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# A Multiple Criteria Satisfaction Analysis tool for measuring patients' satisfaction with Portuguese secondary care: the case of inpatient services

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When it comes to life the critical thing is whether you take things for granted or take them with gratitude.

- Gilbert K. Chesterton

# Preface

The work presented in this dissertation was performed at CEG-IST Center of Management Studies of Instituto Superior Técnico and CERIS, during the period from February to October of 2019, under the supervision of Professor José Rui de Matos Figueira and Professor Rui Domingos Ribeiro da Cunha Marques, and within the frame of the hSNS FCT - Research Project (PTDC/EGE-OGE/30546/2017).

I declare that this document is an original work of my own authorship and that it fulfills all the requirements of the Code of Conduct and Good Practices of the Universidade de Lisboa.

# Acknowledgments

The present dissertation has been written for the completion of my master degree in Biomedical Engineering, at Instituto Superior Técnico. It is the result of five years' intensive studies, where I had the opportunity to grow both academically and personally.

During my studies, I had also the lucky chance of studying abroad during one semester, in Barcelona. There, I was fortunate to taking part of the EIT Health's Master program in Technological Innovation in Health (MTiH), which was one of my most remarkable experiences. This adventure provided me with know-how and shaped me as a future biomedical engineer.

Foremost, I would like to express my gratitude towards my family, for being a source of strength and support during my entire life, in particular, during my academic journey. Exceptionally, to my mother and father, for always encouraging me to be a better person, to follow my dreams fiercely, and above all to believe in myself, even in challenging situations.

Next in order, I would also like to thank all my friends, for patiently motivating me through this journey that is now coming to an end. A special thanks to Manuel Sepúlveda for always believing in me and for cheering me up whenever times were hard.

Furthermore, I would also like to recognize the work of all my professors who I met during these five years, in particular my supervisors, Prof. José Rui Figueira and Prof. Rui Cunha Marques. For the same reason, a special gesture of appreciation to Diogo Ferreira, for his help and patience, if it were not for him, I would probably still be struggling with the model's methodological implementation.

At last, but certainly not least, I am very grateful that I am working as a trainee at José de Mello Saúde, one of the healthcare companies I value the most. Currently allocated to the production department of CUF Descobertas hospital, it has been an exceptionally enriching experience. I can undoubtedly say that it has been a great help during the development of this dissertation, as it introduced me to the hospital context, and to the extreme complexity associated with the healthcare sector.

# Resumo

O sector da saúde é um sector multidimensional, desafiante, em constante mudança e muito complexo. No mundo cada vez mais competitivo da saúde, no qual o principal objectivo é melhorar a qualidade de vida da população, torna-se fundamental alcançar níveis altos, ou excelentes, de satisfação entre os pacientes. Serve o presente estudo para avaliar a satisfação dos utentes em relação aos cuidados de saúde secundários em Portugal, em particular, o serviço de internamento. Concretamente, pretende-se determinar quais os aspectos que os pacientes mais valorizam no serviço considerado, classificar cada critério de satisfação, analisar a procura por este tipo de serviço, e em última instância, identificar possíveis melhorias, estabelecer prioridades e definir oportunidades para que o hospital Amato Lusitano melhore a sua prestação de cuidados secundários. Para isso, foi utilizado um método Multicriterio para Análise de Satisfação (MUSA). A principal vantagem deste método baseado em programação linear é o facto de considerar a natureza qualitativa dos julgamentos e preferências dos pacientes, tal e qual como é expressa nos inquéritos de satisfação. Os resultados mostram que as equipas de auxiliares são as mais valorizadas e mais importantes para os pacientes hospitalizados, especialmente no que se refere à sua disponibilidade. Para além disso, aspectos como o número de visitas, a informação relativa ao estado clínico e o aconselhamento e ensinamentos sobre a saúde foram considerados prioritários no serviço em questão. Contudo, numa perspectiva futura, é aconselhável o estudo de amostras maiores de pacientes, em que se considerem possíveis extensões do método MUSA.



**Palavras-chave:** Serviço de internamento; SNS Português; Satisfação dos pacientes; Análise Multicritério de Satisfação.

# Abstract

Healthcare is a multidimensional, challenging, fast-changing and complex sector. In an increasingly competitive market of healthcare industries, and with the central goal of improving patients' quality of life, it is paramount to achieve high, or excellent, ratings on patient satisfaction. The present study's objective is to evaluate patients' satisfaction concerning the Portuguese secondary healthcare within the NHS, in particular, the inpatient service. More specifically, this study aims at determining which attributes patients value the most in this service valence, at classifying each satisfaction criterion (featuring the hospital attributes), at discovering patients' demanding nature and, lastly, at identifying potential improvements, priorities and opportunities for the Amato Lusitano hospital to improve its performance. To do so, a Multicriteria Satisfaction Analysis (MUSA) method is employed. The main advantage of this linear-programming based model is that it fully considers the qualitative form of customers' judgements and preferences, as they are expressed in the satisfaction questionnaires. Results have shown that the auxiliaries are the most important service feature for hospitalized patients, especially in terms of their readiness and availability. Furthermore, aspects such as the number of visits, the information on patient's clinical status and health advising and teaching have been pointed out as first priorities within the considered service. However, larger samples of patients must be considered for further research and the possible extensions of MUSA must be explored.



**Keywords:** Inpatient service; Portuguese NHS; Patient satisfaction; Multicriteria Satisfaction Analysis.

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# Glossary

**AL** - Amato Lusitano

**DRG** - Diagnostic-Related Groups

**EPE** - Public Enterprise Entity

**ER** - Emergency Room

**FHU** - Family Health Unit

**GDP** - Gross Domestic Product

**GP** - General Practicioner

**HCG** - Health Center Groups

**LHU** - Local Health Unit

**LHUCB** - Local Health Unit of Castelo Branco

**MAUT** - Multi-Attribute Utility Theory

**MCDA** - Multiple Criteria Decision-Aid

**MoU** - The Memorandum of Understanding

**MUSA** - Multicriteria Satisfaction Analysis

**NHS** - National Health Service

**OECD** - The Organisation for Economic Co-operation and Development

**PHCC** - Primary Health Care Centre

**PHCU** - Personalized Health Care Units

**PICU** - Polyvalent Intensive Care Unit

**PPP** - Public-Private Partnerships

**PVI** - Public Voluntary Insurances

**RHA** - Regional Health Administrations

**RORM** - Robust Ordinal Regression Methodology

**UTA** - Utility Additive

**vN-M** - von Neumann-Morgenstern

# Chapter 1

# Introduction

## 1.1 Introduction of the problem

Healthcare systems are continually facing substantial challenges of all kind. Over the years, demographic changes have have had a considerable impact on the healthcare sector, one of the major discrepancies being the unbalanced distribution of the population, alongside with migration and an unhealthy ageing population. The ultimate goal of healthcare services is to overcome these challenges and to improve patients' satisfaction and quality of life. Hence, evaluating the healthcare provision and measuring patients' satisfaction assume priority roles within a hospital.

Generally, this task is mainly devoted to the emergency room, which undoubtedly needs to be more efficient and organized. However, there are (other) areas where patients are equally dissatisfied, and one should focus on those as well, particularly if the health system is Beveridge-based. On the one hand, patients are forced to pay taxes, which mostly finance the healthcare system in Portugal. On the other hand, in exchange, they also have some clear buying decision criteria and demand for efficiency and efficacy, equity on access, low waiting time, and the overall exceeding of their own initial expectations [1]. Additionally, empirical evidence shows that a higher level of patient satisfaction leads to improved outcomes, once satisfied patients are more likely to follow medical advice after discharge.

Measuring patients' satisfaction in secondary healthcare-based services is a rarely addressed, though a very important task. For such a reason, this study focuses on the inpatient service valence. First, it aims at showing the factors that are most likely to cause an impact on satisfaction with care and the willingness to recommend hospital services to others. Then, the critical areas requiring special improvement within the service are identified. Having this kind of information allows the managers to strategically allocate the resources in order to improve patients' experience and satisfaction.

Despite its importance and relevance for the hospital's overall performance, patient satisfaction is not yet a clearly defined concept. Traditionally, its measurement was based on technical and physiological reports of outcomes, in preference to direct reports of patients. More recently, however, several questionnaires have been developed, asking patients to rate aspects of care, and these judgements are nowadays seen as acceptable and beneficial to healthcare managers, which seek to achieve a balance between a

clinically effective and an evidence-based care [2].

Furthermore, the complex multidimensional nature of healthcare must not be forgotten, and one must assess the consumers' relative preferences - also known as weights - with regard to the different service attributes, which is essential information for cost-effective decision-making [3] within the healthcare system.

Letting the patient be involved in quality of care assessment is not, however, without its critics. Some suggest that patients cannot judge technical aspects of care, and that they use, as proxies, features they can evaluate, such as cleanliness of the facilities, or interpersonal aspects [3]. In addition, the satisfaction surveys are believed to have limitations, as they tend to elicit very positive ratings which are not sensitive to specific problems in the quality of care delivery [2].

Nevertheless, following a customer-oriented philosophy and continuous improvement principles, the measurement of patient satisfaction has become one of the most powerful tools for healthcare organizations, offering an effective, direct and meaningful insight about patients' preferences and expectations.

## 1.2 Objectives of the dissertation

In the increasingly competitive market of healthcare industries, managers and policy makers should focus on achieving high, or excellent, ratings of patient satisfaction [4]. Accordingly, the factors influencing (dis)satisfaction should be characterized and used as a means to access and improve the quality of healthcare delivery.

Healthcare settings are characterized by a multidimensional nature, and to understand how each service feature affects patient satisfaction is a very important task. Accordingly, intensive research has been done by several authors, exploring the various dimensions of the perceived service quality, namely the technical, interpersonal, social and moral aspects of care.

It is from our knowledge that healthcare is a very challenging and fast-changing sector, in which the clients are subjects who are experiencing some kind of health-related problem. Therefore, every action or measure within this sector must be carefully analysed and studied, given its direct impact on the patients' lives, whose health might be at stake. Furthermore, if the considered system follows the Beveridge model, like the Portuguese one, patients finance most of the healthcare services, through taxation, but they also have a position for demanding efficacy, efficiency, quality and for their expectations to be exceeded.

The present dissertation aims at evaluating the satisfaction of the Portuguese patients with reference to the secondary healthcare services delivery, in particular, the inpatient service. The main goal is to identify the factors to which managers should pay more attention when trying to improve customer satisfaction, and which areas of low performance should be tackled first. For this purpose, a questionnaire was distributed within the Amato Lusitano hospital, and patients were asked to assess their satisfaction with regard to that particular service. The resulting database was provided and further analysed. Patients' judgements are made according to a set of criteria representing the service's quality, and one assumes that these are well represented by rates.

Patients make a set of independent judgements over the inpatient service and its quality, and these

global and partial judgements (or ratings) have a utility associated. A Multicriteria Satisfaction Analysis is employed, the MUSA method, which is based on the so-called robust ordinal regression analysis. That is, this method assumes that the overall satisfaction results from the partial contribution of each criterion characterizing the concerned service, thus the utility of the overall satisfaction rating results from the sum of the corresponding partial utilities.

At the end of the present study, it is expected that one can: (1) determine the value of each satisfaction categories, (2) estimate what patients value the most within the service in analysis, (3) classify each satisfaction criterion, (4) assess patients' demanding level, and (5) identify the potential improvements, priority areas and opportunities of the hospital to enhance its performance. Once the abovementioned information is collected, healthcare managers must be able to direct more efforts towards the highly ranked attributes within the service, and initiate some improvement strategies in those aspects that are unsatisfactory from the patient's perspective.

## 1.3 Phases of the dissertation development

With the purpose of achieving the aspirations listed in Section 1.2, this dissertation is built upon the procedural plan schematized in Figure 1.1.

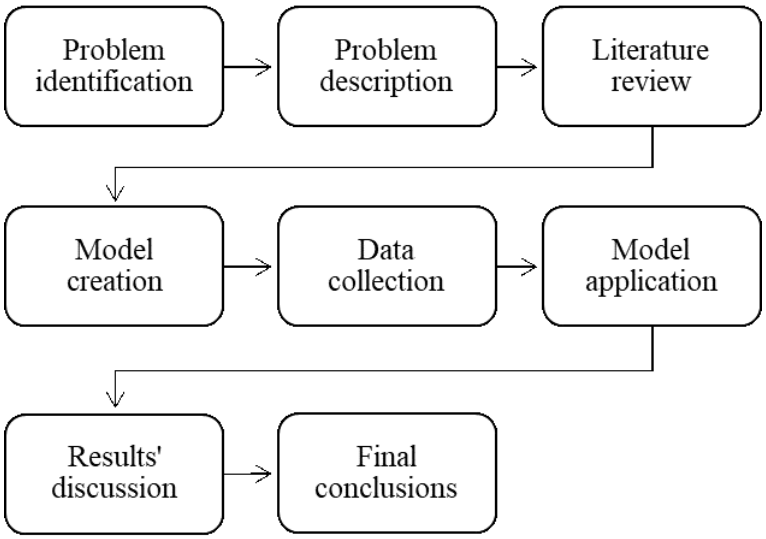


Figure 1.1: Phases of the dissertation.

The first node corresponds to the recognition and establishment of the problem that motivated the present study, by exploring the background and analysing the current state of the art regarding the health sector in Portugal. Once identified, the problem can be described and detailed, considering an adequate framework. Next in order is the acquisition of a solid theoretical basis on the subject covering, for instance, the existing methods for measuring satisfaction with healthcare services, and the latter is achieved through a literature review.

With such reliable foundations concerning the previous stage, one can create a model that suits the

identified problem, based on preexisting literature. The construction of the model is useless until one collects *bona fide* data. In line with that, the data sample was obtained and collected via a simple satisfaction survey, which was composed by questions assessing patients' satisfaction with regard to their experience in the inpatient service and its characteristics.

The following step is to apply the constructed model to the treated sample and obtain the desired results. The latter can then be discussed, according to a series of parameters, and additional analysis may be conducted in order to increase the scope of the study. Lastly, the ultimate resolution of the present research is to withdraw applicable conclusions and adopt accurate measures in order to improve the hospital's overall performance and the patient's quality of life.

## 1.4 Structure of the dissertation

The dissertation at hand is composed of eight sections, which are in line with the objectives and the methodology detailed above. The first section presents an introduction to the already stated dissertation, namely the motivation that led to it, its purpose, main goals and the steps that must be followed to achieve those goals. The remainder of this case study is structured as follows. Throughout Section 2, a detailed description of the problem is provided, exploring the current state of the Portuguese health sector, followed by a comprehensive description about the creation of the Portuguese National Health Service (NHS) and, lastly, the source of the collected data is introduced: a brief description of the Local Health Unit of Castelo Branco (LHUCB) is presented, with a special focus on the Amato Lusitano (AL) Hospital. The literature review occupies the third section. The not yet well defined concept of satisfaction is described, along with the relevance of customer satisfaction to management. The last part of the aforementioned chapter tries to identify some determinants of patients' satisfaction within healthcare services, facilitating the task of choosing the set of criteria and subcriteria to be studied. Section 4 presents the development of the mathematical model used to construct the utility scales associated with satisfaction. Furthermore, the utility theory and the concept of robust ordinal regression analysis are also introduced, as these represent the basis of the model's implementation. Additionally, Section 5 enraptures the case study *per se*, detailing the procedures that led to the application of the chosen model, namely the creation of the database, the final and treated sample, and the variables, *i.e.*, the description of the criteria and subcriteria used to measure satisfaction within the inpatient service. The main results of this research are provided in Section 6. There, one can find the obtained utility functions, the attributes which patients value the most, as well as their demanding nature. Moreover, the Kano's model is also applied, and the general strategic priorities and opportunities are highlighted. The penultimate chapter contains the discussion of the results and the achievements, while the last chapter presents the limitations of this dissertation, together with some future prospects.

# Chapter 2

# Problem definition

The healthcare sector is a delicate one. The ultimate goal of all healthcare systems is to protect, improve and promote the population's health, while optimizing costs, improving efficiency and broadening both the access and the quality of the services. New challenges, technologies and regulations present themselves to the healthcare industry on a daily basis. In line with this, healthcare managers must master their skills on performance evaluation and decision-making in order to overcome these obstacles. Furthermore, they must also recognize the patient's satisfaction as the most valuable tool to evaluate the provision of care. Therefore, the implementation of systems that control for the dis(satisfaction) of users becomes a compulsory measure for the healthcare system to identify the priority areas for improvement.

Similarly to other European countries, the health sector in Portugal continually faces substantial challenges, namely demographic changes, patterns of deprivation, unhealthy ageing and other consequences that can be attributed to the financial crisis. Since 1971, Portugal's health system has been characterized by a strong public component. Movements towards centralization took place, giving the State more responsibility for managing and providing a hierarchical network of services. Five years later, in 1976, the new Constitution called for the creation of the NHS which, from then on, has been at the forefront of health protection for all Portuguese citizens in an universal and general way [5].

Over the years, a positive evolution of health results has been observed, in particular in terms of infant mortality and life expectancy at birth. These improvements are a result of the increased access to public and private health services, and fundamentally, of the improved quality of life. The latter translates into, for instance, the population's access to water, electricity, sanitation and a more pronounced employment rate. Nevertheless, and although there is a strong legal and political commitment to social rights and people's welfare, health inequalities remain a general problem in Portugal, thus some urgent adjustments must be done within the NHS to increase efficiency and quality of health services.

## 2.1 Introduction to the Portuguese health sector

Portugal is a small country located on the western side of the Iberian Peninsula, in south-western Europe. It comprises the mainland and two archipelagos, Azores and Madeira, lying in the Atlantic Ocean.

According to recent estimates for 2015, Portugal has a total of 10.3 million inhabitants [6]. In line with other European countries, Portugal has been suffering profound demographic changes, and health inequalities remain one of the major discrepancies and challenges faced by the Portuguese health system. The population has become mainly concentrated in the metropolitan areas of Lisbon and Oporto, and along the coast, leaving an increasingly sparse and elderly population inland. Moreover, the so-called "double ageing" effect (*i.e.*, a combination between a larger longevity with the reduction of the birth rate) also holds a great impact on the health system. At the same time, migration plays an important part on the aforementioned demographic changes as well. Indeed, there has been observed a gradual decline in immigration coupled with the sudden increase in emigration.

Portugal has been committed to significant efforts for reorganizing its healthcare sector and improving the quality of hospital care in recent years. Since 1974, the country has had a democratic regimen and has experienced remarkable human, social and economic developments, embodied by the membership of the European Community, in 1986, and the Euro Zone, later in 1999.

The evolution of expenses with healthcare in the past few years shows that Portugal has made sustained progress in containing public spending whilst maintaining efforts to continually improve quality and efficiency of care. Also, over the years, the promotion of access rights has been reinforced by successive legislation. Primary care reforms have been successful in improving accessibility, efficiency, quality and continuity of care, as well as enhancing satisfaction in both professionals and citizens.

Over the past decades, Portugal has been pursuing a number of reforms to rationalize its hospital sector, through the promotion of greater specialization and concentration of hospital services. This on going process has started in the early 1990s, with the main goal of concentrating services into fewer and larger hospital centers and hospital groups. Alongside with this horizontal integration, Portugal has also bet on a vertical integration, starting in 1999, with the creation of Local Health Units (LHUs), which integrate hospitals and primary care centers in the same geographical area. In line with this, Family Health Units (FHUs) were also created in 2007 - with the goal of improving multidisciplinary cooperation between providers - and one year later, in 2008, Primary Healthcare Centre (PHCC) groups were established. At the same time, new management models and payment systems have been introduced, namely the development of Public Private Partnerships (PPPs) and the transformation of public hospitals into Public Enterprises (EPEs), which brought more managerial and financial autonomy to hospitals.

The year of 2008 was a critical one, as it marked the beginning of an international social, economical and financial crisis. This crisis resulted in a global recession of worldwide economies, having a meaningful impact on Portugal. Pre-existing issues such as family deprivation, unemployment rate and child poverty were exacerbated, which in turn led to serious consequences to the public healthcare system. In May 2011, due to the inability to refinance its debt, Portugal had to request external financial assistance from the EU. The Memorandum of Understanding (MoU), commonly known as the *Troika*, was signed by the Portuguese Government together with the European triumvirate - composed by the European Commission, the International Monetary Fund and the European Central Bank. The referred document has marked the starting point of an austere period: in exchange for a loan of 78 billion euros, an Economic and Financial Adjustment Programme was agreed.

Until 2015, the austerity measures put in practice by the Ministry of Health aimed at increasing cost-containment, improving efficiency, increasing regulation and governance in the healthcare sector and focused on health promotion. In addition, these also included the rebalance of the pharmaceutical market (new rules, new price settings, increasing of generic drugs), the increasing of co-payments, the expansion and coordination of long-term and palliative care, and the strengthening of primary and hospital care.

During hard times, when the country is suffering from a financial crisis, it is paramount that health authorities monitor the consequences and develop strategic plans to anticipate any side effects, specially in terms of the healthcare sector, and ensure that all citizens have equal access to healthcare services, whenever and wherever they need. In practice, however, this becomes a very complex task to achieve in the short run, given the inability to accurately estimate the real impact that the crisis - whose financial aid program ended by December 2015 [7] - and the MoU measures, have had on healthcare outcomes. Nonetheless, this impact can be measured in terms of access to healthcare services, efficiency and quality of care provision. Regarding these, it is plausible to note that this financial crisis has aggravated the already existing problems within the NHS [5], namely the lack of motivation of health professionals, whose rights and income were reduced, and the dissatisfaction of patients who experienced a lower-capacity system.

It was not until December 2015, when a new socialist government took place, that a redesigned 4-year strategy program was developed, aiming at reforming and revitalizing the NHS, while ensuring an efficient management for long-term sustainability [5]. In more detail, the post-*troika* socialist policies were intended to strengthen the NHS capacity in order to maximize the hospital response, in an appropriate and timely way, to shorten the waiting lists, to promote public health and reinforce primary healthcare, to enhance the proximity to the citizen and to provide continued and palliative care.

Portuguese citizens have enjoyed substantial improvements with respect to their health status and and healthcare outcomes over the last years. For instance, the rates of infant mortality went from being the worst in Europe during the 1980s and 1990s to among the best in 2003 [8]. Life expectancy at birth has improved dramatically, and mortality rates have decreased. However, despite all the efforts at ensuring better access, quality and efficiency, which are essential to guarantee the NHS sustainability, the impact of social determinants is not equitable in Portugal and health inequalities remain one of the key challenges for the NHS.

## 2.2 Portuguese national health service

Low standards of health, unbalanced distribution of units and health professionals, a lack of coordination between different providers, multiple sources of financing and the excessive centralization of some services were some of the main problems faced by the Portuguese healthcare sector around the year of 1970. Furthermore, the public expenditure on health was very low compared to most OECD countries (1.86% of the GDP [9]), since the majority of healthcare services were assured by religious charity hospitals (from the Portuguese word *"misericórdias"*), social welfare medical units and private entities.

Following the democratic revolution of April $25^{\text{th}}$ of 1974, which marked the end of the dictatorial regime, Portugal underwent an authentic restructuring process, especially at political, social and economic

levels, the healthcare sector being no exception. As a consequence, since 1979, the Portuguese healthcare system has been based on a NHS structure (see Table 2.1), expected to promote equity, efficiency, quality, accountability and the devolution of power [10]. Under this tax-financed service, the State extends the provision of free healthcare to all citizens, irrespective of their socioeconomic, employment or legal status, meeting the principle of every citizen's right to health, embodied in the 1976 Constitution of the Portuguese Republic.

Nowadays, in general terms, the healthcare delivery system in Portugal consists of a network of public and private healthcare providers. On the one hand, there is the public sector, comprising public entities, *i.e.*, primary care centers, hospitals, continued and palliative care units. On the other hand, the private sector includes consultations, diagnostic and therapeutic examinations, hospitals and other private clinics, which account for the delivery of clinical material and pharmaceutical products, complementary diagnostics and specialty medical appointments.

In line with several reform trends in many European countries, decentralization is viewed as the key to improve service delivery, to better allocate resources and to reduce health inequities [6]. Accordingly, the 1979 law establishing the NHS laid down the principles of centralized control but decentralized management. Therefore, planning, organizing, regulating and managing the healthcare sector is carried out centrally by the The Ministry of Health (*i.e.*, the coordinating body) and its institutions, whereas the management of the NHS takes place at the regional level, by five Regional Health Administrations (RHAs) introduced in 1993, including North, Center, Lisbon and Tagus Valley, Alentejo and Algarve. Each RHA owns a health administration board accountable to the Ministry of Health and responsible for: (a) imposing the health strategy in its geographical area; (b) coordinating the relationship between the public and private sectors; (c) supervising hospitals; and (d) managing and organizing the delivery of primary healthcare. In practice, however, during the period of the financial crisis, a set of actions and policy measures were taken and significantly diminished the extent of decentralization and autonomy of healthcare organizations within the NHS [11].

Financially speaking, the Portuguese health sector has not undergone significant changes since the publication of the Health Bases Law, in 1990 [12]. Following the Beveridge model, public hospitals are funded through global budgets, with an increasing role of activity-based funding using Diagnostic-Related Groups (DRG). The Ministry of Health allocates funds to the health regions, according to a combination of historical expenditure and capitation, paying for primary care and specific health programs. Part of the financing is also done by: (a) private voluntary insurances (PVI), covering about 20% of the population [5]; (b) occupational-based health insurance schemes (the so-called public or private "health subsystems"), which provide the ability to go to a specialist consultation without a referral from primary care and have quicker access to private provider; and lastly (c) the citizen himself, by means of co-payments due to the provision of exams performed by private providers contracted by the NHS, and to the acquisition of pharmaceutical products.

Despite the fact that the Portuguese health system is mostly a Beveridge-like system, it never fully corresponded to its general characteristics [10]. After its creation, some insurance schemes were left untouched, leaving the door opened for multiple coverage and overinsurance. In fact, approximately 25%

of the population [6] is covered by extra layers of insurance coverage and people can even benefit from triple coverage and become free to purchase services wherever they choose. At the meantime, those people dependent solely on the NHS for coverage, have different access and choice of services, which undermines the equity principle based on need and not ability to pay [13].

Since its creation, a number of changes were introduced to the NHS. For instance, NHS claimed to be a *universal* publicly financed health service. However, the universal coverage is, actually, *almost* free at the point of delivery, *i.e.*, user charges (the so-called "moderating fees") have been later introduced, in 1980, with the explicit objective of regulating over-utilization of several NHS services. Nevertheless, exemptions were created to assure that no person in need would be denied access to healthcare due to financial barriers. Additionally, by the beginning of the 21$^{st}$ century, the NHS has become a mixed system, based on the interaction between the public and the private sectors, integrating primary, secondary and long-term care, with the final goal of combining the universal coverage provided by the NHS with the promotion of efficiency.

Primary healthcare has become the principal undertaking of the NHS. It is centered on the patients, their families and the communities to which they belong, and consists of activities for health promotion, disease prevention, follow-up and treatment of less severe conditions, respecting the physical, psychological, social and cultural dimensions [5]. Some of the abovementioned reforms have resulted in great organizational changes: after 2006, FHUs were created, characterized by small multi-professional and self-organized teams, with their own operational and technical autonomy, and subject to a contract system for basic employment, with decentralized diagnostic means and a benefits system to facilitate great productivity, accessibility and quality. In addition, with a greater organizational and management power, the Health Center Groups (HCGs) were also created, including the former primary healthcare structures, now designated as Personalized Health Care Units (PHCUs).

Primary care should be the first contact between the user and the healthcare system. Patients in the NHS must register with a general practitioner (GP) in their residential area, who then refers them to a NHS hospital, usually located in the same geographic area. Choice of provider is greater for those covered by a health subsystem or PVI [6]. Nonetheless, distribution remains very asymmetric, revealing geographical inequalities in terms of access to these services, often questioning the level of health equity.

With respect to secondary healthcare in the public sector, it is provided by public hospitals, which are characterized by their response in terms of hospitalization, follow-up in specialty medical appointments, complementary diagnostic and therapeutic exams, and unscheduled emergency room (ER) services [5]. In theory, primary care gatekeepers must refer patients to secondary care, with strict referral rules for both outpatient consultations and ER episodes. However, the gatekeeping system operates imperfectly [10], considering that, until very recently, a relatively high proportion of the NHS users were not even registered with a GP, and patients often bypass their GP by visiting the ER services. This situation has been tackled in recent years by increasing the number of GPs within the NHS.

For several years, primary and differentiated care have been poorly articulated within the NHS. For this reason, and aiming at facilitating the link between these levels, vertical integration, in organizational terms, between primary and hospital care has been introduced by the LHUs, with a differentiated financing

model based on capitation financing. There are currently eight LHUs, namely Matosinhos, Nordeste, Alto Minho, Castelo Branco, Guarda, Alto Alentejo, Baixo Alentejo and Litoral Alentejo. Additionally, to increase the response of long-term post hospital and palliative care, a National Long-Term Care Network has been created as well, funded by the public sector and provided by the social sector (mostly by the *Santa Casa da Misericórdia*).

This concept of integrated healthcare focuses on case-management of highly complex patients, more accurate communication between hospitals and primary care health settings, more sophisticated referral systems between the different levels of care and home care follow-up of post hospitalization [11]. In line with the aforementioned ideas, the new government launched, in 2016, the NHS Portal, with information mainly targeted for the user, aimed at enhancing communication, transparency and accountability on healthcare. The kind of information available in this online platform include, for *e.g.*, the waiting times on the emergency department, or the waiting lists for the realization of surgeries.

Considering the private sector, it has always been present in the Portuguese healthcare system, as a complementary response to the NHS. The private healthcare supply is mainly focused on either the more deprived specialities of the NHS, or on more profitable areas, such as diagnostic tests and surgical activity [12]. In Portugal, citizens often use the private system as an alternative to the NHS, for the sake of greater ease of access and/or the comfort provided, bearing in mind their own responsibility for the cost - usually borne by a health subsystem or by private insurance coverage systems.

After the creation of the NHS, Portugal has registered significant improvements in health outcomes in mortality rates, particularly in infant mortality, approaching the most developed countries of the OECD [12] in this matter. These improvements must be attributed to aspects such as the enhancement of healthcare responsiveness, the articulation with the private sector, the development and integration of new technologies, the increasingly employment rate (and consequently the citizen's purchase power), and the global and economic development of the country, together with a greater awareness for healthier lifestyles and disease prevention.

To summarize, Portugal has a strong record on developing coherent and well-focused health plans, but there are significant weaknesses in linking and implementing plans at national, regional and local levels. Inequities are still present and generally determined by (a) geographical imbalances, as hospitals located outside metropolitan areas do not provide for all medical specialities, (b) income, since individuals with lower income face a greater challenge when paying for pharmaceuticals and when accessing health services without NHS coverage, and (c) health literacy, considering that older and/or less educated people do not have easy access to all the health-related information available on the Internet.

## 2.3 Summary

In this chapter, the background of the Portuguese healthcare sector was characterized, and an outline of the present case study was presented. By delivering a comprehensive historical and political view of the Portuguese NHS, one can clearly understand that the implementation of performance techniques is extremely important for the well-functioning of its systems and organizations. Although Portugal has

Table 2.1: Portuguese NHS organization.

| NHS | |
|---|---|
| Primary Care | Family Health Units (*Unidades de Saúde Familiar* - USF) |
| | National Network of Integrated Continuous Care (*Unidades de Cuidados Continuados* - RNCCI) |
| | Personalized Healthcare Units (*Unidades de Cuidados de Saúde Personalizados* - UCSP) |
| | Public Health Unit (*Unidade de Saúde Pública* - USP) |
| | Unit of Shared Assistant Resources (*Unidade de Recursos Assistenciais Partilhados* - URAP) |
| Hospital Care | Public-Private Partnership Hospitals (PPP) |
| | Administrative Public Sector Hospitals (*Hospitais do Sector Público Administrativo* - SPA) |
| | Public Enterprise Entity Hospitals (*Hospitais do Sector Empresarial do Estado* - EPE) |

shown evident attempts to overcome the countless challenges it faces, and to increase aspects such as accessibility, efficiency and quality, there is still a great room for improvement.

# Chapter 3

# Literature Review

Over the past decades, given the customer-orientation philosophy and continuous improvement principles of modern enterprises, consumer satisfaction has gained widespread recognition as a measure for quality in many public sector services, particularly in the healthcare sector. However, to be of any practical use, one must know what people mean when they say they are "satisfied" with a particular aspect of a product/service. The present dissertation proposes an innovative satisfaction measurement model applied to a case study in the healthcare sector. In Section 3.1, a brief introduction is presented and attempts are made in order to define the concept of satisfaction. Section 3.2 focuses on the importance of measuring satisfaction and how it can be done. Lastly, the factors that determine satisfaction with healthcare are addressed in Section 3.3.

## 3.1 What does satisfaction mean?

In the past recent years, the interest in measuring satisfaction with healthcare has clearly grown. The concept itself continues to be widely used and has become largely studied by several authors. Even so, the conceptual basis of satisfaction with healthcare is not fully established, which makes its measurement a complex task, raising issues in the interpretation of survey results.

If one looks in a dictionary for the definition of the word "satisfaction", one will find that it comes from the Latin, meaning "enough" and the fulfilment of one's wishes, expectations, or needs, or the pleasure derived from this, leaving no room for complaint [14]. In fact, although different approaches of defining customer satisfaction may be found in the literature, the most popular of them is based on the fulfilment of customer expectations [15].

Although the abovementioned definition seems quite simple and adequate, it also gives rise to a couple of important aspects which embody the complexity of this matter. First of all, (in healthcare) satisfaction itself does not imply a superior service, *i.e.*, satisfaction can be achieved by an adequate or acceptable standard of service. Secondly, whenever different individuals are asked to evaluate a service, they usually compare their personal subjective standards with their own perception of care received [3], meaning that the concept of satisfaction assumes a relative, rather than an objective, nature.

In order to overcome the existing lack of clarity in the literature regarding how satisfaction is defined and measured, it is worthwhile to consider the highly cited Donabedian's framework on how to examine health services and evaluate quality of medical care [16]. According to his work, quality may play a pivotal role on patients' satisfaction, which in turn is a necessary, but not a sufficient, condition for effective care. Furthermore, the key to assess the quality of care lies in a mix of three clinical and patient-centered indicators:

- *Structure*, refers to all the settings and factors that affect the context in which the process of care takes place, including the physical facilities, equipment and human resources, as well as organizational processes. These factors support the provision of care and influence the way providers and patients act within the healthcare system. Structure is often easy to observe and measure, thus it may be used to assess the average quality of care within a facility or a system.

- *Process*, can be seen as the sum of all the actions that constitute the healthcare process. According to Donabedian, its measurement is nearly equivalent to the measurement of quality of care, given that the process contains indeed all acts of healthcare delivery. Process refers to whether medicine is being properly practiced or not, comprising the set of actions undertaken by both the clinical staff, providing health care, and patients (and/or their families), so as to follow the medical advices.

- *Outcomes*, comprise the effects of healthcare on patients and/or the population. These include changes on health status (for *e.g.*, recovery, survival rate or mortality rate), behaviour or knowledge, as well as patient satisfaction and health-related quality of life. Therefore, outcomes are usually seen as the ultimate indicators of the effectiveness and quality of medical care. The drawback is that measuring outcomes that are exclusively attributed to healthcare is a very complex task.

Throughout his framework, Donabedian regarded "outcome" as the most important aspect, defining it as a *change* in a patient's current and future health status that can be confidently attributed to antecedent care. In fact, although patients' satisfaction is a direct effect of care, *i.e.*, and outcome itself, it cannot be correctly measured without taking into account both structural care and process of care [1].

Furthermore, it seems rather necessary to understand how individuals evaluate care and make judgements, as well. The latter is a very difficult task, not only because its subjective and relative nature, but it also appears to be cognitively and emotionally difficult for some patients to evaluate the quality of care, since their experiences may vary over time and across different providers. For this and other reasons, one cannot state that high quality implies high satisfaction, nor the reciprocal.

## 3.2 The importance of satisfaction to management

How can we know whether an economy performs well or not? What about a company? It is a difficult task to give an adequate answer to any of these questions. In fact, although one may calculate several economic indicators, such as employment, prices and production growth rates, in the final analysis what matters is how well an economy satisfies its customers' needs and wants [17].

In the recent decades, a customer-orientation philosophy has been adopted in modern enterprises, as well as the notion of continuous improvement. Customer satisfaction has become an explicit organizational goal, thus understanding this concept has become one of the most important tasks within business organizations of all types. The latter is true not only because the achievement of customers' satisfaction is a worthy end point in itself, but also because its measurement opens a door revealing their preferences and expectations, in an effective, direct, meaningful and objective way. Thereby, assessing satisfaction expresses a baseline standard performance and a possible standard of excellence for any business organization.

Generally speaking, a core concept of marketing is naturally to be consumer centered, monitoring consumer's needs and wants and adjusting products/services in order to fulfil expectations and, as a consequence, to generate satisfaction. Following this idea, a growing number of customer-driven companies are committed to provide excellent quality and competitive products and services, with the goal of satisfying the needs and preferences of their customers.

However, as it was referred in the previous section (see Section 3.1), satisfaction is an abstract and intangible concept, highly difficult to define. For this reason, it must be translated into a number of measurable parameters, so that it actually means something to companies. Curiously, this is advantageous for two distinct reasons: on the one hand, consumers' satisfaction is a goal in itself, on the other hand, its measurement ends up motivating the employees, who are involved in any stage of the service delivery. In fact, when all the improvement efforts are evaluated by the customers themselves [15], the service providers become more inspired and focused to perform and achieve higher levels of productivity.

In addition, several studies suggest that satisfied customers should exhibit at least one of three measurable characteristics: (1) loyalty, which increases the retention rates, (2) enhanced business, translated into share of wallet, and (3) price tolerance [17]. Although this relation seems rather logical, it is not always strong, since other internal and/or external factors may affect the financial performance of a business organization. For this reason, customer satisfaction should be considered as a necessary, but not a sufficient, condition for the financial viability of a company.

In short, the importance of measuring customer satisfaction to management can be briefly summarized as follows:

- it represents a highly reliable market information that allows business organizations to evaluate their current position against competitors, their strengths and weaknesses, and to design future plans and strategies;
- it is a useful tool to identify potential market opportunities;
- it helps to understand customers' behaviour, particularly their expectations, needs and desires;
- it allows the continuous improvement based on standards that take into account customer behaviour and identify critical satisfaction dimensions that should be improved;
- reveals potential disparities regarding perceptions of service quality between customers and managers.

Everything that has been discussed can be applied to the healthcare sector, whose management bears important and different characteristics when compared to other sectors. Firstly, and most importantly, it is directly related to human life. Moreover, the most pronounced part of financial expenditures within this sector is related to personnel and physical equipment and, since healthcare services are produced by both providers and patients, both parties must be taken into account when evaluating service quality and satisfaction.

The primary goal of healthcare systems is to meet the health expectations of communities, improving patients' satisfaction and quality of life. Even though satisfaction is an important aspect of quality, the relation between these two concepts is somehow difficult to define. On the one hand, patients might be unable to correctly and non-emotionally evaluate the quality of care, given the severity and/or complexity of their illness. On the other hand, providers may have to face a trade-off between providing satisfaction to their patients or better treatment outcomes. Furthermore, the measurement of patient satisfaction is often biased due to several factors that, in turn, do not necessarily affect the quality of the delivered services. [1]. Hence, one can say that satisfaction and quality are two mutually exclusive concepts.

Similarly to what happens in other sectors, there is an inherent value to patient-centered care. Empirical evidence shows that satisfied patients produce better outcomes, given the fact that they are often more likely to follow medical advice after discharge [18]. Therefore, if consumer satisfaction is in fact a priority, it is paramount to ensure that the organisational, financial and regulatory arrangements that influence care delivery are structured in such a way that practitioners are encouraged to foster supportive and interactive relationships with their patients.

It all comes down to this: in order to create the best healthcare services, managers must be able to assess the quality of provided care. Only by this assessment can they ensure continuous improvements in healthcare services. This quality monitoring requires regular and direct feedback from patients about their perceptions of the quality of care. To achieve that, patients may be interviewed or asked to self-complete a questionnaire. With the obtained results, healthcare providers and policy makers must be able to identify service factors that need improvement and to understand patients' needs. Consequently, this creates room for the designing of a strategic plan and the delivery of effective and better quality services to the end users, *i.e.*, the patients themselves [19].

Despite its usefulness, the process of improving patients' satisfaction and providing more effective care also finds its obstacles. That is because reforms must be done regarding work processes and systems, and due to multiple priorities and resource demands within the healthcare sector, health managers and providers may sometimes question the value associated with collecting, analysing and acting upon data on patients' experiences of care [18].

## 3.3 Satisfaction determinants in healthcare

In the increasingly competitive market of healthcare industries, managers should focus on monitoring and achieving high ratings of patient satisfaction to improve the quality of service delivery, as patients have contributor, target and reformer roles in quality assurance. In fact, satisfaction is highly associated

with willingness to recommend to others the hospital in which patients received treatment. Results of patient satisfaction surveys allow policy makers to understand patients' needs and identify service factors that need attention and improvement, and then to make strategic plans for effective and better quality services [19].

There is consensus amongst commentators that a complete definitive conceptualisation of satisfaction with healthcare remains to be established, and that understanding the process by which a user becomes satisfied or dissatisfied is incomplete [3]. In addition, contradicting evidence exists across patient satisfaction studies. This has interfered with measurement efforts and frequently raises issues in the interpretation of survey results. To work around this matter, there is a broad and diverse literature addressing how patients rate the quality of their care, and a growing significance attached to satisfaction outcomes. It is important to understand, however, the difference between studies that rely on the perspective of clinicians, researchers or administrators, and those that actually attempt to learn directly from patients what they value the most in healthcare [20].

One thing is known and agreed: satisfaction is a multidimensional concept that derives from an evaluation of various features of the experience of care. Accordingly, there are the *healthcare factors*, which are judged by consumers in the formation of their perception about the care they receive, the *individual factors*, that consist of cognitive and affective processes reflecting consumers' particular personal characteristics, through which they create their perceptions, and lastly one has to consider the *methodological issues*, which comprise the type of instruments that are used to measure satisfaction.

When satisfaction is measured, consumers may be asked to perform a single global summary judgement and/or to evaluate a set of aspects individually. In both cases, patients are presumed to compare their personal subjective standards with their perception of the care they received. According to Johnson *et al.*, customer satisfaction appears as a function of the customers' expectations, perceptions of performance and prior satisfaction, distinguishing two general conceptualizations of satisfaction [21]:

- on the one hand, satisfaction may be transaction-specific, when it refers to the customer's (dis)satisfaction with a discrete and particular product or service encounter;
- on the other hand, satisfaction may also be seen as cumulative, when it consists of an abstract construct describing customers' overall (dis)satisfaction with her/his consumption experience with a product or service to date; this is a fundamental indicator of a market's current and long-run performance.

Despite all efforts to establish a tangible definition of satisfaction, several problems continue to arise when trying to design a further robust measurement system for patient satisfaction. A common comment on patient satisfaction surveys is that these tend to elicit very positive ratings which are not sensitive to specific problems in the quality of care delivery. As an alternative, it has been argued that questionnaires should attempt to measure patients' experiences of their care, and then determine how such experiences relate to satisfaction [2].

Aiming at overcoming the abovementioned difficulties, a large number of studies propose distinct measurement instruments. This has its drawbacks, however, given that it diminishes the comparability

and the benchmarking between studies. Additionally, several approaches have also been adopted, with the goal of identifying features of patient care that are likely to influence patient satisfaction, for instance the health status, demographic factors (such as gender, age, racial and ethnic groups), socioeconomic factors, and so forth.

Nevertheless, in order to understand the importance of health service determinants and patient-related characteristics that shape patient experience into patient satisfaction [3], the following areas require further research:

- there must be a clearer distinction between different types of expectations, including ideals, aspirations, values, beliefs and standards;
- it is worthwhile to understand how expectations are formed, and explore the impact of individuals' characteristics, such as background, family, friends, past experiences, education, among others;
- understanding how different types of health outcomes and sociodemographic aspects may affect patients' evaluations;
- explore the reasons underlying the differences in satisfaction, observed in several healthcare delivery systems with different incentive structures on physician behaviour;
- investigating common trade-offs made by patients, particularly the relationship between cost and choice, access, technical and interpersonal aspects of care.

Additionally, it is relevant to establish a distinction between satisfaction determinants based on expectations, those focusing on service attributes and those arising from economic theory [3]. The following subsections explore these three approaches.

### 3.3.1 Expectation theories

Similarly to what happens with the concept of satisfaction, "*expectation*" is itself a difficult idea to examine and define. The assumption is frequently made that expectations are formed based on information that consumers collect from several possible sources, namely cultural norms and aspirations, personal experiences, reported views of family, friends and media influences [3].

Expectations emerge repeatedly as having a fundamental role on the determination of satisfaction with healthcare. In 1975, Stimson and Webb were the first to suggest the commonly accepted hypothesis that satisfaction relates to the perception of the benefits of care, and the extent to which these meet the patient's expectations. In line with the expectancy-value theories, expectations capture customers' beliefs that a given response will be followed by some event, which has either a positive or a negative valence.

The essence of this approach relies on the fact that satisfaction is associated with the degree to which perceived performance confirms (or disconfirms) performance expectations. In the simplest form, (dis)satisfaction is viewed as a reflection of the difference between what is expected and what is perceived to have been delivered [3]. Therefore, two opposite situations may be considered. On the one hand,

when the perceived performance exceeds the expectations (*i.e.*, positive disconfirmation) satisfaction increases. On the other hand is the case of a negative disconfirmation, *i.e.*, when the expectations exceed the performance, which in turn results in increased dissatisfaction. It should be clear that, the larger the perceived discrepancy between expectations and experience, the greater the satisfaction (or dissatisfaction).

However, there are several limitations associated with the expectation-based model, as basic conceptual questions remain to be answered, including the definition of expectations and their accurate measurement. Furthermore, the measurement of satisfaction based on how consumers judge and interpret the discrepancy between what they expect and what they received from a care experience can be imprecise and/or unrealistic:

- evidence suggests that expectations vary according to knowledge and prior experience, and are therefore likely to change with accumulated experience [22];
- patient evaluations about the technical aspects of care are particularly problematic areas, owing to their (probable) lack of knowledge;
- different financing plans possibly affect the way patients' evaluate their care, since the expressed satisfaction is, in a way, a reflection of the budgetary benefits they gain.

Given the abovementioned reasons, there is a constant need to educate health consumers about appropriate care and to manage their ideals and expectations about what can realistically and practically be provided [3].

### 3.3.2 Health service attributes

The limitations of the expectations-based models have led to another approach that also attempts to clarify the concept of satisfaction, this one focusing on consumers' evaluations of health service attributes. Considering its multidimensional nature, these methods rely on critical features that affect satisfaction with healthcare.

Fundamentally, the most important attributes of care relate to three main aspects: (1) the patient-practitioner relationship features, (2) the provider characteristics, and (3) the structures of healthcare delivery [3].

The patient-practitioner relationship has its grounds on what has been termed as patient-centered care. Patients are known as unique and should be respected and listened to. Therefore, efforts to promote patient-centered care should include, on the one hand, helping patients to be more active participants in their care, and on the other hand training physicians to be more mindful, informative and empathic, more aware of their patients' health beliefs, to anticipate their needs, protect their privacy and confidentiality, and so forth.

Also playing an important role on satisfaction are the provider characteristics. Although patients do not have the expertise of a trained professional, they do have the capacity to assess what practitioners often refer to as technical quality of care [20]. They are increasingly capable of knowing whether the

exams and treatments are appropriate to their diagnosis, age, gender, or family health status. Besides, across several studies, patients express desire for competent, experienced and well educated providers, who offer effective treatments, accurate diagnoses and treat their patients professionally with concern, caring, warmth and sensitivity.

Last but not least, patients are also able to evaluate the quality of the healthcare organizations' structure and facilities. Accessibility, affordability, choice and equity are some of the organizational issues highly valued by patients in the process of care delivery. Characteristics of the physical environment in which healthcare is delivered also affect satisfaction, such as privacy and security, in and around the facility, cleanliness and comfort, heating, quality of the food provided, a quiet and pleasant environment and up-to-date technology.

It is worth mentioning that different healthcare users assign different weights to particular attributes, given their unique frame of reference from which evaluations are made [3]. Therefore, sociodemographic factors, health status and beliefs, prior expectations, and so forth, may also be considered as intervening variables.

### 3.3.3 Economic approaches

Economically speaking, the concept of satisfaction in the consumption of a product or service is defined as "*utility*".

By applying the utility theory to the healthcare sector, and assuming that consumers have choice within the system, it is reasonable to say that consumers will choose a particular healthcare service and/or provider based on the utility-generating attributes offered. Similarly to what happens in expectation theories, satisfaction depends on whether the actual utility experienced is greater than, equal to, or less than the expected utility [3].

Consumer surplus is earned when consumers are more than satisfied, *i.e.*, whenever the value of the utility exceeds the price. As stated before, different consumers have different preferences and therefore will purchase different products defined by a variety of characteristics. In the presence of limited budgets, most consumers make trade-offs based on their individual preferences and priorities. Moreover, consumer behaviour theory distinguishes three types of goods and services, that can be adjusted to the healthcare sector [3]:

- *Search goods*: utility is predictable and expectations are clear, for *e.g.*, the facility's location and/or opening hours;
- *Experienced goods*: one can only assess their quality after purchasing and trying them, thus expectations are unclear and there is a considerable uncertainty; an example of this is how a patient-practitioner relationship will develop during the process of care;
- *Credence goods*: their purchase is based on trust, since consumers have low or uncertain expectations of their utility-generating process, for instance, the preventive care.

Several indicators of socioeconomic status were used across the existing literature. In general, the findings were inconsistent and inconclusive. However, it can be said that higher income group patients

tend to be more satisfied with overall health services or with access and technical quality [19], while people with lower incomes have been observed to report more problems with in-hospital stays [3]. A particular area requiring investigation is, therefore, the way in which these and other factors influence expectations, and consequently, overall satisfaction.

## 3.4 Summary

This chapter has provided a background to the present case study. A handful of notions and concepts have been introduced, namely the struggle with defining aspects such as satisfaction, or expectations. To describe the former, a series of approaches have been considered, highlighting the Donabedian's framework on how to examine health services and evaluate quality of care. Besides, the importance of measuring satisfaction to management was assessed. Ultimately, the determinants of this multidimensional concept were likewise introduced, and a distinction has been made between those based on expectation theories, on service attributes and on economic approaches.

# Chapter 4

# Multiple criteria customer satisfaction analysis

*Decision* has inspired reflection of many thinkers since the ancient times, and the capacity of humans to decide is claimed to be what distinguishes us from animals. Every decision one ever takes requires balancing a set multiple factors (*i.e.*, different points of view) which can be roughly seen as criteria. This process can be done explicitly, but sometimes it is even done without conscious thought, meaning that in one sense, everyone is well practiced in multicriteria decision-making, without being conscious of it.

For many years, the statement of a decision problem relied merely on the definition of a single criterion, amalgamating the multidimensional aspects of the decision situation into a single scale of measure. In reality, however, the very nature of a decision problem is the existence of a bunch of complex and conflicting information, often reflecting differing points of view and changing with time. In line with this, a new way to look at decision problems has gained more and more attention of researchers - the Multiple Criteria Decision-Aid (MCDA).

Under the term *multicriteria analysis*, two basic approaches have been developed: (1) an activity of decision-aid to a well-defined decision maker, and (2) the aggregation of multiple evaluation criteria, in order to choose one or more actions from set $A$. In both cases, the set of alternatives $A$ is analysed in terms of multiple criteria, thus allowing the modelling of every possible impact and/or consequence related to the aforementioned set.

MCDA's principal aim is to help in the decision process. It starts by helping decision makers learn about the problem situation, about their own and other's values and judgements. Then, through organization, synthesis and appropriate presentation of information, they are capable of identifying the preferred course of action, for each particular case. Briefly, the modeling steps include:

1. logically, a decision problem implies the definition of a set of alternative actions $A$;
2. next in order is the determination of a consistent family of criteria (each criterion is a non-decreasing real valued function defined on $A$);
3. the next step consists on the development of a global preference model to aggregate the marginal

preferences on the criteria;

4. the last step is comprises the decision-aid itself, based on the collected information in the previous points.

With regard to the third point, the nature of the chosen criteria can be of four different types: *measurable*, allowing the preferential comparison of intervals within the evaluation scale, *ordinal*, when the evaluation scale is discrete, *probabilistic*, covering the cases of uncertainty regarding the actions' performances, and *fuzzy*, whenever the actions' performances are intervals of the criterion's evaluation scale [23].

A bridge can be done between MCDA and the satisfaction evaluation problem within the inpatient service, in which the decision maker is the patient her/himself. The current customer-orientation philosophy and the main principles of continuous improvement of modern enterprises make satisfaction measurement a necessary condition and one of the most important issues concerning business organizations of all types. For this reason, it is critical to develop modern operational research and management tools in order to analyse in detail customer satisfaction and translate it into a number of measurable parameters. Extensive research have defined several approaches and proposed models for the abovementioned evaluation problem, adopting the following main principles [24]:

- data are based on customers' judgements and should be directly collected from them;
- the problem of measuring customer satisfaction can be perceived as a multicriteria evaluation problem, assuming that customer's global satisfaction depends on a set of variables representing service characteristic dimensions;
- usually, the aggregation of partial evaluations in a global satisfaction measure (see Figure 4.1) is done by an additive formula.

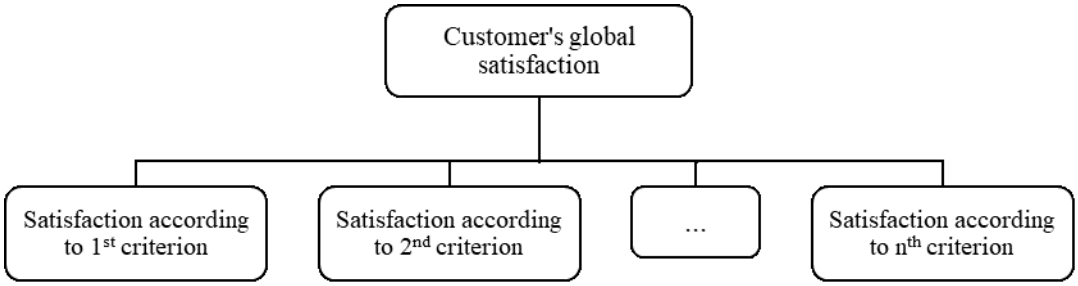


Figure 4.1: Aggregation of customer's partial judgements.

Furthermore, the evaluation of satisfaction is often done through highly objectionable tools, for instance the well-known and widespread SERVQUAL, SERVPERF and HEdPERF. More appropriate optimization models shall be used instead. Accordingly, the present dissertation proposes handling the MUSA method. The latter is a variant of the utility additive (UTA) multicriteria method and consists of a preference disaggregation methodology that follows the principles of ordinal regression analysis under constraints, using linear programming tools. This model, linked to the Kano's model described later in Section 6.1.5, allows the identification of the critical areas where patients are mostly dissatisfied.

## 4.1 Preference theory

When the goal is to master customer behaviour, it is compulsory to model and understand how consumers form their preferences for products and services. In line with this, extensive research has been developed in order to determine how consumers combine perceptions of product or service attributes into preferences.

Preference theory is the field that studies the fundamental aspects of individual decision behaviour, the people's preferences and, among others, the judgements of preferability, worth, value and goodness [25]. It aims at constructing appropriate preference representation functions for decision-making. Throughout these studies, the process of characterizing preferences can be made under certainty or uncertainty (also known as risk), and the alternatives can be described by both single or multiple attributes. A distinction is usually done between preference representation functions under certainty and under uncertainty: the former are defined as *value functions*, while the latter correspond to *utility functions*.

Theoretically speaking, preference theory is primarily concerned with properties of a basic binary relation $\succ$ on a choice set $X$ [26]. For instance, we might present an individual with a pair of alternatives, say $x, y \in X$, and ask which one she/he prefers. Giving this problem, the following situations may arise:

- if the answer is $x \succ y$, this means that the individual prefers $x$ to $y$, where $\succ$ means strict preference. Logically, the opposite may also be true.
- whenever the individual is indifferent between both alternatives, $x \sim y$ will be the given answer. The indifference relation can also be defined as the absence of strict preference. Indifference might arise from several reasons: (1) an individual might truly feel that, in a preference sense, there is no real difference between $x$ as $y$ and vice versa; (2), indifference may also be present in the case where the individual feels uncertain about her/his preference between $x$ and $y$; (3) it may also happen that the individual considers both alternatives incomparable on a preference basis, assigning an indifference relation between them.

Additionally, if it is not the case that $y \succ x$, then $x \succeq y$ is true, where $\succeq$ represents a preference-indifference relation, comprising both the strict preference ($x \succ y$) and the indifference ($x \sim y$) relations.

Preference studies take into account a set of basic axioms of individual choice behaviour. Firstly, it is reasonable to believe that one can state her/his preference without contradiction over a pair of alternatives. This first assumption leads to the notion of *preference asymmetry*: preference is asymmetric as long as, given the pair $x$ and $y$ in $X$, the relations $x \succ y$ and $y \succ x$, do not occur simultaneously. Asymmetry is an "obvious" condition for preference and it can be viewed as a criterion of consistency. Furthermore, once the judgement $x \succ y$ is made, and given a third alternative $z$, the individual should be able to position it somewhere on the ordinal scale: either better that $y$, worse than $x$, or both. This property is defined as *negative transitivity* and it states that, given the third element $z \in X$, either $x \succ z$, or $z \succ y$, or both. Additionally, the concept of *weak order* is applied whenever the preference relation $\succ$ is both asymmetric and negatively transitive. In the presence of a weak order relation, the following properties apply:

1. Strict preference $\succ$ is *transitive* (if $x \succ y$ and $y \succ z$, then $x \succ z$);

2. Indifference $\sim$ is transitive, *reflexive* ($x \sim x$, for all $x$); and *symmetric* ($x \sim y$ implies that $y \sim x$);

3. Exactly one of $x \succ y$, $y \succ x$ or $x \sim y$ holds for each pair $x$ and $y$;

4. Weak preference $\succeq$ is transitive and *complete* (for a pair $x$ and $y$, either $x \succeq y$ or $y \succeq x$ is true).

Thereby, an individual whose strict preference is represented by a weak order, is able to rank all the considered alternatives into a unique order.

### 4.1.1 Preference functions under certainty

As mentioned before, preference representation functions under certainty are often called *value functions*. A real-value function $\dot{v} \in X$ is a numeric representation of preference. Accordingly, $x \succ y$ is true if and only if $\dot{v}(x) > \dot{v}(y)$, for all $x, y \in X$. This type of function is said to be order-preserving (*i.e.*, $\dot{v}(x) > \dot{v}(y)$ is consistent with the order of $x$ and $y$ under $\succ$), and the same can be stated for any monotonic transformations of $\dot{v}$. Furthermore, given the absence of uncertainty, value functions do not have any added meaning apart from the representation of the ranking order of different outcomes or alternatives.

The goal is to replicate the decision maker's preferences with the less possible ambiguity, which sometimes can be a complex task. To work around this difficulty, it is rather common and useful to consider the so-called "strength of preference" notion. In order to do that, the decision maker is asked to order the differences regarding the strength of preference between pairs of alternatives. In other words, the decision maker establishes the "preference differences" between the given alternatives. This can be done by directly rate the alternatives on a cardinal scale, or alternatively, by making direct comparisons of preference differences.

### 4.1.2 Preference functions under risk. Utility theory

Every decision would be easier in a world ruled by certainty. However, on our day-to-day lives, the majority of the decisions we make must take into account the associated risk. Therefore, in reality, the decision maker must responsibly balance judgements about uncertainties with her/his preferences for possible consequences or outcomes. The process of assigning utility numbers to consequences must be such that the maximization of the *expected utility* becomes the appropriate criterion for the decision maker's optimal action.

Indeed, uncertainty is something that cannot be left behind and forgotten. One must pay careful attention to this feature when studying and analysing consumer behaviour. The latter becomes particularly relevant when major purchases are on the table, or decisions regarding consumer durables, or major industrial products, and also whenever the subject is related to the healthcare sector.

From the mid $20^{\text{th}}$ century, utility studies started to focus on preference structures that already incorporated the role of uncertainty and probability. The most significant contribution for this area of concern must have been the formalization of the Expected Utility Theory, by von Neumann-Morgenstern (vN-M), first proposed in 1947.

The vN-M work introduced what is known as the modern utility theory, which describes a method of decision-making under uncertainty, based on a set of axioms of rational behaviour. This theory relies on the assumption that the conventional method for measuring utilities is the standard gamble technique, a lottery-based approach. Accordingly, utility theory does not use a statistical estimation procedure to calculate the parameters. On the contrary, these are estimated directly from lottery and trade-off questions [27]. Furthermore, unlike expectancy value, preference regression, or conjoint analysis, which often include risk as a variable, one of the most unique and useful features of this theory is the explicit inclusion of risk in its axiomatic foundations [27]. The expected utility theory is commonly presented in terms of the following three basic axioms.

Let $P$ be a set of simple probability distributions or lotteries $\{p, q, r, ...\}$ on a nonempty set $X$ of outcomes. For these lotteries and all $\lambda$, $0 < \lambda < 1$, the expected utility axioms are the following:

- Ordering: $\succ$ is a weak order;
- Independence: If $p \succ q$ then $(\lambda p + (1-\lambda)r) \succ (\lambda q + (1-\lambda)r)$ for all $r$ in $P$;
- Continuity: If $p \succ q \succ r$ then there exist some $0 < \alpha < 1$ and $0 < \beta < 1$ such that $\alpha p + (1-\alpha)r \succ q \succ \beta p + (1-\beta)r$.

Furthermore, according to the vN-M expected utility theory, the aforementioned axioms hold if (and only if) there exists a real-valued function $u$ - unique up to a positive linear transformation - such that for all $p, q$ in $P$, $p \succ q$ if and only if

$$\sum_{x \in X} p(x)u(x) \geq \sum_{x \in X} q(x)u(x) \tag{4.1}$$

In addition, unlike value functions, utility functions provide additional useful information, namely the individual's risk attitude. The latter is based on the shape of the function. On the one hand, if it is a concave function, the individual is risk averse. On the other hand, a convex function means that the individual is risk seeking. There is also the possibility of a linear function, which corresponds to a risk neutral situation.

## 4.2 Robust ordinal regression

For the development of decision models, the specification of certain parameters is a required step. For instance, when considering the well-known Multi-Attribute Utility Theory (MAUT), the parameters that must be formulated are the set of marginal value functions represented by $u_i(g_i(a))$, $i = 1, 2, ..., n$.

Several methods have been proposed to characterize decision models. The distinction is commonly made regarding the process of collecting information, which can be done either directly or indirectly. Considering the former, the values of some parameters used in the preference model are directly specified, for *e.g.*, trade-off weights, discrimination thresholds, *etc.*. Contrarily, the preference information may be indirectly collected, taking into account holistic judgements from which compatible values of the model parameters are induced [28]. In the real world, however, asking the decision-maker to directly elicit

preference information can be an uncomfortable task, given that it requires high cognitive effort. For this reason, and aiming at relieving the decision-maker's work, indirect collection of preference information is often considered more interesting, once it naturally requires less cognitive effort in the process.

In line with this, the first step is to ask the decision maker to provide some holistic preference comparisons regarding a set of reference alternatives. Once this information is provided, the so-called ordinal regression methodology is used for inducing the abovementioned parameters. Having concluded these steps, it is possible to formulate a consistent decision model that allows the evaluation of the different alternatives, through an *aggregation approach*.

This process may result in many sets of parameters compatible with the preference information provided by the decision maker, *i.e.*, different value functions. Despite this fact, only one of the resulted functions is used to recommend the best sorting, or ranking of the alternatives. Usually, this process of selection tends to be rather arbitrary. A proposed alternative method emerges, the so-called Robust Ordinal Regression Methodology (RORM), that takes into account all the sets of parameters, and provides a recommendation in terms of necessary and possible consequences of applying all the compatible preference models on the considered set of alternatives [28].

Based on the UTA-like methods, in which only one additive value function is considered compatible with the preference information provided by the decision maker, the first robust ordinal regression method, called the UTA$^{GMS}$, was developed. The UTA$^{GMS}$ aimed at considering the whole set of compatible additive value functions to set up both necessary and possible weak preference relations in the whole set of considered alternatives.

## 4.3 Satisfaction analysis using value or utility scales

Very often in life, we face a number of different context situations that demand us to make the most varied decisions. Sometimes, the description of the consequences of those decisions may even encompass critical happenings, which is the case of human death and/or suffering. When in the presence of the aforementioned cases, it is particularly relevant to assume the responsibility on hands and think hard about such matters commonly known as the "value of a life". Indeed, these kind of decisions must not be made by chance, which would inadvertently contribute to a lot of human anguish.

This is the case of the decisions made within the healthcare sector, in which risk and uncertainty are constantly and inevitably present. In the context of an universal healthcare system, by which every person has the free right to health, patients' evaluation of care and their satisfaction with respect to the provided services must be considered as the most reliable feedback system. The latter is true considering that this kind of feedback provides, in an effective, direct and meaningful way, the patients' true preferences and expectations. It is important to take advantage of this kind of information and, based on it, to make efforts to improve the quality of service provided, because this can positively influence health outcomes. Furthermore, the process of monitoring satisfaction must take into account the whole set of attributes that together characterize a particular service, and the subjectivity of this matter must not be forgotten: each person may assign different weights to each feature, and at the end of the day, the individual's

overall satisfaction will depend on the contribution of those assigned weights.

There are several different methods of multicriteria, and to choose the most recommended one among them, one must take into account the particular circumstances and context of the decision at hand. One example is the total aggregation method, that is more appropriate when trade-off coefficients between criteria have to be computed. Among those multicriteria methods, there is the so-called UTA method, initially proposed by Jacquet-Lagrèze and Siskos (1978, 1982). For the application of the UTA method, the only information required from the decision maker is the global stated preferences between the existing alternatives, which is something that can be asked directly. Thereon, using a linear program, this method allows the estimation of a nonlinear additive function, that provides a convenient pricewise linear approximation of the function. Throughout the remaining of the present chapter, the UTA's basic model is presented.

At this point, it should be clear that the main goal of the UTA-like methods is to compare, rank and evaluate a given set of alternatives (*e.g.* projects), with respect to $N$ different criteria. The set of measured consequences is given by the vector $g(a) = (g_1(a), g_2(a), ..., g_N(a))$ for any project $a \in A$. Assuming the existence of an additive utility function, we obtain:

$$U[g(a)] = \sum_{i=1}^{N} u_i[g_i(a)] \tag{4.2}$$

with $u_i(g_i) \geqslant 0$ and $\frac{du_i}{dg_i} > 0$, satisfying the basic axioms of decision theory, namely the axioms of comparability, reflexivity, transitivity, continuity and strict dominance [29]. Function 4.2 provides the aggregation of the criteria in a common index, aiming at comparing, ranking and accessing the different alternatives. The function $U'$ is estimated by approximation of each alternative $a \in A'$, as follows:

$$U'[g(a)] = \sum_{i=1}^{N} u_i[g_i(a)] + \sigma(a) \tag{4.3}$$

where $\sigma(a)$ refers to a non-negative potential error relative to the utility of each alternative $a$. Finally, the objective function of the UTA method, which is to be minimized, is the sum of the aforementioned errors:

$$F = \sum_{a \in A'} \sigma(a) \tag{4.4}$$

For each pare of alternatives $(a, b) \in A'$, the decision maker is asked to express her/his overall preferences (or indifferences) regarding the set of criteria. These comparisons result in the following constraints:

$$\sum_{i=1}^{N} \{u_i(g_i(a) - u_i(g_i(b))\} + \sigma(a) - \sigma(b) \geqslant \delta \tag{4.5}$$

in the event of strict preferences, and

$$\sum_{i=1}^{N} \{u_i(g_i(a) - u_i(g_i(b))\} + \sigma(a) - \sigma(b) = 0 \tag{4.6}$$

in the event of a strict preference [29]. As it can be observed, in both equations 4.5 and 4.6, the error variable was divided into two different variables, $\sigma^+$ and $\sigma^-$, which correspond to an overestimation and an underestimation error, respectively (see Figure 4.2).

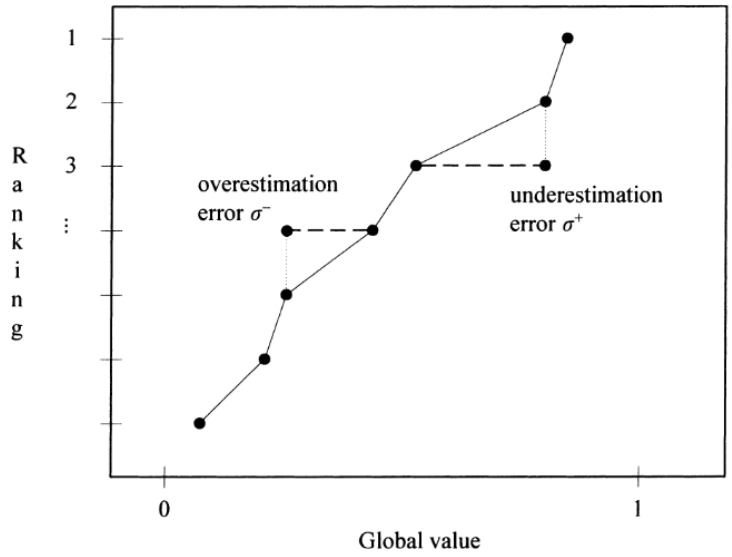


Figure 4.2: Ordinal regression curve. Over and underestimation errors introduces to obtain better results [23]

After the definition of other constraints, such as normalization and non-negativity conditions, a solution can be derived from UTA. This solution corresponds to an estimated additive utility function and may be of two different types:

- $F^* = 0$, corresponds to a situation where there is no error in the utility function estimation, *i.e.*, any solution belonging to the convex set of solutions provides a ranking identical to the one given by the decision maker.

- $F^* > 0$, represents the case when there are positive errors and no solution is admitted by the system of constraints. When this happens, there does not exist a nonlinear additive utility function that perfectly represents the preferences expressed by the decision maker.

Similarly to every linear programming problems, there is not a unique solution, and the set of partial utility functions may vary greatly from one solution to another. Following this idea, and in order to improve the efficacy of the estimation, additional information can be given by the decision maker, such as utilities' differences between alternatives [29].

After the conception of the UTA method, several variants have been proposed, incorporating different forms of global preference or different forms of optimality criteria used in the linear programming formulation. At this point, it appears useful to introduce one of those variants, more precisely, the MUSA method. Its principle methodological frame as been developed by Siskos et al. (1998) and Grigoroudis et al. (1999c). Henceforward in the present dissertation, this innovative method is going to be studied and applied to the data sample. Very briefly, the MUSA method is based on the aggregation of partial into global satisfaction values, as it is going to be explored later on. The next sections of this disser-

tation present an overview of the main notations and definitions of the MUSA method, as well as its methodological frame.

### 4.3.1 Notation

Consider the following notation [1]:

- $G = (g_1, ..., g_j, ..., g_n)$ represents a set of family criteria;
- $g_j$, with $j = 1, ..., n$, is the $j^{th}$ criterion of set $G$ ($n$ denotes the number of criteria);
- $E_j$ is the discrete scale of criterion $g_j$, $(j = 1, ..., n)$;
- $g_j^l$, with $j = 1, ..., n$ and $l = 1, ..., L$, represents the $l^{th}$ dis(satisfaction) level (hereinafter only considered satisfaction levels), *i.e.*, $E_j = \{g_j^1, ..., g_j^l, ..., g_j^{Lj}\}$;
- $g_j^1 \precsim ... \precsim g_j^l \precsim ... \precsim g_j^{Lj}$ denotes a total order for $g_j^l$; symbols $\prec$ and $\backsim$ mean "strictly less preferred than" and "as preferable as", respectively; *e.g.*, the totally satisfied level ($l = L_j$) is strictly more preferred than the totally dissatisfied level ($l = 1$);
- $E = \{g^1, .., g^l, .., g^L\}$ is a discrete scale associated with the overall satisfaction; as before, $g^1 \precsim ... \precsim g^l \precsim ... \precsim g^L$denotes a total order for $g^l$, $l = 1, ...L$;
- $P = \{1, ..., q, ..., p\}$ denotes a set of patients whose satisfaction regarding a hospital (or set of hospitals) is being assessed; each patient $q \in \{1, ..., p\}$, will characterize the hospital according to a single level of each scale $E_j$, for $j = 1, ..., n$ and $E$.
- $x_j^{(q)} \in E_j$ represents the satisfaction level assigned by patient $q$ with respect to the $j^{th}$ criterion, $g_j$;
- $x^{(q)} \in E$ denotes the overall satisfaction level assigned by patient $q$ with respect to the whole hospital (or set of hospitals);
- $\hat{x}^{(q)} \in E$ denotes the overall satisfaction level;
- $v(x^{(q)}) : E \longmapsto [0, 1]$ is a monotone non-decreasing value function of its argument $x^{(q)} \in E$; $v(x^{(q)})$ is the value function associated with each overall satisfaction score, and $v(g^1) = 0 \leqslant ... \leqslant v(g^l) \leqslant ... \leqslant v(g^L) = 1$;
- $v_j(x_j^{(q)}) : E_j \longmapsto [0, 1]$ is a monotone non-decreasing value function associated with the partial satisfaction score $j$, with $v_j(g_j^1) = 0 \leqslant ... \leqslant v_j(g_j^l) \leqslant ... \leqslant v_j(g_j^L) = 1$;
- $\alpha^{(q)}$ is a free error variable associated with patient $q \in \{1, ..., p\}$; it can be decomposed into two non-negative error variables, $\alpha^{(q)+}$ (overestimation error) and $\alpha^{(q)-}$ (underestimation error), such that $\alpha^{(q)} = \alpha^{(q)-} - \alpha^{(q)+}$.

### 4.3.2 Concepts and definitions

Since $x^{(q)} \in E$ is the level assigned by patient $q$ to characterize the overall satisfaction of the hospital, the value of $\hat{x}^{(q)}$ is denoted by $v(\hat{x}^{(q)})$. If an additive model can be employed with the partial values' aggregating purposes, the following is true

$$v(x^{(q)}) = \sum_{j=1}^{n} v_j(x_j^{(q)}) \tag{4.7}$$

where $x_j^{(q)} \in E_j$ is the level of satisfaction selected by patient $q$ to characterize the hospital according to the criterion $g_j$. The overall satisfaction level of a patient $q$ should be the same as the aggregating results, *i.e.*, there should be an indifference between $\hat{x}^{(q)}$ and $x^{(q)}$, denoted by $\hat{x}^{(q)} \sim x^{(q)}$, which implies:

$$v(\hat{x}^{(q)}) = v(x^{(q)}) \tag{4.8}$$

The latter is, however, not always true, given that very often there are some errors present. Therefore, the free variable $\alpha^{(q)}$ will be introduced in Eq. 4.8:

$$v(\hat{x}^{(q)}) = \sum_{j=1}^{n} v_j(x_j^{(q)}) + \alpha^{(q)} \tag{4.9}$$

Since $\alpha^{(q)}$ is free, it can be rewritten as two non-negative variables, $\alpha^{(q)+}$ and $\alpha^{(q)-}$. Finally, Eq. 4.9 is rewritten as follows:

$$v(\hat{x}^{(q)}) = \sum_{j=1}^{n} v_j(x_j^{(q)}) - \alpha^{(q)+} + \alpha^{(q)-} \tag{4.10}$$

### 4.3.3 A standard multicriteria customer satisfaction analysis model

Many of the aforementioned most used models for measuring satisfaction do not consider the qualitative form of customers' judgements, although this is a basic satisfaction input data. Furthermore, these models' results are usually mainly focused on a simple descriptive analysis.

With the goal of overcoming these drawbacks, analysing in more detail customer satisfaction, as well as identifying priorities to improve provider's performance and patients' experience, this dissertation makes use of the so-called MUSA method, initially proposed by Grigoroudis and Siskos [30].

A careful inspection of the aforementioned Eq. 4.10 makes it easy to find similarities between the MUSA method and the principles of goal programming modeling, ordinal regression analysis, and particularly with the additive utility models of the UTA family [30] [31].

The model requires, as input, the data to be analysed, commonly collected via a simple questionnaire, through which the patients evaluate the provided service, *i.e.*, they are asked to express their judgements regarding both their global and partial satisfaction, within a set of discrete criteria. A predefined ordinal satisfaction scale is used for these judgements, as it is presented in Section 5.2. Fundamentally, the major advantage of the employed method is that it fully considers the qualitative form of customers' judgements and preferences, as they are expressed in the conducted surveys.

Furthermore, the main ambition of this very useful linear programming model is the aggregation of independent (unrelated) individual judgements into a collective, monotone, non-decreasing, and positive value function, assuming that a patient's global satisfaction depends on a set of $n$ criteria or variables that represent service characteristic dimensions.

Following the RORM, previously presented in Section 4.2, the MUSA model assumes that the patient's overall satisfaction concerning a given hospital service is indifferent to the aggregated partial satisfaction with respect to each criterion/subcriterion. Therefore, it tries to minimize the deviations for the different criteria, in order to mitigate the inconsistency in patients' judgements.

With respect to the previously introduced notation and fundamental concepts, the basic MUSA mathematical model can be formulated, as follows.

When defining the objective function, one possible approach is the minimization of the sum of the non-negative error variables, for all patients. Furthermore, the value of the objective function reflects the amount of inconsistencies in the model, *i.e.*, when it is zero, all the information provided by the patients, both globally and partially, is consistent, otherwise it is biased for some reason.

$$\text{minimize } z = \sum_{q=1}^{p} (\alpha^{(q)+} + \alpha^{(q)-}) \tag{4.11}$$

subject to:

$$\begin{aligned} & v(g^L) - v(x^{(q)}) = \left( \sum_{j=1}^{n} v_j(g_j^{L_j}) - v_j(x_j^{(q)}) \right) + \alpha^{(q)+} - \alpha^{(q)-} \leftrightarrow \\ & v(x^{(q)}) = \sum_{j=1}^{n} v_j(x_j^{(q)}) - \alpha^{(q)+} + \alpha^{(q)-} \\ & q = 1, ..., p \end{aligned} \tag{4.12}$$

Eq. 4.12 models the indifference relation between the overall satisfaction and the conjoint aggregation of the partial satisfactions. The gap between the values of the highest satisfaction level and the overall $q^{th}$ judgement must be equal to the gap between aggregating results, plus an error term [1].

$$v(g^l) - v(g^{l-1}) \geqslant 0 \ , \ l = 2, ..., L \tag{4.13}$$

$$v_j(g_j^l) - v_j(g_j^{l-1}) \geqslant 0 \ , \ j = 1, ..., n \text{ and } l = 2, ..., L_j \tag{4.14}$$

The last two constraints (4.13) and (4.14), imply that the corresponding value functions are non-decreasing monotone.

$$v(g^L) = 1 \tag{4.15}$$

By imposing the constraint 4.15, one states that the value of the best performance is unitary, *i.e.*, no satisfaction level is preferable to the highest one.

$$v(g^1) = 0 \tag{4.16}$$

Similarly, constraint 4.16 states that the value of the worst satisfaction level is null, and that there is no worse satisfaction level that the lowest one, $l = 1$. Thus, one can conclude that the overall satisfaction value is bounded within the range $[0, 1]$.

$$\sum_{j=1}^{n} v_j(g_j^{L_j}) = 1 \tag{4.17}$$

The latter constraint means that the cumulative value of the best performance in all criteria equals the best performance's value in overall judgements.

$$v_j(g_j^1) = 0 \ , \ j = 1, ..., n \tag{4.18}$$

$$v(g^l) \geqslant 0 \ , \ l = 2, ..., L-1 \tag{4.19}$$

$$v_j(g_j^l) \geqslant 0 \ , \ j = 1, ..., n \text{ and } l = 2, ..., L_j \tag{4.20}$$

$$\alpha^{(q)+}, \alpha^{(q)-} \geqslant 0 \ , \ q = 1, ..., p \tag{4.21}$$

Constraint 4.18 is similar to 4.16, meaning that the partial value of the worst performance in each subcriterion is zero. Likewise, the cumulative value of the lowest satisfaction level in all subcriteria must be null. The last three constraints establish the non-negativity of the variables to be optimized.

### 4.3.4 A hierarchical multicriteria customer satisfaction analysis model

In several applications of the MUSA model, it seems rather useful to consider a hierarchical, instead of flat, structure of criteria. The idea is the decomposition of a complex decision problem into smaller problems involving less criteria. Accordingly, the first criteria level should include the main satisfaction dimensions in a general form, while the second level should consider more detailed characteristics. Also, the total set of main criteria, as well as each of the subcriteria sets, should satisfy the properties of a consistent family of criteria [30].

In line with these ideas, a new formulation of the MUSA method has emerged, and was logically named as hierarchical MUSA. It differs from the previous one as, for each criterion $g_j$, there is a set of subcriteria $G_j = \{g_{j1}, ..., g_{jk}, ..., g_{jn_j}\}$, for $j = 1, ..., n$. Each subcriterion $g_{jk}$ has its own level scale $E_{jk} = \{g_{jk}^1, ..., g_{jk}^l, ..., g_{jk}^{L_{k_j}}\}$, where $v_{jk}(g_{jk}^1) = 0$ for $j = 1, ..., n$ [1].

Considering these alternative definitions, a hierarchical MUSA model can be formulated, and the new

constraints have similar interpretation as the ones presented in Section 4.3.3.

$$\text{minimize } z = \sum_{q=1}^{p}(\alpha^{(q)+} + \alpha^{(q)-}) + \sum_{q=1}^{p}\sum_{j=1}^{n}(\alpha_j^{(q)+} + \alpha_j^{(q)-}) \tag{4.22}$$

subject to:

$$\begin{aligned} & v_j(g_j^{Lj}) - v_j(x_j^{(q)}) = \left(\sum_{k=1}^{n_j}\left(v_{jk}(g_{jk}^{L_{k_j}}) - v_{jk}(x_{jk}^{(q)})\right)\right) + \alpha_j^{(q)+} - \alpha_j^{(q)-} \\ & q = 1, ..., p \text{ and } j = 1, ..., n \end{aligned} \tag{4.23}$$

$$v_{jk}(g_{jk}^{l}) - v_{jk}(g_{jk}^{l-1}) \geqslant 0 \ , \ j = 1, ..., n \ , \ k = 1, ..., n_j \text{ and } l = 2, ..., L_{jk} \tag{4.24}$$

$$\sum_{k=1}^{n_j}\left(v_{jk}(g_{jk}^{L_{k_j}})\right) = v_j(g_j^{Lj}) \ , \ j = 1, ..., n \tag{4.25}$$

$$v_{jk}(g_{jk}^{1}) = 0 \ , \ j = 1, ..., n \text{ and } k = 1, ..., n_j \tag{4.26}$$

$$v_{jk}(g_{jk}^{l}) \geqslant 0 \ , \ j = 1, ..., n \ , \ k = 1, ..., n_j \text{ and } l = 2, ..., L_{k_j} \tag{4.27}$$

$$\alpha_j^{(q)+}, \alpha_j^{(q)-} \geqslant 0 \ , \ q = 1, ..., p \text{ and } j = 1, ..., n \tag{4.28}$$

As mentioned above, these constraints follow the same philosophy as the basic model presented in Section 4.3.3. When applying this hierarchical structured model, it is not necessary to directly assess the weights of criteria and subcriteria. Such weights correspond to the value of the highest scale level [1]:

$$\begin{cases} w_j = v_j(g_j^{L_j}) \ , \ j = 1, ..., n \\ w_{jk} = v_{jk}(g_{jk}^{L_{k_j}}) \ , \ j = 1, ..., n \text{ and } k = 1, ..., n_j \end{cases} \tag{4.29}$$

Despite the advantages of this method, for the purpose of the present dissertation, the basic MUSA model, described in 4.3.3, will be applied.

## 4.4 Summary

This ended chapter contains the theoretical basis behind the development of the MUSA method. The concept of decision has been introduced, as well as the process of decision-making. Next, the preference theory has been addressed, making a clear distinction between the situations under certainty and the ones under risk. The vN-M modern utility theory has also been presented, alongside with the RORM. Lastly, the MUSA method's methodological frame has been detailed, namely its notation and main concepts, and the hierarchical variant of this model has been proposed.

# Chapter 5

# Case study

In the present chapter, Section 5.1 and Subsection 5.1.1 introduce the Local Health Unit of Castelo Branco, and the Amato Lusitano hospital, from which the database was provided. Meanwhile, Sections 5.2 and 5.3 describe the process of data gathering and processing, respectively. The criteria and subcriteria considered in the case study, describing satisfaction in healthcare, are provided in Section 5.4, while the last section (Section 5.5) of Chapter 5 details and explains the methodological considerations.

## 5.1 Local health unit of Castelo Branco

The increased average life expectancy, the new health needs, and the diseases caused by the current lifestyle, translate into higher consumption in health systems, which naturally has an impact on physical, financial and human resource management. Furthermore, the lack of coordination between hospitals and primary care centers, and the high percentage of patients bypassing the referral system, have been a major concern within the healthcare sector. In this context, organizational models have been reinvented, in Portugal, in order to, on the one hand, respond promptly and effectively to society's demands and, on the other hand, to maximize the allocated resources, improving efficiency, effectiveness and accessibility.

In line with this, the so-called LHUs were introduced in 1999, with the goal of improving the health system's response, through an integrated provision and management of all services and levels of healthcare in a given region. Each LHU comprises one or more hospitals and a number of primary care centers, taking into account their geographical proximity and also the balance of specialities and availability of an emergency department.

The creation of LHUs is an example of vertical integration in healthcare, with the main objective of putting the patient in the center, interlinking primary and hospital care provision and, eventually, other levels of healthcare, namely long-term care [6]. Currently, in Portugal, there are eight LHUs. This process of began in 1999, in Matosinhos, followed by: Portoalegre (2007), Guarda, Beja and Viana do Castelo (2008), Castelo Branco (2009) and Santiago do Cacém (2012).

The present dissertation addresses the LHU of Castelo Branco (LHUCB), created through the Decree no.318/2009, on November 2$^{nd}$. The LHUCB integrates the Amato Lusitano (AL) hospital with two

health center clusters, namely Beira Interior Sul and Pinhal Interior Sul. These clusters include eight healthcare centers in total: (a) Castelo Branco, (b) Idanha-a-Nova, (c) Penamacor, (d) Vila Velha de Ródão, (e) Oleiros, (f) Proença-a-Nova, (g) Sertã, (h) Mação, and (i) Vila de Rei.

According to the last general population census results (2011), 108 395 inhabitants reside in this unit's area of influence [32]. In general terms, the birth and fertility rates are extremely low and the population comprised by the LHUCB is mainly aged. This reality translates into an inverted age structure, characterized by a highly dependent population that consumes great amounts of health resources.

The LHUCB is characterized by a public enterprise nature, possessing administrative and financial autonomy. Among its core targets, it provides primary care (health promotion, disease prevention, diagnosis, treatment and rehabilitation), secondary care and also continued care, to the beneficiaries of the NHS and health subsystems, in a comprehensive, personalized and integrated way. A special focus is given to quality and equity of timely and adequate health responses, and the LHUCB also aims at developing clinical and scientific research activities, as well as training and teaching new professionals (depending on the respective capacity).

Financially speaking, LHUs are paid by (demographic) adjusted capitation, derived from the NHS global budget, over the population of a predefined catchment area. In particular, the LHUCB have a Contract-Program celebrated with the Ministry of Health, based on a capitalization value, taking into account the characteristics of the population covered, the market prices for the distinct clinical acts, and the amount to be paid for medical internship and other vertical programs. This value is subject to incentives and penalties as a function of the established qualitative and quantitative goals.

The Contract-Program is in accordance with the strategic plan of the LHUCB and with the contracts of the members of the Administrative Council, upholding its terms on the following principles [33]:

- promotion of access, continuous improvement of the quality of provided healthcare, user satisfaction and health gains;
- trustworthy, rational and efficient management of the available resources, aiming at the economical and financial sustainability of the LHU and the NHS;
- articulated and shared management of the NHS resources, among all its entities, in order to obtain synergies and increase the overall productivity of NHS institutions.

### 5.1.1 Hospital Amato Lusitano

With regard to secondary healthcare, the LHUCB's area of influence has a single hospital, the Amato Lusitano Hospital. Opened on May 1$^{st}$ of 1977, this public hospital was established, organized and administered with the aim of providing the population with differentiated medical care.

The AL hospital provides healthcare in all basic, intermediate, and almost all differentiated valences. Among its various areas of production there are: the inpatient service, outpatient consultations, the emergency department, *Hospital de Dia*, operating rooms and the PICU (Polyvalent Intensive Care Unit). Besides the main production areas, the AL hospital also provides healthcare in specialized diagnostic and therapeutic units.

As mentioned before, the present dissertation intends to evaluate and analyse the levels of patient satisfaction with regard to the inpatient service. Therefore, satisfaction questionnaires were conducted in the AL hospital, during the year of 2018, covering only hospitalized patients, in order to measure their satisfaction with regard to the abovementioned service. Table 5.1 provides data that may be useful for drawing conclusions later on. It shows the capacity of the hospital with regard to the inpatient service, in the same year of the conducted study.

Table 5.1: LHUCB inpatient service activity, in 2018 [32]

| Inpatient Service 2018 | |
|---|---|
| Capacity (no. beds) | 225 |
| Occupancy rate (%) | 71,70 |
| Discharged patients | 7 751 |
| Total inpatient days | 58 885 |
| Medical delay | 7,60 |
| Mortality rate (%) | 6,92 |
| Discharged patients / bed | 34,45 |
| Readmission rate (%) | 6,05 |
| External transfers (%) | 2,59 |

## 5.2 Data and sources

In line with what was presented in Chapter 3, measuring the satisfaction of different players in almost every field, including healthcare, has been a common practice [1]. This kind of researches is particularly useful for the Portuguese NHS, a system that is commonly associated with lack of quality and patient dissatisfaction. However, the majority of the studies covering this matter focuses, on the one hand, on the emergency department, or, on the other hand, on every hospital valences simultaneously. Both approaches are prone to the biasing phenomena, once, in practice, patients do not face the same clinical and emotional conditions in different hospital services.

The main goal of the engaged case study in the present dissertation is to evaluate the patients' satisfaction with regard to secondary healthcare in the Portuguese NHS, more precisely, the inpatient services. Furthermore, a linking is done between the MUSA method - a conjoint analysis based method - and the Kano's model. This combination makes it possible to clearly identify the main critical areas with which patients feel mostly dissatisfied, as well as the aspects of the service that they value the most. The gathering of this kind of information is useful for increasing service quality, by performing a better management of the the available resources and improving specific critical areas. Consequently, it can actually contribute to a greater overall satisfaction, which in turn poses several benefits to the service.

The present case study focuses on a particular healthcare unit in the central region of Portugal - the LHUCB, in Castelo Branco - already introduced and described in Section 5.1. An already existing

database was provided by the Amato Lusitano (AL) hospital, the only hospital making part of the abovementioned LHU. The process of data gathering was done through the conduction of a satisfaction survey, targeting patients that were experiencing, or have experienced, the inpatient service in this hospital.

The resulting data sample was used throughout this study, in order to draw useful conclusions about the performance of the different criteria and subcriteria characterizing the inpatient service.

In a more descriptive way, such a database consists of the results of patients assessing their own global and partial satisfactions, following a Likert-type scale and concerning a set of chosen criteria and subcriteria that characterize the considered service. When answering the survey, each patient was asked to, on the one hand, evaluate her/his satisfaction regarding the inpatient service as a whole and, on the other hand, make a more detailed evaluation with respect to a set of characteristic criteria and subcriteria.

In short, the following questions were answered by each respondent:

- On an ordinal scale (from 1 to 7), where 1 denotes *very dissatisfied* and 7 denotes *very satisfied*, how satisfied are you with regard to [a specific criterion/subcriterion]?

- On an ordinal scale (from 1 to 7), where 1 denotes *very dissatisfied* and 7 denotes *very satisfied*, how satisfied are you with regard to the inpatient service as a whole?

Furthermore, throughout the present case study, the following items must be taken into account:

a) it is assumed, as mentioned before, that a patient's global satisfaction depends on a set of criteria and subcriteria representing the service characteristic dimensions. For this particular case, the evaluation of the inpatient service within the AL hospital relies on eleven main criteria (each of them characterized by a set of subcriteria).

b) both global and partial satisfactions were measured. Patients were asked to select one and only one rate which would characterize their own satisfaction regarding each criteria and subcriteria (partial satisfaction), as well as the whole inpatient service valence (global satisfaction).

c) the distributed inquiry was composed by a total of 65 questions that aim at assessing patients' satisfaction regarding the inpatient service. The provided database carries the answers of 251 subjects. These answers were then properly treated and, with the aid of the MUSA method, one must be able to draw relevant conclusions and, with linking those results with the Kano's model, plan specific improvement actions.

## 5.3 Sample and validation

The sample was provided by the AL hospital, in an Excel file, containing the resulting data from the conducted survey. It comprises the answers from 251 subjects, with respect to 65 questions covering the inpatient service's valence. These answers consist in the results of patients answering how satisfied they are concerning a determined set of criteria and subcriteria, detailed in Section 5.4.

The main interest of this dissertation is to evaluate patients' satisfaction with regard to the Portuguese NHS secondary healthcare services. In its methodological context, it is paramount to be in possession of the most accurate, legitimate and well-funded data, in order to generate *bona fide* information, to draw useful conclusions from the present case study, and to be able to redesign some of the service characteristics, improving its quality and, consequently, the patients' experiences.

In line with this, some adjustments were made to the original sample. Although these *vide infra* considerations led to a reduction of the already small number of answers analyzed for each criterion, they were also important to eliminate any kind of redundancy present in the results, leaving only relevant data for analysis and posterior conclusions.

- it was common that, when answering to questions about a certain criterion, some patients assigned a NR, NS and/or NA classification (from the Portuguese abbreviations of *Não Respondeu*, *Não Sabe*, and *Não Aplicável*, respectively) to several questions. These situations were from the sample. However, whenever a patient ranked every subcriteria, except for one, assigning it with a NR, NS or NA classification, a geometric mean was applied, in order to fill the gap with the most suitable value, based on her/his other evaluations;

- as mentioned before, throughout the questionnaire, each user was asked to classify a set of criteria (global satisfaction), as well as the corresponding subcriteria (partial satisfaction). Using the MUSA method, the weights of each subcriterion are calculated, based on the global evaluation regarding a specific criteria. Therefore, it should be clear that, in cases on which a patient's global evaluation is the same as the several partial evaluations for a specific criteria, a certain level of redundancy is introduced in the model. Hence, in order to optimize the results, these cases had not been taken into account as well;

As expected, after the application of these measures for data treatment, the sample of answers to be analysed regarding each criterion was reduced. Nevertheless, this step was important to obtain more reliable and treatable data, and consequently, more trustful results. Table 5.2 shows the number of considered answers for addressing each criterion.

Note that for some criteria, namely for the '*Volunteering staff*', '*Administrative staff*' or even '*Auxiliary staff*', the initial number of answers (251) was drastically reduced. Considering that for a sample to be statistically valid should contain, at least, 30 answers (N=30), the reliability of the abovementioned criteria is questionable, and something to be discussed later. Nevertheless, these cases were treated in the same way as the other criteria, bearing in mind that merely redundancies were eliminated.

## 5.4 Criteria and sub-criteria describing satisfaction in health care

Keeping in mind the multidimensional nature of the concept satisfaction, in general, the important attributes of care relate to three main issues, namely (1) the characteristics of the provider, (2) the

Table 5.2: Reduced sample after data validation - the number of answers considered for each criteria.

| | |
|---|---|
| [$g_1$] Received Information | 70 |
| [$g_2$] Facilities' quality | 154 |
| [$g_3$] Visits | 109 |
| [$g_4$] Food quality | 113 |
| [$g_5$] Medical staff | 79 |
| [$g_6$] Nursing staff | 49 |
| [$g_7$] Auxiliary staff | 28 |
| [$g_8$] Administrative staff | 23 |
| [$g_9$] Volunteering staff | 10 |
| [$g_{10}$] In-hospital exams and treatments | 74 |
| [$g_{11}$]Discharge process | 222 |
| *Global* | *108* |

features of the patient-practitioner relationship, and (3) the factors related to the structure and setting of healthcare delivery.

As mentioned in Section 3.1, and similarly to what is predicted by the Donabedian's framework, the concept of satisfaction can be seen as a direct effect of care, *i.e.*, an outcome itself, which means that, if the goal is to measure patients' satisfaction with a certain service, one has to take into account both structural care and process of care.

The former is related to the hospital's facilities and non-clinical staff, such as administrative assistants, who may have an impact on patients' satisfaction without providing medical care. Generally, this features can easily be measured, since any individual is able to evaluate whether a certain facility is comfortable, clean, *etc.*, or not, or if there is privacy, commodity and available up-to-date technology in the hospital. Furthermore, it is expected that these variables present lesser impact on patients' expectations regarding the hospital attributes than the process of care [1].

With regard to the process of care, it refers to the way the healthcare professionals and medical staff interact with patients, inducing and motivating the patient to follow medical advice and actively collaborating in care, contributing to her/his health status improvement and better health outcomes. According to Donabedian (1988), the clinical staff (doctors, nurses, and health technicians) performance should be evaluated in terms of two main criteria: *technical performance*, or professional competence, such as knowledge, clinical skills, the ability to provide healthcare in line with patients' needs, *etc.*, and *interpersonal relationship*, which in turn includes subcriteria like kindness, availability to listen to patients' concerns, the capacity to inform the patient about her/his current health status, among others.

In short, the assessment of a family of criteria that consistently represents patients' satisfaction dimensions is one of the most important stages of the implemented methodology. The selected criteria and subcriteria for this dissertation follows the available data that was provided by the AL hospital, and respects the aforementioned Donabedian's model, as one can easily identify which criteria belong to the structural care and which belong to the process of care.

The hierarchical structure of patients' satisfaction dimensions is presented in Figure 5.1 and it indicates

the set of criteria and subcriteria used throughout the conducted survey. The main satisfaction criteria include:

- received information (user's guide, user's rights and duties, ways of complaints, etc),
- facilities' quality (cleaning and hygiene, comfort and commodity, privacy, etc),
- visits (schedule, visit duration, number of visits, etc),
- food quality (preparation, taste, appearance and temperature, variety, quantity, etc),
- medical staff (readiness and availability, attention, sympathy and kindness, etc),
- nursing staff (readiness and availability, attention, sympathy and kindness, etc),
- auxiliary staff (readiness and availability, attention, sympathy and kindness, etc),
- administrative staff (readiness and availability, attention, sympathy and kindness, etc),
- volunteering staff (readiness and availability, attention, sympathy and kindness),
- exams and treatments (readiness and availability, attention, sympathy and kindness, etc), and
- discharge process (home-care provided information and waiting time to leave after discharge).

## 5.5 Methodological considerations

There is only one methodological consideration that could be pointed. After the implementation of the MUSA model, an additional condition was included. In more detail, a threshold of 3% was added to the model, in order to avoid the existence of null utility scores.

This was rather relevant, given the fact that the utility of the last satisfaction level represents the criterion/subcriterion weight. Hence, if no threshold had been considered, one would have obtained null weights for some of the service attributes, which would impact the rest of the results.

## 5.6 Summary

This chapter has described, in a detailed way, the present case study. More precisely, the source of the data sample has been introduced, including a descriptive section about the conducted satisfaction survey. Equally important was the explanation of the measures that were taken in order to treat and validate the data sample. The chosen family of criteria and subcriteria characterizing the inpatient service has been presented, in a hierarchical structure, as shown in Figure 5.1, and lastly, some methodological considerations have been pointed.

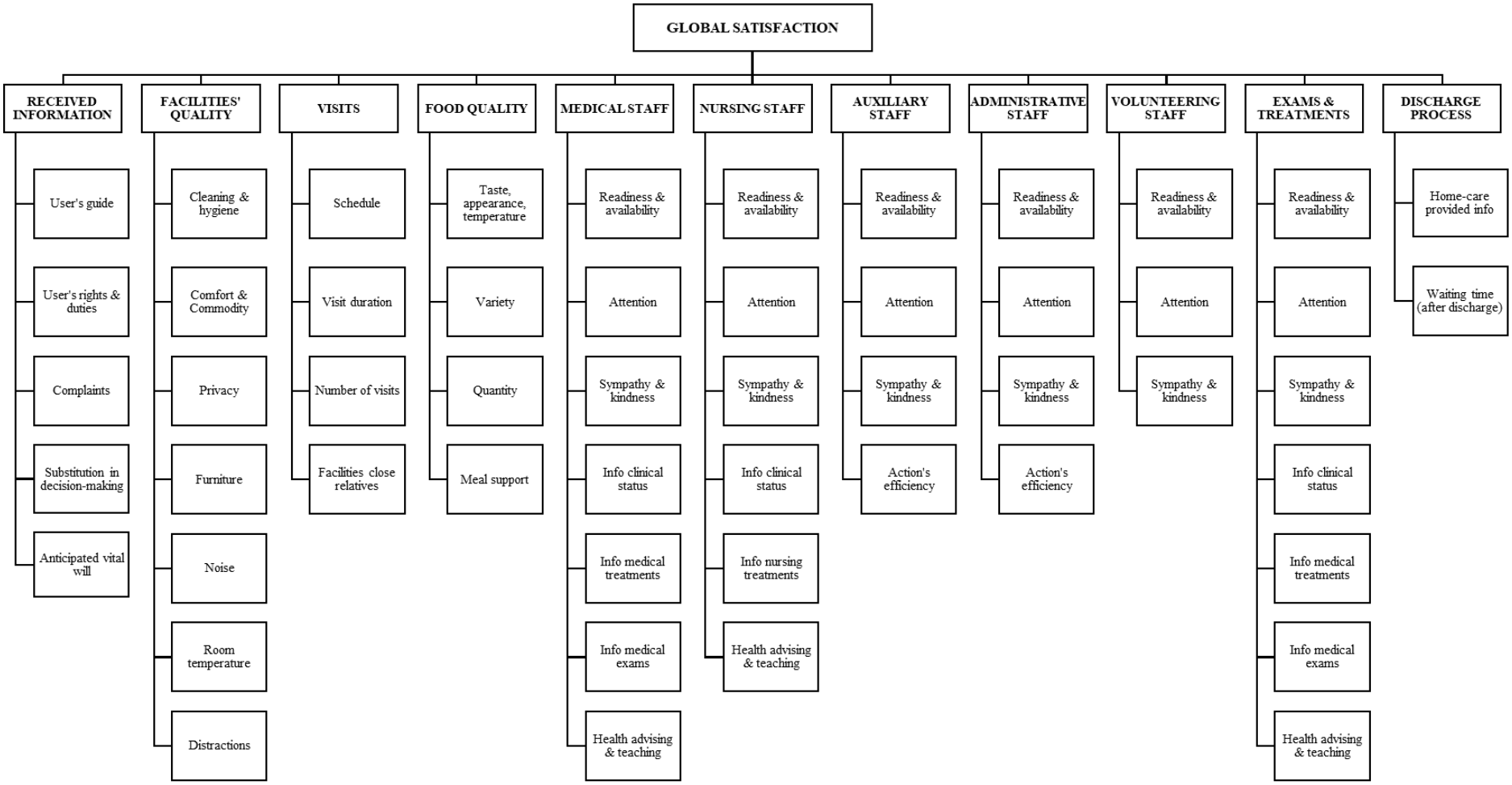


Figure 5.1: Hierarchical structure of satisfaction dimensions.

# Chapter 6

# Model implementation

It should be clear by now that healthcare is a multidimensional service. Nevertheless, it is also true that many of the approaches for measuring satisfaction do not accurately report consumers' relative preferences regarding different attributes, despite the importance of such information for cost-effective decision-making in continuous quality improvement.

The present study has employed the so-called MUSA method, a linear-programming based model proposed to measure the consumers' satisfaction with respect to a specific service and its characteristics.

In this particular case, it is employed concerning the Portuguese secondary healthcare within the NHS, specifically the inpatient service valence, which deserves attention given the volume of produced cases and also the lack of existing literature addressing this very same topic.

In view of that, after the implementation and application of this method, relevant results and conclusions can be drawn. Indeed, the use of a robust mathematical model, like MUSA, brings a series of advantages to the table and broadens the spectrum of conclusions. In short, let us consider the following:

- with the help of the discussed method, it becomes possible to precisely identify which weight is attributed to each criterion or subcriterion by each patient. Despite the fact that, with some empirical knowledge, one may be able to determine which criteria weights the most to patients, this approach would not be accurate enough to draw specific actions of improvement.

- given the previous item, the MUSA method and its results allow the construction of an appropriate strategy, that must be undertaken in order to improve the hospital's overall performance.

- furthermore, one of the additional features of this method is the ability to know how the satisfaction of patients change when the performance in different criteria or subcriteria is improved.

This kind of findings cannot be encountered in the existing literature, despite their great usefulness on supporting public hospitals managers and health policy to draw a coherent strategy, aiming at improving patients' satisfaction and, as an outcome, improving the population's quality of life. Therefore, the employment of the MUSA method appears to be extremely advantageous for this matter.

## 6.1 Results

Throughout the previous sections of this dissertation, a clear idea has been demonstrated: patient satisfaction is indeed a key indicator for the evaluation and continuous improvement of quality in healthcare, considering that it captures patients' personal evaluation of care in a direct and efficient way.

Considerable research has shown that perceived satisfaction influences to an important extent the quality of care. More specifically, results from patient satisfaction studies, like the present one, help healthcare provides to identify potential areas for improvement, which in turn increase the effectiveness of healthcare systems.

Furthermore, when a patient becomes satisfied with the experienced services, she/he is more likely to continue using those, to comply with medical treatment or advice and even to recommend the healthcare service to others, which assumes a particular importance for hospitals.

MUSA departs from the assumption that a patient makes a number of independent judgements on a number of unrelated criteria, considering that there are no interaction effects. Then, the model constructs monotone non-decreasing positive utility functions, associated with the analysed criteria and subcriteria.

From those, the relative importance (weight) of each criterion/subcriterion can be assessed, indicating which criteria are likely to influence customer satisfaction. The estimation of the utility functions and the relative importance of the criteria/subcriteria provides a basis for interpreting the results.

### 6.1.1 Utility functions

The MUSA model constructs monotone non-decreasing positive value (more precisely *utility*) functions, associated with the analysed criteria and subcriteria, and for that, it departs from the basic assumption that a patient makes a series of independent judgements on a set of unrelated criteria. Furthermore, no interaction effects are taken into account, given that the model is formulated as a linear optimization model. In fact, MUSA assumes the indifference relation between the overall satisfaction concerning the hospital service as a whole, and the aggregated partial satisfactions with respect to each criterion or subcriterion.

The obtained utility functions are provided in this section. From Figure 6.1 to Figure 6.11, one can visually analyse the results obtained for the different criteria. In each individual chart it is possible to identify the subcriteria that weigh the most within each specific service attribute. Besides, Figure 6.12 contains very relevant information as well, showing which subcriteria weigh the most for overall patient satisfaction with regard to the inpatient service.

It is worthwhile noticing that, in all cases, the utility functions follow the constraint on Equation 4.15, introduced in Section 4.3.3, which implies that the value of the best performance is unitary, *i.e.*, no satisfaction level is preferable to the highest one. Furthermore, it is also true that the cumulative value of the best performance in all subcriteria equals the best performance's value in overall judgements, in accordance with what was early introduced by equation 4.17.

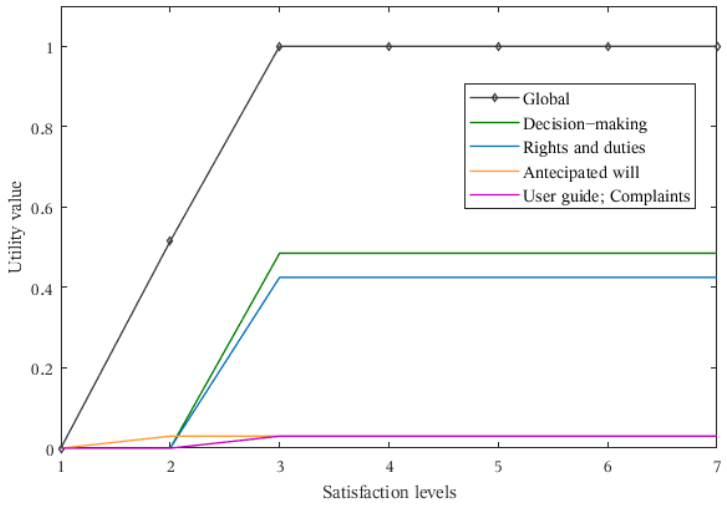


Figure 6.1: Utility function for 'Received information'.

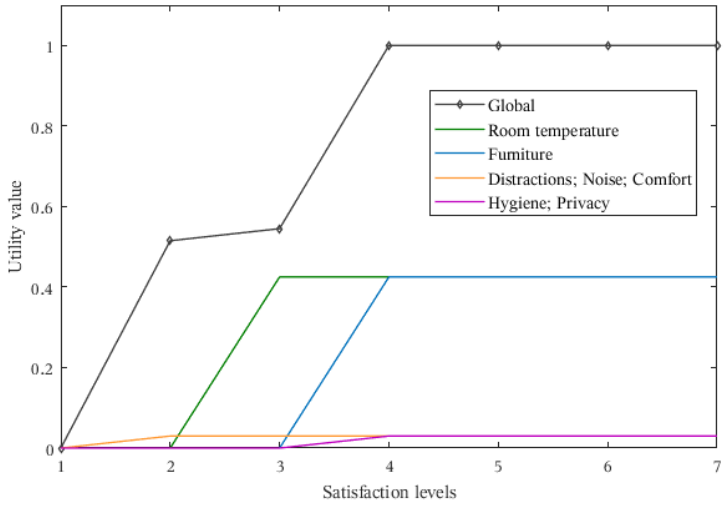


Figure 6.2: Utility function for 'Facilities' quality'.

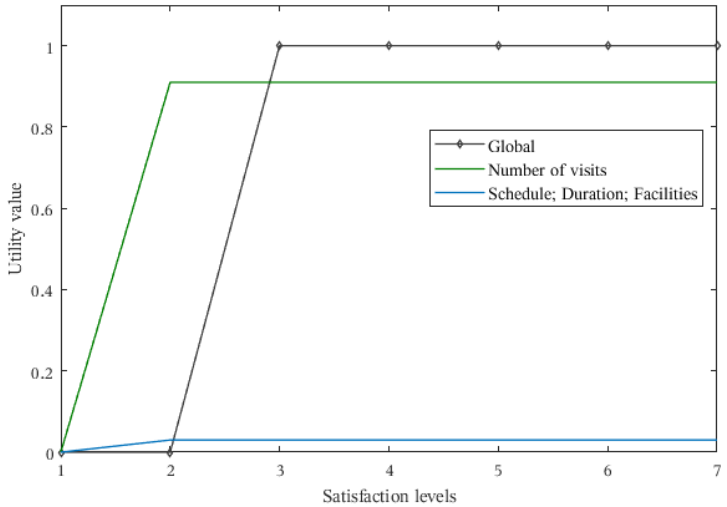


Figure 6.3: Utility function for 'Visits'.

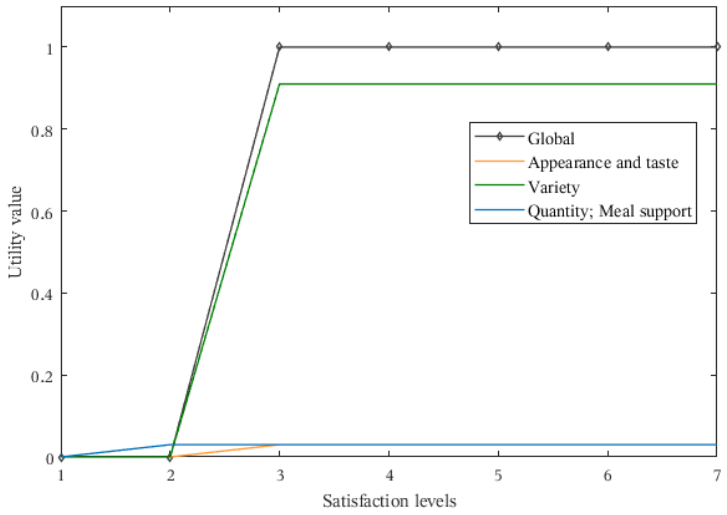


Figure 6.4: Utility function for 'Food quality'.

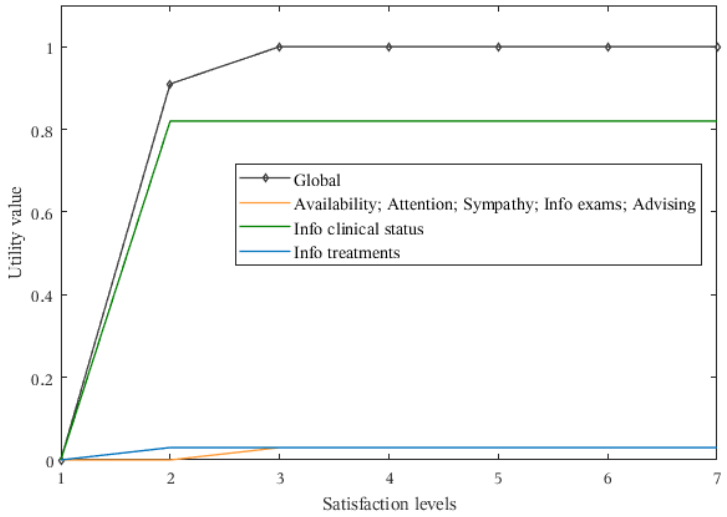


Figure 6.5: Utility function for 'Medical staff'.

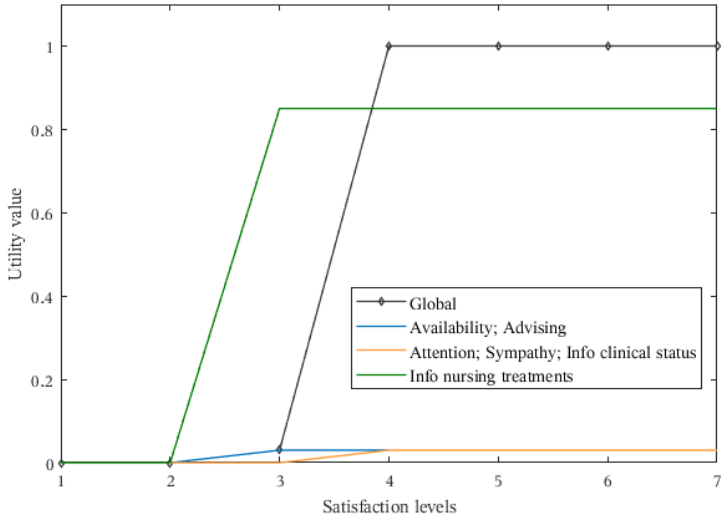


Figure 6.6: Utility function for 'Nursing staff'.

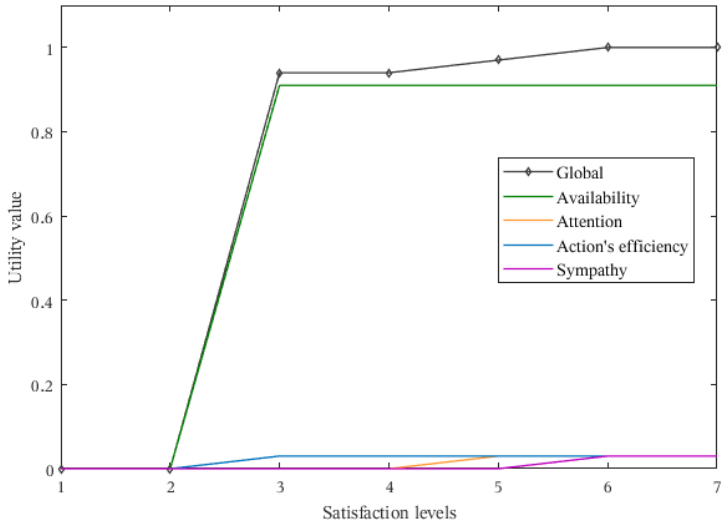


Figure 6.7: Utility function for 'Auxiliary staff'.

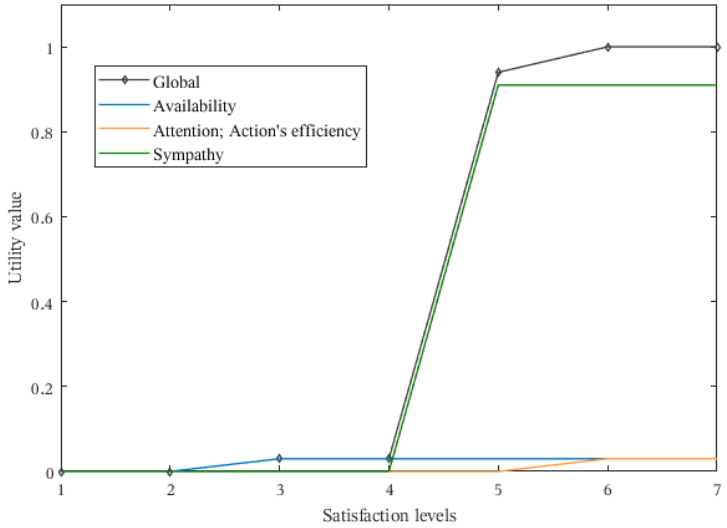


Figure 6.8: Utility function for 'Administrative staff'.

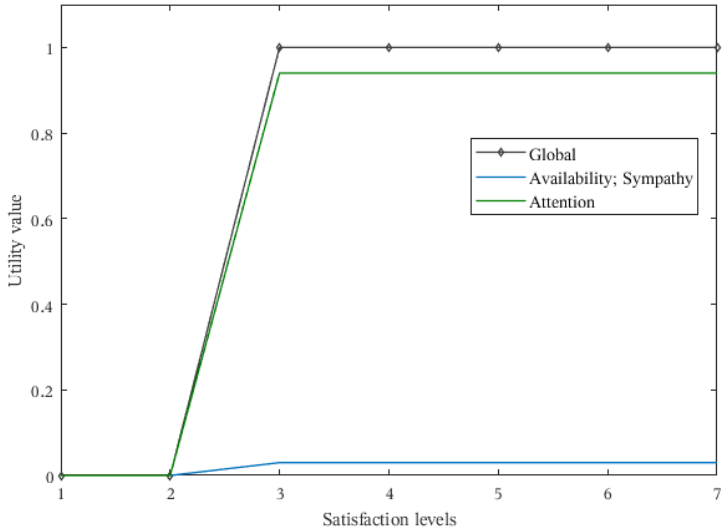


Figure 6.9: Utility function for 'Volunteering staff'.

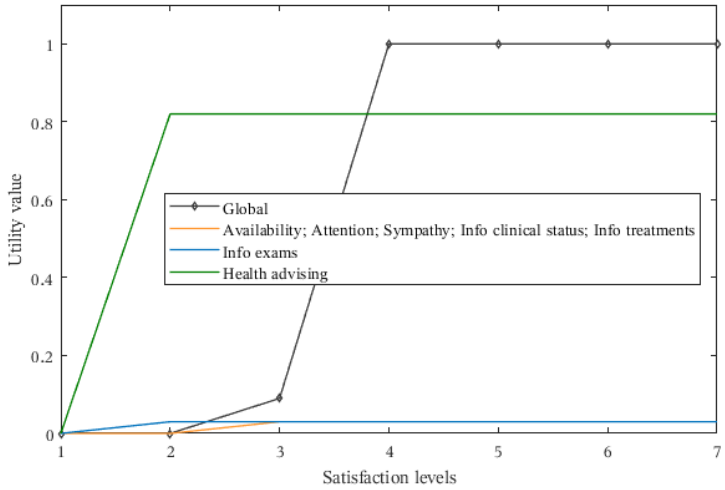


Figure 6.10: Utility function for 'Exams and treatments'.

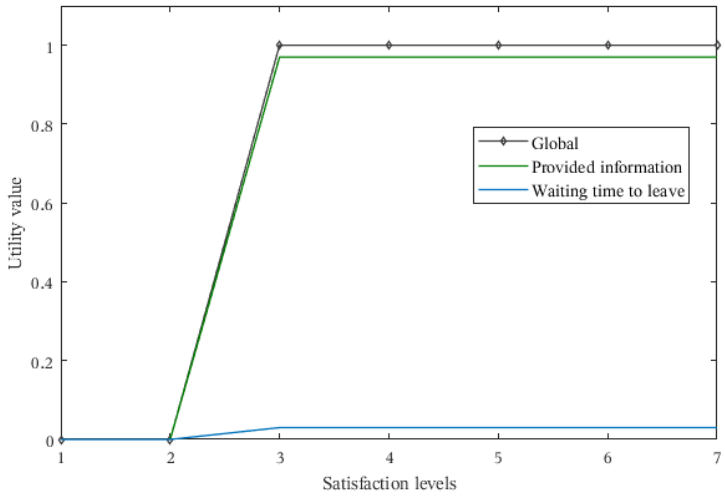


Figure 6.11: Utility function for 'Discharge process'.

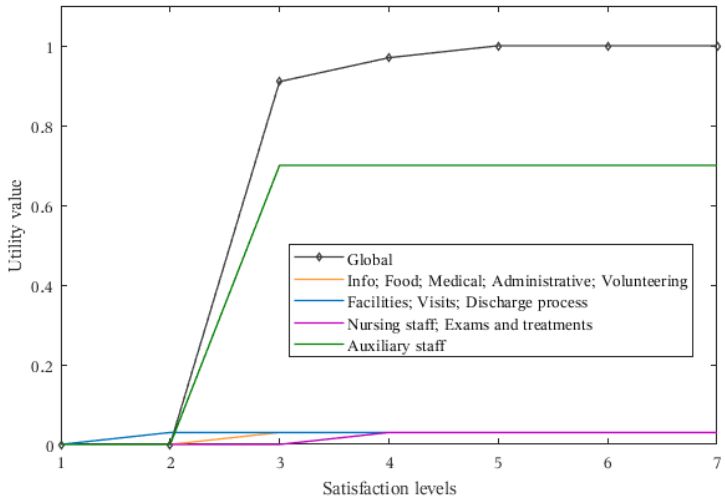


Figure 6.12: Utility function for 'Global satisfaction'.

It can be visually observed for the majority of the obtained results that, within each satisfaction criterion, only one or two subcriteria stand out. For instance, with respect to the '*Received information*',

patients tend to give more importance to aspects such as the 'substitution in decision-making', as well as their 'rights and duties'.

Likewise, considering the '*Medical staff*' and the '*Nursing staff*', the most important feature for patients has shown to be the information they receive about their own clinical status and nursing treatments, respectively. In fact, one is witnessing an increasingly patient-oriented philosophy within the healthcare sector, and the patient is also more intensely interested in participating in her/his process of care. This is probably the reason why the information exchange between the physician/nurse and the patient appears to be so valuable to the latter. However, it is worthwhile noticing that patient preferences for adopting deferential or participatory roles in care vary, and attention must be paid to whether this involvement contributes or not to the satisfaction of the patients.

Furthermore, 'readiness and availability', 'attention' and 'kindness and sympathy' were also three service attributes highly valued by patients. These results were somehow expected, given the fact that, within the inpatient service, patients are usually weak and, besides the treatments, they are also in need for kindness, company and physiological support by the whole team responsible for them.

The fact that some subcriteria stand out from the rest, does not necessarily mean that the rest of the attributes do not matter for the patients and their experience with care. One can safely assume that each subcriterion has its share on patient satisfaction, although some of them require more attention because minimal changes can have a huge impact on satisfaction.

### 6.1.2 Satisfaction levels per criterion and sub-criterion

A number of service features combine to influence the quality of care that is provided. Although it is very debatable the way this quality of care should be evaluated and measured, the levels of patient satisfaction are greatly relevant indicators, once they reflect the consumers' perceptions and the success of providers at meeting their values and expectations. Furthermore, if one of the main goals of healthcare systems is to improve the level of satisfaction with the delivery of care, then the way in which care is delivered must be evaluated through the eyes of the patients themselves.

Nevertheless, evidence suggests that patients tend to indicate that they are generally satisfied with care [2] and that overall satisfaction often provides an overoptimistic evaluation of patients' experiences with healthcare. In line with this, a set of tables are displayed throughout the present section, containing the results in terms of the relative frequencies (% of answers) of the different satisfaction levels regarding each criterion and its corresponding subcriteria. Indeed, these tables report high levels of expected patient satisfaction. Note that, whenever a criterion is characterized by more than one subcriterion, the former's global satisfaction is also presented on the last row of each table, as it is a required input for MUSA method.

Additionally, the last column of each table also provides the patient satisfaction index - observed score obtained through MUSA - regarding each criterion/subcriterion. The latter is computed as the weighted sum of the associated utilities in all satisfaction levels, as follows:

$$S_j = \sum_{l=2}^{L_j} P_{lg_j} \cdot v_j(g_j^l) \tag{6.1}$$

where the first term of the sum consists of the frequency of customers rating the $j^{\text{th}}$ criterion with the satisfaction level $l$.

The following tables contain very useful information, namely for identifying the areas which deserve particular attention, or the service dimensions with which patients seem mostly dissatisfied (or *vice-versa*), and which ones are rather indifferent to the final user. The process of collecting and analysing this kind of information makes it possible to trace priorities and continuously improve specific service characteristics. As a consequence, patients' satisfaction and quality of life are enhanced, which constitutes the ultimate goal of healthcare services.

Table 6.1: Relative frequencies (%) of different satisfaction levels regarding 'Received information' and corresponding subcriteria.

| Criteria | Subcriteria | Level 1 | Level 2 | Level 3 | Level 4 | Level 5 | Level 6 | Level 7 | Satisfaction index |
|---|---|---|---|---|---|---|---|---|---|
| $[g_1]$ | $[g_{1_1}]$ User's guide | 4,29 | 0,00 | 5,71 | 15,71 | 15,71 | 22,86 | 35,71 | 2,87 |
| | $[g_{1_2}]$ User's rights and duties | 4,29 | 0,00 | 5,71 | 12,86 | 18,57 | 24,29 | 34,29 | 40,68 |
| | $[g_{1_3}]$ Ways of complaints | 2,86 | 2,86 | 2,86 | 24,29 | 14,29 | 17,14 | 35,71 | 2,83 |
| | $[g_{1_4}]$ Substitution in decision-making | 1,43 | 2,86 | 5,71 | 27,14 | 15,71 | 21,43 | 25,71 | 46,42 |
| | $[g_{1_5}]$ Anticipated vital will | 5,71 | 2,86 | 2,86 | 27,14 | 28,57 | 22,86 | 10,00 | 2,83 |
| | $[g_1]$ *Global* | *1,43* | *2,86* | *5,71* | *15,71* | *14,29* | *31,43* | *28,57* | *2,69* |

Table 6.2: Relative frequencies (%) of different satisfaction levels regarding 'Facilities' quality' and corresponding subcriteria.

| Criteria | Subcriteria | Level 1 | Level 2 | Level 3 | Level 4 | Level 5 | Level 6 | Level 7 | Satisfaction index |
|---|---|---|---|---|---|---|---|---|---|
| $[g_2]$ | $[g_{2_1}]$ Cleanliness and hygiene | 1,30 | 0,00 | 1,30 | 1,95 | 11,04 | 28,57 | 55,84 | 2,92 |
| | $[g_{2_2}]$ Comfort and commodity | 1,30 | 0,00 | 1,95 | 3,90 | 6,49 | 22,08 | 64,29 | 2,96 |
| | $[g_{2_3}]$ Privacy | 2,60 | 0,00 | 1,95 | 7,14 | 12,99 | 29,22 | 46,10 | 2,86 |
| | $[g_{2_4}]$ Furniture | 1,30 | 0,65 | 1,95 | 9,09 | 15,58 | 31,17 | 40,26 | 40,84 |
| | $[g_{2_5}]$ Noise | 4,55 | 1,30 | 7,79 | 16,23 | 18,83 | 28,57 | 22,73 | 2,86 |
| | $[g_{2_6}]$ Room temperature | 2,60 | 0,65 | 2,60 | 3,90 | 18,18 | 31,82 | 40,26 | 41,12 |
| | $[g_{2_7}]$ Distractions | 1,95 | 1,95 | 3,90 | 14,94 | 12,99 | 20,78 | 43,51 | 2,94 |
| | $[g_2]$ *Global* | *1,95* | *1,30* | *1,95* | *5,19* | *13,64* | *33,77* | *42,21* | *2,92* |

When a patient is hospitalized, this means that she/he will have to stay in the hospital, for a certain period of time. During this stay, the patient is closely followed by the clinical staff, however from that moment on, the clinical aspects of care are not the only ones to be considered. In fact, it becomes paramount to take into account other aspects, more related to the the personal comfort, namely the '*Visits*' and the '*Food*' that is provided: the former, because the hospitalized patient may also need and/or wish for close support from family and/or close friends; also, measuring patients' satisfaction regarding the latter is relevant, with the aim of continually enhancing the quality of the food that is provided, and improving the care experience.

The following five tables (see Tables 6.5, 6.6, 6.7, 6.8 and 6.9) are particularly pertinent for measuring patients' satisfaction with respect to the inpatient service, considering that they reflect the interpersonal component of the care delivery process. There is consistent evidence across several studies in the literature that one of the most impacting health service factors on patient satisfaction is the interpersonal relationship (introduced in section 5.4) that is established between the patient and everyone with whom

Table 6.3: Relative frequencies (%) of different satisfaction levels regarding 'Visits' and corresponding subcriteria.

| Criteria | Subcriteria | Level 1 | Level 2 | Level 3 | Level 4 | Level 5 | Level 6 | Level 7 | Satisfaction index |
|---|---|---|---|---|---|---|---|---|---|
| | $[g_{3_1}]$ Schedule | 1,83 | 3,67 | 8,26 | 15,60 | 22,02 | 25,69 | 22,94 | 2,94 |
| | $[g_{3_2}]$ Visit duration | 1,83 | 0,92 | 8,26 | 15,60 | 23,85 | 28,44 | 21,10 | 2,94 |
| $[g_3]$ | $[g_{3_3}]$ Number of visits | 0,92 | 1,83 | 7,34 | 15,60 | 16,51 | 30,28 | 27,52 | 90,17 |
| | $[g_{3_4}]$ Facilities for close relatives | 0,92 | 0,92 | 1,83 | 9,17 | 13,76 | 25,69 | 47,71 | 2,97 |
| | $[g_3]$ *Global* | *0,92* | *0,00* | *4,59* | *10,09* | *14,68* | *32,11* | *37,61* | *2,94* |

Table 6.4: Relative frequencies (%) of different satisfaction levels regarding 'Food quality' and corresponding subcriteria.

| Criteria | Subcriteria | Level 1 | Level 2 | Level 3 | Level 4 | Level 5 | Level 6 | Level 7 | Satisfaction index |
|---|---|---|---|---|---|---|---|---|---|
| | $[g_{4_1}]$ Preparation, appearance, temperature, taste | 0,88 | 0,88 | 4,42 | 13,27 | 27,43 | 35,40 | 17,70 | 2,95 |
| | $[g_{4_2}]$ Variety | 0,88 | 0,88 | 3,54 | 17,70 | 30,09 | 30,97 | 15,93 | 89,39 |
| $[g_4]$ | $[g_{4_3}]$ Quantity | 1,77 | 1,77 | 1,77 | 8,85 | 19,47 | 29,20 | 37,17 | 2,95 |
| | $[g_{4_4}]$ Meal support | 2,65 | 0,88 | 1,77 | 9,73 | 14,16 | 25,66 | 45,13 | 2,92 |
| | $[g_4]$ *Global* | *1,77* | *0,00* | *0,88* | *9,73* | *23,89* | *35,40* | *28,32* | *2,89* |

she/he relates, during the process of care. It is through establishing a close relation with the patient that the clinical staff (doctors, nurses, auxiliaries, *etc.*) induces and motivates her/him to follow the medical advices and to actively collaborate in the recovery process. Thus, monitoring and evaluating such relationship is believed to be as important as the the clinical staff's technical skills.

Relevant aspects to be considered are, for instance, the 'sympathy and kindness' and the 'readiness and availability' to listen to the patient's concerns and doubts regarding her/his clinical condition, or the capacity to understandably provide accurate 'information' on the patient's current health status, treatments, prescriptions and diagnosis to be carried out. Other relevant aspects of care were also analysed and their corresponding performance is detailed on the following tables as well.

Table 6.5: Relative frequencies (%) of different satisfaction levels regarding 'Medical staff' and its corresponding subcriteria.

| Criteria | Subcriteria | Level 1 | Level 2 | Level 3 | Level 4 | Level 5 | Level 6 | Level 7 | Satisfaction index [%] |
|---|---|---|---|---|---|---|---|---|---|
| | $[g_{5_1}]$ Readiness and availability | 1,27 | 0,00 | 5,06 | 6,33 | 25,32 | 15,19 | 46,84 | 2,96 |
| | $[g_{5_2}]$ Attention | 0,00 | 1,27 | 6,33 | 6,33 | 18,99 | 21,52 | 45,57 | 2,96 |
| | $[g_{5_3}]$ Sympathy and kindness | 0,00 | 0,00 | 5,06 | 8,86 | 15,19 | 24,05 | 46,84 | 3,00 |
| $[g_5]$ | $[g_{5_4}]$ Information on the patient's clinical status | 3,80 | 2,53 | 6,33 | 3,80 | 15,19 | 37,97 | 30,38 | 78,89 |
| | $[g_{5_5}]$ Information on the medical treatments | 1,27 | 2,53 | 3,80 | 8,86 | 15,19 | 37,97 | 30,38 | 2,96 |
| | $[g_{5_6}]$ Information on the exams | 2,53 | 1,27 | 7,59 | 8,86 | 18,99 | 35,44 | 25,32 | 2,89 |
| | $[g_{5_7}]$ Health advising and teaching | 1,27 | 2,53 | 5,06 | 15,19 | 21,52 | 30,38 | 24,05 | 2,89 |
| | $[g_5]$ *Global* | *3,80* | *1,27* | *2,53* | *6,33* | *11,39* | *29,11* | *45,57* | *2,86* |

Table 6.6: Relative frequencies (%) of different satisfaction levels regarding 'Nursing staff' and its corresponding subcriteria.

| Criteria | Subcriteria | Level 1 | Level 2 | Level 3 | Level 4 | Level 5 | Level 6 | Level 7 | Satisfaction index [%] |
|---|---|---|---|---|---|---|---|---|---|
| | $[g_{6_1}]$ Readiness and availability | 2,04 | 0,00 | 0,00 | 6,12 | 8,16 | 24,49 | 59,18 | 2,94 |
| | $[g_{6_2}]$ Attention | 2,04 | 0,00 | 2,04 | 6,12 | 4,08 | 26,53 | 59,18 | 2,88 |
| | $[g_{6_3}]$ Sympathy and kindness | 2,04 | 0,00 | 2,04 | 0,00 | 12,24 | 16,33 | 67,35 | 2,88 |
| $[g_6]$ | $[g_{6_4}]$ Information on the patient's clinical status | 0,00 | 2,04 | 2,04 | 6,12 | 10,20 | 44,90 | 34,69 | 2,88 |
| | $[g_{6_5}]$ Information on the nursing treatments | 0,00 | 4,08 | 0,00 | 4,08 | 14,29 | 38,78 | 38,78 | 81,53 |
| | $[g_{6_6}]$ Health advising and teaching | 0,00 | 4,08 | 2,04 | 14,29 | 10,20 | 48,98 | 20,41 | 2,88 |
| | $[g_6]$ *Global* | *0,00* | *2,04* | *2,04* | *4,08* | *2,04* | *26,53* | *63,27* | *2,92* |

The '*Exams and treatments*' and the '*Discharge process*' were other important criteria considered throughout the present case study. Once again, the performance of subcriteria related to the general information exchange - either on the clinical status, or exams, or home-care precautions - is examined.

Table 6.7: Relative frequencies (%) of different satisfaction levels regarding 'Auxiliary staff' and its corresponding subcriteria.

| Criteria | Subcriteria | Level 1 | Level 2 | Level 3 | Level 4 | Level 5 | Level 6 | Level 7 | Satisfaction index [%] |
|---|---|---|---|---|---|---|---|---|---|
| $[g_7]$ | $[g_{7_1}]$ Readiness and availability | 3,57 | 0,00 | 0,00 | 7,14 | 14,29 | 42,86 | 32,14 | 87,75 |
| | $[g_{7_2}]$ Attention | 3,57 | 0,00 | 0,00 | 7,14 | 10,71 | 46,43 | 32,14 | 2,68 |
| | $[g_{7_3}]$ Sympathy and kindness | 3,57 | 0,00 | 3,57 | 3,57 | 7,14 | 25,00 | 57,14 | 2,46 |
| | $[g_{7_4}]$ Action's efficiency | 0,00 | 3,57 | 0,00 | 7,14 | 14,29 | 50,00 | 25,00 | 2,89 |
| | $[g_7]$ *Global* | *0,00* | *3,57* | *0,00* | *7,14* | *7,14* | *39,29* | *42,86* | *68,70* |

Table 6.8: Relative frequencies (%) of different satisfaction levels regarding 'Administrative staff' and its corresponding subcriteria.

| Criteria | Subcriteria | Level 1 | Level 2 | Level 3 | Level 4 | Level 5 | Level 6 | Level 7 | Satisfaction index [%] |
|---|---|---|---|---|---|---|---|---|---|
| $[g_8]$ | $[g_{8_1}]$ Readiness and availability | 0,00 | 0,00 | 8,70 | 17,39 | 13,04 | 39,13 | 21,74 | 3,00 |
| | $[g_{8_2}]$ Attention | 0,00 | 0,00 | 8,70 | 13,04 | 17,39 | 26,09 | 34,78 | 1,83 |
| | $[g_{8_3}]$ Sympathy and kindness | 0,00 | 4,35 | 4,35 | 8,70 | 30,43 | 21,74 | 30,43 | 75,17 |
| | $[g_{8_4}]$ Action's efficiency | 4,35 | 0,00 | 4,35 | 13,04 | 17,39 | 17,39 | 43,48 | 1,83 |
| | $[g_8]$ *Global* | *0,00* | *0,00* | *4,35* | *13,04* | *21,74* | *30,43* | *30,43* | *2,86* |

Table 6.9: Relative frequencies (%) of different satisfaction levels regarding 'Volunteering staff' and its corresponding subcriteria.

| Criteria | Subcriteria | Level 1 | Level 2 | Level 3 | Level 4 | Level 5 | Level 6 | Level 7 | Satisfaction index [%] |
|---|---|---|---|---|---|---|---|---|---|
| $[g_9]$ | $[g_{9_1}]$ Readiness and availability | 0,00 | 0,00 | 0,00 | 10,00 | 50,00 | 30,00 | 10,00 | 3,00 |
| | $[g_{9_2}]$ Attention | 0,00 | 0,00 | 0,00 | 30,00 | 20,00 | 50,00 | 0,00 | 94,00 |
| | $[g_{9_3}]$ Sympathy and kindness | 0,00 | 0,00 | 0,00 | 10,00 | 20,00 | 20,00 | 50,00 | 3,00 |
| | $[g_9]$ *Global* | *0,00* | *0,00* | *0,00* | *20,00* | *0,00* | *50,00* | *30,00* | *2,03* |

The expected and observed satisfaction scores with regard to these criteria are provided by the following two tables.

Table 6.10: Relative frequencies (%) of different satisfaction levels regarding 'Exams and treatments' and its corresponding subcriteria.

| Criteria | Subcriteria | Level 1 | Level 2 | Level 3 | Level 4 | Level 5 | Level 6 | Level 7 | Satisfaction index [%] |
|---|---|---|---|---|---|---|---|---|---|
| $[g_{10}]$ | $[g_{10_1}]$Readiness and availability | 2,70 | 2,70 | 2,70 | 17,57 | 21,62 | 27,03 | 25,68 | 2,84 |
| | $[g_{10_2}]$ Professionals' attention | 4,05 | 0,00 | 1,35 | 12,16 | 13,51 | 29,73 | 39,19 | 2,88 |
| | $[g_{10_3}]$ Sympathy and kindness | 4,05 | 0,00 | 1,35 | 8,11 | 16,22 | 29,73 | 40,54 | 2,88 |
| | $[g_{10_4}]$ Information on the patient's clinical status | 5,41 | 0,00 | 0,00 | 16,22 | 18,92 | 28,38 | 31,08 | 2,84 |
| | $[g_{10_5}]$ Information on the medical treatments | 5,41 | 0,00 | 2,70 | 12,16 | 21,62 | 28,38 | 29,73 | 2,84 |
| | $[g_{10_6}]$ Information on the exams | 5,41 | 1,35 | 2,70 | 12,16 | 22,97 | 28,38 | 27,03 | 2,84 |
| | $[g_{10_7}]$ Health advising and teaching | 5,41 | 1,35 | 1,35 | 14,86 | 18,92 | 28,38 | 29,73 | 77,57 |
| | $[g_{10}]$ *Global* | *2,70* | *1,35* | *1,35* | *9,46* | *20,27* | *17,57* | *47,30* | *2,83* |

Table 6.11: Relative frequencies (%) of different satisfaction levels regarding 'Discharge process' and its corresponding subcriteria.

| Criteria | Subcriteria | Level 1 | Level 2 | Level 3 | Level 4 | Level 5 | Level 6 | Level 7 | Satisfaction index [%] |
|---|---|---|---|---|---|---|---|---|---|
| $[g_{11}]$ | $[g_{11_1}]$ Home-care provided information | 1,80 | 0,45 | 0,45 | 4,50 | 4,95 | 15,32 | 72,52 | 94,82 |
| | $[g_{11_2}]$ Waiting time to leave (after discharge) | 2,25 | 0,45 | 0,45 | 5,86 | 4,50 | 17,57 | 68,92 | 2,92 |
| | $[g_{11}]$ *Global* | *1,80* | *0,45* | *0,00* | *4,05* | *5,86* | *16,22* | *71,62* | *2,75* |

### 6.1.3 What do customers value the most in healthcare services?

Each healthcare user owns a unique frame of reference from which evaluations are made. Which implications arise from the latter point? Naturally, different people will assign different weights to the same particular attributes. The abovementioned frame of reference includes the so-called antecedent factors, comprising, for *e.g.*, sociodemographic factors (age, gender, income, race, education), health status and health beliefs. Moreover, consumers' judgements are a representation of a series of perceptions created through cognitive and affective processes, which reflect their particular personal characteristics [3].

In its simplest definition, a weight is basically a value trade-off among the rest of the criteria. The process of assessing the different criteria weights is of paramount importance, given the following two main aspects: (1) first, one can accurately determine which factors are most likely to influence satisfaction (or dissatisfaction) with the care delivery process, and (2) consequently, it becomes possible to identify potential actions and strategies in view of improving patients' experiences and satisfaction.

Table 6.12 provides the main results achieved through the application of the MUSA method. On this table, the third column contains both criteria and subcriteria weights, which are directly obtained from the MUSA. In order to compute the extent to which each subcriterion impacts on the overall satisfaction, the fourth column was added, displaying the result of the product between the weight of each subcriterion and their corresponding criterion's weight. This column provides an overall vision of each subcriterion importance and impact on the whole set of variables. It is worthwhile noticing that, although within a certain criterion the sum of subcriteria weights is unitary, in the overall vision this is no longer true. Additionally, a fifth column provides the MUSA-based satisfaction scores ($S_j$) with regard to each criterion and subcriterion.

From the analysis of the results presented on the table, one can say that one criterion stands out completely, that is the '*Auxiliary staff*'. Patients assigned it a weight of 70.00% (on a scale from 0% to 100%). This value is not even comparable to the rest of the criteria weights, which do not exceed a weight of 3.00% on the same scale. What seems to contribute to this colossal difference is the auxiliaries' 'readiness and availability', with an importance score of 91.00%. More precisely, this particular subcriterion weighs 63.7% for the patients' satisfaction regarding the whole inpatient service. This value is monumental, given that the weights of the other subcriteria do not exceed 3.00%, which is residual and corresponds to the imposed threshold detained in Section 5.5.

For further conclusions, may the interested reader explore Section 7, in which an analysis, detailing each criterion at the time, is conducted.

### 6.1.4 Customers demanding nature

Patients can be more or less demanding with regard to a particular criterion or subcriterion, and this difference translates into different shapes of the utility functions. For a non-demanding patient, the utility of a criterion or subcriterion does not increase, even after a certain level of satisfaction is reached. In opposition, there is a defined level of satisfaction that, when attained, substantially increases the demanding patients' utility.

The estimated utility functions obtained through MUSA are therefore a great tool to analyse the patients' demanding nature with regard to the selected criteria and subcriteria. Depending on their shape, Grigoroudis and Siskos (2002, 2010) identified three different types of customer groups (see Figure 6.13) with different demanding levels, detailed as follows:

- *Neutral customers*: the form of the characteristic utility function is linear; these customers are neither demanding nor non-demanding and their satisfaction grows linearly with the percentage of their own fulfilment expectations;

– *Demanding customers*: these refer to the case of a convex utility function (the major relative improving of the criterion's utility function occurs close to the last satisfaction level); they are defined as the ones that are not really satisfied unless a particular criterion or subcriterion is totally fulfilled, *i.e.*, unless they receive the best quality level;

– *Non-demanding customers*: this is the case of concave utility functions (contrarily to the demanding customers, in this case such an increase of the utility function happens on lower satisfaction levels); customers express that they are satisfied, although only a small percentage of their expectations is fulfilled.

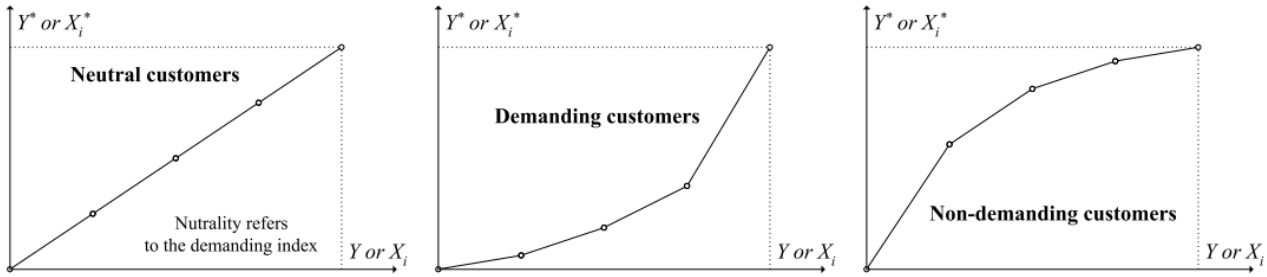


Figure 6.13: Utility functions with different demanding levels [30].

Perhaps, at this moment, one should reconsider the obtained utility functions (see Figures 6.1 - 6.11). Oddly, from the direct observation of the functions' shape, they all look concave. Hence, the only thing that could possibly be asserted is that patients were, in general, non-demanding. That is, when asked to evaluate their satisfaction with regard to the inpatient service, the majority of the respondents expressed high levels of satisfaction, although only a small portion of their expectations were effectively fulfilled.

Nevertheless, these conclusions based exclusively on the representation of the utility curves can be rather dubious, thus the estimation of an index for studying patients' demanding nature may offer more trustworthy results. Let $D_j$ be the demanding index, for $j \in \{1, ..., n\}$. Such an index can be very useful for customer behaviour analysis, once it can indicate the extent of a company's improvement efforts. In short, the higher the demanding index, the more the satisfaction level should be improved in order to fulfill customers' expectations [30].

Fundamentally, the demand corresponds to the average deviation of the estimated utility curves (achieved by MUSA) from a "normal" (*i.e.*, linear) function. This translates into the area below both curves (adapted from Ferreira, D. C., Marques, R. C., Pedro, M. I., 2019, *Luxury 5-star hotels in five European capital cities: How to improve customer satisfaction?*, Elsevier Editorial System for Tourism Management.)

$$D_j = \frac{\left( \int_1^{L_j} \frac{v_j(g_j^l)}{g_j^{L_j}} - v_j(g_j^l)\, dl \right)}{\int_1^{L_j} \frac{v_j(g_j^l)}{g_j^{L_j}}\, dl} \tag{6.2}$$

Furthermore, it is known that $\int_1^{L_j} \frac{v_j(g_j^l)}{g_j^{L_j}}\, dl = \frac{g_j^{L_j} \cdot v_j(g_j^{L_j})}{2}$. Since ordinal scales are used, the j$^{\text{th}}$ criterion's utility function can be treated as a series of linear parts. Hence,

$$\int_1^{L_j} v_j(g_j^l)\, dl = \sum_{l=2}^{L_j} \frac{1}{2}\left[v_j(g_j^l) - v_j(g_j^{l-1})\right] + v_j(g_j^{l-1}) \\ = \frac{1}{2}\sum_{l=2}^{L_j} v_j(g_j^l) + v_j(g_j^{l-1}) \tag{6.3}$$

The final expression for the demanding index calculation becomes as follows:

$$D_j = \frac{v_j(g_j^{L_j}) - \frac{1}{g_j^{L_j}} \cdot \sum_{l=2}^{L_j}\left(v_j(g_j^l) + v_j(g_j^{l-1})\right)}{v_j(g_j^{L_j})} \\ = 1 - \frac{1}{v_j(g_j^{L_j}) \cdot g_j^{L_j}} \cdot \sum_{l=2}^{L_j}\left(v_j(g_j^l) + v_j(g_j^{l-1})\right) \tag{6.4}$$

For neutral patients, the demanding index assumes the value of zero, $D_j = 0$. Positive demanding indexes, $D_j > 0$, identify demanding patients. The extreme case of positive demanding nature happens when $D_j = 1$. Contrarily, negative values of $D_j$ are attributed to non-demanding patients, and the extreme case happens when $D_j = -1$. Moreover, similar indexes can be obtained for each subcriterion as well, $D_{k_j}$. Naturally, the demanding indexes are defined in the interval $[-1, 1]$. Table 6.15 provides the demanding indexes per criterion and subcriterion. Positive (negative) values identify demanding (non-demanding) patients, while values close to zero the denote neutral ones.

As it can be observed, for the majority of the cases, patients have manifested a non-demanding nature. If one considers that neutral demanding indexes are within the interval [-5% - 5%], then criteria with which patients are demanding are scarce: 'attention', 'sympathy and kindness' of the 'Auxiliary' and 'Administrative staff', and the latter's 'actions' efficiency'. Patients have shown to be non-demanding for most of the inpatient service attributes, in particular for 'Facilities' quality', 'Visits' and 'Discharge process'.

### 6.1.5 Kano's model

Which products or services can be used or improved to obtain a higher level of patient satisfaction? Which characteristics of the product or service have a greater influence and impact on satisfaction (or dissatisfaction)? Which attributes do patients value the most? In any business, knowing how your customers' requirements impact on satisfaction is very important when prioritizing development efforts and managing resources. Furthermore, this pursuit of quality has become a key factor, not only within the industry, but is has also found its application in different sectors and services, including the healthcare sector.

Trying to answer to the abovementioned questions has not been an easy task, given the highly subjective nature of this matter. On the one hand, the eventual improvement of patients' satisfaction regarding a set of criteria or subcriteria depends directly on each criterion's nature and on patients' own perceptions

and experiences. On the other hand, potential criteria can be more or less relevant to patients, *i.e.*, different patients may look to different service requirements in a different way, which naturally constitutes a great source of complexity.

What has been found is that not all customer requirements have the same ability to deliver high satisfaction when done well. In the light of this, it may occur that, for example, some satisfaction dimensions are taken for granted by patients. If those dimensions are not entirely fulfilled, patients generally become deeply dissatisfied. However, enhancing the service's performance in such features will not induce neither patient satisfaction nor patient dissatisfaction.

Several models have been proposed in the literature trying to tackle this complex scenario. The so-called Kano's model, created in the early 80's by the Japanese professor Noriaki Kano, is a commonly used tool among organizations, as an insightful way of understanding, categorizing and prioritizing five types of customer requirements (or potential features) for products and services. Later, a weakness has been identified in this model: its inability to take account of the precise degree of importance accorded to certain quality attributes [34]. Hence, Kano's model has undergone some modifications and has been refined by Yang (2005), in order to incorporate additional information, namely the weight of each requirement [1].

This method is based on the assumption that the features of a specific product or service are multidimensional, affecting the level of customer satisfaction to varying degrees. Accordingly, customer preferences can be classified into five different categories (see Figure 6.14):

1. *Must-be requirements*, are the ones that must be seen as basic attributes of a product or service (*i.e.*, prerequisites). The customer expects to get them and very often takes them for granted, thus if they are not entirely fulfilled, customers become very dissatisfied; otherwise, they become just neutral, a state of 'not-dissatisfied'. In the context of healthcare, due to their importance for the patient, these requirements may range from *necessary* to *critical*, according to Kano's refined version [34];

2. *One-dimensional (or desired) qualities*, the case where customer satisfaction is proportional to the level of fulfilment: the greater the fulfilment of desired quality attributes, the higher is the customer satisfaction, or *vice-versa*. It is worth noticing that, in the past, customer satisfaction has been perceived in one-dimensional terms. These are the requirements the customers are able to articulate, and are usually explicitly demanded. Moreover, according to Yang (2005) [34], these may be *low* or *high* value-added criteria;

3. *Attractive requirements*, these may be either *less* or *highly* attractive, and correspond to the product/service criteria which have the greatest influence on how satisfied a costumer will be. Attractive requirements are neither explicitly expressed nor expected by the customer. On the contrary, they correspond to pleasant surprises or delights and cause satisfaction if present but do now cause dissatisfaction if absent.

4. *Indifference requirements*, as it can be observed in Figure 6.14, these are the requirements that most customers simply do not care about whether they are present or absent. Customers' satisfaction

remains neutral under either circumstance, and they add no further value to customers' experience. Depending on their degree of importance [34], indifference requirements can be *potential* or *care-free*.

5. *Reverse quality attributes*, are the features that cause customer dissatisfaction when present, and satisfaction when absent. These basically constitute the reciprocal of one-dimensional requirements.

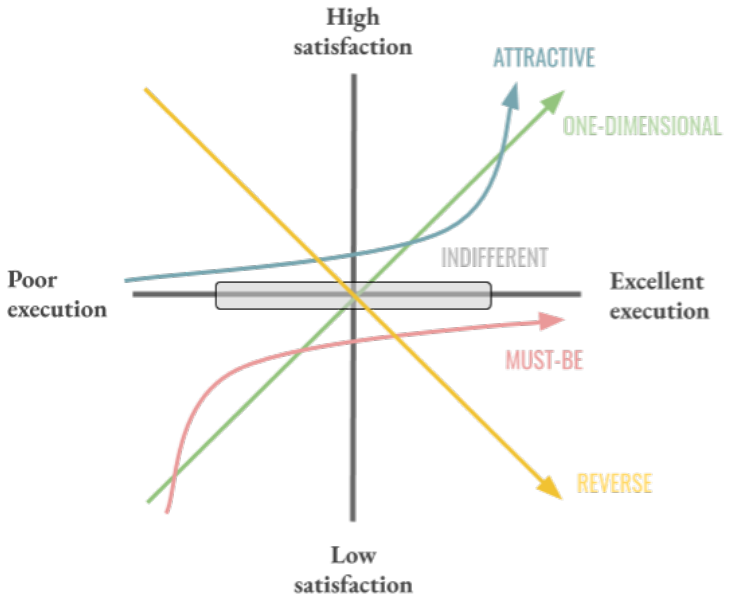


Figure 6.14: Kano's model of customer satisfaction.

The Kano's model of customer satisfaction is a useful tool to explore customers' stated needs and unstated desires, and to resolve them into different classes, each class with a different impact on customer satisfaction. Linking MUSA to the Kano's model, quality attributes that have the greatest influence on customer satisfaction can therefore be easily identified, and these can then be used to focus on a better management of resources to improve patients' experiences.

For this purpose, patients were divided into two distinct groups: those globally *satisfied* and those globally *dissatisfied*. The former exhibit an overall satisfaction score above the neutral level ($4^{\text{th}}$ satisfaction level) while the latter correspond to patients whose overall satisfaction score is below that same level. Furthermore, the Kano's model categorizes requirements into two dimensions of quality: (1) a more objective one involving the fulfilment of quality and (2) a more subjective aspect involving customers' perception of satisfaction. Rather than a linear relationship, these two dimensions share an asymmetric non-linear relationship.

The advantages of classifying customer requirements by means of the Kano's model are several. The more relevant ones are listed below:

1. it allows the identification of the product criteria which have the greatest influence on customers' satisfaction;

2. it provides valuable support in trade-off situations regarding the product development stage;

3. each category differs in the utility expectations of different customer segments;

4. the identification (and fulfilment) of the attractive requirements can offer a wide range of possibilities for differentiation [35], specially in relation to competitors.

In practice, and considering weight as measure of relative importance, it is rather logical that a dissatisfied patient will assign a much larger weight to must-be requirements than a satisfied patient. Additionally, if a requirement receives the same weight from a dissatisfied and a satisfied patient, such a requirement is considered as one-dimensional. Finally, with regard to the attractive criteria, a dissatisfied patient will assign them a low weight while satisfied patients assume the opposite position and consider such criteria as important to them.

To sum up, (a) if the weight is higher for dissatisfied patients than it is for satisfied patients, then the corresponding attribute is a must-be requirement; (b) the opposite situation is true for attractive requirements; (c) if both dissatisfied and satisfied patients assign similar weights to a certain subcriterion, then the latter corresponds to an one-dimensional requirement [1].

By assessing the MUSA method twice, one for each patients' group, one can then compute and compare the corresponding weights: the weight associated with dissatisfied patients, $w_{jk}^{d} = v_{jk}^{d}(g_{jk}^{L_{k_j}})$, and the weight associated with satisfied patients, $w_{jk}^{s} = v_{jk}^{s}(g_{jk}^{L_{k_j}})$. Table 6.14 contains the abovementioned weights. Furthermore, with the help of Table 6.13, it is possible to assess to which Kano's model category each subcriterion belongs. The latter categorization is presented on the same table.

Table 6.13: Kano's model applied to MUSA and corresponding categories.

| Level 1 | Level 2 | Kano's categories |
|---|---|---|
| Subcriterion ($g_{jk}$) | $w_{jk}^{d} > w_{jk}^{s}$ | Must-be requirement |
| | $w_{jk}^{d} < w_{jk}^{s}$ | Attractive requirement |
| | $w_{jk}^{d} \approx w_{jk}^{s}$ | One-dimensional requirement |

It is worth explaining the reason why the '*Volunteering staff*' criterion does not present any kind of categorization. In fact, regarding this criterion, there were no answers with an overall satisfaction score below the neutral level, thus it was not possible to compute the value of $w_{jk}^{d}$.

By following the introduced distinction between the Kano's categories, there are some must-be requirements within the services of a hospital as well. Whenever these qualities are not entirely fulfilled, patients become extremely dissatisfied. The latter is somehow expected, considering the fact that healthcare services are mainly paid by patients' own taxes. Hence, the identification of must-be requirements is crucial for the hospital's continuous improvement and enhancement of patients' satisfaction and experience. In addition, a negative performance on these attributes has a greater impact on overall satisfaction than a positive performance. Therefore, tackling these requirements and taking measures to fulfill them will capture the dissatisfied patients which, as a consequence, will naturally increase the overall hospital's performance.

Table 6.14 details the categorization of the different subcriteria, according to the Kano's model. On this table, one can easily identify the must-be requirements. As it can be observed, the majority of the subcriteria is described as one-dimensional requirements, *i.e.*, value-added quality attributes. These can be seen as the voice of the patient, since they are typically connected to patients' explicit needs and desires and are usually at the top of their minds when making choices and evaluating options. Patients' perception of satisfaction tends to grow up as a (linear) function of hospital's performance on these subcriteria. Therefore, the hospital should always try to do its best on these kind of service dimensions.

Additionally, attractive requirements (or excitement factors) can also be found on the referred table. These are the service's innovations and unexpected surprises for the patient. A positive performance on these attributes pose a greater impact on overall satisfaction than a negative performance. The attractive qualities can be selected as competitive weapons to draw the attention of customers, especially the new ones.

### 6.1.6 Margins for improvement

Throughout the previous sections, the fundamental results from the application of the MUSA method were explored. In more detail, we have determined the weights that patients inherently attribute to each satisfaction dimension, making it possible to identify what features patients value the most within the inpatient service, their demanding nature and, together with the Kano's model, the categorization of the different service qualities was performed.

Although these outcomes alone are already of great relevance, the following sections aim at showing how patient satisfaction should be improved. More specifically, MUSA also provides other outcomes, including the margins for improvement, the priorities and the appropriate opportunities and strategic movements for the AL hospital to improve its performance and enhance satisfaction, in terms of the inpatient service.

When the goal is to improve and enhance the patients' experience with a certain service, it is rather logical to first ascertain whether there is room for improvement or not, and if so, in which dimensions that could be beneficial. Following this idea, each criterion/subcriterion may have associated a defined improvement index, which should depend on two main components: (1) the importance of the particular satisfaction dimension (*i.e.*, its weight) and (2) its contribution to patients' dissatisfaction.

In accordance to the formulation of the MUSA method, described in Section 4.3.3, the average improvement indexes can be defined as $\Delta_j$ and $\Delta_{jk}$, for all $j = 1, ..., n$ and $k = 1, ..., n_j$. These average indexes can provide the improvement margins on a specific criterion/subcriterion, and they are assessed according to the following equations [1]:

$$\begin{cases} \Delta_j = v_j(g_j^{L_j}) \cdot \left(1 - \sum_{l=2}^{L_j} P_{lg_j} \cdot v_j(g_j^l)\right) \ , \ j = 1, ..., n \\ \\ \Delta_{jk} = v_{jk}(g_{jk}^{L_{k_j}}) \cdot \left(1 - \sum_{l=2}^{L_{k_j}} P_{lg_{jk}} \cdot v_{jk}(g_{jk}^{l_{k_j}})\right) \ , \ j = 1, ..., n \text{ and } k = 1, ..., n_j \end{cases} \tag{6.5}$$

On both equations, the first term of the product corresponds to the importance of that particular satisfaction dimension, *i.e.*, the weight resulting from the direct application of the MUSA method. The second term is defined as the dissatisfaction level of criterion $j$ (or subcriterion $k$). The first term of the sum consists of the frequency of patients that have rated the criterion $j$ with the satisfaction level $l$, with $l = 1, ..., 7$. The latter multiplies by a term that denotes the value of the monotone non-decreasing utility function for that specific criterion and $l$.

The potential improvement indexes are normalized in the interval [0,1]. From the direct observation of Equation 6.5, $\Delta_j$ or $\Delta_{jk}$ may be null whenever the patients assign no weight for the corresponding $j^{\text{th}}$ criterion or $k^{\text{th}}$ subcriterion, or in cases where patients are fully satisfied with it, reporting no level of dissatisfaction. Moreover, the higher the dissatisfaction term, the higher the average improvement index, which translates into larger margins for improvement.

Table 6.15 presents the obtained $\Delta_j$ and $\Delta_{jk}$ for each criteria and subcriteria.

### 6.1.7 Managerial priorities

The demanding nature ($D_j$ and $D_{k_j}$) of patients has a direct impact on priorities. At this point, by combining these results with the average improvement indexes, $\Delta_j$ and $\Delta_{jk}$, strategic priorities can be drawn, and improvement diagrams can be developed.

These diagrams consist of maps, similar to the one presented in Figure 6.15, which are divided into four quadrants according to demanding (high/low) and margin for improvement (high/low) [30]. These may be used to rank the improvement priorities, as follows:

- *First priority*, is represented by the red colored area, characterized by low demanding indexes and high potential for improvement. This $4^{\text{th}}$ quadrant comprises dimensions to enhance (criteria/subcriteria) with direct improvement actions.
- *Second priority*, the orange ($1^{\text{st}}$ quadrant) and yellow ($3^{\text{rd}}$ quadrant) areas of the diagram include the satisfaction dimensions that simultaneously have either high or low demand and room for improvement.
- *Third priority*, these satisfaction dimensions should be of last priority, given their high demanding nature and allied to little room for improvement.

The priorities are also provided on Table 6.15. At the bottom of this table, one can find the criteria and subcriteria distribution centroids. These were used to establish a distinction between high/low demanding index, and the large/small margin for improvement. This means that, if the centroid of $\Delta$ is 0.50 for the $j^{\text{th}}$ criterion, large and small margins for improvement are verified for higher and lower values of $\Delta$, respectively.

### 6.1.8 'Market' opportunities

In a highly competitive, fast-changing and customer-oriented market, effectively delivering service quality is the key for enhancing customer satisfaction. Products and services possess various attributes, some

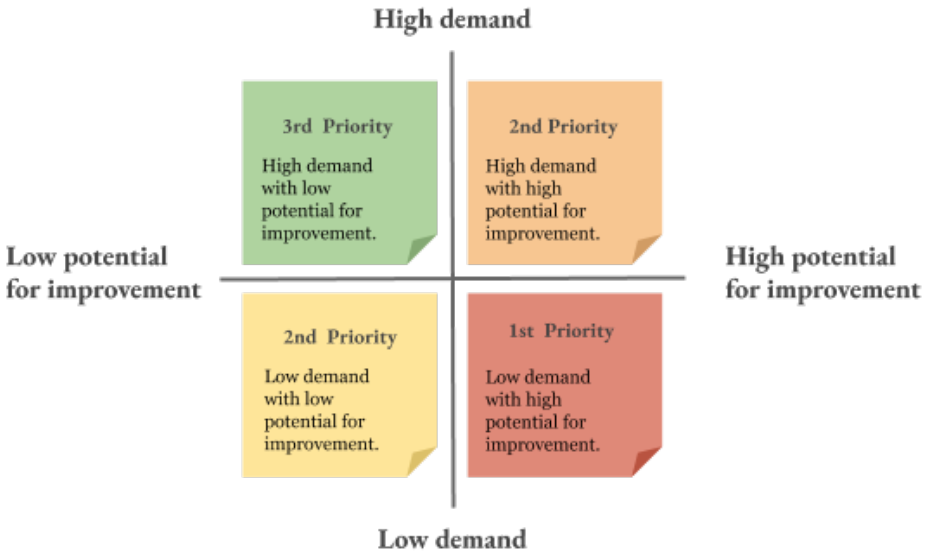


Figure 6.15: Improvement diagram with strategic priorities.

being more important than others. Moreover, customer requirements can be both explicit and implicit, and the latter must be explored by the enterprises, once their fulfilment and improvement can make customers feel more satisfied and surprised.

The Kano's model, explored in Section 6.1.5, determines the categories of individual quality attributes on the basis of customer satisfaction and dissatisfaction, with how their individual requirements are catered to [36]. Although this approach allows the analysis of customer requirements, it does not take into account the fact that quality attribute performance and importance can affect the abovementioned categorization.

Action diagrams, like the one presented in Figure 6.16, are developed by the combination of criteria/subcriteria average satisfaction indexes and weights [30]. These reflect opportunities for resources allocation and define the required improvement efforts, indicating the strong and weak points of customer satisfaction. Accordingly, these maps are divided into four quadrants, according to performance (high/low) and importance (high/low):

- *Leverage opportunity* - satisfaction criteria with high importance and high satisfaction, require medium priority and could be advantageous against competition.
- *Transfer resources* - less important criteria with a high verifying considerable satisfaction, are a low priority, and resources should be transferred elsewhere.
- *Status quo* - generally no action is required for these dimensions, as they are of little importance and performance.
- *Action opportunity* - these are the criteria that need attention. once they are highly valued and present low satisfaction scores.

This type of diagrams can be used in order to identify priorities for improvement. The first priority is allocated to the $4^{\text{th}}$ quadrant, and includes attributes that are important to customers (patients) but

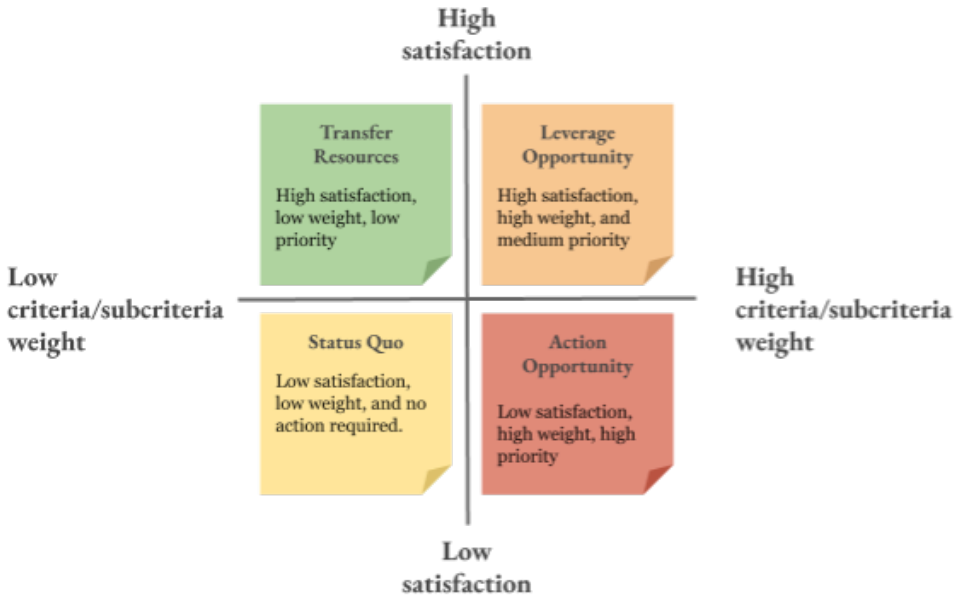


Figure 6.16: Opportunities' diagram.

company's (hospital's) performance is rated moderately low. As second priority, there are the leverage opportunities, located on the 1$^{st}$ quadrant, specially if there is room fr improvement. At the bottom left quadrant, the third priorities are included. The latter may not be much relevant at the time of the study, but they may become more important in the future, and if that happens, their performance must be improved. Lastly, the forth priority for improvement should be attributed to criteria at the top left of the action diagram, as these are less important criteria which exhibit a relatively high level of satisfaction.

Table 6.12: MUSA main results regarding criteria and subcriteria weights.

| Criteria | Subcriteria | Subcriteria weight [0-1] | Overall weight | Satisfaction index [0-1] |
|---|---|---|---|---|
| $[g_1]$ | User's guide | 0,0300 | 0,0009 | 0,0287 |
| | User's rights and duties | 0,4250 | 0,0128 | 0,4068 |
| | Ways of complaints | 0,0300 | 0,0009 | 0,0283 |
| | Substitution in decision-making | 0,4850 | 0,0146 | 0,4642 |
| | Anticipated vital will | 0,0300 | 0,0009 | 0,0283 |
| | *Global* | *0,0300* | - | *0,0269* |
| $[g_2]$ | Cleanliness and hygiene | 0,0300 | 0,0009 | 0,0292 |
| | Comfort and commodity | 0,0300 | 0,0009 | 0,0296 |
| | Privacy | 0,0300 | 0,0009 | 0,0286 |
| | Furniture | 0,4250 | 0,0128 | 0,4084 |
| | Noise | 0,0300 | 0,0009 | 0,0286 |
| | Room temperature | 0,4250 | 0,0128 | 0,4112 |
| | Distractions | 0,0300 | 0,0009 | 0,0294 |
| | *Global* | *0,0300* | - | *0,0292* |
| $[g_3]$ | Schedule | 0,0300 | 0,0009 | 0,0294 |
| | Visit duration | 0,0300 | 0,0009 | 0,0294 |
| | Number of visits | 0,9100 | 0,0273 | 0,9017 |
| | Facilities for close relatives | 0,0300 | 0,0009 | 0,0297 |
| | *Global* | *0,0300* | - | *0,0294* |
| $[g_4]$ | Preparation, appearance, temperature, taste | 0,0300 | 0,0009 | 0,0295 |
| | Variety | 0,9100 | 0,0273 | 0,8939 |
| | Quantity | 0,0300 | 0,0009 | 0,0295 |
| | Meal support | 0,0300 | 0,0009 | 0,0292 |
| | *Global* | *0,0300* | - | *0,0289* |
| $[g_5]$ | Readiness and availability | 0,0300 | 0,0009 | 0,0296 |
| | Attention | 0,0300 | 0,0009 | 0,0296 |
| | Sympathy and kindness | 0,0300 | 0,0009 | 0,0300 |
| | Information on the patient's clinical status | 0,8200 | 0,0246 | 0,7889 |
| | Information on the medical treatments | 0,0300 | 0,0009 | 0,0296 |
| | Information on the exams | 0,0300 | 0,0009 | 0,0289 |
| | Health advising and teaching | 0,0300 | 0,0009 | 0,0289 |
| | *Global* | *0,0300* | - | *0,0286* |
| $[g_6]$ | Readiness and availability | 0,0300 | 0,0009 | 0,0294 |
| | Attention | 0,0300 | 0,0009 | 0,0288 |
| | Sympathy and kindness | 0,0300 | 0,0009 | 0,0288 |
| | Information on the patient's clinical status | 0,0300 | 0,0009 | 0,0288 |
| | Information on the nursing treatments | 0,8500 | 0,0255 | 0,8153 |
| | Health advising and teaching | 0,0300 | 0,0009 | 0,0288 |
| | *Global* | *0,0300* | - | *0,0292* |
| $[g_7]$ | Readiness and availability | 0,9100 | 0,6370 | 0,8775 |
| | Attention | 0,0300 | 0,0210 | 0,0268 |
| | Sympathy and kindness | 0,0300 | 0,0210 | 0,0246 |
| | Action's efficiency | 0,0300 | 0,0210 | 0,0289 |
| | *Global* | *0,7000* | - | *0,6870* |
| $[g_8]$ | Readiness and availability | 0,0300 | 0,0009 | 0,0300 |
| | Attention | 0,0300 | 0,0009 | 0,0183 |
| | Sympathy and kindness | 0,9100 | 0,0273 | 0,7517 |
| | Action's efficiency | 0,0300 | 0,0009 | 0,0183 |
| | *Global* | *0,0300* | - | *0,0286* |
| $[g_9]$ | Readiness and availability | 0,0300 | 0,0009 | 0,0300 |
| | Attention | 0,9400 | 0,0282 | 0,9400 |
| | Sympathy and kindness | 0,0300 | 0,0009 | 0,0300 |
| | *Global* | *0,0300* | - | *0,0203* |
| $[g_{10}]$ | Readiness and availability | 0,0300 | 0,0009 | 0,0284 |
| | Professionals' attention | 0,0300 | 0,0009 | 0,0288 |
| | Sympathy and kindness | 0,0300 | 0,0009 | 0,0288 |
| | Information on the patient's clinical status | 0,0300 | 0,0009 | 0,0284 |
| | Information on the medical treatments | 0,0300 | 0,0009 | 0,0284 |
| | Information on the exams | 0,0300 | 0,0009 | 0,0284 |
| | Health advising and teaching | 0,8200 | 0,0246 | 0,7757 |
| | *Global* | *0,0300* | - | *0,0283* |
| $[g_{11}]$ | Home-care provided information | 0,9700 | 0,0291 | 0,9482 |
| | Waiting time to leave (after discharge) | 0,0300 | 0,0009 | 0,0292 |
| | *Global* | *0,0300* | - | *0,0275* |
| Centroids | Criteria | 0,0910 | - | 0,0876 |
| | Subcriteria | 0,0300 | - | 0,0294 |

Table 6.14: Kano's model applied to MUSA: satisfied and dissatisfied patients' related weights for subcriteria.

| Criteria | Subcriteria | Dissatisfied patients $w^d_{jk} = v^d_{jk}(g^{L_{k_j}}_{jk})$ | Satisfied patients $w^s_{jk} = v^s_{jk}(g^{L_{k_j}}_{jk})$ | Kano's category |
|---|---|---|---|---|
| $[g_1]$ | User's guide | 0,0300 | 0,0300 | One-dimensional |
| | User's rights and duties | 0,0300 | 0,0300 | One-dimensional |
| | Ways of complaints | 0,8800 | 0,0300 | Must-be |
| | Substitution in decision-making | 0,0300 | 0,8800 | Attractive |
| | Anticipated vital will | 0,0300 | 0,0300 | One-dimensional |
| $[g_2]$ | Cleanliness and hygiene | 0,8200 | 0,0300 | Must-be |
| | Comfort and commodity | 0,0300 | 0,0300 | One-dimensional |
| | Privacy | 0,0300 | 0,8200 | Attractive |
| | Furniture | 0,0300 | 0,0300 | One-dimensional |
| | Noise | 0,0300 | 0,0300 | One-dimensional |
| | Room temperature | 0,0300 | 0,0300 | One-dimensional |
| | Distractions | 0,0300 | 0,0300 | One-dimensional |
| $[g_3]$ | Schedule | 0,0300 | 0,0300 | One-dimensional |
| | Visit duration | 0,0300 | 0,0300 | One-dimensional |
| | Number of visits | 0,9100 | 0,9100 | One-dimensional |
| | Facilities for close relatives | 0,0300 | 0,0300 | One-dimensional |
| $[g_4]$ | Preparation, appearance, temperature, taste | 0,9100 | 0,9100 | One-dimensional |
| | Variety | 0,0300 | 0,0300 | One-dimensional |
| | Quantity | 0,0300 | 0,0300 | One-dimensional |
| | Meal support | 0,0300 | 0,0300 | One-dimensional |
| $[g_5]$ | Readiness and availability | 0,0300 | 0,0300 | One-dimensional |
| | Attention | 0,0300 | 0,0300 | One-dimensional |
| | Sympathy and kindness | 0,8200 | 0,0300 | Must-be |
| | Information on the patient's clinical status | 0,0300 | 0,8200 | Attractive |
| | Information on the medical treatments | 0,0300 | 0,0300 | One-dimensional |
| | Information on the exams | 0,0300 | 0,0300 | One-dimensional |
| | Health advising and teaching | 0,0300 | 0,0300 | One-dimensional |
| $[g_6]$ | Readiness and availability | 0,8500 | 0,0300 | Must-be |
| | Attention | 0,0300 | 0,0300 | One-dimensional |
| | Sympathy and kindness | 0,0300 | 0,0300 | One-dimensional |
| | Information on the patient's clinical status | 0,0300 | 0,0300 | One-dimensional |
| | Information on the nursing treatments | 0,0300 | 0,8500 | Attractive |
| | Health advising and teaching | 0,0300 | 0,0300 | One-dimensional |
| $[g_7]$ | Readiness and availability | 0,0300 | 0,9100 | Attractive |
| | Attention | 0,0300 | 0,0300 | One-dimensional |
| | Sympathy and kindness | 0,0300 | 0,0300 | One-dimensional |
| | Action's efficiency | 0,9100 | 0,0300 | Must-be |
| $[g_8]$ | Readiness and availability | 0,9100 | 0,9100 | One-dimensional |
| | Attention | 0,0300 | 0,0300 | One-dimensional |
| | Sympathy and kindness | 0,0300 | 0,0300 | One-dimensional |
| | Action's efficiency | 0,0300 | 0,0300 | One-dimensional |
| $[g_9]$ | Readiness and availability | - | 0,0300 | - |
| | Attention | - | 0,9400 | - |
| | Sympathy and kindness | - | 0,0300 | - |
| $[g_{10}]$ | Readiness and availability | 0,8200 | 0,0300 | Must-be |
| | Professionals' attention | 0,0300 | 0,0300 | One-dimensional |
| | Sympathy and kindness | 0,0300 | 0,0300 | One-dimensional |
| | Information on the patient's clinical status | 0,0300 | 0,8200 | Attractive |
| | Information on the medical treatments | 0,0300 | 0,0300 | One-dimensional |
| | Information on the exams | 0,0300 | 0,0300 | One-dimensional |
| | Health advising and teaching | 0,0300 | 0,0300 | One-dimensional |
| $[g_{11}]$ | Home-care provided information | 0,9700 | 0,0300 | Must-be |
| | Waiting time to leave (after discharge) | 0,0300 | 0,9700 | Attractive |

Table 6.15: Demanding and average improvement indexes for all criteria and subcriteria. Strategic priorities and opportunities.

| Criteria | Subcriteria | Demanding index [-1 - +1] | Average improvement index [0 - 100 %] | Strategic improvement | Opportunities |
|---|---|---|---|---|---|
| $[g_1]$ | User's guide | -0,2857 | 2,91 | ? | ? |
| | User's rights and duties | -0,2857 | 25,21 | ? | Leverage opp. |
| | Ways of complaints | -0,2857 | 2,92 | ? | ? |
| | Substitution in decision-making | -0,2857 | 25,99 | ? | Leverage opp. |
| | Anticipated vital will | -0,5714 | 2,92 | 2nd priority | ? |
| | *Global* | *-0,2857* | *2,92* | *3rd priority* | *?* |
| $[g_2]$ | Cleanliness and hygiene | 0,0000 | 2,91 | 3rd priority | ? |
| | Comfort and commodity | -0,2857 | 2,91 | ? | ? |
| | Privacy | 0,0000 | 2,91 | 3rd priority | ? |
| | Furniture | 0,0000 | 25,14 | 2nd priority | Leverage opp. |
| | Noise | -0,5714 | 2,91 | 2nd priority | ? |
| | Room temperature | -0,2857 | 25,02 | ? | Leverage opp. |
| | Distractions | -0,5714 | 2,91 | 2nd priority | ? |
| | *Global* | *-0,5714* | *2,91* | *2nd priority* | *?* |
| $[g_3]$ | Schedule | -0,5714 | 2,91 | 2nd priority | ? |
| | Visit duration | -0,5714 | 2,91 | 2nd priority | ? |
| | Number of visits | -0,5714 | 8,95 | 1st priority | Leverage opp. |
| | Facilities for close relatives | -0,5714 | 2,91 | 2nd priority | ? |
| | *Global* | *-0,5714* | *2,91* | *2nd priority* | *?* |
| $[g_4]$ | Preparation, appearance, temperature, taste | -0,2857 | 2,91 | ? | ? |
| | Variety | -0,2857 | 9,66 | ? | Leverage opp. |
| | Quantity | -0,5714 | 2,91 | 2nd priority | ? |
| | Meal support | -0,5714 | 2,91 | 2nd priority | ? |
| | *Global* | *-0,2857* | *2,91* | *3rd priority* | *?* |
| $[g_5]$ | Readiness and availability | -0,2857 | 2,91 | ? | ? |
| | Attention | -0,2857 | 2,91 | ? | ? |
| | Sympathy and kindness | -0,2857 | 2,91 | ? | ? |
| | Information on the patient's clinical status | -0,5714 | 17,31 | 1st priority | Leverage opp. |
| | Information on the medical treatments | -0,5714 | 2,91 | 2nd priority | ? |
| | Information on the exams | -0,2857 | 2,91 | ? | ? |
| | Health advising and teaching | -0,2857 | 2,91 | ? | ? |
| | *Global* | *-0,2857* | *2,91* | *3rd priority* | *?* |
| $[g_6]$ | Readiness and availability | -0,2857 | 2,91 | ? | ? |
| | Attention | 0,0000 | 2,91 | 3rd priority | ? |
| | Sympathy and kindness | 0,0000 | 2,91 | 3rd priority | ? |
| | Information on the patient's clinical status | 0,0000 | 2,91 | 3rd priority | ? |
| | Information on the nursing treatments | -0,2857 | 15,70 | ? | Leverage opp. |
| | Health advising and teaching | -0,2857 | 2,91 | ? | ? |
| | *Global* | *0,0000* | *2,91* | *3rd priority* | *?* |
| $[g_7]$ | Readiness and availability | -0,2857 | 11,15 | ? | Leverage opp. |
| | Attention | 0,2857 | 2,92 | ? | ? |
| | Sympathy and kindness | 0,5714 | 2,93 | 3rd priority | ? |
| | Action's efficiency | -0,2857 | 2,91 | ? | ? |
| | *Global* | *-0,2857* | *21,91* | *2nd priority* | *Leverage opp.* |
| $[g_8]$ | Readiness and availability | -0,2857 | 2,91 | ? | ? |
| | Attention | 0,5714 | 2,95 | 3rd priority | ? |
| | Sympathy and kindness | 0,2857 | 22,59 | ? | Leverage opp. |
| | Action's efficiency | 0,5714 | 2,95 | 3rd priority | ? |
| | *Global* | *-0,2857* | *2,91* | *3rd priority* | *?* |
| $[g_9]$ | Readiness and availability | -0,2857 | 2,91 | ? | ? |
| | Attention | -0,2857 | 5,64 | ? | Leverage opp. |
| | Sympathy and kindness | -0,2857 | 2,91 | ? | ? |
| | *Global* | *-0,2857* | *2,94* | *3rd priority* | *?* |
| $[g_{10}]$ | Readiness and availability | -0,2857 | 2,91 | ? | ? |
| | Professionals' attention | -0,2857 | 2,91 | ? | ? |
| | Sympathy and kindness | -0,2857 | 2,91 | ? | ? |
| | Information on the patient's clinical status | -0,2857 | 2,91 | ? | ? |
| | Information on the medical treatments | -0,2857 | 2,91 | ? | ? |
| | Information on the exams | -0,5714 | 2,91 | 2nd priority | ? |
| | Health advising and teaching | -0,5714 | 18,39 | 1st priority | Leverage opp. |
| | *Global* | *0,0000* | *2,92* | *3rd priority* | *?* |
| $[g_{11}]$ | Home-care provided information | -0,2857 | 5,03 | ? | Leverage opp. |
| | Waiting time to leave (after discharge) | -0,2857 | 2,91 | ? | ? |
| | *Global* | *-0,5714* | *2,92* | *?* | *?* |
| Centroids | Criteria | -0,3117 | 4,64 | - | - |
| | Subcriteria | -0,2857 | 6.27 | - | - |

# Chapter 7

# Discussion and managerial implications

The present dissertation has made use of the innovative MUSA method, which is a very useful linear-programming model, proposed by Grigoroudis and Siskos, with the intention of measuring and analysing consumers' satisfaction regarding a specific service, and identifying priorities to improve the service's performance. In this case, the method is employed concerning the Portuguese National Health Service (NHS), more specifically the inpatient service. Important conclusions can be drawn from the results present on the several tables provided in Chapter 6.

## 7.1 Received information

The '*Received information*' criteria is characterized by five subcriteria as detailed in Figure 5.1. Table 6.1 presents the answers given by the patients when evaluating the general information they receive during their journey through the inpatient service. The percentage of answers for each level of satisfaction may translate into the expected level of satisfaction with regard to each criterion and subcriterion. For this purpose, one can consider the sum of answers within the $6^{\text{th}}$ and $7^{\text{th}}$ levels of satisfaction. This can then be compared to the MUSA-based satisfaction score, also provided in the last column of the abovementioned table, in order to draw conclusions.

Globally speaking, patients seem very dissatisfied with the received information, with a MUSA satisfaction score of only 2.69%. This value is not even close to the expected satisfaction level of 60.00%. Furthermore, for each received information's related subcriterion, it is possible to conclude that both expected and observed satisfaction scores do not look similar, except for the 'user's rights and duties' and 'substitution in decision-making', for which both scores are statistically comparable. These two subcriteria are also the ones with a larger weight on average, with 42.50% and 48.50%, respectively. Accordingly, there is a considerable margin for improvement on 'user's rights and duties' and 'substitution in decision-making'. Besides, the latter has shown to be the subcriterion with the highest scope for improving. As mentioned in Section 6.1.4, and according to Table 6.15, patients have shown to be non-demanding for

most of the received information's attributes, specially for the 'anticipated vital will'. The ways by which patients can complain about the service have shown to be a must-be requirement, according to Kano's model, since its weight for dissatisfied patients (88.00%) is larger than the weight achieved for satisfied patients' set (3.00%). This means that patients become deeply dissatisfied when they do not find adequate ways to complain and/or to suggest improvements about the service, although they do not exhibit any signs of satisfaction, otherwise. In addition, patients are relatively satisfied with their 'rights and duties' and 'substitution in decision-making', which results in a leverage opportunity for both attributes. Lastly, this refers to a 3$^{rd}$ priority criterion.

## 7.2 Facilities' quality

The way patients experience the hospital's facilities may impact their future choice of a healthcare provider. Even when that choice is unattainable (*e.g.*, due to law constraints), it may contribute to a lower demand for healthcare, which may entail serious consequences to the population. The '*Facilities' quality*' criterion includes attributes such as the hygiene, the comfort and commodity, the room temperature and the noise, *etc.*.

From Table 6.2, one would expect that, globally, around 76.00% of the patients were highly satisfied with this criterion. However, once again, this is not in agreement with the observed satisfaction score of 2.92%, provided by MUSA. Regarding the subcriteria weights, the ones revealing higher levels of importance are 'furniture' (42.50%) and 'room temperature' (42.50%). Public healthcare providers seem to have a considerable room for improvement with regard to these two facilities' features, given their large weight and the satisfaction level they achieved. Furthermore, the 'cleanliness and hygiene' achieved a much larger weight for the dissatisfied patients (82.00%) than for the satisfied ones (3.00%), thus this subcriterion is considered a must-be requirement: when facilities do not have proper hygiene, patients become very dissatisfied, because they take this attribute for granted, *i.e.*, they believe that hospitals should always be cleaned, in order to ensure patients' safety and comfort. 'Privacy' appears to be an attractive requirement, according to the Kano's model, meaning that patients are satisfied whenever privacy is fulfilled, although they do not exhibit any dissatisfaction otherwise. Patients, who in the present case study have shown to be non-demanding consumers, have exhibit a low demanding index specially in terms of 'noise' and 'distractions' (-0.5714). Overall, the '*Facilities' quality*' appears at the third quadrant of the improvement diagram, as second priority, given its low demand, associated with low potential for improvement.

## 7.3 Visits

When measuring satisfaction with regard to this particular valence, that is the inpatient service, it seems rather relevant to consider, not only the hospitalized subjects, but also her/his family and/or close friends, who intend to visit and follow the recovery process. Besides, the patient her/himself usually requires that kind of close support, as well. In line with this, it seems plausible to evaluate the satisfaction regarding

the '*Visits*' criterion, whose expected levels of satisfaction are present on Table 6.3.

According to the abovementioned table, one would expect this attribute to achieve a global level of satisfaction close to 70.00%. However, the score provided by MUSA is only 2.94%, which is a much lower value. Within this criterion, the most weighty attribute is the 'number of visits', which achieved a score of satisfaction of nearly 91.00%. Furthermore, and by the observation of Table 6.15, the '*Visits*' criterion offers almost no scope for improvement (2.91%). Nevertheless, the larger improvement index refers to the most pronounced subcriterion, the 'number of visits', however with a score of only 8.95%. Similarly to the rest of the subcriteria, this one is characterized by a demanding index of -0.5714, a lower value than the centroid. Hence, the 'number of visits' is considered a 1$^{st}$ priority, while the rest of the attributes are considered second priorities. In terms of the Kano's model categorization, the whole set of subcriteria are one-dimensional, meaning that patients become dissatisfied whenever these requirements are not fulfilled.

## 7.4 Food quality

When a patient is hospitalized, this means she/he will have to stay in the hospital for a certain period of time (days, weeks, or even months). During this stay, the patient is closely followed by the medical and nursing staff, in order to recover fast and avoid additional complications after treatment. From the moment the patient is admitted in the inpatient service, the clinical aspect of care are not the only ones to take into account. Indeed, despite the fact that we are talking about a hospital, it becomes paramount to consider some hotel management features as well, as the latter also play an important role in patients' satisfaction. In line with this, aspects such as the '*Food quality*' must be monitored and continually improved, so as to enhance the care experience. When asked to evaluate the food, one instantly thinks of aspects such its 'preparation', 'appearance', 'temperature', 'taste', and aspects like the 'variety' and 'quantity', as well. Together with those, the 'support' that patients receive, if needed, during their meal, is also a relevant element.

On Table 6.4, one can find the results from the conducted survey, with respect to the quality of the food provided in the inpatient service of the Amato Lusitano Hospital. Apparently, this criterion would present a satisfaction score of around 64.00%, however, from the application of MUSA, patients seem rather dissatisfied with it, with a global satisfaction index of only 2.89%. Similarly to the previous one, this criterion is also characterized by four one-dimensional subcriteria, which means that the patients' satisfaction will be proportional to the level of fulfillment. Furthermore, patients seem rather satisfied with the food 'variety' (89,39%), which is also the feature to which patients assigned the highest importance. In terms of demand, patients appear to be particularly non-demanding about the 'quantity' and the 'meal support'. Classified as a 3$^{rd}$ priority, the '*Food quality*' has almost no room for improvement.

## 7.5 Medical staff

The '*Medical staff*' is one of the most important dimensions within the inpatient service. A patient usually sees the doctors as people with authority, great clinical knowledge and responsibility, seeking for them

whenever they need some kind of technical information about the care process. Furthermore, doctors are responsible for a part of the interpersonal component of the care delivery process, and the quality of this relationship tends to affect the treatments' efficacy and patients' health status. As mentioned before, in Section 6.1.1, patients aspire to be increasingly involved in their process of care, and according to some empirical studies, this may indeed generate better health outcomes. Therefore, if doctors, besides diagnosing and treating, also share part of the clinical information with their patients, the latter become more actively involved and confident in the doctors' work. Likewise, when evaluating the satisfaction with the '*Medical staff*', the feature with the highest importance for patients was indeed the 'information on their own clinical status' (82.00%), as shown on Table 6.12.

Table 6.5 has predicted that patients would be highly satisfied with this criterion, with an expected satisfaction score of around 75.00%. On reality, however, the global satisfaction index returned by MUSA did not exceed 3.00%. Given the fact that, globally, this criterion has reached a low weight (3.00%), there is not much margin for improvement and therefore only a low ($3^{\text{rd}}$) priority should be given to the 'Medical staff'. Essentially, one can say that patients become extremely dissatisfied when doctors do not exhibit 'sympathy and kindness', and neutral otherwise, as this is one attribute patients take for granted (*i.e.*, a must-be requirement). Moreover, the 'information on clinical status' exhibit a larger weight for satisfied patients (82.00%) than for the dissatisfied ones (3.00%), meaning that this subcriterion is considered as attractive for patients who do not get dissatisfied when it is not fulfilled.

## 7.6 Nursing staff

If one looks at the interpersonal relationship, established between the patient and the whole team responsible for her/his recovery process, as a pie, the '*Nursing staff*' also owns a considerable slice of this pie. As expected, the majority of nurses' professional and human competences are considered as one-dimensional requirements. However, Table 6.14 shows that 'readiness and availability' exhibits a weight that is much larger for the dissatisfied patients (85.00%) than the satisfied ones (3.00%), and the opposite is true for the 'information on the nursing treatments'. Accordingly, these features are classified as must-be and attractive requirements, respectively. Patients show neither demanding nor non-demanding natures with regard to this criteria ($D_j = 0$, *i.e.*, neutral). The most, and only one, prominent attribute after the evaluation of this criterion, has been the 'information on nursing treatments'. With the combination of a relatively high performance, with an average satisfaction index of nearly 82.00%, and a relatively high importance (85.00%), this feature has 15.70% room for improvement. Nevertheless, the '*Nursing staff*' has been classified as a $3^{\text{rd}}$ priority for improvement.

## 7.7 Auxiliary, Administrative and Volunteering staff

To better interpret the obtained results, the non-clinical staff was analysed together, which includes the auxiliaries, administratives and volunteers. From tables 6.7, 6.8 and 6.9, in particular from the high frequency of answers within the $6^{\text{th}}$ and $7^{\text{th}}$ levels of satisfaction, one should expect that the satisfaction

with regard to these three criteria would be considerable, and never below the score of 60.00%. However, the observed MUSA-based indexes have been much lower.

The only criterion that stands out is the '*Auxiliary staff*'. The latter also establishes a close relationship with patients during their stay in the hospital. Furthermore, auxiliaries are, very often, the most accessible contact patients get: except for the drugs administration, this team is responsible for the patients' hygiene, the food distribution, and for any particular situation for which patients ask for information, help or comfort. In line with this, this feature's extreme importance would be expected, specially in terms of the auxiliaries' 'readiness and availability' (91.00%). Moreover, the hospital's performance on this criterion is favorable, with a global average satisfaction index of almost 70.00%. Patients seem particularly demanding in relation to components such as the 'attention' and 'kindness and sympathy'. The '*Auxiliary staff*' has been considered has a $2^{\text{nd}}$ priority, with a margin for potential improvement of almost 22.00%. As a must-be requirement, patients have highlighted the auxiliaries' action's efficiency, and their 'readiness and availability' as an attractive requirement.

Considering the '*Administrative staff*', they are responsible for admitting patients, scheduling their exams/consultations, and directing them inside the hospital. Furthermore, this personnel also deals with more administrative matters, such as invoicing and applying insurers authorizations'. Basically, administratives are the first contact patients establish with the hospital, thus a careful communication and aspects such as 'sympathy and kindness' are very important for a good experience of care (weighing around 90.00%). This particular subcriterion was the most relevant within the '*Administrative staff*'. Patients have shown to be particularly demanding for it, and considerably satisfied with its performance (75.00%).

Without possessing technical skills and clinical knowledge, the '*Volunteering staff*' is predisposed to help, guide and communicate with patients, aspects that are extremely important for a hospitalized patient. As a matter of fact, by analysing table 6.12, the volunteers' 'attention' was the most valuable criteria (94.00%), and patients seem highly satisfied with it. It is worthwhile noticing that it was not possible to apply the Kano's model to this criteria, once there were no answers with an overall satisfaction score below the neutral level, thus it was not possible to compute the value of $w_{jk}^{d}$ (see Table 6.14).

## 7.8 Exams and treatments

When a patient is hospitalized, additional exams and treatments are usually scheduled, aiming at improving the patients' health status. Improvement on this criterion has low priority ($3^{\text{rd}}$), although the 'health advising and teaching' subcriterion exhibits 18.39% margin for improvement. The latter is also the feature to which patients attribute the highest importance, weighing 82.00% for the global satisfaction with regard to the 'Exams and treatments'. Moreover, patients seem quite satisfied with it. The 'readiness and availability' component has shown to be a must-be requirement, weighing much more to the dissatisfied patients (82.00%) than to the satisfied ones (3.00%). The rest of the subcriteria are classified as one-dimensional, except for the 'information on clinical status', which is an attractive quality.

## 7.9 Discharge process

The satisfaction regarding the '*Discharge process*' is evaluated based on only two subcriteria. This process assumes a particular importance, specially when the inpatient service is being considered. In general, discharge from hospital is routine and uneventful. However, for a percentage of people, discharge from acute care requires careful planning to ensure continuity of care. Accordingly, essential elements for a successful and responsible discharge are, among others, 'home-care provided information' (for *e.g.*, in terms of complex medical needs and requirements), communication and education. Furthermore, patient satisfaction is closely linked to the length of hospital stay, meaning that the 'waiting time to leave' after being discharged has also a considerable impact on patient satisfaction.

That being said, from Table 6.11, one would expect that the global satisfaction score for this criterion would be around 87.00%, considering the frequency of global evaluations above the $5^{\text{th}}$ level of satisfaction. However, after applying the MUSA method, the obtained satisfaction index was only 2.75%. 'Home-care provided information' is the most important feature for the discharged patients, and the hospital seems to have a pretty good performance with respect to this subcriterion. Furthermore, the latter is a must-be requirement, while the 'Waiting time to leave' after discharge has been classified as attractive, according to Kano's model.

# Chapter 8

# Concluding remarks and future work

## 8.1 Concluding remarks

Patient satisfaction plays a central role in the hospitals' performance, especially within the public healthcare sector, in which the *universal* NHS, although almost free at the point of use, is payed mostly by the patients themselves, through general taxation. In line with that, it is of extreme importance to identify what service attributes the patients value the most, how demanding the patients are regarding each satisfaction criterion (featuring the service attributes), how can one classify them, and to find potential improvements, priorities and opportunities for hospitals in order to improve their performance.

This particular study has considered a sample of hospitalized patients from the AL hospital, who have experienced the inpatient service. The MUSA method was then employed to analyse this sample. As described in Section 4.3.3, this method is based on the principles of multicriteria analysis, and particularly on aggregation-disaggregation approach and linear programming modelling. Fundamentally, the major advantage of MUSA is that it fully considers the qualitative form of customers' judgements and preferences, accounting for the fact that the scale that is used is traditionally ordinal. This way, the proposed methodology does not arbitrarily quantify the collected information.

The results derived from the application of MUSA are sufficient enough to analyse in detail the satisfaction evaluation problem and to assess the reliability of the method's implementation. These include value functions, criteria weights, average satisfaction, demanding and improvement indexes, and moreover they allow the construction of action and improvement diagrams.

However, one has to keep in mind that, given its empirical nature, MUSA is not entirely flawless, neither is the present study. More specifically, the model assumptions and the quality of the collected data may bring potential implementation problems to the MUSA method. On the one hand, the chosen satisfaction criteria set may not correspond to a consistent family of criteria and, on the other hand, it should not be forgotten that patients may not be rational decision-makers and might be unable to correctly and non-emotionally evaluate the quality of care, given the severity and/or complexity of their illness. Another issue that must be considered concerns the existence of distinct patient groups, whose preference value systems (value functions, criteria weights, *etc.*) may differ.

Unfortunately, the obtained results seem to be inconsistent with the reality, as reported on Chapter 7. In fact, the utility functions provided by MUSA were the starting point for these inconsistencies. For some of the criteria, the value of the global satisfaction has been lower than the value of some partial satisfactions, which is odd and probably related with the provided data. Additionally, as discussed before, within each service attribute, only one or two features stood out, while the others presented *almost* null weights. From Table 6.12, one can easily confirm that the majority of the criteria/subcriteria weighs only 3.00%, which is actually the threshold that was imposed on the model (see Section 5.5).

That being said, one should expect that, concerning the additional results (namely satisfaction, demanding and improvement indexes), these would also be affected. Starting with the average satisfaction index, $S_j$, Equation 6.1 makes it evident that, if $v_j(g_j^l)$ assumes almost insignificant values, close to zero, then the satisfaction score becomes very low as well, which is exactly what can be observed on the third column of Table 6.12. Now for the computation of the demanding indexes, from Equation 6.4, it is possible to conclude that, the lower the criteria/subcriteria weight, the more negative will be the $D_j$, and as expected, for the generality of the cases, a non-demanding nature was observed. Lastly, in general terms, the results show almost no room for improvement (note that neither the criteria nor the subcriteria centroids exceed 7.00% of potential improvement). After carefully analysing Equation 6.5, the latter becomes easily explained. In fact, considerable improvement indexes can be obtained if, and only if, the criteria/subcriteria weight deviates from zero, which is the case of the facilities' room temperature, for instance.

Notwithstanding the lack of consistency of the obtained results, one should not forget that these are purely outcomes from the mathematical structure underlying the MUSA method. Grigoroudis and Siskos have created this model so as to optimize the criteria/subcriteria weights and value functions by minimizing the potential errors associated with patients' judgements. Additionally, the independence that is assumed between criteria may give rise to the Halo effect, meaning that, in reality, the patients' assessment about one criterion may influence their opinion about another criterion. Therefore, and specially if the sample is not adequate, it is possible to acquire results with no practical meaning. Furthermore, as a linear programming model, MUSA is sensitive to the number of constraints and variables, meaning that, the higher the number of satisfaction levels (7 levels were considered in this case) the higher the probability of failure.

It is reasonable to say that the provided and treated data sample constitutes the main reason why the present study was inconclusive. In fact, for some criteria, the analysed sample was not even statistically valid ($N < 30$). The satisfaction survey was distributed in 2018, targeting only hospitalized patients at the AL hospital. On Table 5.1, one can verify that, during that same year, nearly 7 750 patients were discharged. Despite this fact, the analysed sample comprised the answers of only 251 patients, which is relatively low, considering the hospital's total capacity of 225 beds.

Bottom line, one can declare that the goals set forth at the beginning of the present dissertation were not entirely reached. Future research shall include a sensitivity and robustness analysis and a larger and more segmented patient sample must be examined.

## 8.2 Future work

In line with the preceding section, the main prospective developments can be epitomized in a few remarks.

Firstly, MUSA's linear programming nature makes it sensitive to the number of satisfaction levels. It is understandable that, the higher the scale, the easier it is for the patients to assess their satisfaction with regard to a certain product/service. However, on the other side of the coin, this also enhances the failure probability of the mathematical model. Hence, future research shall compare these results with the ones obtained through less satisfaction levels (for instance five).

Additionally, if the goal is to accurately measure the performance of the inpatient service, then a much larger data sample should be considered. This way, even after data processing, the sample remains statistically valid, and more consistent results can be obtained. In particular, with respect to the AL hospital, a sample comprising half the number of the discharge patients in one year (*i.e.*, around 3 870 patients) should be more adequate.

Furthermore, although satisfaction surveys are widely used tools for measuring patient satisfaction with regard to healthcare services, these also entail several disadvantages. The most criticized aspect must be the surveys' subjectivity. In fact, patient satisfaction studies focus on subjective judgements of users, and do not account for the existence of different patient groups whose preference value systems may differ. The segmentation of the total set of patients into smaller groups according to particular characteristics (*e.g.* age, sex) must be the most reliable solution to tackle this problem.

Also, a possible future consideration could be conducting the same study but leaving the Auxiliary staff aside, given that the latter was the only criterion that stood out. Hence, removing it from the sample could allow a more detailed analysis on the rest of the criteria. Furthermore, other objective functions could be explored, in order to compare different results from different contexts.

Finally, a possible alternative to the traditional surveys would be a smartphone application, that would allow patients to evaluate each step of their journey through the inpatient service. Ideally, patients would have a QR code, for instance at the admission table, where they could scan the code with the smartphone and instantly evaluate their satisfaction with the service provided by the '*Administrative staff*'. Likewise, patients would be able to evaluate the different aspects of the inpatient service, soon after they have experienced those. It is reasonable to imagine that, this way, patients' judgements would be fresher and more trustful, and more consistent data would be collected.

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