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PERCEPTIONS AND SATISFACTION WITH DENTAL HEALTHCARE: A CASE STUDY

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Abstract: *This paper presents the main results of a survey carried out by a network of dental surgeries, with the aim of investigating patients' feelings about dental cures and their overall satisfaction with the supplied service. Information was collected by means of a questionnaire filled in by a sample of 885 patients. The most remarkable outcomes are relative to patient segmentation and patient satisfaction.*

Keywords: *Patient segmentation, patient satisfaction, cluster analysis, nonlinear principal component analysis.*

1. Introduction

The firms operating in the *Business to Consumer* (B2C) have widely recognized the importance of systematically conducted surveys, aimed at discovering consumers' needs, expectations, feelings, opinions. In recent years this practice has shown a widespread diffusion and today the statistical tools suggested for Market Analysis are occasionally or regularly applied in several fields, including public or private services. In particular, a growing attention is devoted to the measurement of the perceived quality of a delivered service, and of the user satisfaction. In the field of health services, the whole set of tools arranged for determining individual perceptions of the quality of delivered healthcare and for inspecting the user satisfaction is called "patient satisfaction analysis". The number of papers published in the medical and nursing literature, incorporating the term "patient satisfaction", constantly grew in the last years, reflecting a change in Health Service management over the past decade (see for example [1] and [2]).

Following this tendency, in 2008 a network of 13 Italian dental surgeries carried out a survey by means of a specific questionnaire filled in by $N=885$ patients. The use of the statistical

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techniques of cluster analysis and dimensionality reduction allowed to inspect patients' feelings about dental cures and their overall satisfaction with the supplied service. Aim of this paper is to present the most remarkable results of the survey, highlighting their importance for the management in making operative decisions aimed at the improvement of the quality and the development of the service. The paper is organized as follows: in section 2 the questionnaire is described, while sections 3 and 4 present the outcomes in terms of patient segmentation and patient satisfaction analysis, respectively. In section 5 concluding remarks are given.

2. The questionnaire

The questionnaire was aimed at portraying, besides the usual demographic information about gender, age, job, ..., the patient's characteristics in terms of needs, habits and satisfaction with dental cures. In the following we will mainly refer to questions asking for:

- a ranking of 6 different aspects of the supplied service according to their importance in the patient's perceptions (Table 1),
- the satisfaction judgements of the patient (rated in Likert-type scale from 1 to 5, with higher scores reflecting more satisfaction) with respect to a set of items concerning medical, relational, environmental and organizational features (Table 2).

Table 1. Question about the importance devoted by the patient to the different aspects of the supplied service

COULD YOU ARRANGE A RANKING OF THE FOLLOWING ASPECTS OF OUR SERVICE ?

Logistic (easy to reach, easy to park the car, ...)

Environment (comfort, cleanliness, disinfection, ...)

Efficiency (waiting time for an appointment, possibility to modify appointments, punctuality, ...)

Politeness (of the doctors, of the nurses, of the secretaries, ...)

Strictly medical service (ability of the doctors, professional knowledge, attention to the patient's problems, ...)

Price (price wrt quality, payment facilities, ...)

Table 2. Question about the facet satisfaction (judgements expressed on a scale ranging from 1 to 5, with higher scores reflecting more satisfaction)

HOW SATISFIED ARE YOU WITH....

1. ... the easiness to reach the dental surgery and, eventually, to park the car?
2. ... the comfort of the waiting room?
3. ... the cleanliness of the rooms?
4. ... the hygienic condition and the disinfection of the surgery room?
5. ... the technologic level of equipments?
6. ... the opening times?
7. ... the waiting time for an appointment?
8. ... the flexibility when you need to modify appointments?
9. ... the punctuality?
10. ... the politeness and the efficiency of the secretaries?
11. ... the politeness and the efficiency of the nurses?
12. ... the quality of the healthcare delivered by the doctors?
13. ... the attention to your problems and the human relationships?
14. ... the ability in extinguish pain?
15. ... the comprehensibility of the explanations about the treatments?
16. ... the price with respect to the quality?
17. ... the payment facilities?

The distribution of the 885 respondents among the 13 dental surgeries is shown in Table 3.

Table 3. Frequency distribution of the respondents in the 13 dental surgeries

Dental surgery	1	2	3	4	5	6	7	8	9	10	11	12	13
Respondents	20	61	49	68	58	80	87	171	31	46	40	81	93

3. Patient segmentation

The first step consisted in the analysis of the patients from the point of view of the importance devoted to the different aspects of the service. For a correct approach to the problem, the following two main features of dental healthcare, which substantially differentiate it from many other health services, have to be taken into account:

- in the dental field patients most commonly seek private surgeries, like those who carried out the present survey;
- a part of dental healthcare deals with prevention (periodical controls, teeth cleaning, ...) and aesthetic surgery, which could be considered by patients as less urgent and essential than other kind of cures.

For these two reasons, economic and environmental aspects, which usually play a secondary role when dealing with health, have to be taken into account when analyzing the opinions of these patients. Concerning the answers to the questions of Table 1, we find that in general patients consider the medical quality to be the most important aspect of the service, immediately followed by the environmental, organizational and courtesy aspects. Furthermore, the price is globally more important than logistic (Figure 2, top left).

Of course these evidences are relative to the ‘average patient’, but differences among patients from these points of view could be very insightful. A segmentation should bring to light the existence of different needs with respect to dental healthcare.

In order to obtain segmentation, the non-hierarchical cluster analysis technique of k -means ([6]) was performed, based on the euclidean distance among the ranks expressed in the questions of Table 1. Figure 1 shows the pattern of the ratio DB/DT , where DB and DT denote respectively the between and the total deviance, as a function of the number of clusters. The relative increase of DB in the solution with k clusters with respect to the solution with $k-1$ clusters is reported in the same graph.

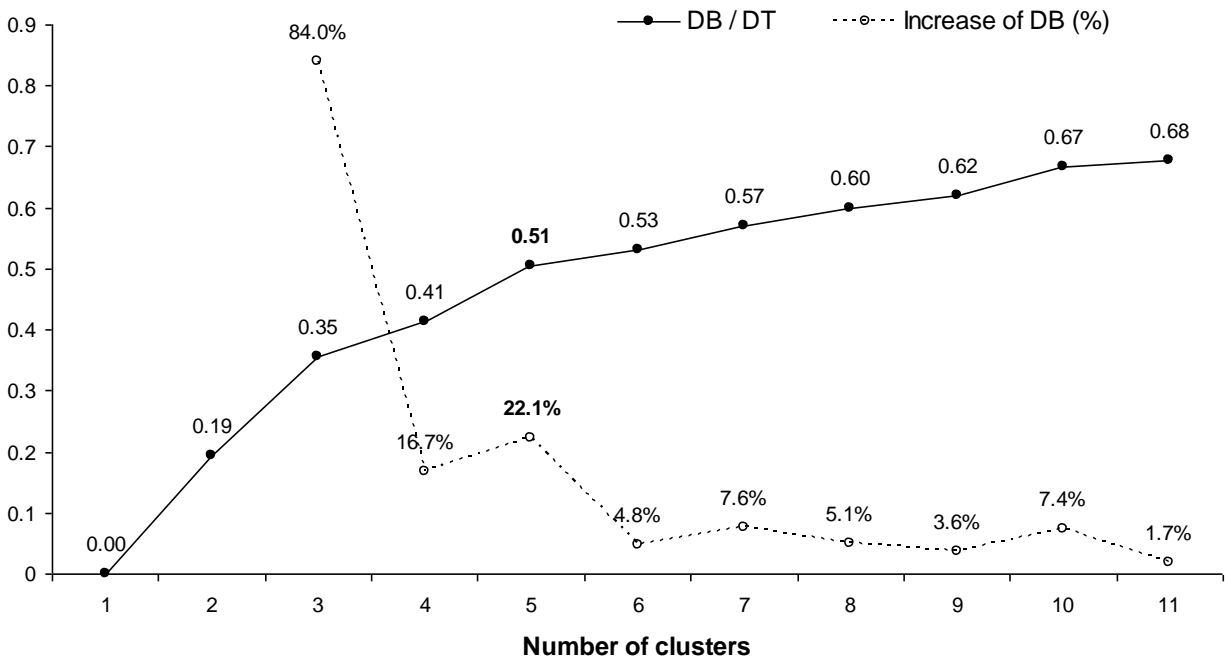


Figure 1. Ratio DB/DT and relative increase of DB against number of clusters

The best solution, both from a statistical and an interpretative point of view, was found with 5 clusters (DB/DT=0.51), whose main differentiating features can be roughly summarized as follows:

- C1 (40.5%): patients devoting scarce attention to price;
- C2 (9.6%): patients highly interested in logistic aspects;
- C3 (22.3%): patients who, in change of a lower price, could renounce to environmental comfort, but not to efficiency;
- C4 (6.3%): patients extremely interested in logistic aspects and devoting very scarce attention to the strictly medical aspect of the service;
- C5 (21.3%): patients who, in change of a lower price, could renounce to efficiency, but not to environmental comfort.

Figure 2 shows the average ranks within the clusters, which confirm the different opinions revealed by the segmentation.

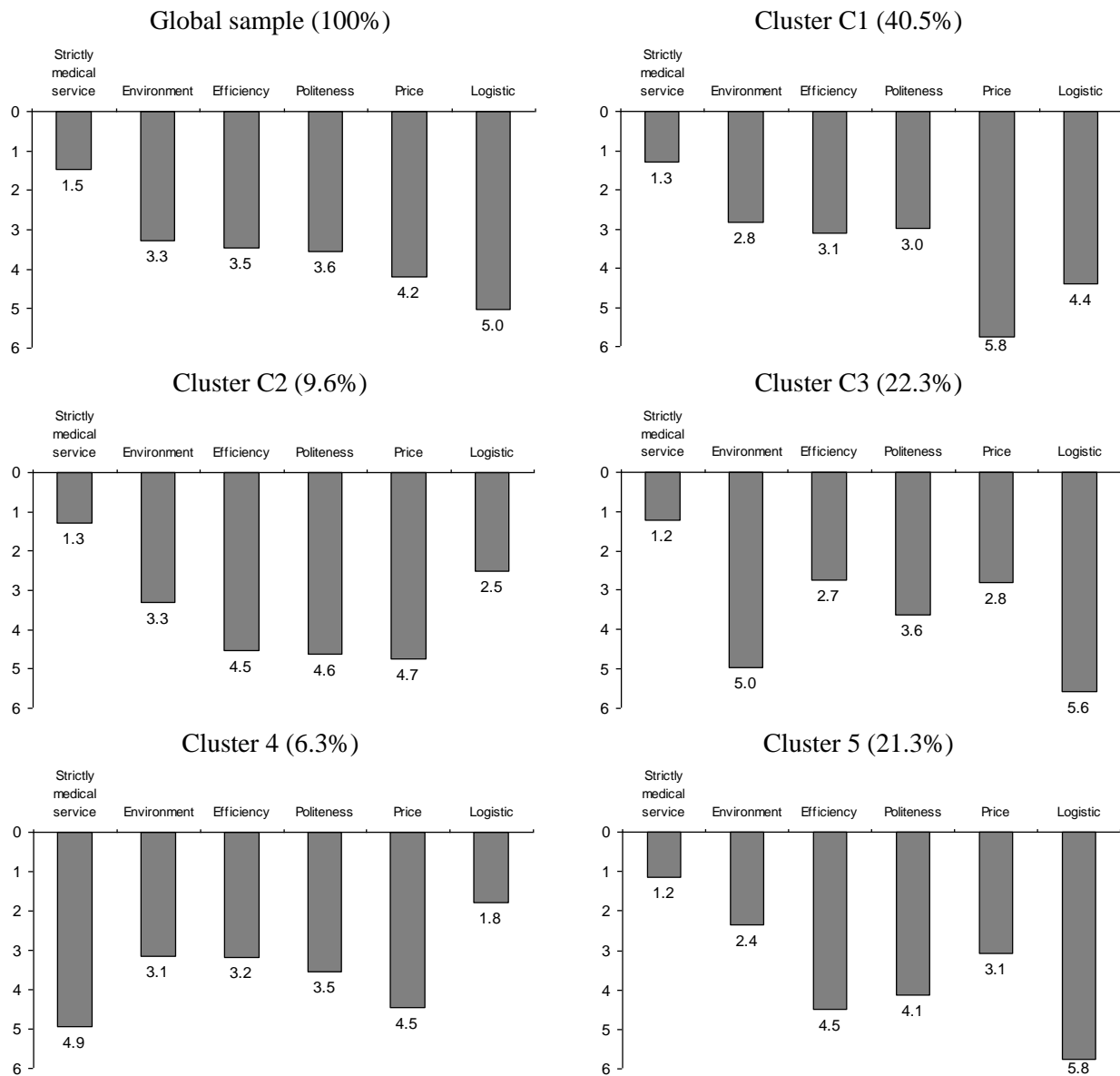


Figure 2. Average ranks assigned to the six aspects of the dental service

In order to describe the profile of the patients with different characteristics, a deeper investigation has been carried out about the description of the clusters from the point of view of gender, age, kind of medical treatments required, overall satisfaction (as declared in a single question, asking for a mark from 1 to 10).

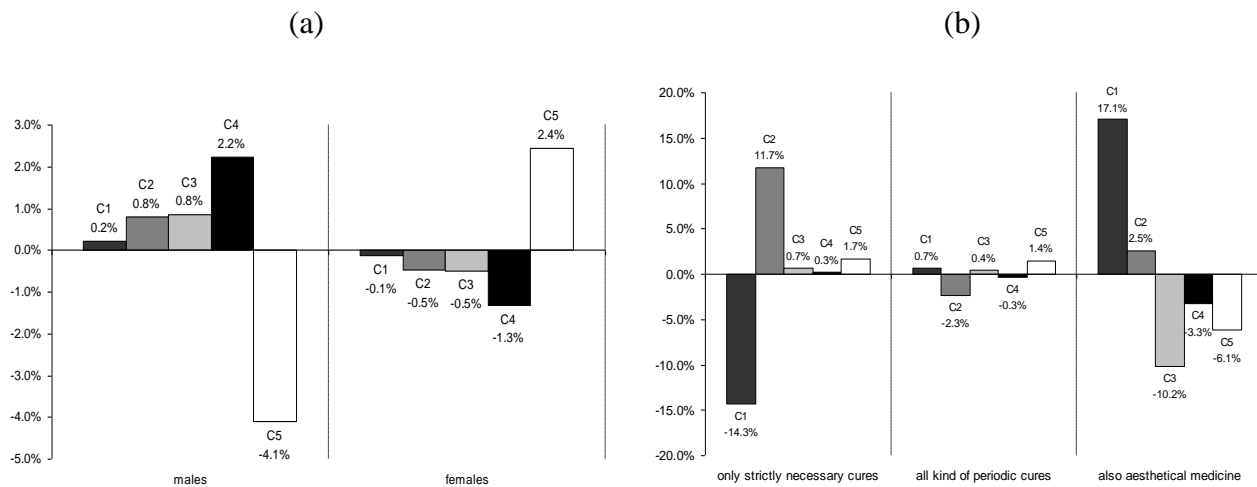


Figure 3. Cluster distribution by gender (a) and kind of treatments required (b) (differences respect to the corresponding proportions in the whole sample)

Figure 3a shows the characteristics of clusters by gender: we observe that cluster C4 and C5 are slightly over-represented, respectively among males (+2.2% with respect to the proportion of this cluster in the sample) and females (+2.4% with respect to the proportion of this cluster in the sample). The remaining clusters do not exhibit appreciable differences from this point of view.

No appreciable differences have been found among cluster in the age distribution.

Another interesting remark can be drawn about the kind of treatments required, of which we may distinguish three categories of habit, corresponding to an increasing favour toward dental cures: patients who seek a dentist only for strictly necessary treatments, patients who also undergo all the recommended periodical cures, patients who seek aesthetic medicine. Figure 3b displays the distribution of the cluster membership with reference to these three categories. Cluster C2 is over-represented (+11.7% with respect to the proportion of this cluster in the sample) among the patients seeking a dentist only when strictly necessary. Thus, the main cause inducing patients to neglect the basic recommendations about dental health seems to be connected to logistic problems or lack of time. Anyway, it is clear that patients who openly declare not to care price (cluster C1), very rarely behave this way. On the other hand, cluster C1 has a clear prevalence (+17.1%) in the category of highly-demanding patients, requiring (expensive) treatments beyond health cures. The composition by cluster of “ordinary” patients (periodical cures and strictly necessary treatments) reflects that of the whole sample.

The average level of overall satisfaction within the clusters is summarized in Table 4 (since the marks range from 1 to 10, we treat overall satisfaction as an interval scaled variable).

Table 4. Average overall satisfaction within the clusters

Cluster	C1	C2	C3	C4	C5
Average overall satisfaction	9.15	8.65	8.82	8.96	8.78

The highest average overall satisfaction is in cluster C1, immediately followed by C4. This could provide a rationale for cluster C4, characterized by a quite unusual disregard of the medical aspects of the service: maybe these patients are so satisfied that they take medical quality for granted. The lowest average satisfaction level is in cluster C2. Anyway the overall satisfaction is

generally very high. It is interesting to perform a formal test for equal levels of overall satisfaction within clusters. Although overall satisfaction may be treated as an interval scaled variable, the distributional assumptions required by ANOVA are not fully appropriate. For this reason we opt for the nonparametric testing procedure based on ranks, suggested by [4] and [5], with null hypothesis $Me_1 = Me_2 = \dots = Me_5$, where Me_j is the median overall satisfaction of cluster j . The procedure is based on the assumption that the overall satisfaction, although recorded with at least ordinal scaled measurements, is an absolutely continuous random variable whose density functions within clusters can differ for the median value. For this reason, even in presence of equal observed medians (as it is the case in the present analysis, where we observe the median value 9 in each cluster), the test could eventually lead to reject the hypothesis of equal medians in the underlying distributions. The procedure operates as follows: once the N patients are ranked according to their overall satisfaction, by assigning the rank r_{ij} to the i th patient of the cluster j , for $j=1, \dots, 5$ and $i=1, \dots, n_j$ (in presence of ties the average rank is used), the following test statistic is computed

$$g = \frac{\tilde{g}}{\sum_{s=1}^q t_s (t_s^2 - 1)} \quad \text{where} \quad \tilde{g} = \frac{12}{N(N+1)} \left[\sum_{j=1}^5 n_j \left(\sum_i \frac{r_{ij}}{n_j} \right)^2 \right] - 3(N+1)$$

and t_s ($s=1, \dots, 10$) is the number of patients assigning score s to the overall satisfaction.

The asymptotic distribution of g is χ_{k-1}^2 , where $k=5$ is the number of clusters. In the present case study we obtain $g = 19.6$ and the null hypothesis of equal median overall satisfaction within clusters is rejected with p -value 0.0006.

Table 5 shows that dental surgeries are quite different from the point of view of patient segmentation. Each surgery should reflect on the composition of its patients within the 5 clusters, as different attitudes result in different needs. It is important to note that more than 40% of the patients give an appreciable importance to price. In certain surgeries these patients are more than 55% and managers should carefully meditate on it.

Table 5. Percentage of patients belonging to the 5 clusters in each surgery

	Dental surgery												
	1	2	3	4	5	6	7	8	9	10	11	12	13
C1	25	28	37	37	30	47	52	50	50	26	42	40	34
C2	30	10	20	4	17	11	5	12	18	8	11	0	6
C3	25	26	20	29	20	17	12	18	14	32	37	22	34
C4	5	5	11	6	10	11	6	4	5	11	0	9	3
C5	15	31	11	24	23	15	26	17	14	24	11	29	23

4. Patient satisfaction

The second part of the analysis was aimed at inspecting the patient satisfaction with the service, by means of the construction of a composite index starting from the judgements expressed in the

questions of Table 2. In order to take into account the ordinal scale of the Likert-type variables used to ask for satisfaction judgements, the dimensionality reduction method of Nonlinear Principal Component Analysis ([3]) was used. Although the scree plot (Figure 4) suggests to retain only the first principal component, the varimax rotated factor loading analysis (Table 6) indicates two interesting dimensions of satisfaction, accounting for a 51% of the total variance.

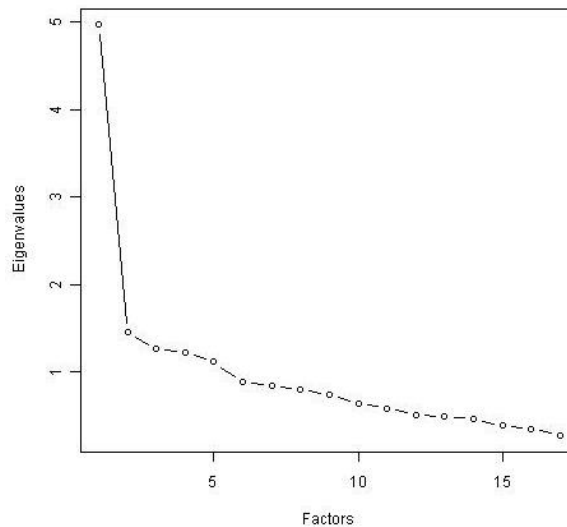


Figure 4. Screeplot

Table 6. Loadings of the first two rotated dimensions (Nonlinear Principal Component Analysis)

Item	D1	D2
1. ... the easiness to reach the dental surgery and, eventually, to park the car ?	0.0325	0.4896
2. ... the comfort of the waiting room ?	0.4153	0.4531
3. ... the cleanliness of the rooms ?	0.7241	0.1263
4. ... the hygienic condition and the disinfection of the surgery room ?	0.7678	0.0472
5. ... the technologic level of equipments ?	0.6098	0.2326
6. ... the opening times ?	0.1925	0.6758
7. ... the waiting time for an appointment ?	0.1768	0.8099
8. ... the flexibility when you need to modify appointments ?	0.2339	0.7568
9. ... the punctuality ?	0.3365	0.6539
10.... the politeness and the efficiency of the secretaries ?	0.6485	0.3534
11.... the politeness and the efficiency of the nurses ?	0.6886	0.3077
12.... the quality of the healthcare delivered by the doctors ?	0.7602	0.1552
13.... the attention to your problems and the human relationships ?	0.6147	0.3319
14.... the ability in extinguish pain ?	0.4970	0.4625
15.... the comprehensibility of the explanations about the treatments ?	0.4956	0.4735
16.... the price with respect to the quality ?	0.2494	0.6904
17.... the payment facilities ?	0.2729	0.6631

These two dimensions may be interpreted respectively as *Satisfaction with healthcare* and *Satisfaction with organizational aspects*. It is important to observe that patients, who in general are unable to evaluate the real medical quality, tend to consider medical and relational aspects of the healthcare as a unique dimension, separate from managerial efficiency. This evidence has

been revealed also by other studies about patient satisfaction (see for example [7]). So, we more properly can speak of *perceived* medical quality, which is influenced by aspects other than strictly medical, like the human relations with the doctor and the way he informs the patients about their problems.

Computing the average levels of these two dimensions of satisfaction for the patients of each dental surgery, we can interestingly analyse the positioning of the dental surgeries with respect to these two dimensions (Figure 5). Each surgery may then decide which aspects of the service should be improved in order to increase patient satisfaction.

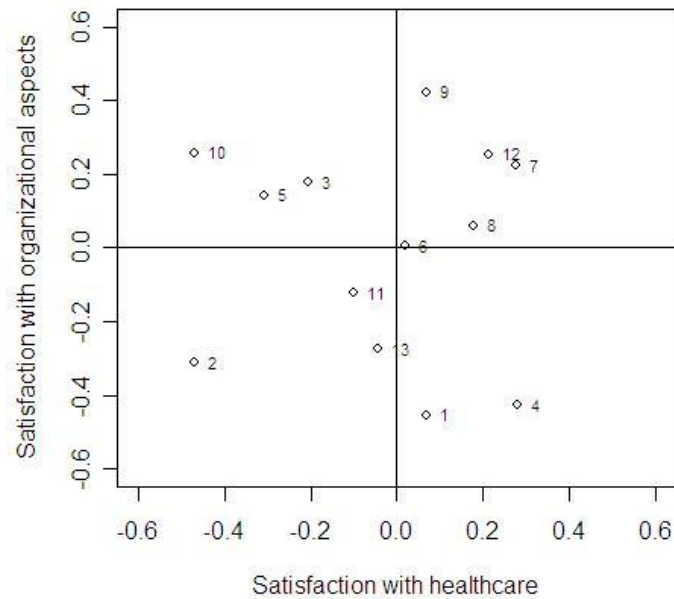


Figure 5. Positioning of dental surgeries with respect to the two dimensions of satisfaction

In addition, for each cluster obtained by means of the segmentation described in section 3, the average level of the two dimensions may be computed (Figure 6).

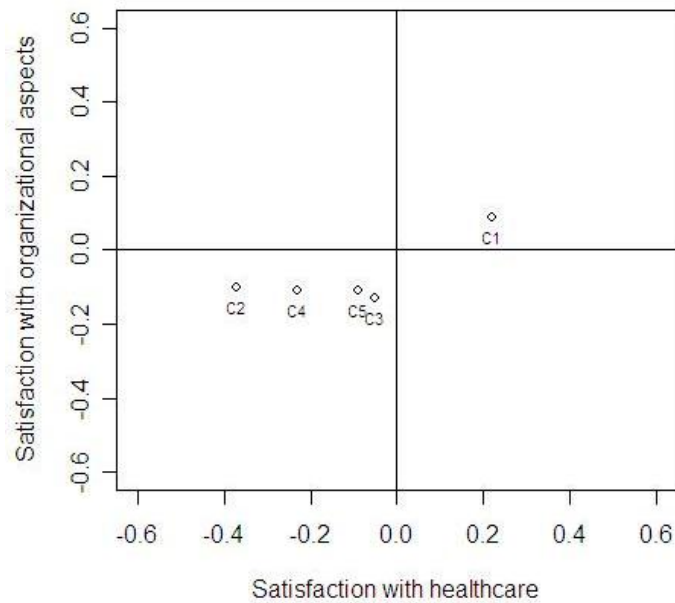


Figure 6. Positioning of clusters with respect to the two dimensions of satisfaction

We observe that only cluster C1 is characterized by levels of satisfaction higher than the average both with the healthcare and with the organizational aspects. For this reason, surgeries with a high percentage of patients in cluster C1 (see Table 5) tend to be positioned on the right top quadrant of Figure 5. Actually, we have to remark that the most appreciable differences among clusters are observed in the healthcare dimension, whereas the values of the organizational satisfaction are quite compressed.

Finally, we can compute the average satisfaction levels in the two dimensions also within the four groups obtained dividing patients according to the expressed scores of overall satisfaction. The results are shown in Figure 7.

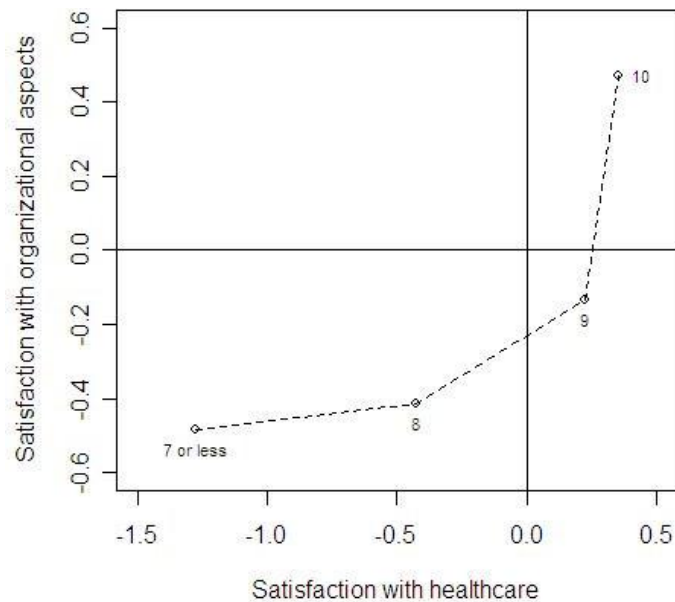


Figure 7. Pattern of the overall satisfaction judgements with respect to the two dimensions of satisfaction

It is remarkable to note that satisfaction with healthcare is determinant when moving from a medium-low (7 or less) to a medium (8) level of overall satisfaction. The progress from a medium to a higher (9) level of overall satisfaction requires increasing levels of both healthcare and organizational satisfaction. Finally, the highest level of overall satisfaction (10) is reached thanks to further improvement in the organization. That is to say that the first important point is healthcare, but once accomplished, patients assign increasing importance to the organizational aspects: the excellence is achieved when also executive matters are fulfilled.

5. Concluding remarks

In this paper a case study is presented deriving from a survey in the dental healthcare sector. The most important results are concerned with patient segmentation and patient satisfaction analysis. About the former aspect, we remark the existence of different attitudes toward dental healthcare, originated from different configurations of the importance given to the various aspects of service. Even though the quality of the healthcare generally remains the most valuable attribute of the service, this point can provide useful suggestions about how the accessory aspects should be organized in order to design different kinds of services, suited on the various categories of patients.

From the point of view of patient satisfaction, the analysis confirms the common tendency to combine medical and relational aspects in a unique dimension. Also this point has to be carefully taken into account by professionals, as satisfaction seems to be determined both by their medical competence and by the relationships with the patients.

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References

- [1]. Crow, R., Gage, H., Hampson, S. *et al.* (2002). The measurement of satisfaction with healthcare: implications for practice from a systematic review of the literature. *Health technology assessment*, 6, 1–245.
- [2]. Fitzpatrick, R. (1991). Surveys of patient satisfaction: I – Important general considerations. *British Medical Journal*, 302, 887–889.
- [3]. Gifi, A. (1990). *Nonlinear multivariate analysis*, Chichester: Wiley.
- [4]. Kruskal, W.H. (1952). A nonparametric test for the several sample problem. *Annals of Mathematical Statistics*, 23, 525–540.

- [5]. Kruskal, W.H., Wallis, W.A. (1952). Use of ranks in one criterion variance analysis. *Journal of the American Statistical Society*, 47, 583–621.
- [6]. Zani, S., Cerioli, A. (2007). *Analisi dei dati e data mining per le decisioni aziendali*. Milano: Giuffrè editore.
- [7]. Zuccolotto, P. (2009). Measuring Job and Patient Satisfaction in presence of missing values: a case study with Interval Imputation. *forthcoming on Electronic Journal of Applied Statistics, DSS*.