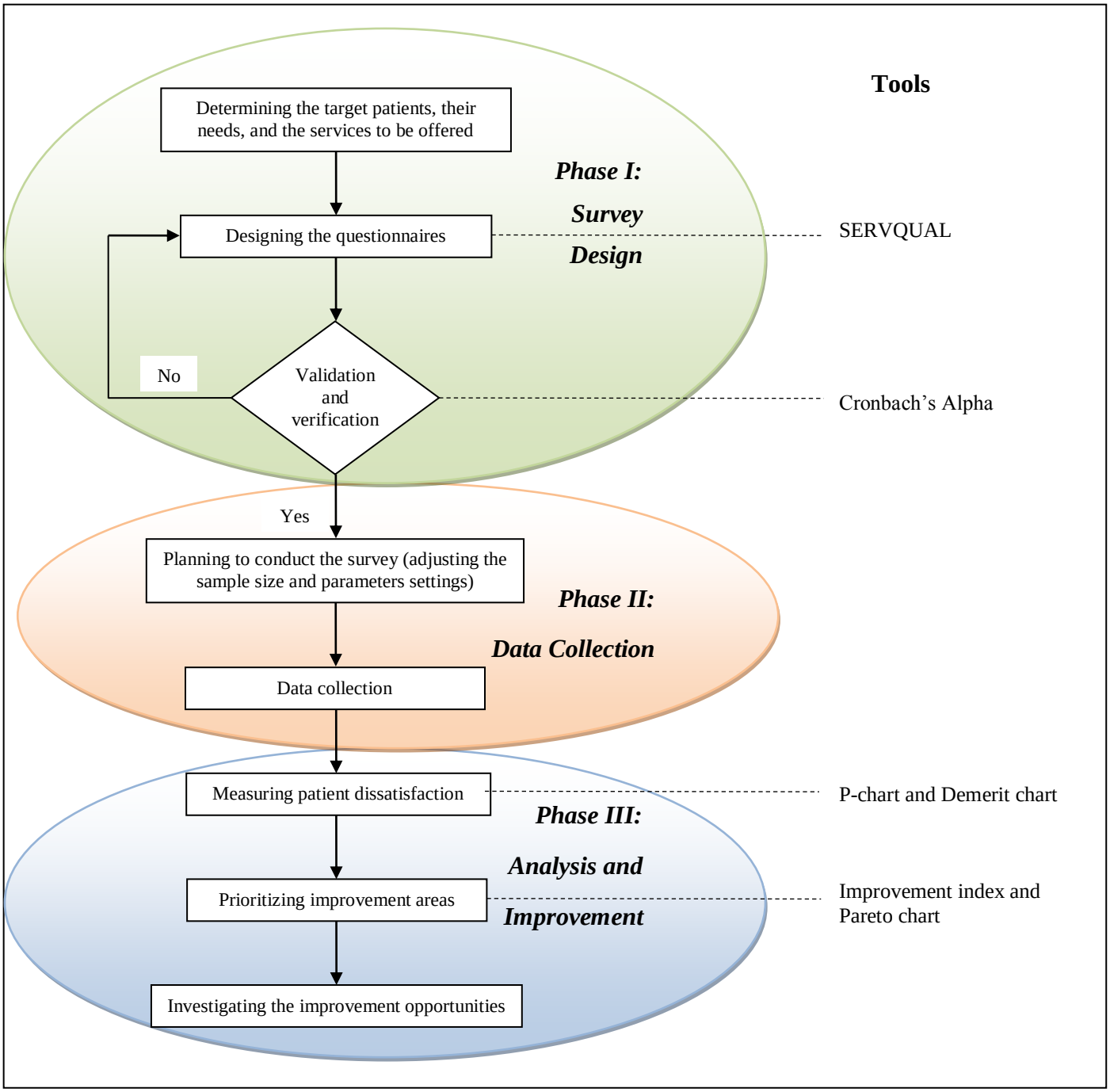

Fig. 1. The Proposed Methodology of the Research

4. Case Study

The proposed framework in section 3 was implemented on a real-world example of a public hospital in Iran to demonstrate its capability. The hospital has 550 general hospital beds and is

located in the city of Mashhad, the second largest city of the country on the northeast of Iran. The survey was conducted between June and August 2012.

4. 1. *Survey Design*

In the first step, the patients who had spent at least one night in the hospital were selected as target patients. Outpatients were excluded from the process. In order to fully utilize patients' ideas both in developing and answering to the questionnaire, we did not rely only on conventional SERVQUAL questionnaires that propose several questions for each dimension. Additionally, the patients were asked to develop their own criteria. To this end, each SERVQUAL dimension and a brief description about it is read for each patient. Then, he or she was asked to utter any criterion that is deemed to be important with respect to that dimension. Finally, gathered criteria form interviewed patients were combined with other important criteria taken from the pertinent literature. For instance, listening to patients' concerns is stated as an important criterion in the studies of (Parasuraman *et al.*, 1991; Landrum *et al.*, 2007; Teng *et al.*, 2007). After interviewing the patients, it was expanded into two separated criteria: physicians' satisfactory explanations about the disease and medications, and nurses' satisfactory answers to patients' concerns and demands. The division is probably because patients differentiate between how physicians and nurses treated them during their hospital stay. Moreover, high number of criteria associated with the intangible dimension (as can be seen in Table 1) may be the sign of more attention of patients to physical perspectives of the service rather than more virtual dimensions such as assurance or reliability.

The advantage of this procedure is that the questionnaire is customized based on the ideas of patients who are actually using the specific hospital services being studied. On the other hand, the application of SERVQUAL ensures that every dimension of the hospital services is taken into account. The latter is important since the patients, as non-expert people, might neglect some criteria corresponding to the virtual service dimensions. Totally, 82 patients were randomly selected and interviewed among which 58 were male (70.7%) and 24 were female (29.3%). After collecting their ideas, the criteria which conveyed identical meanings were combined and similar criteria were omitted from further process. The remainders were chosen for verification and reliability check.

For the verification purpose, the questionnaire was given to a group of hospital experts composed of 5 physicians and 10 experienced nurses. They were asked to revise the questionnaire by providing their opinion regarding the existing criteria. According to their views, 3 criteria were amended and 2 others were eliminated. At the end, 19 criteria were verified. These criteria are shown in Table 1. Next, Cronbach's alpha was used to examine the reliability of criteria. In this step a criterion was purposefully added to the previous criteria which measures general patients' dissatisfaction level with hospital services. It is used both as an indicator according which the internal consistencies of other criteria are evaluated and for calculating the correlation coefficient (discussed in subsection 4.3.2.). The results of reliability examination indicate that the overall Cronbach's alpha is equal to 0.926 ranging from 0.802 to 0.919 for different dimensions. The overall value reports that the criteria are highly consistent and are designed to address a single purpose (patients' dissatisfaction with hospital services). As a rule of thumb, a value equal to or more than 0.7 is regarded as satisfactory (Bland & Altman, 1997).

Table 1. SERVQUAL Criteria for the Case Study of the Research

Tangibles	Cleanness of the room, bed sheets, and blankets
	Hygiene of hospital environment
	Room facilities
	Cleanness of toilets and washrooms
	Level of Noise in the room
	Temperature and lighting of the room
	Dishes cleanness
	The adequacy of amount of food
Reliability	Nurses' skill and proficiency
	Physician's skill and proficiency
	Providing high quality food
Responsiveness	Physicians' availability
	Frequent clinical care and checkup performed by nurses
Assurance	Assuring to preserve patient's privacy during the examination
	Physicians' satisfactory explanations about the disease and medications
	Nurses' satisfactory answers to patients' concerns and demands
Empathy	Physicians' personalized attention to the patient during examination
	Nurses' communication and understanding of patient's situation
	Physicians' communication and understanding of patient's situation

After purifying and confirming SERVQUAL criteria for our case study, we modified the classification of criteria. Currently, the criteria are expressed under SERVQUAL dimensions where each dimension can contain criteria relating different hospital areas (e.g. nurses, physicians, etc). Since the ultimate end of this research is improving hospital services, it is necessary that the results clearly delineate which hospital units require improvement. To this end, the criteria are reclassified under four main schemes, namely nurses, physicians, environment and facilities, and food service, each of which connect the criteria to a certain unit or group of hospital staff. When patients' ideas are to be collected and directly used as the indicators of dissatisfaction, classifying physicians and nurses as different causes of dissatisfaction helps the respondents to make more concentrative and objective judgments (Rogers *et al.*, 2000). The reclassification of criteria is shown in Table 2.

This reclassification can be useful in two distinct ways. Firstly, when the patients, as non experts, are specifying their dissatisfaction level by answering the questions, they can fully draw their attention to the class being assessed and compare the different criteria of that class against each other. This impedes patients' confusion and results into more insightful and reliable answers to the questionnaire. Secondly, after data collection, the performance of each unit against other units together with the weaknesses and strengths within each unit are highlighted. This facilitates further analysis for finding improvement opportunities and instructively helps the managers as where to draw their attention and effort. The order of questions in Table 2 is the same as the order they appear in the questionnaire.

Table 2. Re-Classification of Criteria

Criteria	Questions (Sub-criteria)
Nurses' Criteria	1. Nurses' skill and proficiency
	2. Frequent clinical care and checkup performed by nurses
	3. Nurses' satisfactory answers to patients' concerns and demands
	4. Nurses' communication and understanding of patient's situation
Physicians' Criteria	5. Physicians' personalized attention to the patient during examination
	6. Physician's availability
	7. Physician's skill and proficiency
	8. Physicians' communication and understanding of patient's situation
	9. Physicians' satisfactory explanations about the disease and medications

	10. Assuring to preserve patient's privacy during the examination
Environment and Facility Criteria	11. Cleanness of the room, bed sheets, and blankets
	12. Hygiene of hospital environment
	13. Room facilities
	14. Cleanness of toilets and washrooms
	15. Level of Noise in the room
	16. Temperature and lighting of the room
Food Service Criteria	17. Dishes cleanness
	18. The adequacy of amount of food
	19. Providing high quality food

4. 2. Data Collection

The first step in the second phase is planning the sample size and parameters settings. In order to calculate the sample size, Cochran formula for calculating the sample size is used, as shown in Equation (1) (Montgomery & Runger, 2002).

$$n = \frac{\mathrm{N}\, \mathrm{Z}^2_{\alpha/2}\ (1-\mathrm{p})\mathrm{p}}{(\mathrm{N}-1)\mathrm{e}^2+\mathrm{p}(1-\mathrm{p})\, \mathrm{Z}^2_{\alpha/2}} \qquad (1)$$

Where N is the amount of statistical society being studied; $\mathrm{Z}^2_{\alpha/2}$ is the normal probability of the abscissa of the normal curve that cuts off an area α at the tails; e is the desired level of precision; and p the estimated proportion of an attribute that is present in the population.

In the case of the hospital under consideration, N is equal to 500, the total number of available hospital beds. Margin of error is set to 0.1 at 0.95 confidence level. Since the value of p is not known, it should be set such that the sample size is maximized and the error is minimized. It has been shown that p=0.5 is the most appropriate value for this purpose (Montgomery & Runger, 2002). By using the aforementioned settings in Equation (1), the sample size was equal to 82. It shows the number of patients that should be interviewed at each round of sampling.

The sampling was conducted randomly in two or three days per week. In each day, 82 questionnaires were distributed among the patients hospitalized in different hospital units. A paper-and-pencil self-rating questionnaire method was used. Sampling took about 1.5 months and 12 rounds of sampling were made. All the questionnaires were completed by the patients and

returned (100% return rate). No incomplete or invalid questionnaires (e.g. giving more than one answer to a question) were found. In 12 rounds of sampling, a total number of 984 patients were interviewed, out of which 660 (67.3%) were male and 324 (32.7%) were female. 132 (13.4%) interviewees were aged between 20 and 30 years, 334 (34%) were 30 to 40, 383 (38.9%) were 40 to 50, and 135 (13.7) were 50 and older.

4. 3. Analysis and Improvement

4. 3. 1. Measuring and Monitoring Patients' Dissatisfaction

Although it is true that services are intangible and less measurable than manufacturing goods, it should not hinder quality improvement efforts for services (Büyüközkan *et al.*, 2011). If the service elements, dimensions, inputs, and outputs are clearly defined, manufacturing quality control and improvement techniques can be similarly applied to service area. Statistical control charts are great tools for monitoring quality characteristics. These charts can detect any meaningful variation within the processes and signal for corrective action. Upon the type of data provided from sampling different control charts can be applied. When measuring patient dissatisfaction, each dissatisfaction preference expressed by the respondents can be counted as nonconformity. Therefore, attribute control charts that deal with nonconformities such as p-chart and Demerit chart are applicable. Such charts are quite useful for quality improvement efforts in service industries due to the nature of quality characteristics found in service practices; however their application sometimes requires ingenuity because the observability in service businesses is fairly low and such businesses do not primarily have a natural measurement system (Montgomery, 2008).

For the studied hospital, the proposed Likert scale in section 3 was divided into three classes: SD and D were considered as nonconformities. SS and S were considered as conformities and NN was deemed to be neutral. Nonconformities provided the required information to draw attribute control charts. Before drawing control charts, the collected data are organized according to the frequency of dissatisfactions observed. Table 3 shows the frequency of dissatisfied patients in each of the samples taken as well as the dissatisfaction count for each question of the questionnaire for all the samples. The frequency of dissatisfied patients for all the groups of criteria namely nurses' criteria, physicians' criteria, environment and facility criteria, and food

service criteria are also presented in gray rows throughout the table. These data are used to calculate the control limits and draw the control charts.

Table 3. Dissatisfaction Count per Question and per Sample

Questions (sub-criteria)	Sample												Count (per question)
	1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	
1. Nurses' skill and proficiency	3	5	7	9	9	4	6	5	3	4	4	5	**64**
2. Frequent clinical care and checkup performed by nurses	7	4	7	11	12	5	6	4	4	5	4	4	**73**
3. Nurses' satisfactory answers to patients' concerns and demands	8	6	8	12	9	9	10	6	4	7	8	8	**95**
4. Nurses' communication and understanding of patient's situation	6	6	11	14	12	7	9	8	8	12	8	7	**108**
Count per sample (nurses' criteria)	**24**	**21**	**33**	**46**	**42**	**25**	**31**	**23**	**19**	**28**	**24**	**24**	**340**
5. Physicians' personalized attention to the patient during examination	5	3	6	2	4	5	2	2	3	1	2	2	**37**
6. Physician's availability	7	6	6	4	6	4	3	4	7	4	5	3	**59**
7. Physician's skill and proficiency	2	4	7	6	5	5	4	3	5	4	5	4	**54**
8. Physicians' communication and understanding of patient's situation	2	3	4	6	5	4	9	7	6	7	8	6	**67**
9. Physicians' satisfactory explanations about the disease and medications	4	3	4	3	2	6	4	5	4	5	3	5	**48**
10. Assuring to preserve patient's privacy during the examination	1	1	2	3	5	3	2	4	4	2	3	2	**32**
Count per sample (physicians' criteria)	**21**	**20**	**29**	**24**	**27**	**27**	**24**	**25**	**29**	**23**	**26**	**22**	**297**
11. Cleanness of the room, bed sheets, and blankets	9	10	8	8	8	14	10	9	7	11	14	14	**122**
12. Hygiene of hospital environment	15	17	18	19	16	16	25	17	19	21	26	23	**232**
13. Room facilities	24	19	25	21	26	23	15	27	27	20	21	22	**270**
14. Cleanness of toilets and washrooms	25	22	23	20	22	23	33	24	23	26	26	24	**291**
15. Level of Noise in the room	26	25	24	35	25	18	21	18	19	21	24	22	**278**
16. Temperature and lighting of the room	27	37	21	18	12	26	20	19	7	11	11	9	**218**
Count per sample (environment and facility criteria)	**126**	**130**	**119**	**121**	**109**	**120**	**124**	**114**	**102**	**110**	**122**	**114**	**1411**

17. Dishes cleanness	35	30	18	25	19	16	17	17	24	22	11	14	**248**
18. The adequacy of amount of food	25	33	33	22	28	24	44	38	36	44	25	28	**380**
19. Providing high quality food	40	47	55	23	56	59	56	53	37	54	66	67	**613**
Count per sample (food service criteria)	**100**	**110**	**106**	**70**	**103**	**99**	**117**	**108**	**97**	**120**	**102**	**109**	**1241**
Total Count per Sample	**271**	**281**	**287**	**261**	**281**	**271**	**296**	**270**	**247**	**281**	**274**	**269**	***3289***

In order to draw a p-chart, it is assumed that the fraction nonconforming units (i.e. dissatisfied patients) follow binomial distribution and each unit (patient) is a realization of a Bernoulli random variable with parameter *p*; where *p* is the probability that any unit does not conform to the specifications. When *p* is not known, it can be estimated using observed data. To do that, *m* preliminary samples should be taken, each of size *n* (for this study *m*=12 and *n*=82). Then, the fraction nonconforming can be calculated as shown in Equation (2).

$$\hat{p}_i = \sum_{i=1}^{m} \frac{D_i}{n} \qquad i = 1,2,..., m \qquad (2)$$

Where $\hat{p}_i$ denotes the fraction nonconforming estimation and D_i shows the number of nonconforming units. Then, the average of individual samples taken is computed as shown in Equation (3).

$$\bar{P} = \frac{\sum_{i=1}^{k} P_i}{\mathrm{k}} \qquad (3)$$

Where $\bar{P}$ is the estimation of unknown fraction nonconforming *p*. Eventually, the center line and control limits of the p-chart are obtained as shown in Equations (4) – (6).

$$UCL = \bar{P} + 3\sqrt{\frac{\bar{P}(1-\bar{P})}{n \times s}} \qquad (4)$$

$$CL = \bar{P} \qquad (5)$$

$$LCL = Max\ (\bar{P} - 3\sqrt{\frac{\bar{P}(1-\bar{P})}{n \times s}}, 0) \qquad (6)$$

The p-chart for each of the four groups of criteria is plotted using the data of Table 3. The control limits are calculated according to Equations (4) – (6). The charts for nurses' criteria, physicians'

criteria, environment and facility criteria, and food service criteria are plotted using *Minitab 16* computer software and are represented in Fig. 2 to Fig. 5, respectively.

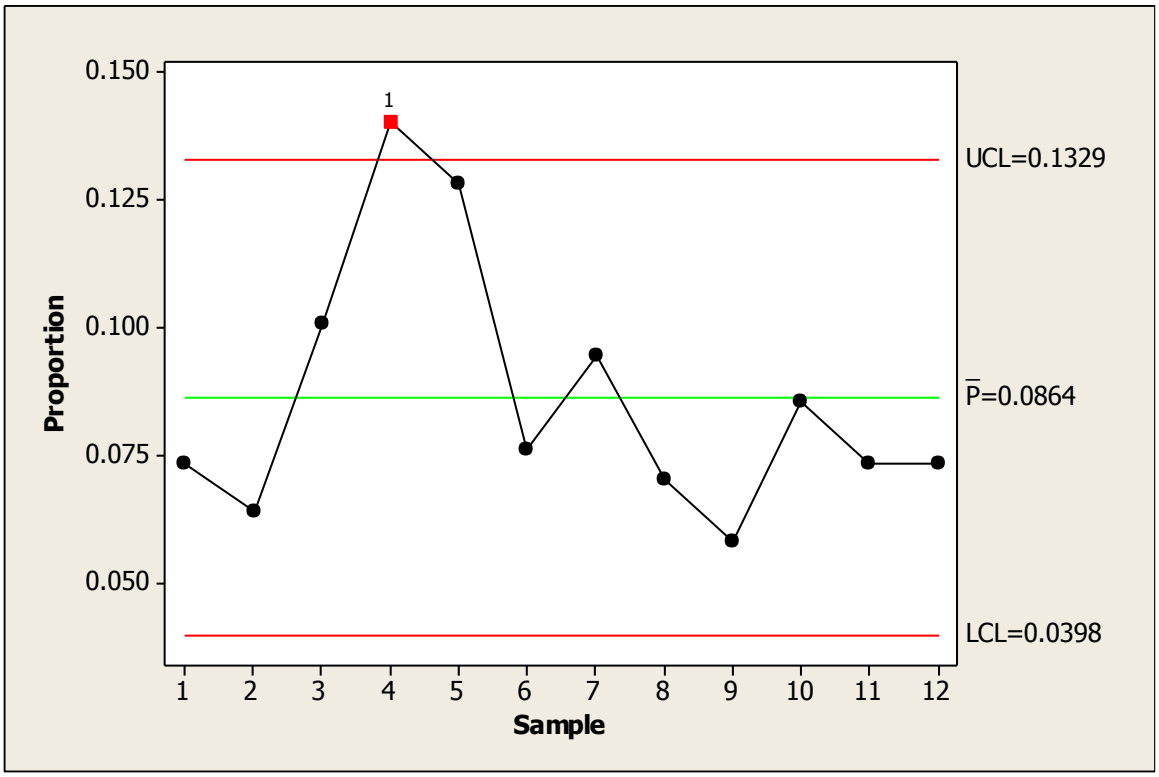

Fig. 2. P-chart of Dissatisfaction for the Nurses' Criteria

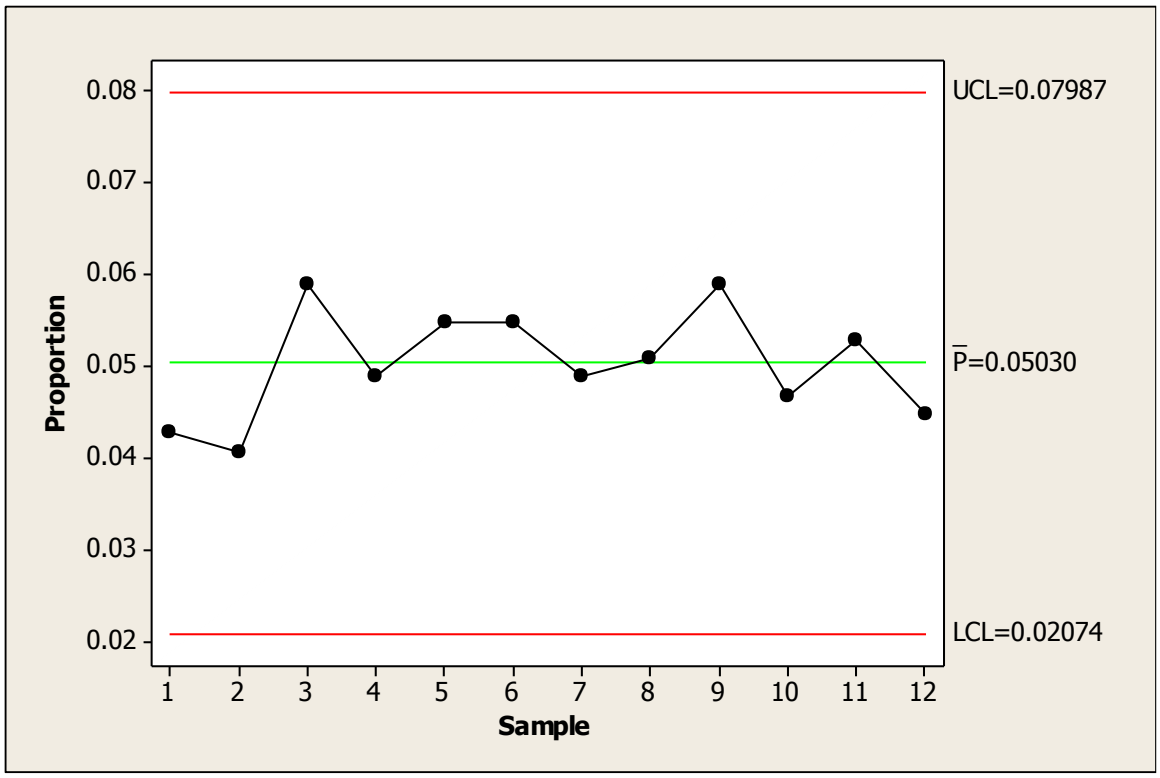

Fig. 3. P-chart of Dissatisfaction for the Physicians' Criteria

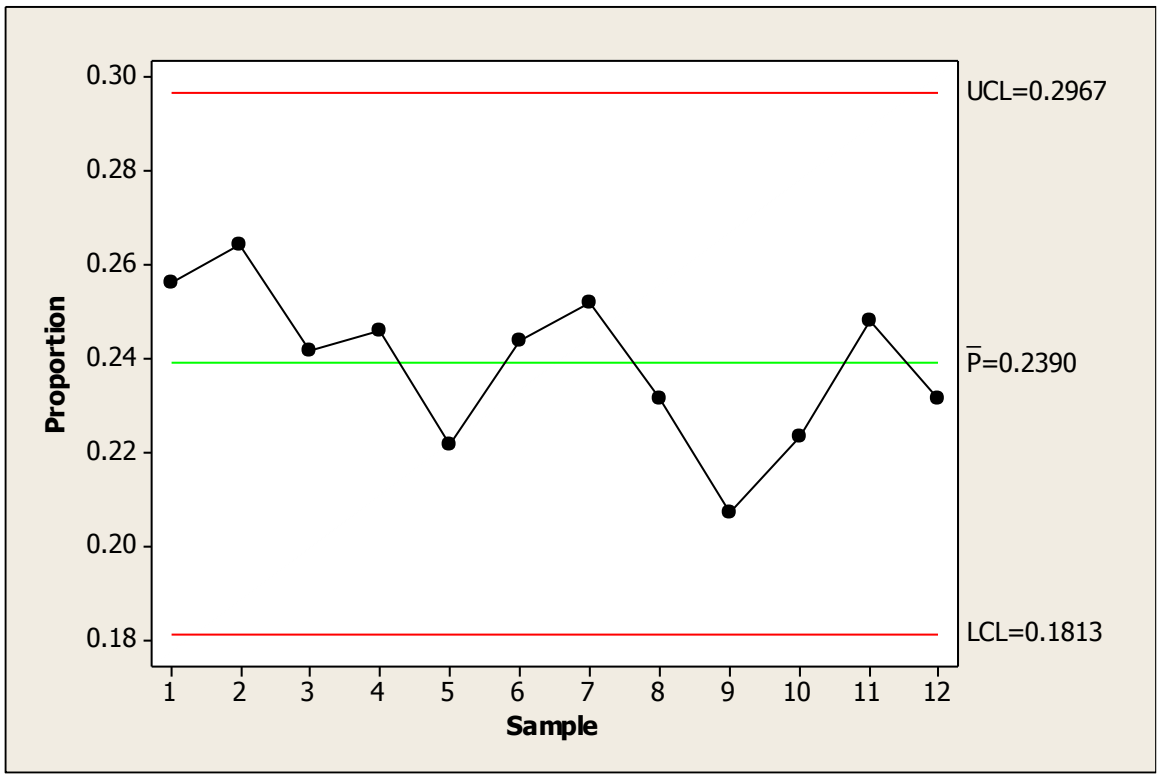

Fig. 4. P-chart of Dissatisfaction for the Environment and Facility Criteria

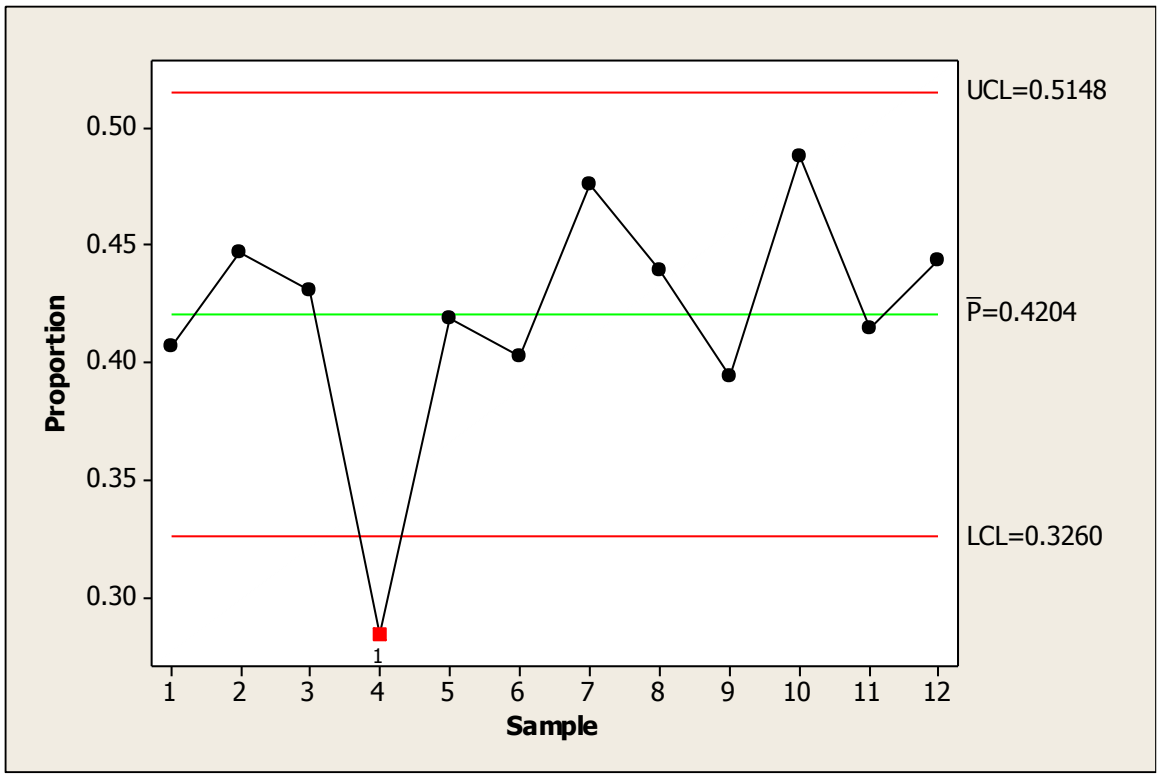

Fig. 5. P-chart of Dissatisfaction for the Food Service Criteria

As can be seen, two points plot out of the control limits, sample 4 in Fig. 2 (nurses' criteria) and sample 4 in Fig. 5 (food service criteria). Regarding the first out-of-control point, an enquiry made from the matron revealed that some of the nurses were on holiday leave on the days samples 4 and 5 were taken. The dissatisfaction could be resulted both from decreasing the number of nurses available and using less experienced nurses. Since assignable causes could be found for sample 4, the point was omitted from the chart and the control limits were recalculated. Here again, point 5 was also plotted out-of-control after redrawing the chart (new UCL = 0.1268, new LCL = 0.0362). This point can also be excluded with similar reason with that of point 4. After omitting points 4 and 5, all the points were plotted within the control limits of nurses' criteria chart and no meaningful pattern (e.g. upward or downward trends or cyclic patterns) could be observed.

About the second out-of-control point pertaining to food service criteria, investigations showed that in the day that sample 4 was taken, the hospital kitchen was undergoing maintenance and repair and the food was supplied from a restaurant outside the hospital. Therefore, the meal had higher quality than expected compared to daily meals cooked in the hospital kitchen. This

considerably reduced the food dissatisfaction level amongst the patients and caused the point to be drawn lower than the LCL. After omitting point 4 from food service criteria and revising the control limits, the chart indicate no lack of control and no systematic behavior.

Having drawn the p-charts, the same data were used to draw Demerit charts. The aim of drawing two control charts was to increase the reliability in monitoring patients' dissatisfaction by deploying different tools. It can also provide the opportunity to compare the methods in terms of performance and sensitivity. Demerit systems for attribute data (or simply Demerit charts) are especially useful when all the defects are not equally important (Montgomery, 2008). In the case of hospitals, such an assumption is often true. A mistake by a nurse in giving the right dozes of medicine could be disastrous whilst unequal amount of meals in the dishes does not have such severe impacts. One possible Demerit scheme is categorizing the questions into four classes according to their importance: A (very serious), B (serious), C (moderately serious), and D (minor). In order to define the importance of each questions the questionnaire were returned to the same group of experts used for the verification. They were asked to assign each question to a class of Demerit scheme. Then, each question was assigned to the class that had the majority of opinions. We also asked the experts to give weights to each class. For each problem, an appropriate set of weights should be determined for each class of defects according to the requirements (Montgomery, 2008). Here, the weights for the classes A, B, C, and D are respectively 10, 5, 3, and 1. When the class of importance for each question is determined, Equations (7) – (9) should be used to calculate the parameters required for plotting the Demerit charts (Nembhard & Nembhard, 2000).

$$d_i = 10c_{iA} + 5c_{iB} + 3c_{iC} + c_{iD} \quad (7)$$

$$U_i = \frac{d_i}{n_i} \quad (8)$$

$$\bar{U} = 10\bar{u}_A + 5\bar{u}_B + 3\bar{u}_C + \bar{u}_D \quad (9)$$

Where d_i is the weighted total number of Demerits in inspection unit i and c_{iA}, c_{iB}, c_{iC}, and c_{iD} denote the counts of nonconformities observed for the classes of defects A, B, C, and D,

respectively. U_i is number of Demerits per unit i. $\bar{U}$ is the center line of the Demerit chart and $\bar{u}_k$ (k = A, B, C, and D) is the average number of nonconformities per unit in each class.

The control limits to plot the Demerit chart can be obtained according to the Equations (10) – (12) (Nembhard & Nembhard, 2000).

$$UCL = \bar{U} + 3\sqrt{(w_A^2\bar{u}_A + w_B^2\bar{u}_B + w_C^2\bar{u}_C + w_D^2\bar{u}_D)/n_i} \quad (10)$$

$$CL = \bar{U} \quad (11)$$

$$LCL = Max(\bar{U} - 3\sqrt{(w_A^2\bar{u}_A + w_B^2\bar{u}_B + w_C^2\bar{u}_C + w_D^2\bar{u}_D)/n_i}\,, 0) \quad (12)$$

The data required for plotting the Demerit chart of nurses' criteria are presented in Table 4. As can be seen, the class of importance for each question is shown in the second column of the table. For each sample, the count of nonconformities is shown in a column titled 'c' and the weighted value which is the multiplication of 'c' by the weight of the class is shown in a column titled 'w'. The weighted total number of Demerits (d_i) is the summation of column 'w'. The number of Demerits per unit (U_i) is resulted from the division of d_i by the number of observations which is 82. Each U_i, shown in the last row of Table 4, is the representative of one sample in the Demerit chart of nurses' criteria.

Table 4. Demerit Chart Parameters for the Nurses' Criteria

Question	Class	Sample																					
		1		*2*		*3*		*4*		*5*		*6*		*7*		*8*		*9*		*10*		*11*		*12*	
		c	**w**	**c**	**w**	**c**	**w**	**c**	**w**	**c**	**w**	**c**	**w**	**c**	**w**	**c**	**w**	**c**	**w**	**c**	**w**	**c**	**w**	**c**	**w**
1	A	3	30	5	50	7	70	9	90	9	90	4	40	6	60	5	50	3	30	4	40	4	40	5	50
2	A	7	70	4	40	7	70	11	110	12	120	5	50	6	60	4	40	4	40	5	50	4	40	4	40
3	C	8	24	6	18	8	24	12	36	9	27	9	27	10	30	6	18	4	12	7	21	8	24	8	24
4	C	6	18	6	18	11	33	14	42	12	36	7	21	9	27	8	24	8	24	12	36	8	24	7	21
d_i		142		126		197		278		273		138		177		132		106		147		128		135	

U_i	1.73	1.54	2.40	3.39	3.33	1.68	2.16	1.61	1.29	1.79	1.56	1.65

Using Equations (10) – (12) and the data of Table 4, the Demerit chart for the nurses' criteria was plotted. The chart is shown in Fig. 6.

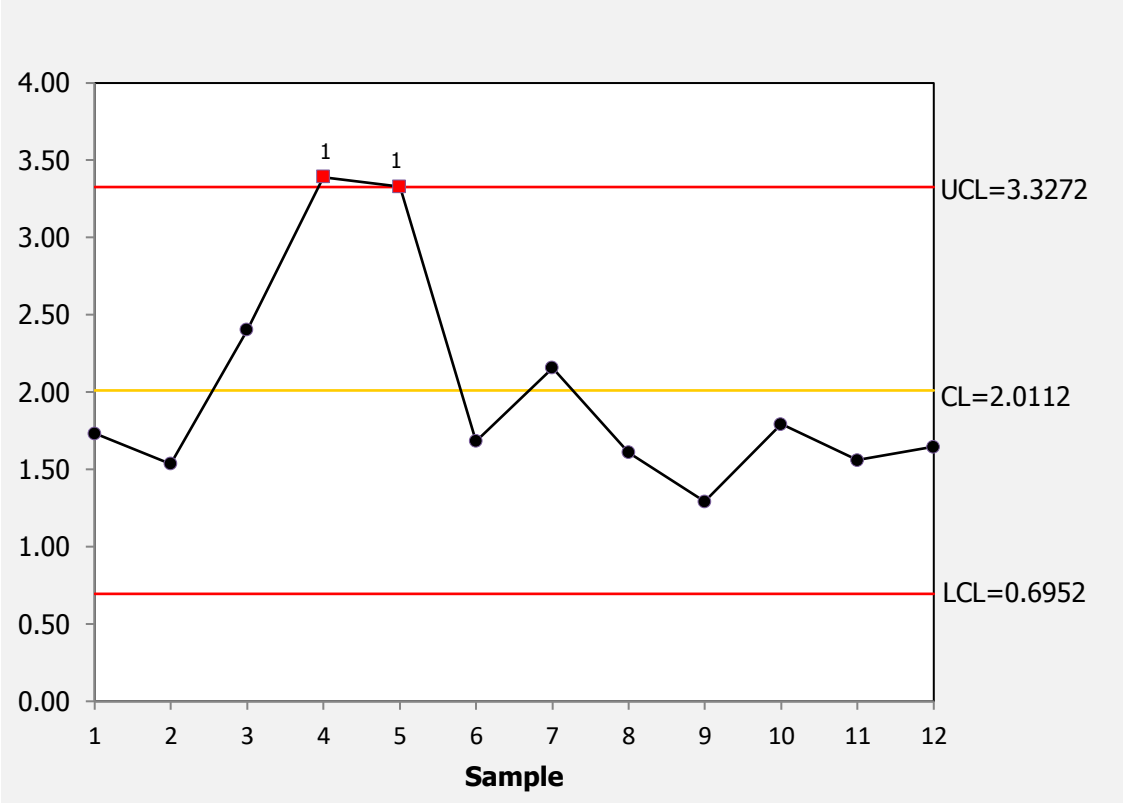

Fig. 6. Demerit Chart of Dissatisfaction for the Nurses' Criteria

The same calculations have been made for the other groups of criteria. The data related to physicians' criteria, environment and facility criteria, and food service criteria are shown in Tables 5 – 7, respectively. The Demerit chart for each group is plotted after its pertaining table. The charts are represented in Figs. 7 – 9.

Table 5. Demerit Chart Parameters for the Physicians' Criteria

Question	Class	Sample																							
		1		*2*		*3*		*4*		*5*		*6*		*7*		*8*		*9*		*10*		*11*		*12*	
		c	**w**	**c**	**w**	**c**	**w**	**c**	**w**	**c**	**w**	**c**	**w**	**c**	**w**	**c**	**w**	**c**	**w**	**c**	**w**	**c**	**w**	**c**	**w**
5	A	5	50	3	30	6	60	2	20	4	40	5	50	2	20	2	20	3	30	1	10	2	20	2	20

6	A	7	70	6	60	6	60	4	40	6	60	4	40	3	30	4	40	7	70	4	40	5	50	3	30
7	B	2	10	4	20	7	35	6	30	5	25	5	25	4	20	3	15	5	25	4	20	5	25	4	20
8	A	2	20	3	30	4	40	6	60	5	50	4	40	9	90	7	70	6	60	7	70	8	80	6	60
9	A	4	40	3	30	4	40	3	30	2	20	6	60	4	40	5	50	4	40	5	50	3	30	5	50
10	B	1	5	1	5	2	10	3	15	5	25	3	15	2	10	4	20	4	20	2	10	3	15	2	10
d_i		195		175		245		195		220		230		210		215		245		200		220		190	
U_i		2.38		2.13		2.99		2.38		2.68		2.80		2.56		2.62		2.99		2.44		2.68		2.32	

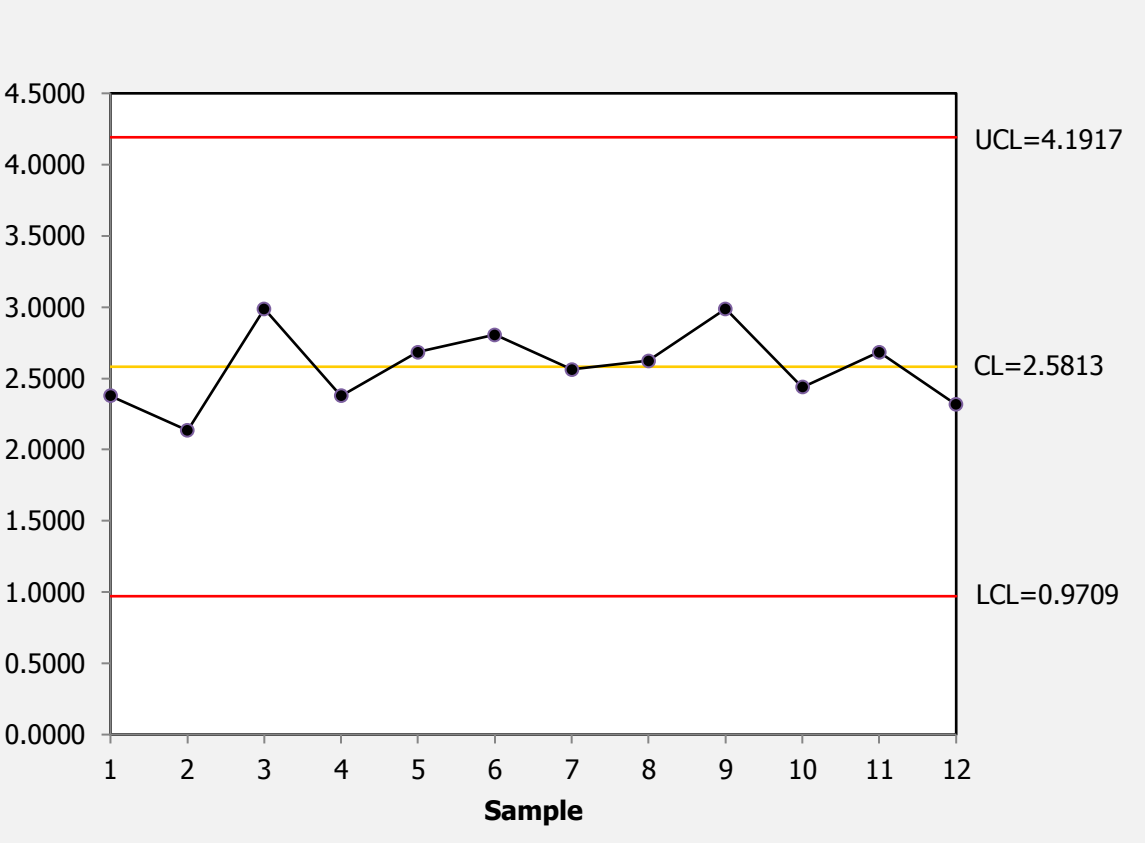

Fig. 7. Demerit Chart of Dissatisfaction for the Physicians' Criteria

Table 6. Demerit Chart Parameters for the Environment and Facility Criteria

Question	**Class**	**Sample**																							
		1		***2***		***3***		***4***		***5***		***6***		***7***		***8***		***9***		***10***		***11***		***12***	
		c	**w**	**c**	**w**	**c**	**w**	**c**	**w**	**c**	**w**	**c**	**w**	**c**	**w**	**c**	**w**	**c**	**w**	**c**	**w**	**c**	**w**	**c**	**w**

11	B	9	45	10	50	8	40	8	40	8	40	14	70	10	50	9	45	7	35	11	55	14	70	14	70
12	C	15	45	17	51	18	54	19	57	16	48	16	48	25	75	17	51	19	57	21	63	26	78	23	69
13	A	24	240	19	190	25	250	21	210	26	260	23	230	15	150	27	270	27	270	20	200	21	210	22	220
14	A	25	250	22	220	23	230	20	200	22	220	23	230	33	330	24	240	23	230	26	260	26	260	24	240
15	C	26	78	25	75	24	72	35	105	25	75	18	54	21	63	18	54	19	57	21	63	24	72	22	66
16	C	27	81	37	111	21	63	18	54	12	36	26	78	20	60	19	57	7	21	11	33	11	33	9	27
d_i		739		697		709		666		679		710		728		717		670		674		723		692	
U_i		9.01		8.50		8.65		8.12		8.28		8.66		8.88		8.74		8.17		8.22		8.82		8.44	

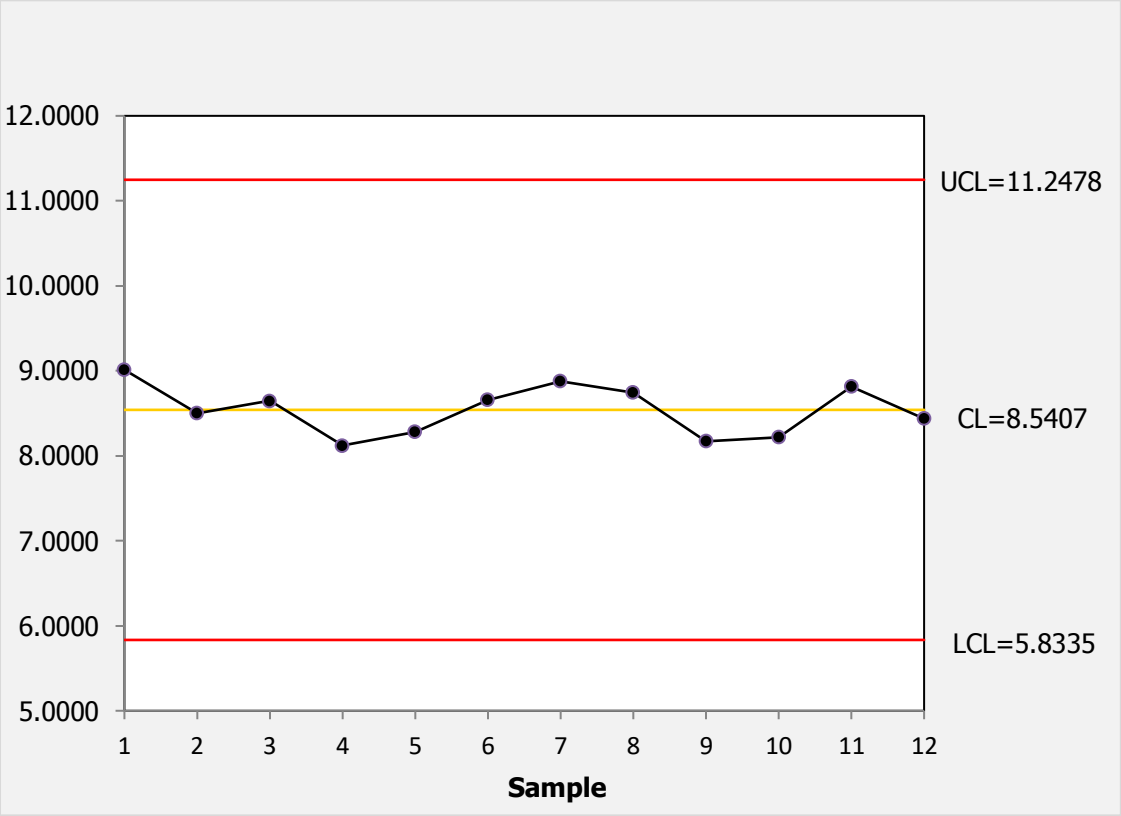

Fig. 8. Demerit Chart of Dissatisfaction for the Environment and Facility Criteria

Table 7. Demerit Chart Parameters for the Food Service Criteria

Question	Class	Sample																							
		1		*2*		*3*		*4*		*5*		*6*		*7*		*8*		*9*		*10*		*11*		*12*	
		c	**w**	**c**	**w**	**c**	**w**	**c**	**w**	**c**	**w**	**c**	**w**	**c**	**w**	**c**	**w**	**c**	**w**	**c**	**w**	**c**	**w**	**c**	**w**
17	A	35	350	30	300	18	180	25	250	19	190	16	160	17	170	17	170	24	240	22	220	11	110	14	140
18	C	25	75	33	99	33	99	22	66	28	84	24	72	44	132	38	114	36	108	44	132	25	75	28	84
19	A	40	400	47	470	55	550	23	230	56	560	59	590	56	560	53	530	37	370	54	540	66	660	67	670
d_i		825		869		829		546		834		822		862		814		718		892		845		894	
U_i		10.06		10.60		10.11		6.66		10.17		10.02		10.51		9.93		8.76		10.88		10.30		10.90	

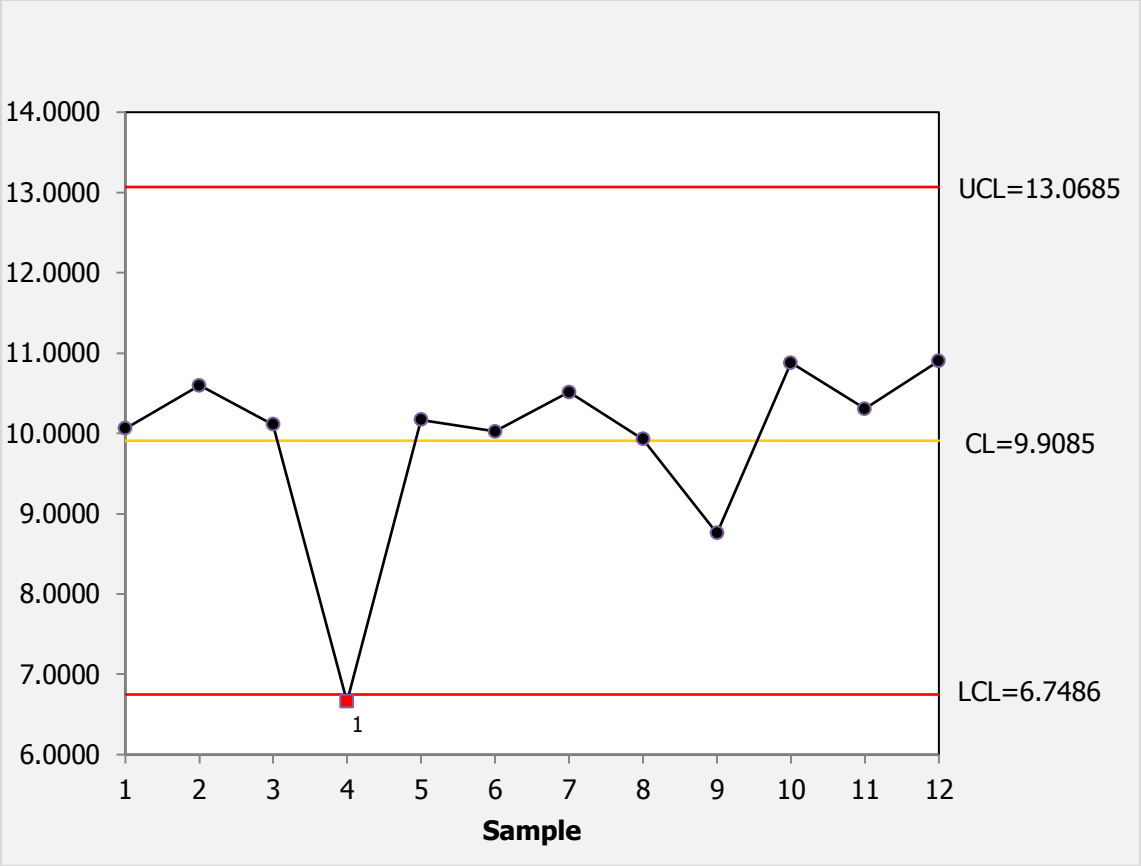

Fig. 9. Demerit Chart of Dissatisfaction for the Food Service Criteria

Totally, three points are plotted out-of-control limits, two of which are the same as the ones of p-charts pertaining to food service and nurses' criteria. The third point belongs to sample 5 of the nurses' criteria. Since assignable causes have already been found for all the three points during the investigation of p-charts, these points were omitted from the charts and the control limits were revised. All the points are plotted within new control limits and show no systematic behavior. Therefore, the control limits are accepted and the processes are deemed to be under control. In many out-of-control manners observed in service control charts, the cause of alarm can be suppressed by small measures. For instance, dissatisfactions with food and hygiene do not always imply fundamental problems. We have observed patients who were dissatisfied with food due to stains on the dishes or dissatisfied with hygiene just because of irregular emptying of trashcans. These sources of dissatisfaction can be easily uprooted by increased attention to dish washing process and timely emptying of trashcans.

By comparing p-charts and Demerit charts, it can be seen that sample 5 of nurses' criteria is initially plotted inside the control limits of p-chart while it is out-of-control in the Demerit chart (Fig. 2 and Fig. 6). This can implicate that Demerit chart is more sensitive in discovering out-of-control points. More sensitive charts usually show more false alarms; however, in this case since an assignable cause was found for the out-of-control sample, the sensitivity is apropos. Yet, more investigation is needed to validate such a conclusion for other applications of these control charts. In addition, the weights given to nonconformities by experts can influence the outcome of Demerit chart and change the situation of a certain point in the chart. In order to avoid false alarms and discover points with assignable causes more quickly, we propose that weights are adjusted only by experts who have worked within the system and are familiar with the consequences of each type of nonconformity. Such weighting highlights significant flaws while devalues unimportant ones and leads to the construction of more sensitive and sharper Demerit charts. Generally speaking, if appropriate weights are assigned to nonconformities, Demerit chart can perform more accurately in finding meaningful variations.

After omitting samples with assignable causes, if the control charts do not indicate any lack of control, the existing control limits, called trial control limits, are accepted as the process control limits and can be used for current and future monitoring (Montgomery, 2008). In some cases, the accepted control limits are unfavorable from managers' perspective and the number of complaints and dissatisfactions are still high, even though the process is statistically under control. In these occasions, using narrower control limits can force improvement in process quality. However, narrowing the limits must be exercised with care as it may cause too many false alarms and erode the trust in control chart program (Montgomery, 2008). A better solution is using other SPC tools, such as Pareto chart as in the next subsection, together with control charts to make further improvements.

4. 3. 2. Prioritizing the Improvement Areas

Whilst control charts are great statistical process control (SPC) tools to provide real time information, managers and caregivers may be interested to investigate the undergoing processes from a more long-term perspective. Making further analysis using other SPC tools such as Pareto chart along with the application of control charts can bring more insightful results and provide significant payback to the company (Montgomery, 2008). Identifying and improving weaker

areas can boost the overall organizational performance in the long run which leads to more controlled processes with less variability.

The initial step in this regard is to ascertain the degree that each criterion should be improved. In this study, we have ranked the service criteria according to a novel and easy-to-calculate measure called 'improvement index'. The index takes into account not only the importance of each criterion with respect to the ultimate goal (dissatisfaction with hospital services), but also the proportion of patients who were dissatisfied with the services. By this, the need of each area to improvement is accurately identified based on both the relative importance of that area and the frequencies of dissatisfactions observed.

The improvement index can be defined as the multiplication of Spearman's rank correlation coefficient by the percentage of dissatisfaction. Where Spearman's rank correlation coefficient is the strength of connection between each question and the overall dissatisfaction with the services offered (a question was purposefully added as explained in subsection 4.1.). *Minitab* software was used to calculate the correlation coefficient based on the results achieved from the questionnaires. The second element of the improvement index, percentage of dissatisfaction, indicates the percentage of respondents who chose 1-strongly dissatisfied (SD) and 2-dissatisfied (D) for each criterion of the questionnaire. The figures for correlation coefficient, percentage of dissatisfaction, and the improvement index for each question is presented in Table 8.

Table 8. Calculating the Improvement Index for the Criteria of the Questionnaire

Criteria	Questions (sub-criteria)	Correlation Coefficient	Percentage of Dissatisfaction	Improvement Index
Nurses' Criteria	1. Nurses' skill and proficiency	0.71	6.50%	0.046
	2. Frequent clinical care and checkup performed by nurses	0.62	7.42%	0.046
	3. Nurses' satisfactory answers to patients' concerns and demands	0.67	9.65%	0.065
	4. Nurses' communication and understanding of patient's situation	0.75	10.98%	0.082
Physicians' Criteria	5. Physicians' personalized attention to the patient during examination	0.59	3.76%	0.022

	6. Physician's availability	0.73	6.00%	0.044
	7. Physician's skill and proficiency	0.61	5.49%	0.033
	8. Physicians' communication and understanding of patient's situation	0.75	6.81%	0.051
	9. Physicians' satisfactory explanations about the disease and medications	0.66	4.88%	0.032
	10. Assuring to preserve patient's privacy during the examination	0.64	3.25%	0.021
Environment and Facility Criteria	11. Cleanness of the room, bed sheets, and blankets	0.79	12.40%	0.098
	12. Hygiene of hospital environment	0.73	23.58%	0.172
	13. Room facilities	0.67	27.44%	0.184
	14. Cleanness of toilets and washrooms	0.59	29.57%	0.174
	15. Level of Noise in the room	0.63	28.25%	0.178
	16. Temperature and lighting of the room	0.66	22.15%	0.146
Food Service Criteria	17. Dishes cleanness	0.72	25.20%	0.181
	18. The adequacy of amount of food	0.67	38.62%	0.259
	19. Providing high quality food	0.71	62.30%	0.442
overall dissatisfaction with the services offered (measurement goal)		1		

The next step is prioritizing the criteria according the achieved improvement indices. We have deployed Pareto chart to rank the criteria and identify the *critical few* areas which require immediate improvement. With respect to strategic decisions, Pareto chart is a great assisting tool that visualizes the performance of service for managers and facilitates strategic decision making. Such decisions are critically important as they are tightly interwoven to patients' satisfaction in the healthcare (Andaleeb, 2001). In order to provide a general look on all the service dimensions, the average of improvement indices for each group of criteria is taken and shown in Fig. 10. According to the results the most critical group of criteria is food service followed by environment and facility. Since most of both of the questions in these two groups of criteria pertain to tangibles, the hospital must pay special attention to this SERVQUAL dimension in order to reduce the current level of dissatisfaction.

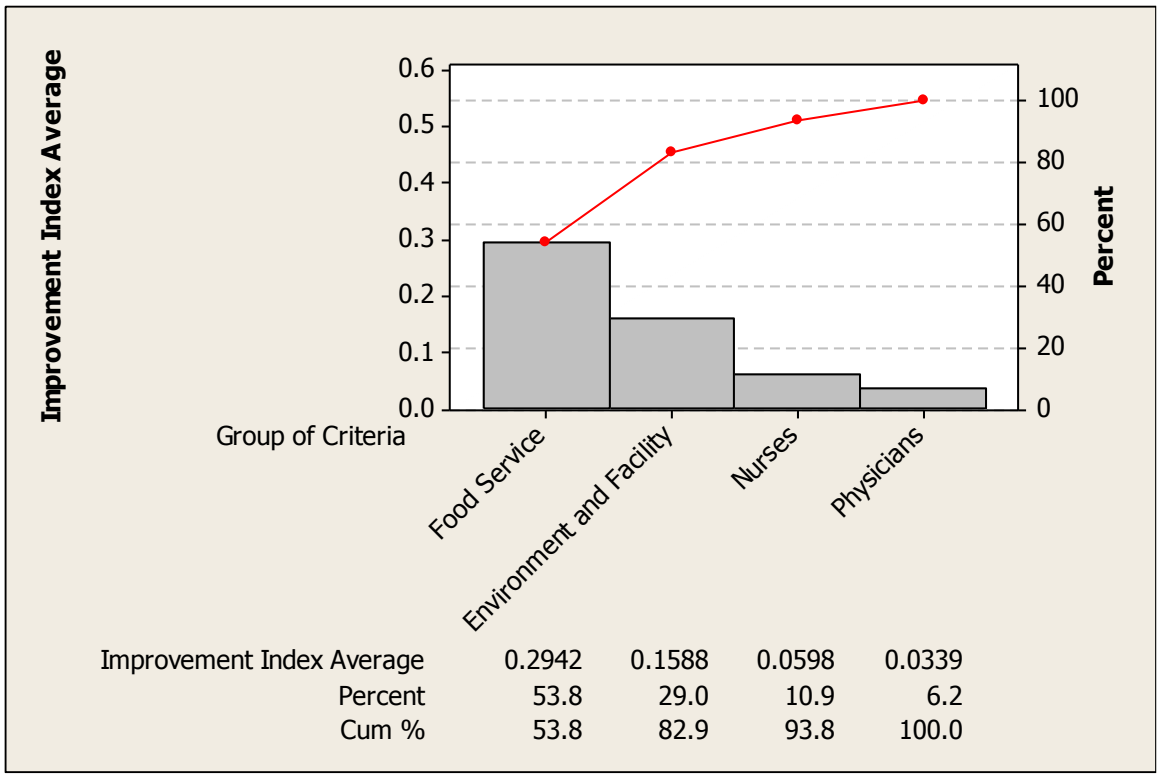

Fig. 10. The Pareto Chart of Improvement Indices for Groups of Criteria

For making long-term growth, after defining the need of each area for improvement, different strategies can be adopted. One strategy is choosing all of the sub-criteria (questions) underlying the most critical group of criteria (the sub-criteria of food service in this study) and concentrate the effort solely on them to improve service processes and hinder patient dissatisfaction. This 'picking all within the most important' strategy is quite favorable when there is a large gap in the ranking between the most critical group of criteria or SERVQUAL dimension and the second one. Another strategy is picking the most important sub-criteria belonging to the most important groups of criteria or SERVQUAL dimensions (e.g. the first two sub-criteria of food service and the first two sub-criteria of environment and facility). This 'picking several sub-important out of several hyper-important' strategy can be suitable when the gap between the groups of criteria or SERVQUAL dimensions is not relatively large.

In the case of our hospital, managers decided to adopt the second strategy and concentrate on the quality and the adequacy of food (the first sub-criteria of food service) as well as improving room facilities, reducing the noise level, and cleanness of washrooms and toilets (the first sub-

criteria of environment and facility). Generally speaking, no rule of thumb can be proposed to make such managerial decisions. They involve considering several factors: the amount of resources (e.g. time, money, and staffing) managers have in hand and/or are willing to assign for improvement, the existing gap in the ranking among the critical groups of criteria or SERVQUAL dimensions and among the critical criteria underlying each group or dimension, and the needs of departments for improvement based on the managers' expertise and insight.

5. Implications and Limitations

Various studies have stressed the importance of monitoring hospital services after delivering the service in order to ensure that the customers' expectations are entirely met. The degree that these expectations are met is strongly related to customers' satisfaction or dissatisfaction about the service (Dawn & Lee, 2004). The main purpose of this study is eliminating or reducing patients' dissatisfaction as it is an overriding measure for assessing healthcare performance. As discussed previously, satisfaction and dissatisfaction are not two ends of the same line, but they are often unrelated to each other. As a result of the negativity bias theory patients give more weight and importance to their negative feelings rather than positive ones (Baumeister *et al.*, 2001). Accordingly, caregivers should be aware that negative feelings are always stronger and spread out more quickly. A previous study shows that a dissatisfied customer informs about nine to ten people about his experience using word-of-mouth and 13% of them notify more than 20 people, whereas the figure for a satisfied patient is about four to five people only. Moreover, dissatisfaction imposes huge amounts of cost to hospitals. A hospital with an average amount of 5000 discharges per year spends more than $750,000 on settling the dissatisfactions and complaint cases (Press *et al.*, 1991).

We believe that designing questionnaires serve as the cornerstone for the rest of a quantitative study. Whilst the perception and preferences of patients with the services are directly proportional to service quality and performance, indications of previous research show little patient involvement in the design of questionnaire. A review of literature on the data collection methods applied for measuring patients' satisfaction shows that merely 11 out of 54 studies have engaged patient inputs in the development of questionnaires (Castle *et al.*, 2005). This articulates that for constructing questionnaires not enough attention has been devoted to the ideas and preferences of patients as the main service consumers. This can threaten the reliability of patient-

absent inputs. We also believe that in measuring dissatisfaction, utilizing patients' ideas is more crucial. That is because according to the negativity bias theory discussed earlier, the criteria concerning dissatisfaction are more memorable for the patients during the development of questionnaires. This will result into the development of more dissatisfaction-oriented questionnaires. On the other hand, our experience during the case study of this paper shows that extracting patients ideas for defining research criteria can be cumbersome and time consuming: At first, the goal of the research should be explained to patient in simple words. Then, a perspective of what is expected from him/her should be portrayed (e.g. explaining SERVQUAL dimensions and asking relevant criteria for each dimension in the case of this paper). Finally, his/her criteria should be translated into appropriate form to be used in the questionnaire. By all means, inputting patients' ideas and involving them in the initial steps lay a more robust foundation for the next stories of research to be built on.

In spite of the advantages of using patients' ideas in the survey design phase, a common pitfall is that the vision of patients across the subject of study is very limited and they lack in depth understanding to define inclusive criteria. A patient, as a layman, may not be able to see the dark corners of care service and consequently neglects vital aspect. Our main motive for using SERVQUAL in the survey design was to address this issue. As a tool that has been extensively used in the healthcare, it casts light over all different angles of the services, especially intangible dimensions, and lets the patient to see every perspective in order to help the researchers define the criteria. This explains why the study does not set about measuring the gaps between patients' perceptions and expectations like other studies exploiting SERVQUAL.

Choosing the right control chart drastically affects the success or the failure of a quality improvement program. It requires good knowledge on different types of the charts available, their functionality, and their fields of application as well as a profound insight on the processes being monitored. Due to the intangibility and vagueness, control chart selection in service sector should start with an accurate definition of what is to be controlled and what are the corresponding parameters for control charts. For instance, number of quotes delivered within 24 hours in an insurance company, number of correspondence with incomplete data in a bank, or number of dissatisfied patients in a hospital can be set as the equivalent for the number of defectives to construct a control chart. Next, is exploring among the available charts according to

the type of data. For previous examples, since the data are discrete, control charts for attributes should be used. p-chart, np-chart, Demerit chart, c-chart, and u-chart are the most common ones. While c-chart and u-chart deal with the count of defects per inspection unit, the rest count the number of defectives per subgroup samples. In our case study, since it was impossible for a patient to be dissatisfied with each of sub-criterion more than once, c-chart and u-chart are inapplicable. Therefore, p-chart and Demerit chart are the appropriate choices both of which have been deployed in this paper and their outcomes are compared.

Another issue regarding chart selection is the number of quality characteristics monitored in a control chart. In this study, we have deployed four univariate control charts to monitor four dimensions of the case study hospital. An alternative solution for monitoring these dimensions can be the use of a single multivariate control chart. Multivariate control charts offer some advantages over univariate ones such as facilitation of monitoring an entire unit with a fewer number of charts and reduced number of false alarms (Kourti, 2005; Waterhouse *et al.*, 2010). However, some considerations must be taken into account prior to their application. First, they are designed to control correlated quality characteristics. If the characteristics being controlled are not correlated, separate univariate control charts should be used. Hence, it is essential to study the existence of correlation among the quality characteristics in the first place (Kourti, 2005). Second, since several correlated variables are involved, interpreting the signals from multivariate control charts is more difficult in comparison with univariate control charts. When a *p*-variable chart alerts an out-of-control situation, it is necessary to construct *p* univariate charts or apply other statistical techniques to find out which variable manifests out-of-control behavior (MacCarthy & Wasusri, 2002; Bersimis *et al.*, 2007). Third, by increasing the number of variables they become less efficient (Waterhouse *et al.*, 2010). Broadly speaking, application of multivariate control charts in healthcare is a new domain that calls for more research and is encouraged for future research.

Our findings indicate that criteria pertaining to tangibles dimension of SERVQUAL such as food service and facility and environment require intense attention for both short-term and long-term. The significance of tangibles in healthcare is advocated by (Vandamme & Leunis, 1993; Choi *et al.*, 2004), but in contrary to the findings of (Lim & Tang, 2000; Butt & Run, 2010; Zarei *et al.*, 2012). The contradiction can be explained according to the type of investigated hospital. While

the opposing results were collected in private hospitals which typically invest more money on physical and environmental aspects, this paper and supporting studies investigate public hospitals whose duty is providing low cost healthcare services to a large number people and environment and aesthetics are of secondary importance.

We acknowledge the limitations of this study that may limit the generalizability of its results. First, the case study of this research investigates one public hospital only. Therefore, the results may not comprehensive enough to be generalized to other public hospitals. However, we believe that the proposed framework is adoptable for evaluating the prevalence of patients' dissatisfaction in any hospital, whether public or private, since it meets the requirements of a holistic quality improvement program in service sector: setting the standards, monitoring the system performance against these standards, providing timely feedback, and taking corrective actions when the standards are not met (Yasin *et al.*, 1991). These requisites are well considered within the phases of our proposed framework. Another general limitation is that all SERVQUAL-based studies assess functional quality but not the technical quality of the service (Margaritis *et al.*, 2012). That is because patients are not eligible to evaluate the quality of specialized hospital services. For instance, the idea of a patient about the quality of food or the attitude of care provider is much more important and reliable for assessing hospital service compared to his idea about the appropriateness of a prescribed medicine.

6. Conclusion

Monitoring and improving service quality in public hospitals has turned into a critical issue and requires adopting creative approaches. Many public hospitals suffer from high rate of dissatisfaction and spend a lot of their resources on settling issues regarding Patients' dissatisfaction. Previous research has shown that by satisfying the patients, the amount of time and money spent on resolving patient complaints decreases considerably (Press *et al.*, 1991). This paper offers a framework to monitor and minimize hospital patient dissatisfaction. Reducing dissatisfaction is believed to improve the quality of services provided by the hospitals from the customers' point of view. The results of case study indicate that food service and the criteria pertaining to nurses should receive immediate attention, while tangibles, especially food service and environment and facilities, should receive further resources from managers to be fundamentally improved.

We believe that improving healthcare quality through minimizing patient dissatisfaction calls for bulk research in future. Since statistical tools and especially SPC are integral necessities for this purpose, we recommend disseminating SPC amongst medical students as previous research shows that it is usually not included in the curriculum of medical classes (Mohammed, 2004). A recommendation for future research is implementing the proposed framework of this study in other hospitals and comparing the results with the ones of this study. For prioritizing the improvement areas, multiple-criteria decision making tools such analytic hierarchy process (AHP) (Zarei & Wong, 2014) or technique for order of preference by similarity to ideal solution (TOPSIS) (Nejatian & Zarei, 2013) can be applied. Moreover, other statistical control charts can be used to monitor satisfaction/ dissatisfaction. The results can be useful to choose the proper control chart for developing healthcare surveillance programs. Finally, as discussed in section 5, an interesting future research thread is the application of multivariate control charts to the health domain and patient dissatisfaction in particular. Univariate and multivariate control charts can be simultaneously applied and the outcomes can be compared.

- *Questionnaires and forms are available upon demand from the corresponding author*.

References

Altuntas, S., T. Dereli and M. K. Yilmaz (2012). Multi-criteria decision making methods based weighted SERVQUAL scales to measure perceived service quality in hospitals: a case study from Turkey. *Total Quality Management & Business Excellence* 23(11-12): 1379-1395.

Altuntas, S. and E. Yener (2012). An Approach Based on TRIZ Methodology and SERVQUAL Scale to Improve the Quality of Health-Care Service: A Case Study. *Ege Academic Review* 12(1): 95–104.

Andaleeb, S. S. (2001). Service quality perceptions and patient satisfaction: a study of hospitals in a developing country. *Social Science and Medicine* 52(9): 1359–1370.

Annandale, E. and K. Hunt (1998). Accounts of disagreements with doctors. *Social Science and Medicine* 46(1): 119–129.

Baumeister, R. F., E. Bratslavsky, C. Finkenauer and K. D. Vohs (2001). Bad is Stronger than Good. *Review of General Psychology* 5(4): 323-370.

Benneyan, J. C., R. C. Lloyd and P. E. Plsek (2003). Statistical process control as a tool for research and healthcare improvement. *Quality and Safety in Health Care* 12(6): 458–464.

Bersimis, S., S. Psarakis and J. Panaretos (2007). Multivariate statistical process control charts: an overview. *Quality and Reliability Engineering International* 23(5): 517-543.

Bland, J. M. and D. G. Altman (1997). Statistics notes: Cronbach's alpha. *BMJ* 314: 314-572.

Buskirk, R. H. and J. T. Rothe (1970). Consumerism - An Interpretation. *The Journal of Marketing* 34(4): 61-65.

Butt, M. M. and E. C. d. Run (2010). Private healthcare quality: applying a SERVQUAL model. *International Journal of Health Care Quality Assurance* 23(7): 658-673.

Büyüközkan, G. and G. Çifçi (2012). A combined fuzzy AHP and fuzzy TOPSIS based strategic analysis of electronic service quality in healthcare industry. *Expert Systems with Applications* 39(3): 2341-2354.

Büyüközkan, G., G. Çifçi and S. Güleryüz (2011). Strategic analysis of healthcare service quality using fuzzy AHP methodology. *Expert Systems with Applications* 38(8): 9407-9424.

Canel, C., S. Mahar, D. Rosen and J. Taylor (2010). Quality control methods at a hospital. *Int J Health Care Qual Assur* 23(1): 59-71.

Carey, R. G. (2000). Measuring Health Care Quality: How do you Know your Care has Improved? *Evaluation and the Health Professions* 23(1): 43-57.

Castle, N. G., J. Brown, K. A. Hepner and R. D. Hays (2005). Review of the literature on survey instruments used to collect data on hospital patients' perceptions of care. *Health Services Research* 40(6): 1996–2017.

Chen, A., Y. Lu, S. Gupta and Q. Xiaolin (2013). Can customer satisfaction and dissatisfaction coexist? An issue of telecommunication service in China. *Journal of Information Technology* 29(3): 237-252.

Chen, T. T., K. P. Chung, F. C. Hu, C. M. Fan and M. C. Yang (2011). The use of statistical process control (risk-adjusted CUSUM, risk-adjusted RSPRT and CRAM with prediction limits) for monitoring the outcomes of out-of-hospital cardiac arrest patients rescued by the EMS system. *J Eval Clin Pract* 17(1): 71-77.

Chiam, P. J. and A. Feyi-Waboso (2009). The use of control charts in monitoring postcataract surgery endophthalmitis. *Eye (Lond)* 23(5): 1028-1031.

Choi, K.-S., W.-H. Cho, S. Lee, H. Lee and C. Kim (2004). The relationships among quality, value, satisfaction and behavioral intention in health care provider choice: A South Korean study. *Journal of Business Research* 57: 913– 921.

Coyle, J. and B. Williams (1999). Seeing the wood for the trees: defining the forgotten concept of patient dissatisfaction in the light of patient satisfaction research. *International Journal of Health Care Quality Assurance Incorporating Leadership in Health Services* 12(4): i–ix.

Dawn, A. G. and P. P. Lee (2004). Patient expectations for medical and surgical care: a review of the literature and applications to ophthalmology. *Survey of Ophthalmology* 49(5): 513-524.

Eriksson, U. and M. Svedlund (2007). Struggling for confirmation--patients' experiences of dissatisfaction with hospital care. *J Clin Nurs* 16(3): 438-446.

Fatahi, A. A., R. Noorossana, P. Dokouhaki and B. F. Moghaddam (2012). Zero Inflated Poisson Ewma Control Chart for Monitoring Rare Health-Related Events. *Journal of Mechanics in Medicine and Biology* 12(04): 1250065.

Hantula, D. A. (1995). Disciplined Decision Making in an Interdisciplinary Environment: Some Implications for Clinical Applications ff Statistical Process Control. *JOURNAL OF APPLIED BEHAVIOR ANALYSIS* 28(3): 371-377.

Herzberg, F. and B. Mausner (1959). *The Motivation to Work*. New York, Wiley.

Hinton, P. R. (2004). *Statistics Explained*. London, Routledge.

Hoe, J. (2007). Quality service in radiology. *Biomed Imaging Interv J* 3(3): e24.

Isik, O., D. Tengilimoglu and M. Akbolat (2011). Measuring health care quality with the Servqual method: a comparison in public and private hospitals. *Healthmed* 5(6): 1921-1930.

Jiang, W., L. Shu, H. Zhao and K.-L. Tsui (2012). CUSUM Procedures for Health Care Surveillance. *Quality and Reliability Engineering International*: n/a-n/a.

Joner, M. D., W. H. Woodall, M. R. Reynolds and R. D. Fricker (2008). A one-sided MEWMA chart for health surveillance. *Quality and Reliability Engineering International* 24(5): 503-518.

Kao, S.-C. (2012). Monitoring Turnaround Time Using An Average Control Chart in The Laboratory. *International Journal of Industrial Engineering-Theory Applications and Practice* 19(12): 476-487.

Koetsier, A., N. F. de Keizer, E. de Jonge, D. A. Cook and N. Peek (2012). Performance of risk-adjusted control charts to monitor in-hospital mortality of intensive care unit patients: a simulation study. *Crit Care Med* 40(6): 1799-1807.

Kourti, T. (2005). Application of latent variable methods to process control and multivariate statistical process control in industry. *International Journal of Adaptive Control and Signal Processing* 19(4): 213-246.

Landrum, H., V. R. Prybutok and X. Zhang (2007). A comparison of Magal's service quality instrument with SERVPERF. *Information & Management* 44: 104–113.

Lee, A. V., J. P. Moriarty, C. Borgstrom and L. I. Horwitz (2010). What can we learn from patient dissatisfaction? An analysis of dissatisfying events at an academic medical center. *J Hosp Med* 5(9): 514-520.

Lee, M. A. and Y. H. Yom (2007). A comparative study of patients' and nurses' perceptions of the quality of nursing services, satisfaction and intent to revisit the hospital: a questionnaire survey. *Int J Nurs Stud* 44(4): 545-555.

Li, Q. (2013). A novel Likert scale based on fuzzy sets theory. *Expert Systems with Applications* 40(5): 1609-1618.

Lim, P. C. and N. K. H. Tang (2000). A study of patients' expectations and satisfaction in Singapore hospitals. *International Journal of Health Care Quality Assurance* 13(7): 290 - 299.

Lonial, S., D. Menezes, M. Tarim, E. Tatoglu and S. Zaim (2010). An evaluation of SERVQUAL and patient loyalty in an emerging country context. *Total Quality Management & Business Excellence* 21(8): 813-827.

MacCarthy, B. L. and T. Wasusri (2002). A review of non-standard applications of statistical process control (SPC) charts. *International Journal of Quality & Reliability Management* 19(3): 295-320.

Margaritis, E., M. Katharaki and G. Katharakis (2012). Exceeding parents' expectations in Ear–Nose–Throat outpatient facilities: The development and analysis of a questionnaire. *Evaluation and Program Planning* 35(1): 246–255.

Mohammed, M. A. (2004). Using statistical process control to improve the quality of health care. *Quality and Safety in Health Care* 13(4): 243–245.

Montgomery, D. C. (2008). *Introduction to Statistical Quality Control*. New Jersey, Wiley.

Montgomery, D. C. and G. C. Runger (2002). *Applied Statistics and Probability for Engineers*. New York, Wiley.

Mulcahy, L. and J. Q. Tritter (1998). Pathways, pyramids and icebergs? Mapping the links between dissatisfaction and complaints. *Sociology of Health and Illness* 20(6): 825–847.

Nejatian, M. and M. H. Zarei (2013). Moving Towards Organizational Agility: Are We Improving in the Right Direction? *Global Journal of Flexible Systems Management* 14(4): 241-253.

Nembhard, D. A. and H. B. Nembhard (2000). A Demerits Control Chart for Autocorrelated Data. *Quality Engineering* 13(2): 179-190.

Nikakhtar, A., K. Y. Wong, M. H. Zarei and A. Memari (2011). Comparison of Two Simulation Software Systems for Modeling a Construction Process. *Third International Conference on Computational Intelligence, Modelling and Simulation (CIMSiM 2011)*. Langkawi, Malaysia, IEEE computer society**:** 200-205.

Ogrodniczuk, J. S., A. S. Joyce and W. E. Piper (2007). Effect of patient dissatisfaction with the therapist on group therapy outcome. *Clinical Psychology & Psychotherapy* 14(2): 126-134.

Pakdil, F. and T. N. Harwood (2005). Patient satisfaction in a preoperative assessment clinic: an analysis using SERVQUAL dimensions. *Total Quality Management & Business Excellence* 16(1): 15-30.

Parasuraman, A., L. L. Berry and V. A. Zeithaml (1991). Refinement and reassessment of the SERVQUAL scale. *Journal of Retailing* 67: 420–450.

Parasuraman, A., V. A. Zeithaml and L. L. Berry (1985). A conceptual model of service quality and its implications for future research. *Journal of Marketing* 49(41-50).

Parasuraman, A., V. A. Zeithaml and L. L. Berry (1988). SERVQUAL: a multiple-item scale for measuring customer perceptions of service quality. *Journal of Retailing* 64(1): 12-23.

Peetersa, G. and J. Czapinski (1990). Positive-Negative Asymmetry in Evaluations: The Distinction Between Affective and Informational Negativity Effects. *European Review of Social Psychology* 1(1): 33-60.

Polit, D. F. and W. Chaboyer (2012). Statistical process control in nursing research. *Res Nurs Health* 35(1): 82-93.

Press, I., R. F. Ganey and M. P. Malone (1991). Satisfied patients can spell financial well-being. *Healthcare Financial Management* 45(2): 34–36.

Rogers, A., S. Karlsen and J. Addington-Hall (2000). `All the services were excellent. It is when the human element comes in that things go wrong': dissatisfaction with hospital care in the last year of life. *Journal of Advanced Nursing* 31(4): 768-774.

Schweizer, K. (2011). On the Changing Role of Cronbach's α in the Evaluation of the Quality of a Measure. *European Journal of Psychological Assessment* 27(3): 143-144.

Spiliotopoulou, G. (2009). Reliability reconsidered: Cronbach's alpha and paediatric assessment in occupational therapy. *Aust Occup Ther J* 56(3): 150-155.

Srijumpa, R., T. Chiarakul and M. Speece (2007). Satisfaction and dissatisfaction in service encounters: Retail stockbrokerage and corporate banking in Thailand. *International Journal of Bank Marketing* 25(3): 173-194.

Teng, C.-I., C.-K. Ing, H.-Y. Chang and K.-P. Chung (2007). Development of service quality scale for surgical hospitalization. *Journal of the Formosan Medical Association* 106(6): 475–484.

Thor, J., J. Lundberg, J. Ask, J. Olsson, C. Carli, K. P. Harenstam and M. Brommels (2007). Application of statistical process control in healthcare improvement: systematic review. *Quality and safety in health care* 16(5): 387-399.

Vandamme, R. and J. Leunis (1993). Development of a multiple-item scale for measuring hospital service quality. *International Journal of Service Industry Management* 4(3): 30–49.

Vuori, H. (1988). Patient Satisfaction: An Attribute or Indicator of Quality Care? *International Journal of Health Care Quality Assurance* 1(2): 29-32.

Waterhouse, M., I. Smith, H. Assareh and K. Mengersen (2010). Implementation of multivariate control charts in a clinical setting. *International Journal for Quality in Health Care* 22(5): 408–414.

Williams, B., J. Coyle and D. Healy (1998). The meaning of patient satisfaction: An explanation of high reported levels. *Social Science and Medicine* 47(9): 1351–1359.

Woodall, W. H. (2006). The Use of Control Charts in Health-Care and Public-Health Surveillance. *Journal of Quality Technology* 38(2): 89-134.

Woodall, W. H., B. M. Adams and J. C. Benneyan (2012). The Use of Control Charts in Healthcare.*Statistical Methods in Healthcare* 251-267, John Wiley & Sons, Ltd.

Yasin, M. M., R. F. Green and M. Wafa (1991). Statistical Quality Control in Retail Banking. *International Journal of Bank Marketing* 9(2): 12-16.

Zarei, A., M. Arab, A. R. Froushani, A. Rashidian and S. M. G. Tabatabaei (2012). Service quality of private hospitals: The Iranian Patients' perspective. *BMC Health Services Research* 12(31): 7.

Zarei, M. H. and K. Y. Wong (2014). Making the recruitment decision for fresh university graduates: a study of employment in an industrial organisation. *International Journal of Management and Decision Making* 13(4): 380–402.