Ph.D. Dissertation in Business and Management Studies

Specialization in Accounting and Management Control

Management Accounting: Exploring the Implementation of Alternative Methodologies in Hospital Settings

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1.1. Biographic note

Vítor Macedo was born in Amarante, where he presently lives, on the 28th October 1969. He is father of an Economist and a soon-to-be Engineer and Musician.

He finished his undergraduate studies in Economics in 1994 at FEP – School of Economics and Management of the University of Porto. He went back to FEP some years later, where he finished the Master in Accounting in 2009. He also completed a Master in Services Engineering and Management at FEUP – Faculty of Engineering of the University of Porto, in 2012.

At present, he is lecturer at FEP (since 2015/16), in the courses of Introduction to Accounting and Accounting and Financial Report, of the Bachelors in Economics and in Management. He is also invited professor at UCP-P/CPBS – Universidade Católica Portuguesa – Porto/Católica Porto Business School, in Executive Training, since 2019. He regularly visits CESPU – Cooperativa de Ensino Superior Politécnico e Universitário, CRL, since 2012, to teach courses of Management Accounting and Financial Analysis, as well as the Professional Association of Engineers since 2018, to teach Finance for Engineers.

From December 1992 onwards, he worked in three areas: business enterprises, public hospitals and the already mentioned higher education and training. In the business sector, he held chief positions in the financial area, management control and general direction in enterprises from wholesale, engineering and construction, fuel distribution and metalworking industry. In the healthcare sector, he has been a member of the board of directors of public hospitals in two distinct periods: from January 1998 to December 2002 at Hospital de São Gonçalo – Amarante, and from December 2006 to October 2007 at Hospital Padre Américo – Vale do Sousa, E.P.E., immediately followed by Centro Hospitalar do Tâmega e Sousa, E.P.E. until March 2013. Finally, in higher education and training, besides the current positions, he has been invited assistant at ISCAC/Coimbra Business School, in the course of Corporate Finance, during 2013/14, and in the course of Portuguese Economy as lecturer in 2018/19 (in substitution). He also taught Management

Accounting – Costing Systems at the Professional Association of Accountants in 2016 and worked for IEFP – Instituto de Emprego e Formação Profissional and two training companies.

1.2. Acknowledgements

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I am equally in debt with many people from *Centro Hospitalar e Universitário de São João*. I got lucky from the beginning, when the Board of Directors of that time welcomed the idea and provided me with all means needed to gather data, process it and discuss results. From then on, I could always count on the assistance from the Director of the Management Control Department, who, with the highest knowledge and professionalism, ran so many queries on the remarkably advanced *Business Intelligence* tool, and got to know more about the ABC project at the Hospital from the project’s Champion. Later, when the current Board of Directors took charge, I did not notice a single difference and continued to receive full support from inside the Hospital.

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Comments and suggestions received during the *XVIII grudis Conference* in Santarém in February 2019 were truly important for the final balance of the thesis. I am grateful to two anonymous reviewers and I am highly pleased to meet and hear the advices from Professors Teemu Malmi and Maria Joao Major.

They are only mentioned now, but they could have been the first. Thanks to my Family for all patience and support, and to my Friends from my Hometown for endlessly saying "do not forget to tell us, we want to be there".

1.3. Abstract

The transformation of public hospitals into enterprises in Portugal, which started in 2002, was one of the most impactful changes that occurred in one of the most valued sectors in society. Like in many other European countries, the Portuguese government was seeking to modernize healthcare and get control over costs through the internalization of business-like management practices and tools. Interpreting the government's will and taking advantage of its central position in the Portuguese hospital network, the *Hospital de São João* took the unprecedented decision of implementing a sophisticated ABC-based cost accounting system. However, the process was not straightforward and the Hospital has faced multiple progresses and setbacks, in spite of an entrenched culture of information for management and clinical revision that turned the Hospital into a symbol of modernism in the Portuguese healthcare field.

Eventually, the Hospital decided to leave the ABC solution, some of the reasons for this being its complexity, its high maintenance costs, and the difficulty to analyze the information it provides, issues that were widely reported in the literature. This dissertation explores these topics, by evaluating the capacity of a less demanding *mezzo* costing methodology to serve the purpose of generating cost estimates for both local hospital management and national funding. It extends prior comparisons established in the literature between bottom-up micro costing – "the best methodology available" – and mixed approaches, by combining that methodology with elements drawn from bottom-up gross costing. The results are contrasting, in spite of clearly aligned cost estimates for medical DRGs. The additional comparison with the national tariffs reveals a large difference between costs for medical DRGs and the established prices, highlighting concerns about hospitals' financial sustainability. Furthermore, this research relies on the contribution from other sciences, namely by applying cluster analysis, in order to render the estimates more meaningful for assisting management and clinical revision, two of the goals pursued with the corporatization process and apparently embedded in the culture of the Hospital under study. It also contributes to the literature by focusing on the study of variance instead of handling mean costs, as the vast majority of literature on cost estimates has produced so far.

I also came to understand that the issues above were not sufficient to explain the outcome of the ABC project and the development of management tools in the Hospital under study. I understood that a more complete explanation would necessarily involve the exploration of major events, decisions and hesitations that characterized the last eighteen years of the healthcare field. It would be necessary to understand the positions adopted by major stakeholders in the field and how their actions conditioned and framed the evolution of management accounting. Prior literature on institutional logics presents hospitals as agents that interpret the will of those stakeholders located at higher places in the field, such as the government and professional bodies, and act strategically in order to attain their goals. This thesis provides evidence that in particular contexts of turbulence, governments may lose their ability to effectively signal or even decide their will, and hospitals may lose their ability to interpret expectations made upon them. In spite of that, an *intelligent* policy of involving all relevant professional groups together with a bargaining power that stems from a central position in the field can insulate the Hospital from waves in the field and keep creating sophisticated management tools, whether or not they involve management accounting.

1.4. Sumário

A transformação de hospitais públicos em empresas em Portugal, que teve o seu início em 2002, corresponde a uma das mais significativas mudanças que ocorreram num dos setores mais estimados pelos cidadãos. Tal como em muitos países europeus, o Governo português procurava modernizar o setor da saúde e obter o controlo sobre os custos através da utilização pelos hospitais de práticas e ferramentas de gestão típicas do setor privado. Interpretando a intenção governamental e tirando partido da sua localização central na rede hospitalar nacional, o *Hospital de São João* tomou a decisão sem precedentes de implementar um sofisticado sistema de contabilidade de custos baseado no ABC. Todavia, o processo não correu sem sobressaltos e o Hospital enfrentou muitos avanços e recuos, apesar da cultura entrincheirada de informação para a gestão e revisão da prática clínica, que tornou o Hospital num símbolo de modernismo no setor da saúde em Portugal.

Eventualmente, o Hospital decidiu abandonar aquela solução por razões relacionadas com a sua complexidade, os elevados custos de manutenção e a dificuldade de analisar a informação proporcionada pelo sistema, explicações frequentemente apontadas na literatura. Esta tese explora estes tópicos, avaliando a capacidade de uma metodologia intermédia (designada nesta tese por metodologia *mezzo*), menos exigente, servir os objetivos de gerar estimativas de custos quer para a gestão local do Hospital, quer para fundamentar o financiamento nacional do internamento hospitalar. A tese estende comparações anteriormente apresentadas na literatura entre o *bottom-up micro costing* – “a melhor metodologia existente” – e abordagens mistas, ao combinar aquela metodologia com elementos retirados de uma outra: o *bottom-up gross costing*. Os resultados são contrastantes, apesar de as estimativas de custos estarem completamente alinhadas em relação aos GDHs[1] médicos. A comparação adicional com os preços nacionais revela uma grande diferença entre os custos dos GDHs médicos e os preços definidos, levantando questões sobre a sustentabilidade financeira dos hospitais. Adicionalmente, esta tese baseia-se no contributo de outras áreas científicas, concretamente através da aplicação da análise de *clusters*, de modo a obter estimativas com maior significado para o apoio à gestão

[1] Grupos de Diagnósticos Homogéneos.

e à revisão da prática clínica, dois dos objetivos perseguidos com a empresarialização da gestão hospitalar e aparentemente absorvidos pela cultura do Hospital estudado. A tese também contribui para a literatura ao focar-se no estudo da variância, em vez de tratar custos médios, como a grande maioria da literatura sobre estimativas de custos produziu até ao momento.

Vim, também, a aperceber-me de que os assuntos já mencionados não seriam suficientes para explicar o resultado do projeto ABC e do desenvolvimento de ferramentas de apoio à gestão no Hospital estudado. Verifiquei que uma explicação mais abrangente iria envolver, necessariamente, o entendimento de acontecimentos mais vastos, de decisões e de hesitações que caracterizaram os últimos dezoito anos do setor da saúde. Seria necessário entender as posições assumidas pelos principais *stakeholders* deste campo e como as suas intervenções condicionaram e enquadraram a evolução da contabilidade de gestão. A literatura anterior sobre as lógicas institucionais apresenta os hospitais como agentes que interpretam a vontade desses *stakeholders* posicionados nos lugares mais altos do campo da saúde, como o governo e as ordens profissionais, e atuam estrategicamente para atingirem os seus objetivos. Esta tese proporciona evidência de que em contextos de particular turbulência, os governos podem perder a sua capacidade de sinalizar, de facto, as suas intenções, e os hospitais podem perder a sua capacidade de interpretar as expectativas que são criadas sobre eles. Apesar disso, uma política *inteligente* de envolvimento dos grupos profissionais relevantes, em conjunto com o poder negocial que emerge da posição central que detém, podem permitir ao Hospital isolar-se das vagas do campo e continuar a criar ferramentas de gestão sofisticadas, quer envolvam ou não a contabilidade de gestão.

1.5. List of abbreviations

ABC – Activity-Based Costing

ACSS – *Administração Central do Sistema de Saúde* (Central Administration of the Health System)

APHP – *Associação Portuguesa de Hospitalização Privada* (Portuguese Association of Private Hospitalization)

ARS – *Administração Regional de Saúde*

BI – Business Intelligence (name given at CHSJ to the internal information system)

CHSJ – *Centro Hospitalar de São João*

CHUSJ – *Centro Hospitalar e Universitário de São João*

DRG – Diagnosis-Related Groups

ED – Emergency department

ENSP – *Escola Nacional de Saúde Pública* (School of Public Health, New University of Lisbon)

ER – Emergency room

HSJ – *Hospital de São João*

IT – Information Technology

LoS – Length of stay

MAS – Management accounting systems

MC – Management control

MCD – Management Control Department

MCS – Management control systems

MoF – Ministry of Finance

MoH – Ministry of Health

NHS – [British] National Health Service

NPM – New Public Management

OR – Operating room

PPS – Prospective payment systems

SNS – *Serviço Nacional de Saúde* (the Portuguese National Health Service)

UAGs – *Unidades Autónomas de Gestão* (name given at CHSJ to responsibility centers)

VRC – Variance ratio criterion

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Management Accounting: Exploring the Implementation of Alternative Methodologies in Hospital Settings

1. Introduction

1.1. The context

From the 1980s onwards there has been a global trend in the management of public services, including healthcare, known as New Public Management (NPM). NPM is most notably known for the introduction of private sector styles of management and the emphasis on management by objectives and results, but it virtually pervaded all aspects of management practice (Kurunmäki, 1999a; Kurunmäki *et al.*, 2003; Lægreid and Neby, 2016). All these reforms contributed to accentuate the accountability of hospital structures of management and decision, from the department directors and senior physicians to the board of directors (Jacobs *et al.*, 2004; Kurunmäki, 2004). This movement has been amplified by the introduction of an improved algorithm that succeeded in classifying all inpatients into a set of manageable classes – the Diagnosis-Related Groups (DRGs) – and the related Prospective Payment Systems (PPS). The latter are a new mechanism of paying hospitals for their production, which "triggered a shift in the balance of political and economic power between the providers of medical care (hospitals and physicians) and those who paid for it [*i.e.*, the government and central authorities]" (Mayes, 2007, p. 21). The enactment in the USA of the Medicare's PPS was rapidly followed by many other countries to the point that it is considered by Mayes as "the single most influential post-war innovation in medical financing" (Mayes, 2007, p. 21).

The objectives underlying the changes reported above were diverse and reflect a willingness of public authorities to exert more pressure on the field in order to get more control over the healthcare sector. In fact, factors like continuous improvements in health technologies and drugs, along with the ageing of the population, created a pressing need to contain the accelerated rise in costs (Llewellyn and Northcott, 2005; Abernethy *et al.*, 2007). Besides, the sector had long been characterized by the predominance of the medical profession as well as self-regulation, and changing the rules of the game could be an opportunity to challenge the medical power (Jacobs *et al.*, 2004; Jackson *et al.*, 2014).

Indeed, the dramatic changes in the healthcare sector just mentioned raised the interest on costing systems from governments, regulators, professions, and, also, Academia.

Prior to PPS, U. S. hospitals were reimbursed under a cost-plus system in relation to Medicare patients (Eldenburg *et al.*, 2017), while global budgets were the most usual funding model in Europe (Tan *et al.*, 2011). The main concerns in healthcare in both sides of the Atlantic were fairness of access and quality of care (Chua and Preston, 1994; Eldenburg *et al.*, 2017). For instance, in the British National Health Service (NHS), politicians have historically given more attention to the management of waiting lists during winter than to hospital budgets (Street and Dawson, 2002). As a result, patients tended to overuse care, while hospitals were not motivated to control costs, because they did not feel pressures to contain them, whether competitive, professional or regulatory (Eldenburg *et al.*, 2017). Since cost management was not a priority, there was little incentive for hospitals to invest in refined cost accounting systems (Street and Dawson, 2002; Eldenburg *et al.*, 2017). Instead, cost accounting systems in place reflected the reporting demands imposed by the regulators (Tan *et al.*, 2011; Eldenburg *et al.*, 2017).

The introduction of PPS transferred the operational and financial risks of providing care for healthcare units. This means that hospitals began to face the risk of financial default in case of cost overruns, a risk that was worsened by the existence of high fixed costs (Eldenburg *et al.*, 2017). The only way for hospitals to ensure their financial stability was to be efficient to the point that costs remained below the fixed fee received for treating patients (Eldenburg *et al.*, 2017). Such a new necessity of disaggregated information on costs led to a need for improved cost accounting systems (Chua and Preston, 1994; Ballantine *et al.*, 1998; Eldenburg *et al*., 2017).

Nevertheless, in comparison to mainstream business enterprises, changes in accounting systems in healthcare were shaped by a much more complex institutional environment (Cardinaels and Soderstrom, 2013). The existence of multiple stakeholders, such as the government and central authorities, physicians and hospital managers, with their own historical roles and objectives, turned the introduction of new accounting systems into much more than a technical issue. Arguing against reported inefficiencies (Kurunmäki, 1999b; 2004), governments pointed out accounting systems as means to better assist hospitals to control the spending of resources (Kurunmäki, 1999b) as well as to ground external financial reporting (Nyland *et al.*, 2009).

In fact, traditional costing systems were designed to control total expenditure and provide information for central authorities (Jackson *et al*., 2014), but new accounting systems were sought to go further and shed light on medical practices and patterns of resource consumption as well (Eldenburg *et al.*, 2010). Therefore, cost accounting in healthcare has grown in relation to the capacity of providing valuable information both for internal management (including the revision of clinical activity) and for assisting central authorities in assessing the hospitals' financial performance and establishing prices.

In recent years, more emphasis has been put on improved cost accounting systems, namely applying *activity-based costing* (ABC) and gradually changing the focus of estimates from hospital departments and mean patients to individual patients, trying to follow their stay at the hospital (Jackson, 2000; Chapman *et al.*, 2013; Raulinajtys-Grzybek, 2014). This approach is seen by some authors as a means of turning accounting closer to the medical profession, as it comes from inside the organization, *i.e.*, it is not imposed from the outside, and it is centered on patients to the point that it "follows patients across services, sites, and time" (Porter and Lee, 2013, p. 18).

These improved methodologies and ABC in particular, seem to be harder to implement in healthcare than in other industries (Cardinaels *et al.*, 2004). In fact, evidence points to low rates of adoption in hospitals (Eden *et al.*, 2006; Chapman and Kern, 2012), what, considering the potential value attributed to ABC, may be regarded as a "disappointing result" (Chapman and Kern, 2012, p. 24). Even though, a renewed attention is being given to cost accounting in healthcare throughout Europe: Denmark, Germany and the Netherlands have already rendered mandatory more detailed methodologies and are being followed by a similar movement in the British Isles, as English hospitals have been encouraged to participate in a national project on a volunteer basis and in Ireland a pilot project is being carried out as well (Blunt and Bardsley, 2012; Chapman *et al.*, 2013; Vogl, 2013).

In Portugal, the situation has known progresses and setbacks and it seems to be confusing at present. In 2007, the Ministry of Health (MoH) launched a national project aiming at implementing ABC in five hospitals, to which five others were added in the following year (Borges *et al.*, 2010; Picoito and Major, 2013). However, the project run with constant delays and it was abandoned by all hospitals involved. Some years later, around 2013/2014, the MoH brought cost accounting to the fore again. This time, there was less ambition, as the intention was only to improve the mandatory model, but after a sudden political change of plans, the government dropped the project and tried, with no success, to generalize SAP to all public hospitals. In turn, the Portuguese accounting regulator[2] issued in 2015 a norm[3] on cost accounting expressly recommending the implementation of ABC in hospital settings. Although a period of transition was foreseen in order to allow organizations to cope with the improved level of complexity, lessons eventually learnt from previous projects seemed not to have been taken into account when issuing the norm, as, to my knowledge, there seems to be no progress to this day.

Besides the national ABC project just mentioned, there was another single project, run in parallel but with total autonomy by a large teaching hospital in the North of the Country, an issue to which I now turn, while presenting the research objectives and questions.

[2] *Comissão de Normalização Contabilística*
[3] *Norma de Contabilidade Pública 27* (NCP 27).

1.2. Research objectives and questions

A few years ago, I have acknowledged that the *Hospital de São João* (HSJ), one of the largest public hospitals in Portugal, had successfully implemented an improved ABC cost accounting system and later stepped back, deciding to abandon this ambitious project. I have also known that the decision to implement the costing system had been taken internally, and that it had implied a considerable investment. "Why so?", it was the question that came to my mind.

A couple of exploratory interviews with the member of the board of directors with supervision over finance and accounting and with the chief of the Management Control Department (MCD) highlighted the complexity and the maintenance costs as the main reasons for the step back. But some additional information seemed to me to be worthwhile to understand, as HSJ seemed to decide to explore a way to process information for clinical and financial management other than management or cost accounting. In fact, it was referred the development of a sophisticated information system that gathered data from multiple internal sources and processed information for use by physicians, department directors and managers. To a certain extent, such an improved system seemed to have replaced ABC, and it also seemed to be highly estimated by all its users. In relation to management or cost accounting in particular, there was only the intention to perform the mandatory model in the best possible way, but even this intention was being postponed and the mandatory model was deployed as usual, with no particular attention or usefulness.

The case of HSJ seemed to me to be a rather interesting research theme, in some distinct but related ways. Namely, I identified the three research objectives that I am now going to outline.

The first research objective emerged from the reported difficulties to implement and maintain an ABC system. As complexity and high maintenance costs were the main reasons pointed out to abandon ABC at HSJ, my first objective was to evaluate whether a less demanding *mezzo* costing methodology could make use of data available in the improved information system and render comparable estimates. This first research objective comprised as well a comparison between the *mezzo* estimates and prices paid to HSJ, an issue worthy of relevance given the weight of inpatient care in the Hospital's total revenues.

Then, the role played by cost accounting, its relation to improved information systems, and its usefulness and acceptation, led to the second research objective: organizing cost estimates for some DRGs, as a means to better understand what happens inside each one and evaluating their consistency. At stake was, on the one side, the capacity to readdress cost accounting, changing the focus from the estimation of mean costs to the analysis of variance, and, on the other side, the ability to make it more friendly, understandable and actionable for physicians and managers, as it seemed to be the strength of the apparently *alternative and sophisticated* information system. In addition, evaluating the consistency of the DRGs could shed some light into the fairness of the funding system, a key issue for both hospitals and regulators.

Finally, as the third research objective, I was interested in trying to understand the reasons beneath the sequence of decisions made at HSJ about more sophisticated cost accounting systems, comprising the implementation of ABC, the step back, the thorough commitment with the *alternative* information system and the postponement of more care about the mandatory cost accounting system.

The previous means that the research questions of this thesis are as follows:

Question one: what characteristics can a *mezzo* cost accounting methodology assume and how similar are cost estimates it produces to those of ABC and prices paid to HSJ?

Question two: how can the analysis of variation within homogeneous single DRGs contribute to better clinical review, hospital management and hospital funding?

Question three: why was one of the most proactive enterprise hospitals in Portugal so hesitant in implementing sophisticated management accounting systems over time?

1.3. Research methodology

The HSJ is a large teaching hospital located in Porto, in the North of Portugal. It is one of the largest public hospitals in the Country, together with two other hospitals of the same level, located in Coimbra, a university town in the center of Portugal, and in the capital, Lisbon. When in 2003 the first set of corporate hospitals was created[4], only medium size hospitals were elected (Campos, 2003) and none of the mentioned large hospitals was considered. However, a few years later, in 2005, all of the first enterprise hospitals were converted from the initial "company" legal status into "corporate public entities", another legal status equally allowed by the legislation of 2002, and, this time, the HSJ was included[5]. The HSJ would also be subject to two further transformations from 2006 to the present day: in 2011 it was merged with the much smaller *Hospital de Valongo* to form the *Centro Hospitalar de São João* (CHSJ); and in 2018 it was renamed to its current denomination: *Centro Hospitalar Universitário de São João* (CHUSJ). For this reason, I will chronologically refer to HSJ, CHSJ or CHUSJ when I am analyzing subjects related to each period.

The CHUSJ serves directly part of the city of Porto and two municipalities of the Porto Metropolitan Area, but, through the referencing network, it is the final hospital for the whole Northern region. In 2018, it performed about 756 thousand clinical consultations, 255 thousand emergency episodes, 36.9 thousand programmed surgeries, 2.3 thousand deliveries and 16.1 thousand sessions of hospital day. It has 1.042 hospital beds and 39.912 discharges have been performed in 2018. The number of professionals almost reached 6 thousand and the value of services provided to the State, as the main buyer and funder, stayed above 306 million Euros in that year. The global value of services rendered was above 316 million Euros[6].

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[4] Corporate hospitals were created after the previous year's legislation, namely the Resolution of the Council of Ministers nr. 41/2002, and Law nr. 27/2002, November 8th. The latter introduced major changes to the "Health Basis Law" (Law nr. 48/90, August 24th), first issued in 1990. This legislation allowed new legal and statutory forms for public hospitals and enforced changes in funding and labor.
[5] Corporate hospitals were turned into corporate public entities through the *Decreto-Lei* nr. 93/2005, June 7th, and HSJ acquired this legal form through the *Decreto-Lei* nr. 233/2005, December 29th. This legislation had practical effects at the beginning of the following year.
[6] All data provided here was taken from the CHUSJ's Annual Report and Accounts.

In his literature review about managerialist studies, *i.e.*, research aiming to produce relevant insights for the management function, Malmi (2016) reviewed all papers presented in ten leading accounting journals over the 25 preceding years. Those studies were divided into two classes: non-interventionist and interventionist; the former were further classified into descriptive studies, conceptual prescriptive studies without empirical content, and studies suggesting frameworks, models, algorithms while not providing evidence of practical implementation of the suggested contributions; the latter comprised essentially action research and also studies applying a particular type of action research: the constructive approach.

Among all research strategies categorized above, I found the non-interventionist study of frameworks, models and algorithms particularly fitting to my research objectives and a powerful means to try to answer the first two research questions. As suggested in the classification by Malmi (2016), my objective was not to try to devise a particular framework, model or algorithm in order to be implemented by a particular hospital, in a consulting fashion. Rather, I aim to contribute to the literature by establishing comparisons between alternative costing methodologies not yet present in prior literature and to innovatively apply quantitative methodologies to costing estimates, bringing quantitative methodologies typical of other fields to the world of management accounting. In addition, by studying alternative costing methodologies and applying techniques imported from other fields of knowledge and with links to current improved IT infrastructures, I was following the suggestions for future research by Malmi (2016, p. 42), according to whom: "(…) digitalization, and its impact on business models and processes, should provide interesting research opportunities for managerially-oriented researchers" and "both interventionist and non-interventionist research strategies are needed to address contemporary issues".

Given the comprehensive nature of my research objectives, I understood that the integration of quantitative and qualitative methods was the best research strategy, as suggested by Brewerton and Millward (2001) and Mason (2002). Combining both types of methods could also be a way of acquiring a more holistic view on the implementation of improved accounting systems. I started by using a quantitative approach in the first two chapters, performing the calculations and the analysis required to answer the first and the second research questions, and I answer the third research question by employing a qualitative approach.

Once decided the research strategy, I then designed my research as a case study, having the CHUSJ and the implementation of more sophisticated management accounting systems as my focus. Literature identifies the case study as the most suitable approach to gain an in-depth and detailed view on a particular organization or on a theme under scrutiny (Bell, 1999; Brewerton and Millward, 2001; Yin, 2014). In addition, the case study may raise topics of interest that otherwise would not appear in the research agenda (Brewerton and Millward, 2001). In my case, the CHUSJ provided me with the opportunity to compare cost estimates obtained through ABC with a *mezzo* costing methodology, but the exploratory interviews recalled that "there is more to the picture than meets the eye" and enforced the need to understand the complex route followed by the creation of public enterprise hospitals in Portugal and their effects on the implementation of improved management accounting systems. When exploring such a route and effects, I employed an explanatory case study design (Ryan *et al.*, 2002; Scapens, 2004) to the understanding of management accounting and control changes in healthcare (Major *et al.*, 2018). I obtained and analyzed a narrative of events covering the period from the beginning of the corporatization of public hospitals in Portugal to the present date and applied it to the case of CHUSJ and its implementation of improved management accounting systems, in order to add further insights to the institutional theory and institutional logics in particular. However, the case study is "much more than a story about or a description of an event" (Bell, 1999, p. 10), implying the ability of the researcher to make use of different data sources, prepare the research design and data collection and ensure triangulation as a means to inform theoretical interpretation (Bell, 1999; Brewerton and Millward, 2001; Major *et al.*, 2018).

Research may benefit from the strategic use of different methods and data sources (Brewerton and Millward, 2001; Mason, 2002). Firstly, data and data sources may be used at early stages of the research project to strategically signal topics of research interest, while later on they are more useful to ensure triangulation. Secondly, different data and data sources may be required to answer each research question.

I started by conducting four exploratory interviews, two with members of the board of directors with supervision over the financial area, management accounting and IT, one with the MCD Director and the remaining one with the ABC project champion. These exploratory interviews provided me with a broader vision about the implementation of more sophisticated management accounting systems as a research subject and prepared the starting off of my empirical study. During the initial stages, data gathered were mainly information on the selected DRGs, patients classified into those DRGs, clinical procedures, resources used and costs. At my request, the MCD Director ran many successive queries to the information system in place at CHUSJ, a technologically advanced system based on business intelligence, and provided me with tens of thousands of entries, which I integrated and processed within my spreadsheet prepared for the *mezzo* costing solution that I devised for establishing the intended comparisons. On a regular basis, the advances in calculations were assessed and the transitory results were interpreted in meetings with the MCD Director. Similar interpretation efforts were maintained with professors of accounting within Academia. Data collection, calculations and the assessment of the estimates and comparisons lasted from October 2014 to March 2018. Estimates for DRGs with large populations were obtained from samples, and particular attention was given to ensure the representativeness of the samples, *i.e.*, the matching between populations and samples. The preparation of the clustering procedures began sometime earlier, by the end of 2017, but effectively running clustering techniques started in March 2018 and the validation and interpretation of results were accomplished in October 2018.

At later stages, data were mainly collected from documents and, again, interviews, this time under the format of semi-structured interviews. Documents gathered outside the CHUSJ corresponded to several reports and presentations prepared by the *Unidade de Missão*, an entity created to centralize the corporatization process on behalf of the MoH; a report issued in 2006 by a Commission created to assess the performance of the initial corporate hospitals; a two-volume report issued by the *Tribunal de Contas* (Audit Court) in 2011; major laws which framed the evolution of the "enterprise hospital" in Portugal; Accounting Norm nr. 27, related to Management Accounting in the Public Sector; *Sistema de Normalização Contabilística para Administrações Públicas – SNC-AP*, concerning Financial Accounting in the Public Sector; articles in technical publications related to healthcare; and, finally, interviews given to the media by members of the government and also by some of my own interviewees as a means to prepare the script for the semi-structured interviews; internal documents corresponded to annual reports and accounts, as well as annual contracts established with the MoH.

Exploratory interviews along with the initial literature review allowed me to realize that the attempts made by the CHUSJ and the MoH to implement more sophisticated management accounting systems occurred within a particularly complex context. I also realized the need to obtain a broad and integrated view on the reasons that may trigger the decisions to take ambitious and risky steps ahead, but may as well pose obstacles to these. In that sense, I tried to get access to people with a broad understanding of the process, either at CHUSJ or at the broader national level, through distinct ties to both settings. Literature on methodologies reports the unrivaled capacity of interviews to get insights about situations of particular complexity (Brewerton and Millward, 2001; Mason, 2002; Yin, 2014). Compared to other methodologies, such as surveys or narratives, face to face interviews leave the researcher with the opportunity to witness and interpret the reactions of the interviewees and the greater or lesser attention or emphasis given to each subject under analysis. Semi-structured interviews, specifically, were especially useful for my research objectives, as they allowed me to prepare in advance specific sets of questions for each interviewee, covering the subjects which I found of particular importance over prior research steps, but also left space for unforeseen major topics to emerge during the conversation and reflect both the experience and vision of the interviewee (Bell, 1999; Mason, 2002). This methodology served as well as a means to allow triangulation, either between distinct methodologies, *i.e.*, documental analysis and interviews, or between the content of the interviews, and, in that way, to improve the validity and reliability of the gathered data (Mason, 2002; Yin, 2014; Major *et al.*, 2018).

Consequently, along with a set of questions specifically envisaged for each interviewee, regarding his/her background and link to healthcare, some questions were commonly presented to different interviewees, especially if that could assist on triangulation between visions conveyed by people located at a more operational level and others with political or supervisory power. Information obtained during the interviews was sometimes used to fine-tune the script already prepared for subsequent interviews, especially when new and unforeseen issues came to the fore, calling for triangulation with information to be obtained from other interviewees with distinct functions in healthcare, or with an informed view built from outside the sector. Generally, I started the interviews by generic questions and then I focused on to the specific area of intervention/knowledge of each interviewee. Sometimes I let the conversation flow in a relatively free way and I changed the order of the prepared questions whenever the conversation led me to a point that I intended to launch later on. I noticed that the interviewees raised many subjects by their own initiative, which reveals true interest in management accounting sophistication and the acknowledgement of the importance of management accounting for a better functioning of healthcare as a whole.

To define the number and distribution of the interviews, I based myself on the example presented by Flick (2002) and on the considerations above about the need to try to capture the understanding of key players acting locally and globally in healthcare. Interviews were performed, in this order, with the Chairman, the Member of the board in charge of the financial area, the MCD Director (all within CHSJ), one Academic, the Former Assistant Secretary of State for Health, another Academic, the President of the Association of Private Hospitalization and the President of the Central Authority for Health Systems. The eight interviews were conducted from the October 29th 2018 to February 22nd 2019, and lasted from 46 minutes to almost 2 hours and a half, representing over 12 hours in total and about 1 hour and a half on average. All interviews were tape recorded and fully transcribed, to help reliability and triangulation, providing information that I will use mostly throughout Chapter Three.

1.4. Structure of the thesis

The thesis is organized as follows: after this Introduction, I will compare in Chapter One two alternative costing systems for a set of DRGs, the first one based on ABC and the second one corresponding to a less demanding *mezzo* methodology; I will also compare estimates from both costing systems with prices set for that year. At stake is the first research question outlined above. In Chapter Two, I move to the second research question, by applying cluster analysis to cost estimates obtained through the *mezzo* methodology proposed in the previous chapter, in order to render those estimates more helpful for reviewing clinical activity, managing hospitals and establishing fair prices. In Chapter Three, I will discuss factors which led to the decision to quit the ABC projects, either at CHSJ or at the national level, and analyze progresses and setbacks on the sophistication of management accounting systems in healthcare and in CHSJ in particular, to the point that this proactive and dynamic Hospital decided to continuously invest in the creation of a modern and sophisticated management tool that to some extent replaced management accounting. The thesis ends with a section on the main conclusions, limitations and suggestions for future research.

Chapter One

Costing Systems in Hospital Settings: Testing Alternative Methodologies

1. Introduction

Continuous rising costs led governments in the Western world to try both to modernize and tighten the control over public services through the introduction of private-like management principles. In healthcare, most notably, a far-reaching advance has been obtained in relation to the capacity to better classify and put a price on services rendered by hospitals. Within this new context, cost accounting achieved a higher importance both for the hospitals – which could better manage costs and retain the earnings – and central authorities – that acquired a better understanding on hospital costs in order to establish prices.

Alternative costing methodologies have been presented and compared in the literature, and a particular one that estimates costs for individual patients relying on their actual consumption of resources in terms of quantities and prices emerged as *the gold standard*. Even though, as it is hard to implement and maintain, this methodology has known setbacks in many countries, including Portugal. For this reason, and aware of a costing exercise undertaken by a large Portuguese hospital using ABC and considering individual patients as final cost objects, *i.e.*, a methodology that fits the definition of *the gold standard*, I will compare in this Chapter those estimates with the ones obtained through an alternative less demanding *mezzo* methodology, that combines the ability to directly assign the cost of drugs, examinations and other components with large impact on total costs to individual patients – as in ABC –, with other components obtained from the hospital's annual accounts and assigned to individual patients based on inpatient stay. I will also compare the estimates with prices paid to the hospital. In addition, as the *mezzo* methodology preserves the capacity to attach cost estimates to individual patients, it may be as well a useful tool for reviewing the clinical activity and identify deviations from intended practices, an issue to which I will turn on Chapter Two.

I will start this Chapter with a brief historical reconstitution of management reforms in healthcare, as they have impact on the evolution of cost accounting methodologies in this sector. After, I will refer how a sophisticated algorithm managed to classify all inpatient care into a set of treatment classes (like a product line of a firm) and allowed for the establishment of a "list of prices" for paying hospitals for those services. Then, I will turn to costing methodologies in particular and present previous comparisons in the literature. After summarizing ABC and explaining the proposed *mezzo* methodology I will present the estimates and analyze the results. Finally, I will end the Chapter with a discussion on the comparison of estimates and how it might help on improving financial/clinical management and hospital funding.

2. The importance of the health sector and "the cost control problem"

Healthcare costs are consistently increasing in high-income countries (Abernethy *et al.*, 2007; Raulinajtys-Grzybek, 2014) thus becoming a major concern for politicians and hospital managers. Since the media always give much attention to healthcare subjects, they help to generalize concerns about cost containment in the sector and put even more pressure, especially over politicians, in order to control the rate of growth of the expenditures (Eden *et al.*, 2006).

Healthcare is often presented as one of the most dynamic and changing industries (Llewellyn and Northcott, 2005; Hyvönen and Järvinen, 2006). Uninterrupted advances in medical technologies and genetics extend the array of treatment solutions and promote people's expectations about more and better care (Llewellyn and Northcott, 2005; Abernethy *et al.*, 2007).

However, besides advances in technology, other factors contribute as well to make this sector particularly complex. Compared to other industries, within healthcare there are more stakeholders playing decisive roles, making the institutional environment and the hospital governance more complex (Cardinaels and Soderstrom, 2013). To make things harder, that environment is highly politicized (Abernethy *et al.*, 2007) and the goals of those stakeholders are often conflicting.

Governments in many developed countries such as the USA, Australia, Germany, Finland, UK and France introduced a series of reforms from the 1980s onwards to tackle the referred need to contain costs. On the one hand, those reforms were driven by the will to both better allocate and manage resources and to increase the accountability of hospitals and primary care units (Abernethy *et al.*, 2007) and, on the other hand, they were remarkably affected by the complex nature of this sector. I will briefly report them in the next section.

2.1. Numerous responses to the cost control problem with emphasis on management techniques and new funding mechanisms

The cost control problem induced numerous responses, including attempts to install private-sector like management techniques and new funding mechanisms based on "transferring risk" from central authorities to local providers.

By introducing private sector management practices and control mechanisms, governments sought to "modernize" the healthcare sector (Conrad and Uslu, 2012) and induce a transition from administrative to managerial culture (Kurunmäki, 1999b). I will summarize changes in management control in four groups: the internal reorganization of hospital units and the diffusion of economic concepts; the introduction of business oriented management control models; the benchmarking of hospital costs; and, finally, the infusion of managers with prior links to the private sector.

Hospitals have long been characterized by a high degree of professional self-governance, which hampered hospital boards and national authorities to evaluate the efficiency of resource usage and to interfere in complex operational processes managed by health professionals (Coombs, 1987; Abernethy and Stoelwinder, 1995; Kurunmäki, 1999a; b). In order to overcome these limitations, hospitals enforced the attributions of clinical departments, preserving clinical autonomy but inducing the accountability of the departments through decentralized budgeting mechanisms (Kurunmäki, 2004). Such a shift towards a more business type organization was accompanied by the diffusion of concepts of efficiency, accountability, economy and cost containment with the aims of leading physicians to link their activity to the costs incurred in resource consumption as well as engaging physicians and managers in dialogue (Coombs, 1987; Chua and Preston, 1994; Abernethy and Stoelwinder, 1995; Abernethy *et al.*, 2007).

New management practices required new models of performance measurement and particularly the balanced scorecard was welcomed by physicians (Ballantine *et al.*, 1998; Aidemark, 2001), due to its ability of combining financial indicators with other non-financial, related to patients and process outcomes.

Evidence shows that the costs of supposedly similar clinical activities vary clearly across hospitals (Northcott and Llewellyn, 2003; Llewellyn and Northcott, 2005). Despite problems of comparability resulting from differences about allocation methods, the release of information on hospital costs was regarded as a “visible standard against which institutions compare themselves” (Llewellyn and Northcott, 2005, p. 557). Thus, through benchmarking, hospital managers and governments could assess their relative efficiency and get information on best clinical practices and associated costs (Northcott and Llewellyn, 2003; Abernethy *et al.*, 2007; Conrad and Uslu, 2011).

Finally, following the introduction of private-sector like management practices, business managers entered public hospitals, both as members of the board and as accountants or other professions new to the public sector, such as the controller (Ballantine *et al.*, 1998; Cardinaels and Soderstrom, 2013). Besides contributing with their expertise to manage innovations, such movement meant to make health services “more commercially minded” (Ballantine *et al.*, 1998, p. 73), as well as to emphasize cost control and to attempt to force physicians to change (Broadbent *et al.*, 1991).

Nevertheless, reforms did not restrain to management techniques. In fact, one of the most notable and well documented reforms was the development and the subsequent diffusion of PPS, a funding system that established the payment to the hospitals for their actual production (Chua and Preston, 1994; Abernethy *et al.*, 2007; Pirson *et al.*, 2013). Prior to changes in hospital reimbursement, the roles of providing and funding healthcare were combined attributions of the state, but changes clearly distinguished between providing health services and paying for it. This shift is known as "the purchaser-provider split" (Cardinaels and Soderstrom, 2013) and transferred the financial risk of performing the economic activity of providing care from the state to organizations competing for "business" (Conrad and Uslu, 2012).

PPS replaced the traditional funding methods, like the fee-for service and global budgets, which were based on historical levels and were dependent on a negotiation process between health organizations and central authorities (Abernethy *et al.*, 2007; Geissler *et al.*, 2011). However, prospective systems require the ability of setting quantities and prices in advance for a large range of health services, and that was only possible after the creation of a new means of measuring the hospital's output, based on a statistical analysis of clinical activity, named "Diagnosis-Related Groups", or "DRGs". It introduced a new way of evidencing the hospitals' output, allowing for the measurement of output and cost "per line of service".

2.2. The problems of evidencing, understanding and managing the output of the hospital

Unlike traditional organizational settings where the definition of products and services was easy to do and understand, it was hard to monitor the resource usage during the production process within hospitals (Thompson *et al.*, 1979; Mateus, 2010). In fact, the decisions that, at the end, determine resource usage and profitability, like drug prescription and selection of treatment procedures, were up to physicians and were not made by managers (Thompson *et al.*, 1979; Fetter *et al.*, 1980; Geissler *et al.*, 2011).

Identifying and measuring the hospital activity was hard as a result of the diversity of both patients and clinical procedures (Northcott and Llewellyn, 2003). Since each patient was different from the others and received a particular combination of services, in theory the “product line” of a given hospital could be as large as the number of patients itself (Fetter *et al.*, 1980). Nevertheless, patients also shared demographic, diagnostic and therapeutic conditions and based on those similarities a research team of industrial engineers at Yale proposed a classification scheme that was able to group the entire range of patients into a set of classes (*i.e.*, the DRGs), simultaneously manageable and meaningful to physicians and other relevant professions related to hospitals, like managers, planners and regulators (Fetter *et al.*, 1980; Quentin *et al.*, 2011).

Making the hospital’s output understandable and manageable was a requiring step to track and assess the resource utilization. Since patients classified within which group were expected to have similar conditions, they were also expected to follow similar paths and make use of the same kind of resources. These features would allow the establishment of patterns of good practices, and monitoring systems in place would reveal exceptions and deviations from those practices (Fetter and Freeman, 1986; Urbano and Bentes, 1990; Samuel *et al.*, 2005).

By interacting with the clinical practice, DRGs could enhance further analysis in order to find out the reasons for variations in service utilization, treatment processes and outcome (Fetter *et al.*, 1980). Thus, DRGs could become a tool to assist physicians in reviewing their procedures and to provide managers with improved insights on deviations from the expected practices.

Recalling what I have stated earlier in this Chapter, reforms in healthcare throughout the 1980s and 1990s have been oriented both to control expenditures and to introduce greater accountability and a more efficient use of resources. Attaining such purposes would require national authorities to reduce the perceived ambiguity of healthcare objectives by overcoming the problems of measuring and comparing the outputs of health service providers (Kurunmäki, 2004).

Major changes were then introduced in competition and regulation (Kurunmäki *et al.*, 2003; Cardinaels and Soderstrom, 2013) and in particular the provider-purchaser split, together with the introduction of PPS, demanded extended information to inform prices for hospital funding (Abernethy *et al.*, 2007) as well as to establish effective comparisons between hospitals (Fetter *et al.*, 1980).

In fact, the new funding method employed the DRG algorithm based on cost and volume to allocate national resources (Abernethy *et al.*, 2007). The operation mode of the DRG mechanism was the following: first of all, all inpatient costs were divided by the global number of patients, calculating a "mean" national patient cost; secondly, patients were then classified into disease categories, according to the DRG classification scheme; in step three, a cost weight was assigned to each category, establishing a "price" for the different "product lines" (Fetter and Freeman, 1986, and Samuel *et al.*, 2005, as cited in Abernethy *et al.*, 2007); finally, the volume of funding resulted from the mean national value multiplied by the hospital global cost weight multiplied by the number of patients.

National authorities recognized that traditional funding methods had harmful effects and unintended consequences. In the United States, the fee-for service was responsible for the majority of the resources allocated to hospitals (Geissler *et al.*, 2011). Fees were calculated using data from previous years (therefore named "retrospective payment") and should ideally reflect the actual individual patient costs. As fee-for-service payment covers costs (even of those more demanding and expensive pathologies) and may contain a profit margin, it functions as an incentive to increase production and solve the patients' needs, but, on the other hand, it may lead to the provision of unnecessary services. In contrast, global budgets were the common funding mechanism in Europe (Geissler *et al.*, 2011; Tan *et al.*, 2011). Central funding authorities and hospitals agreed on a given payment for a certain level of activity, commonly measured in terms of bed days or number of cases, for the upcoming year. This mechanism is administratively simpler than fee-for-service, but has the risk of leading hospitals to reduce the number of cases, or, at least, the complexity of the cases, in order to balance their financial situation by receiving the global amount of money fixed at start and containing expenses.

Having in mind such harmful effects, policy makers were attracted by the idea of paying hospitals through DRGs (Geissler *et al.*, 2011). While implying a complex process of gathering and processing large quantities of data, DRG-based payment systems could provide "incentives to increase the number of cases treated and to reduce the number of services per case" (Geissler *et al.*, 2011, p. 15). Stated in other words, each individual hospital was a "price taker", without the capacity to interfere in the price definition, but it could change its processes and contain its costs, saving the difference between the established price and its actual costs, or avoiding costs higher than the prices (Berki, 1983; Chua and Preston, 1994).

Likewise, the traditional metrics such as the length of stay, global costs and death rates were not accurate enough to ground national comparisons, because hospitals with a higher proportion of complex cases would tend to have worse indicators. Within this context, direct comparisons were not appropriate and, again, the DRG relative scale could better capture the complexity of care delivered by the different hospitals and the inherent costs (Fetter *et al.*, 1980; Mateus, 2010).

Summing up this Section, DRGs have been introduced over time either to increase the transparency of hospital production (*i.e.*, to help in the management function), or to pay hospitals accordingly to their output. Geissler *et al*. (2011) summarizes the introduction of DRGs in Europe and compares the main purposes at start and in the year 2010. It is interesting to notice that early adopters, such as Finland and Sweden, were especially focused on performance measurement, while countries that introduced DRGs later (such as Germany and the Netherlands) intended to use them mainly as a basis for paying hospitals.

3. Costing methodologies

The "new business-like operational culture" (Kurunmäki, 2004, p.330) introduced in healthcare created the need for improved cost accounting systems (Cardinaels and Soderstrom, 2013), which, in turn, required a systematic and more detailed recording of costs, revenues and prices per line of services (Kurunmäki, 2004).

At this point, both the will to control the overall expenditures in healthcare, *i.e.*, the costs at the macro level, and the introduction of new accounting and governance structures at the micro level, converged to the need to design and implement improved costing systems. The existing costing and budgetary systems had been designed essentially to control total expenditure and provide data for central authorities and should be replaced by systems designed to assist management tasks (Kurunmäki, 2004). Such new accounting systems would benefit from improved management information capabilities (Lehtonen, 2007) and would tie medical decisions to delegated financial accountability (Kurunmäki, 2004). However, a new problem emerged, since the design of the new cost accounting systems and practical issues like the choice of more specific criteria for tracking the resource allocation were not straightforward.

3.1. Alternative approaches to cost measuring

Broadly speaking, the available approaches to estimate the resource consumption may vary from the direct measurement of patient-specific resource utilization to the cost assignment based on national administrative databases (Mogyorosy and Smith, 2005).

Albeit there is no consensus in labeling the methodologies to estimate inpatient costs (cf., for instance, Jackson, 2000, and Tan *et al.*, 2009b), two broad and opposed approaches are usually presented: top-down or gross costing and bottom-up or micro costing (Mogyorosy and Smith, 2005; Chapman *et al.*, 2013). In the former, cost objects are defined at a highly aggregated level, such as inpatient days, and are valued from comprehensive sources, such as annual accounts (Tan *et al.*, 2009b), while in the latter costs are obtained after the identification and measurement of all resource items used to provide services (Mogyorosy and Smith, 2005) and are valued from local sources.

The selection of the appropriate methodology depends, first of all, on the purposes of the institution responsible for carrying out the costing exercise (Chapko *et al.*, 2009). For instance, gross accounting delivers estimates measuring relatively large resource units, such as acute hospital inpatient care episode (Mogyorosy and Smith, 2005; Tan *et al.*, 2009b), but they may be accurate enough for generating national estimates to establish prices per DRG.

Gross accounting methodologies are easier to implement and less expensive to maintain. For instance, *per diem* costs can be readily estimated from mandatory hospital reports and aggregated national databanks (Mogyorosy and Smith, 2005; Tan *et al.*, 2009b). However, by doing so, these methodologies assign the same daily cost to each patient, regardless of his/her conditions and patterns of care (Jackson, 2000). Stated in other words, these methodologies rely on some assumptions, like the lack of practice variation among clinicians and hospitals (Negrini *et al.*, 2004), which can have considerable impact on the accuracy of the unit cost estimates. In addition, the accuracy and reliability of the estimates depend on the quality of secondary data (Luce, 1996, Muenning, 2002, and Drummond, 2005; as cited in Mogyorosy and Smith, 2005).

By contrast, micro costing methodologies start by identifying services provided to a particular patient and, afterwards, measure and cost the resources used to deliver those services (Clement *et al.*, 2009; Chapman *et al.*, 2013). These methodologies record and assign direct costs such as costs of drugs, other materials and staff time to particular patients, trying to establish cause-effect relations between patients and resources.

While measuring the hospital's output at the patient or a specific service level, micro costing can get closer to the actual consumption of resources and can capture the variability of patterns of patient care, enabling "clinical and other decision-makers to understand whether differences in treatment costs arose from variations in unit costs or from variation in service intensity" (Jackson, 2000, p. 237). For this reason, it is considered as the appropriate approach in the provider's perspective, and are often reported as "the gold standard" (Jackson, 2001; Clement *et al.*, 2009; Tan *et al.*, 2009b).

Nevertheless, micro costing demands highly detailed information and this is precisely the main reason stressed in the literature to hamper its generalization to most healthcare providers (Larsen and Skjoldborg, 2004; Vogl, 2012). On the one hand, micro costing implies the understanding of the production processes while, on the other hand, it requires a complex work of identifying the service components (such as drugs, materials and staff time), as well as quantifying and costing the units used to fulfill the service.

As we have seen, top-down or gross costing and bottom-up or micro costing, are opposed approaches to estimate costs. Graphically, they can be depicted as follows:

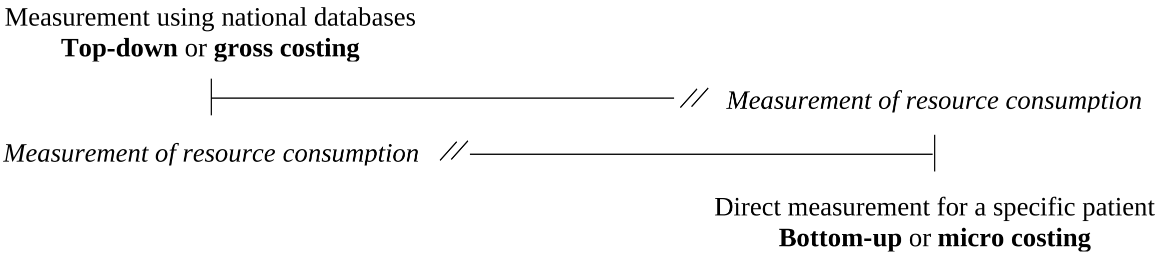

Figure 1 Top-down or gross costing vs. bottom-up or micro costing methodologies

However, for practical reasons, such as access to data and timeliness of the costing exercise, as well as the compromise between the cost of obtaining cost estimates and the quality of the cost information produced (Mogyorosy and Smith, 2005; Chapman *et al.*, 2013), those approaches are frequently used in combination. Accordingly, the scheme in Figure 1 must be readdressed like in Figure 2:

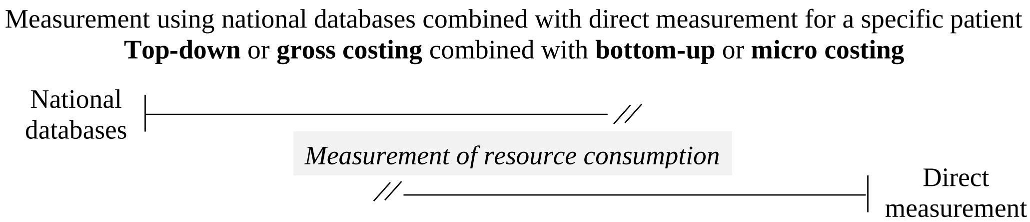

Figure 2 Combination of top-down or gross costing and bottom-up or micro costing methodologies

Tan *et al.* (2009b; 2011) propose an extended organization of methodologies, in part distinctive from the most common dual classification gross costing vs. micro costing. Their organization starts by considering two levels of analysis: the first one is related to the quantification of units of resource utilization (or in other word, the identification of cost components), whereas the second one refers to the valuation of those quantities (i.e., attaching monetary value to resource use). The first level distinguishes between gross costing and micro costing, while the second level contrasts top-down to bottom-up approaches. Gross costing methods are characterized by defining cost components at a highly aggregated level, such as inpatient days, while micro costing methods define cost components at the most detailed level. In turn, top-down approaches call for values from comprehensive sources, like annual accounts, in contrast with bottom-up ones, which identify the resources directly employed in treating patients.

Combining both levels in a matrix format as in Figure 3 below, we get the following set of methodologies: top-down micro costing, top-down gross costing, bottom-up gross costing and bottom-up micro costing.

Resource use

– Accuracy +

Unit costs Accuracy

–	Top-down gross costing	Top-down micro costing
+	Bottom-up gross costing	Bottom-up micro costing

Figure 3 Methodology matrix – the level of accuracy at the identification and valuation of cost components

Source: Tan et al. *(2009b)*

Briefly explaining the matrix in Figure 3, bottom-up micro costing methods identify resource use at the patient-specific level and rely on hospital specific unit costs; top-down micro costing methods still identify resource use at the patient-specific level but appeals to national tariffs for unit costs; in top-down gross costing methods, resource use is based on inpatient days and unit costs are based on national tariffs; at last, in bottom-up gross costing methods, resource use is based on inpatient days and unit costs are hospital-specific (Tan *et al.*, 2009b).

The proposed methodologies differ in relation to the level of accuracy in allocating costs to cost objects and the combination of bottom-up with micro costing methods is considered the gold standard (Tan *et al.*, 2009b; 2011).

Following remarkable improvements in hospital information systems, a particular micro costing methodology known as "clinical costing" or "patient level costing" has emerged (Jackson, 2000; Blunt and Bardsley, 2012; Vogl, 2012).

Advances in information systems came from the capacity of integrating data from administrative databases, medical devices and specialty level applications, such as lab and operating rooms. When individual patients are admitted, they receive a record number and all kind of clinical data is "tagged" to that number (Jackson, 2001). For instance, each lab test or X-ray, or the time of anesthesia and surgery, is attached to the patient's file and identify the intermediate products or services used by that individual patient. By summing the costs of all these intermediate products and services, the cost per individual patient is obtained.

Clinical costing provides information on costs for individual patients, which is at a highly "granular" level (Chapman *et al.*, 2013). Starting from this information, it is possible to obtain costs at the DRG-level or at the department-level. However, there is an important distinction related to estimates at DRG-level obtained through clinical costing and from top-down methodologies, as, in the former, DRG costs is equal to the average of individual patients, while, in the latter, all patients are assumed to have the same average cost (Jackson, 2000).

Therefore, clinical costing has the major advantage of preserving information about the variability inherent to individual clinical practices and can be used in order to identify different patterns of care and highlight, for instance, patterns of use of high-cost diagnostic tests (Jackson, 2000; Chapman *et al.*, 2013).

3.2. Comparison of cost estimates in the literature

Comparisons between top-down and bottom-up approaches to generate cost estimates have been presented in the literature.

Chapko *et al.* (2009) compared mean cost estimates for patients who have received care from the US Department of Veterans Affairs (VA) in 2001, taking advantage of the two comprehensive nationwide costing systems in place. The top-down system started by the total VA budget and assigned it to specific services through a series of weighting systems, whereas the ABC-type bottom-up system started by estimating the cost of individual services, such as lab tests and acute hospital day, and then aggregated the cost of services provided to individual patients in order to get the cost estimates.

Making use of the classification proposed by Tan *et al.* (2009b) and presented in Figure 3, Chapko *et al.* (2009) were comparing top-down gross costing with bottom-up micro costing, as represented bellow in Figure 4.

The authors found some agreement between the estimates obtained through the two methodologies (for instance, the estimates for DRG *Chronic obstructive pulmonary disease* reached $8,144 and $7,221, using top-down and bottom-up, respectively). In accordance with those findings, the authors considered that when variance was not relevant for the costing exercise, as is the case of central authorities, then top-down approaches might be more appropriate. Conversely, when knowing variation among patients is at stake, as happens in relation to managers in charge of healthcare facilities, then a bottom-up approach would be preferable.

Another comparison among different costing methodologies has been made by Larsen and Skjoldborg (2004). This time, there were three methodologies under comparison: the charge system, the DRG system and ABC. The charge system corresponds to the traditional allocation method, based on annual accounts produced as well for external report. Since the main objective is to evaluate costs in confront with approved budgets, information on costs is mainly concerned with organizational units, instead of specific patients. Consequently, costs are first attributed to departments, through an iterative process, and are later divided by the department’s number of actual bed days during the year. The DRG system takes into consideration national data on costs and prices. All calculations are performed by the MoH, which establishes a base tariff that aims to reflect the average national costs for treating inpatients. This average value is then multiplied by the weight attributed to each DRG in order to set prices. One should notice that this methodology is similar to the one used in Portugal. Finally, ABC required an increasingly detailed breakdown of activities within departments. The authors faced highly aggregated information on costs, focused on departments. While values for costly materials were available, labor, equipment and inventories required the further use of questionnaires and interviews to base cost estimates.

Transferring these methodologies into the matrix by Tan *et al.* (2009b), we are now highlighting three quadrants: top-down gross costing (DRG), bottom-up gross costing (charge) and bottom-up micro costing (ABC), as described in Figure 4 bellow.

As the study considered three subsets of patients, it gets harder to summarize results. However, to some extent, estimates were relatively similar, with the exception of DRG estimates for subset one, clearly under the two other ones, as well as DRG estimates for subset two, this time above the other ones. The period of hospitalization affected the results: for short periods, ABC produced relatively higher cost estimates, on account of several activities which were only performed once, irrespectively of shorter or longer stays. The comparison might as well been affected by the ABC system design, having many cost categories indexed to bed days. Finally, the authors also stressed the contribution of labor in total cost estimates and called attention for the purpose of costing when deciding which methodology to employ.

A third research project on comparing costs has been carried out by Clement *et al.* (2009). This study used data from Alberta, Canada, which allowed the researchers to employ three distinct costing methods: micro costing, a method based on the Refined-Grouper Number (RGN) and a third one based on the Case-Mix Grouper (CMG). Contrarily to the previous studies presented in this review of costing comparisons, the central authority used micro costing data to support calculations. Therefore, the average costs produced for both RGN and CMG, two classification schemes similar to the DRG system, were based on micro costing methods in such a way that the comparison involves only micro costing approaches. This time, using the matrix by Tan *et al.* (2009b), the comparisons are fully aligned at the right quadrants, like in Figure 4 bellow.

Interestingly, this research has been possible because a single hospital in the Calgary Health Region followed a complete micro costing methodology.

The three methodologies produced substantially different cost estimates. Micro costing was responsible for both the highest costs and the widest range of values.

A slightly different approach has been taken by Mishra *et al.* (2001) when comparing cost estimates for DRGs covering heart transplantation, lung transplantation and thoracotomy. Like Larsen and Skjoldborg (2004), one term of the comparison corresponded to the values established by the DRG system in place, in this case, in Norway; but the other term did not strictly match a single quadrant in the matrix proposed by Tan *et al.* (2009b). In fact, the alternative method studied by the authors could partially be labeled as bottom-up micro costing, because a large proportion of costs where directly allocated to specific patients. These costs included drugs and materials as long as they exceeded USD 14 a day and, in addition, a refined method to relate costs with physicians and nurses in the wards to specific patients was created. This method worked as follows: four classes of patients have been created reflecting the intensity of care (or the need for support from physicians and nurses) and the standard number of professionals together with time involved in care procedures were related to each category through time and motion studies. Costs with the operation theater were also allocated to specific patients on the basis of time and the number of professionals involved. However, there was still a relevant part of costs apportioned to patients on regard of inpatient discharges, like costs with administrative sections, and inpatient days, such as costs with diagnostics, meals and sterilization.

Recovering the matrix by Tan *et al.* (2009b), this time the configuration is slightly different from the previous representations, as also shown in Figure 4 bellow.

The bottom-up method employed was not supported on ABC, but, perhaps on account of the narrow number of patients included in the study, patients were closely monitored, time and motion studies have been used to consider the intensity of resource utilization (especially in regard of physicians and nurses in the wards), and costs have been related to specific patients with a high level of detail.

The authors found a correspondence between median costs in the study and estimates based on Norwegian DRG weights and, accordingly, they concluded that DRG weights used for heart and lung transplantation were well funded. Nevertheless, the authors stressed the superior capacity of the bottom-up method, regarding its ability to analyze variance, but also recognized the high costs of fully implementing bottom-up methods in hospitals.

Finally, I will refer to the comparison of methodologies performed by Tan *et al.* (2009b). This study used data from representative general hospitals in the Netherlands to compare three methodologies, bottom-up micro costing, top-down micro costing and bottom-up gross costing, in relation to appendectomy, normal delivery, stroke and acute myocardial infarction.

The bottom-up micro costing method was implemented using samples for all pathologies under study in 15 hospitals for the year 2005. Information on resource use by individual patients was available as well as on hospitals' unit costs for those resources. The researchers obtained unit costs for diagnostics and devices from hospital financial databases, for drugs from hospital pharmacies and direct labor costs for physicians and nurses were calculated as standardized costs per day or minute. Costs for hotel and nutrition, indirect time of nurses and device use was apportioned to patients based on inpatient days, while overheads (general expenses, administration and registration, energy, maintenance, insurance and personnel costs of support departments) were added to direct costs using a mark-up percentage.

In turn, the top-down micro costing was conducted in 23 hospitals for the year 2004. Contrarily to the first methodology, this time information on resource utilization was only available for average patients and unit costs were based on national tariffs. Overheads were first allocated to all departments and afterwards redistributed using weights such as m^2 and staff full time units.

At last, bottom-up gross costing estimates were produced using data from 25 hospitals for the year 2007. Direct and indirect costs were taken from hospitals' annual accounts and divided by the annual number of inpatient days to calculate costs per inpatient day. These costs were afterwards multiplied by the length of stay (LoS) to determine mean costs per patient.

Considering, once again, the matrix by Tan *et al.* (2009b), the comparison involved three quadrants, as shown in Figure 4 below. Nevertheless, Tan *et al.* framed their research problem in a more interesting way: to what extent could cost components be removed from the *golden* bottom-up micro costing methodology and be replaced by components obtained thorough alternative top-down micro costing and bottom-up gross costing and still provide reliable estimates?

The authors found that by *individually* (emphasis in the original) replacing the cost components of the bottom-up micro costing with cost components of the top-down micro costing *fairly reliable* total cost estimates were obtained. However, they stressed the risk of weakening the results if the substitution affects cost components with a large impact on total costs, such as in the research cases, labor in normal delivery as well as inpatient stay in appendectomy and stroke. Still, if two or three cost components were *simultaneously* (emphasis in the original) replaced, results would be comparable.

Conversely, the authors argue that bottom-up gross costing might be a weak alternative to bottom-up micro costing, especially in the presence of wide cost variation among patients. In addition, their study found wide cost variation for patients with long LoS, as happened for stroke (with a mean LoS of 9.2 days) and acute myocardial infarction (5.7). In both cases, total cost estimates using bottom-up gross costing were twice the estimates generated through bottom-up micro costing. On the contrary, in relation to the only case with a low LoS (normal delivery, with only 0.8 days), the estimates did not differ significantly.

In Figure 4 bellow I readdress all the comparisons which I have just summarized, framing the approaches into the matrix proposed by Tan *et al.* (2009b), first shown in Figure 3.

As I have stated, the authors of all the studies described above classified the methodologies in comparison under a single dual perspective: top down or gross costing on one side and bottom-up or micro costing on the other one. However, I presented the studies in reference to the extended classification by Tan *et al*. (2009b), which, as we have seen, encompasses four classes of methods, instead of the commonly used two ones. I consider that Figure 4 bellow can make the reclassification easier to understand.

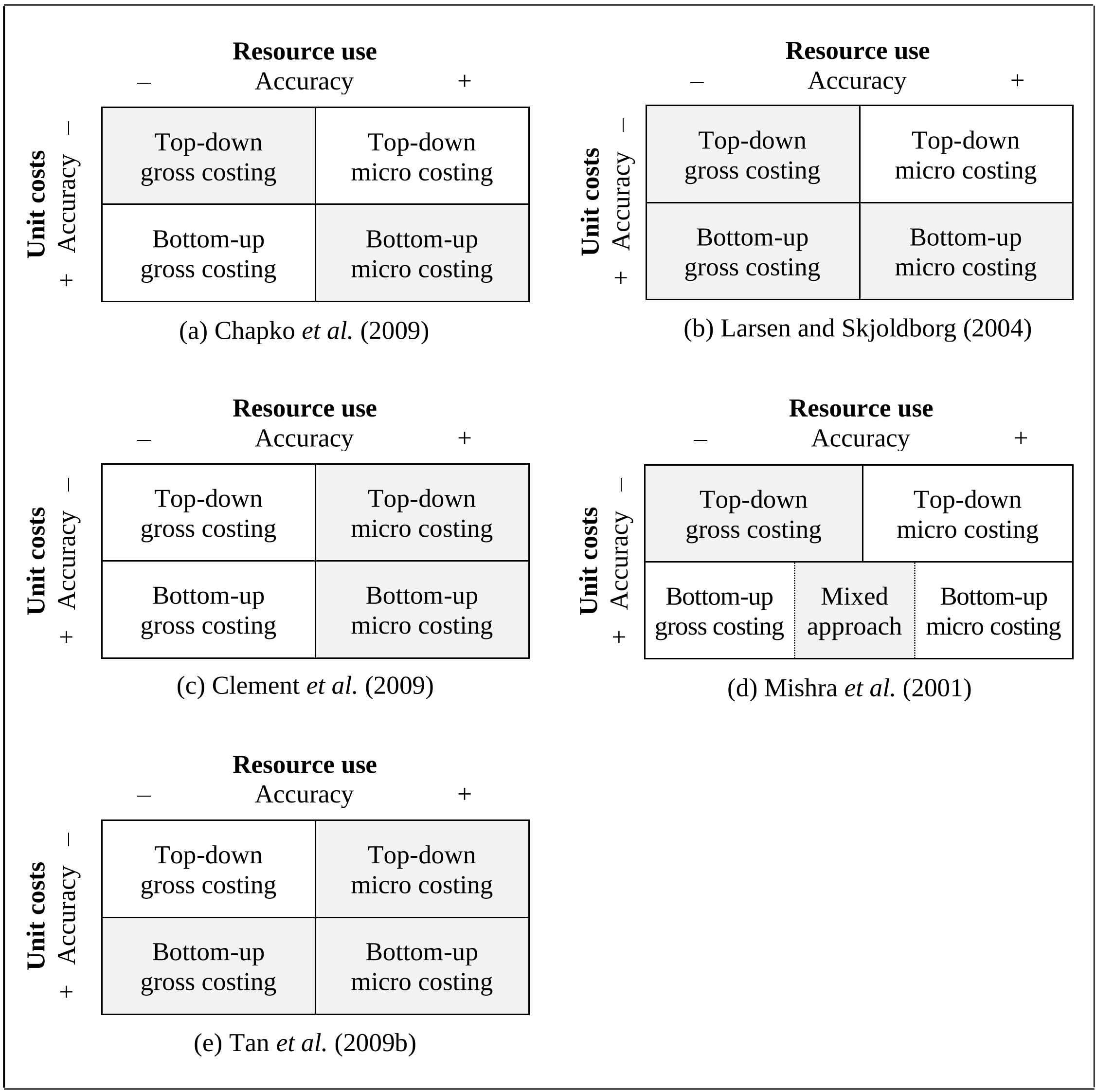

Figure 4 Framing the comparison of methodologies by Chapko *et al.* (2009), Larsen and Skjoldborg (2004), Clement *et al.*, (2009), Mishra *et al.* (2001) and Tan *et al.* (2009b) accordingly to the classification proposed by Tan *et al.* (2009b)

In relation to other comparisons in the literature, the approach by Tan *et al.* is innovative for two reasons: first, the comparison is established between a preferred method and the results obtained when some features of that method are dropped; and second, findings suggest that bottom-up micro costing provides more accurate results when combined with top-down micro costing than combined with bottom-up gross costing.

Stated in other words, it is possible to devise a mixed approach, combining bottom-up micro costing and top down micro costing, which can equally been used when problems with the inner complexity and high costs of bottom-up micro costing, limitations in IT infrastructures and unavailability of data hamper the utilization of strict bottom-up micro costing methods.

The right quadrants in the matrix in Figure 4 (e) may be redrawn in order to express the findings of Tan *et al.* (2009b), like in Figure 5 below:

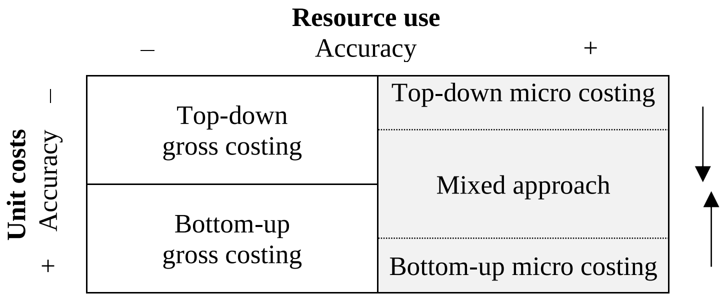

Figure 5 The mixed approach introduced by Tan *et al.* (2009b), resulting from replacing cost components of bottom-up micro costing by components of top-down micro costing

After summarizing comparisons of methodologies in the literature, I am now entering the field work and test alternative methodologies on estimates for individual patients in a Portuguese public hospital, using data for the year 2009.

4. Empirical analysis: testing alternative methodologies to estimate inpatient costs

I have tested two alternative clinical costing methodologies, the first one a *mezzo* solution combining bottom-up micro costing and bottom-up gross costing and the other one using

ABC, to estimate costs of inpatients grouped into the following six DRGs: stroke (14); chronic obstructive pulmonary disease (88); appendectomy with major complicated diagnosis, with complications and co morbidities (164); appendectomy with major complicated diagnosis, without complications and co morbidities (165); appendectomy without major complicated diagnosis, with complications and co morbidities (166); appendectomy without major complicated diagnosis, without complications and co morbidities (167). Numbers in brackets correspond to the index in the Portuguese DRG classification scheme and will make references easier in the text.

These DRGs have been chosen for three main reasons. In the first place, in order to cover both medical and surgical DRGs. In the second place, they have been included in previous studies (*e.g.*, Tan *et al.*, 2009a; b; Chapko *et al.*, 2009) and results can eventually be considered in international comparisons in future research. In the third place and most importantly, these DRGs rank among the most common ones, both at CHUSH and in the Country, therefore, with major implications for management and funding.

In relation to the first methodology, I performed all calculations and estimates. Instead, the costing exercise using ABC has been undertaken by the hospital itself, with technical support from Deloitte Consulting. All details on cost estimates, as well as on methodological issues, were transmitted to me by the board of directors, the director of the management accounting and control department and the hospital project team leader, during several meetings. In addition, a paper by Borges *et al.* (2010), addressing a similar project launched in parallel by the MoH in partnership with the same consulting company, has been considered in order to complete the methodological analysis.

In the following sections, I will present an in-depth description of the two methodologies under comparison. Nevertheless, since both methodologies use certain elements drawn from annual cost accounts of the hospital, I will start by introducing the cost accounting model mandatory to Portuguese public hospitals.

4.1. The Portuguese cost accounting mandatory model

The mandatory model for Portuguese public hospitals relies on the cost center allocation framework, which establishes that costs must be apportioned to the centers of activity responsible for them to occur (St-Hilaire and Crépeau, 2000). According to the Costing Manual (*Plano de Contabilidade Analítica dos Hospitais*, 2007), those centers of activity correspond to *homogeneous sections*, which are grouped into main departments (where the provision of care effectively takes place, *i.e.*, clinical departments, either in- or outpatients), ancillary services departments (both clinical, like laboratories, operating rooms or radiology, and general, as facility management), and administrative departments (include the board of directors and the financial department, among others). Table 1 below summarizes the organization of the homogeneous sections.

Homogeneous Sections and Cost Centers	
Groups of homogeneous sections	Homogeneous sections/Cost centers
Main (clinical) sections	Clinical inpatient services: medical specialties (*, internal medicine and pneumology), surgical specialties (*e.g.*, general surgery and orthopedics), obstetrics/gynecology and child and adolescent health Clinical outpatient services: day-case treatments, emergency, outpatient appointments, ambulatory surgery
Ancillary clinical support sections	Diagnostic and therapeutic tests (*e.g.*, laboratory and imaging) Anesthesiology (anesthesiology and chronic pain) Operating Room Other clinical support services (*e.g.*, nutrition/dietetics and psychology)
Ancillary general support sections	Facilities and equipment services Hotel services (*e.g.*, hygiene/cleaning and laundry)
Administrative sections	Board of directors Administrative services (*e.g.*, accounting and procurement)
Non-imputable	Costs not induced by the activities of the other sections (*e.g.*, tests ordered by other hospitals)

Table 1 Homogeneous sections and cost centers according to the Costing Manual

Cost calculations consider the full range of costs incurred by the hospital, including all operating expenses, staff costs and capital costs (Mateus, 2011). Following a step-down approach, at the end of the allocation process all costs must be apportioned to clinical departments (Costa *et al.*, 2008; Mateus, 2011), as described here (see Figure 6). In order to do so, the Costing Manual imposes four sequential steps (Plano de Contabilidade Analítica dos Hospitais, 2007; Mateus, 2011). In step one, all costs are directly attributed to the corresponding cost center, irrespectively of its nature. In step two, the costs of the administrative departments are distributed by all the other sections using the amount of direct costs as the allocation driver. In step three, all direct and indirect costs already attributed to ancillary general support sections are then reallocated to either clinical departments or ancillary clinical support services, in regard of the activities internally provided to them (*e.g.*, the number of hours of repairing machinery or the kg. of washed textiles). Schematically, looking at Table 1 above, we can figure out that we are *moving upwards* in the Table and also that there is only missing a final step: reallocating all direct and indirect costs of the ancillary clinical sections to the clinical departments. Once again, the allocation driver corresponds to the volume of internal services provided, such as weighted lab tests or the number of surgeries performed.

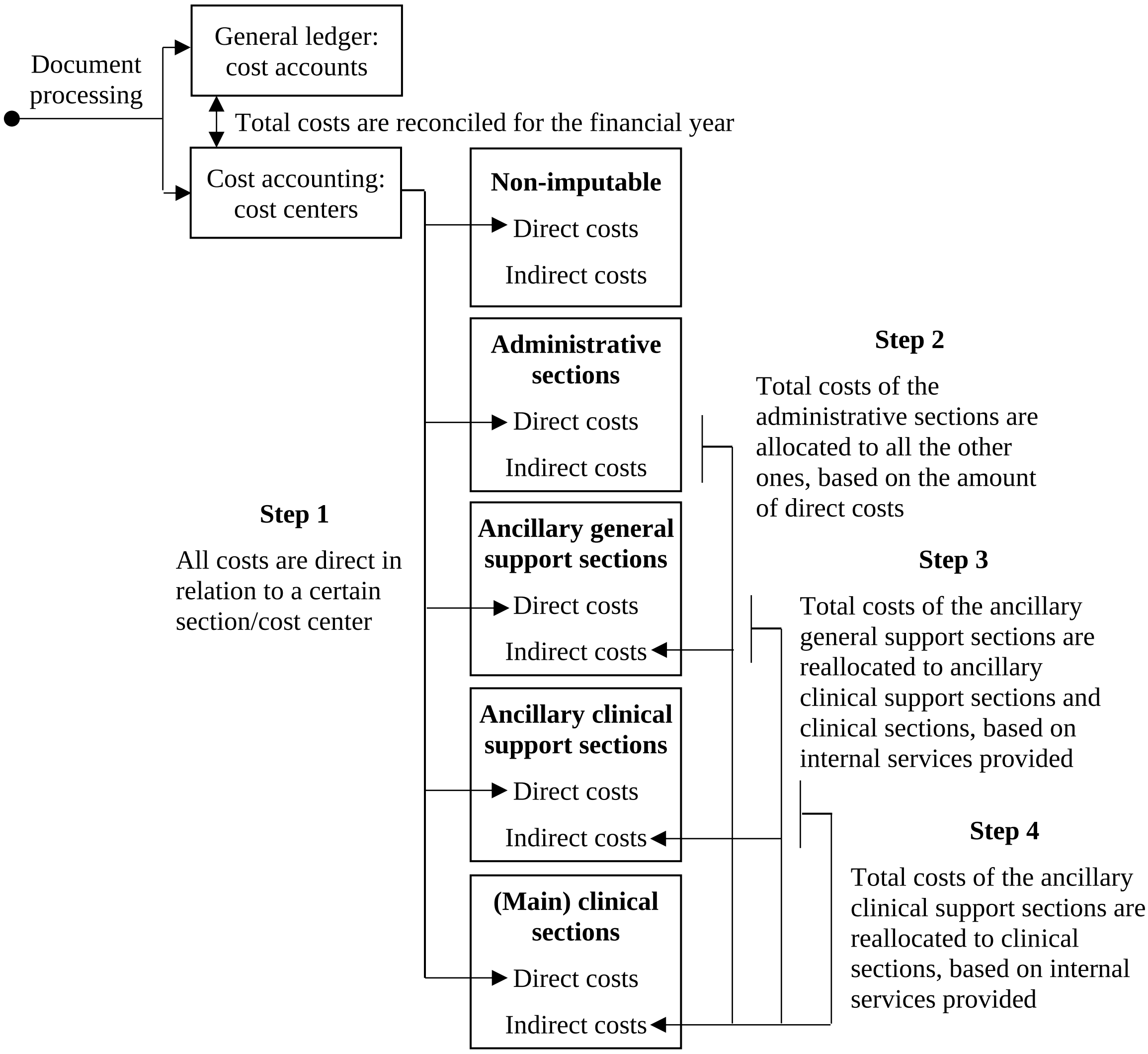

Figure 6 Structure and rules for cost allocation according to the Costing Manual

The allocation of direct costs in step one is simple to undertake, but the allocation of indirect costs (overheads) performed in the remaining steps is much more demanding and follows the method known as *the reciprocal method* (Plano de Contabilidade Analítica dos Hospitais, 2007; Tan *et al.*, 2011), or as *the simultaneous equation method* (St-Hilaire and Crépeau, 2000). It takes into account bilateral deliveries between overhead departments (at the same *level*), which implies that the interaction must be computerized and repeated the number of times needed to eliminate unallocated amounts. Figure 7, taken from Tan *et al.* (2011) represents the deployment of the reciprocal method for overhead allocation.

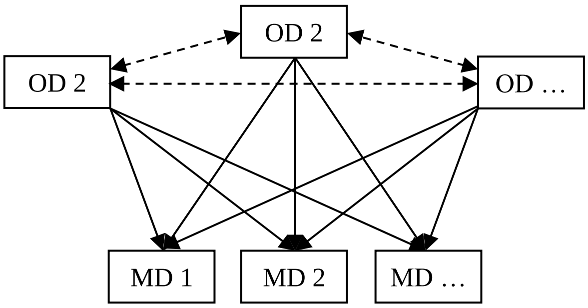

Figure 7 Reciprocal method for overhead allocation

Notes: OD – overhead department; MD – medical department

Source: Tan et al. *(2011)*

As described here, the step-down approach beneath the Portuguese mandatory model apportions all hospital costs to main (clinical) sections. This information is further used to disclose and assess the operational performance of public hospitals, by dividing the total costs of clinical sections by the respective unit measure of production. Materializing what I have just said, it is possible to obtain average costs per inpatient, inpatient day, day-case treatment, outpatient appointment, emergency episode, home visit and ambulatory surgery.

4.2. The ABC system

ABC contrasts with traditional costing systems in relation to the allocation of indirect costs to cost objects. In fact, most direct costs are relatively easy to trace to cost objects, either products or services (Mogyorosy and Smith, 2005), but indirect costs require allocation methods in order to be assigned to products or services (Picoito and Major, 2013).

In practice, by using traditional costing systems, overheads are allocated to hospital departments using a single allocation base (Mogyorosy and Smith, 2005; Borges *et al.*, 2010), which results in allocating most overheads to those departments that are responsible for high volumes of services, irrespectively of the actual use of overheads. Since overheads can be motivated more by complexity than by volume of services (Drury, 2004; Mogyorosy and Smith, 2005), the utilization of a single allocation base can lead to distortions in cost estimates.

Regarding the high diversity of hospital services and the proportion of indirect costs on hospital global costs, ABC is often presented as a more suitable approach to deliver cost estimates for hospital services (Negrini *et al.*, 2004; Vogl; 2013). Nevertheless, while recognizing that indirect costs comprise a large proportion of overall costs, estimates are not fully aligned: Oostenbrink *et al.* (2002, as cited in Tan *et al.*, 2009a) report 24% in The Netherlands, Freeman *et al.* (1985, as cited in St-Hilaire and Crépeau, 2000) present between 35 and 40%, and the highest estimate encountered during the literature review, 40%, is presented by Mogyorosy and Smith (2005).

The main refinement introduced by ABC is the identification of activities as the most accurate allocation base (Tan *et al.*, 2011; Horngren *et al.*, 2012), due to its reported ability of reflecting cause-and-effect relationships between overheads and medical departments (Borges *et al.*, 2010; Cooper and Kaplan, 1988, as cited in Tan *et al.*, 2011). Overheads are, then, assigned to medical departments or other cost objects based on the activities that are on their origin (Tan *et al.*, 2011). By introducing activities, the allocation process is divided into two stages (Figure 8): in the first stage, resource costs are allocated to activities (through resource cost drivers), while, in the second stage, costs of activities are assigned to cost objects (through activity cost drivers).

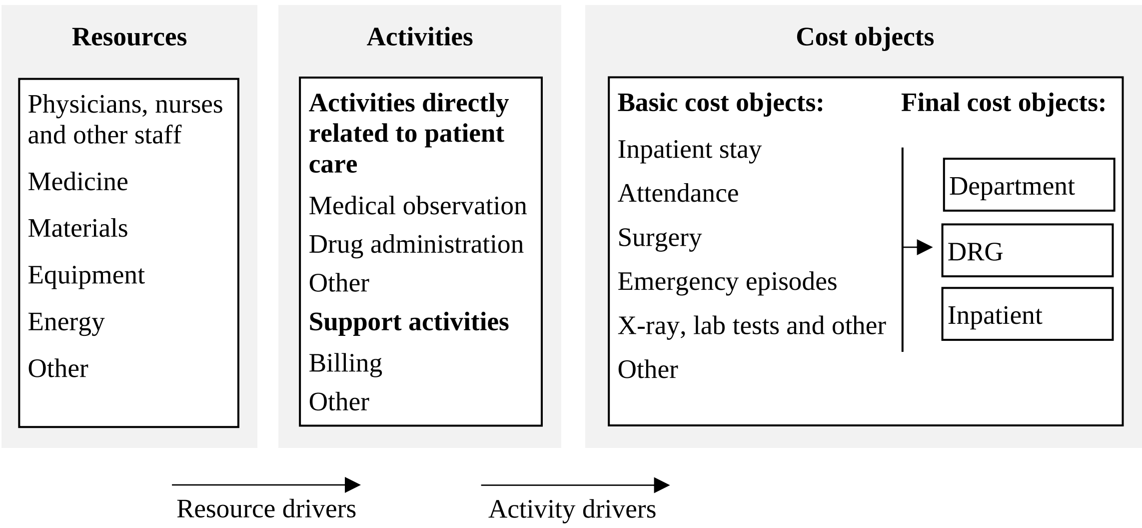

Figure 8 ABC two-stage allocation process

Adapted from Borges et al. *(2010)*

Compared to traditional cost accounting, ABC tries to redefine a large proportion of indirect costs by creating smaller cost pools (the activities) in a way that costs can then be reclassified into direct costs, in reference to the newly created cost pools (Mogyorosy and Smith, 2005).

Another important distinction of ABC compared to traditional systems concerns the range of costs considered in final estimates. In ABC, all costs are considered, whether industrial or administrative, while traditional systems only assigned industrial costs to products (Borges *et al.*, 2010). Nevertheless, it is important to note that the Portuguese cost accounting model imposes the assignment of all costs to cost objects, regardless of its nature.

Figure 8 shown above is related to the implementation of ABC in ten Portuguese public hospitals. However, it is widely comparable to the methodology followed by CHSJ with a few major distinctions, especially the final cost object. Although suggested in Figure 8, the national project established departments and DRG as the only final cost objects. On the contrary, CHSJ went further and defined individual patients as the final cost objects.

The deployment of the new costing methodology at CHSJ, as happened in the national project, started by classifying the whole range of costs into four classes: direct costs, common costs, joint costs and costs not addressed in ABC.

The first class of costs is immediately related to the applicable cost object and therefore does not imply any kind of driver. Drugs are an example of this first class. On the contrary, common and joint costs imply the utilization of drivers in order to establish a relation between resources and activities in phase one of cost assignment. The main driver used for this purpose is direct labor hours. Going forward, in phase two, new drivers were identified to assign activity costs to cost objects. Those were the cases of time, measured in terms of hours/minutes concerning diagnostics and attendances, and in terms of days regarding inpatient stay; the number of inpatients; the number of kg. of textiles; the number of meals; and the number of sterilization cycles (Borges *et al.*, 2010).

A key point in the deployment of the costing model has been the identification of activities. As reported in the literature (Drury, 2004; Chapman and Kern, 2010), the major role was given to those in charge of the departments, through interviews that could shed light to differentiated activities and to their normal duration (Borges *et al.*, 2010). However, Borges *et al.* (2010) recognize the bias introduced by this mechanism of ascribing time to the activities, since the interviewees tend to hide non used time, by dividing their full working time by the set of identified activities. Although such methodology fails in capturing "non-value-added costs" (Waters *et al.*, 2003, as cited in Borges *et al.*, 2010), *i.e.*, the costs of inefficiency or unused capacity, this cannot be seen as a weakness of the model, because the Portuguese cost accounting mandatory model is also based on a full absorption approach and, therefore, comparisons can be made.

Within the operating room, time and motion studies have also been used along with the referred interviews to define normal times for each activity. Normal times were then used as weights for attributing the full number of workable hours to the activities.

Activities were identified and organized sequentially. The first distinction was made between "patient oriented processes" and "support processes", whether connected with the patient relationship management or integrated in management functions. At this initial stage, processes were defined in broad terms, such as "emergency department", "operating room", or "patient service" as examples of patient oriented processes, and "human resources management", "planning and control" or "clinical files management" as examples of support processes. Afterwards, each process was divided into activities, which, in turn, might be subdivided into more detailed support activities. Figures 9 and 10 displayed on the next page, adapted from Borges *et al.* (2010), illustrate how activities related to the emergency department and the operating room were defined.

Activities Related to the Emergency Department

- Transporting patients
- Receiving, registering and charging fees
- Performing triage
- Providing care

- Performing clinical observation at emergency room (ER)
- Receiving, assessing, treating and referencing patients admitted in the ER
- Observation and treating non priority patients
- Performing observation and treatment by specialists
- Transferring patients into the Intermediate Intensive Care Unit
- Ensuring patients' surveillance while waiting for the results of examinations
- Giving support to families
- Getting support activities

- Drugs provisioning by the pharmacy
- Materials provisioning by procurement and logistics
- Provisioning hygiene and cleaning by hotel services
- Provisioning sterilization of equipment and devices
- Provisioning maintenance of equipment and devices by the facilities management service
- Provisioning textiles by the laundry
- Fulfilling general ED management

Figure 9 Activities related to the ED

Adapted from Borges et al. *(2010)*

Activities Related to the Operating Room

- Preparing operating rooms
- Preparing patient within the operating room
- Administering anesthesia
- Performing surgery
- Supervising postoperative recovery
- Support activities to the operating room

- Drugs provisioning by the pharmacy
- Materials provisioning by procurement and logistics
- Provisioning hygiene and cleaning by hotel services
- Provisioning sterilization of equipment and devices
- Provisioning maintenance of equipment and devices by the facilities management service
- Provisioning textiles by the laundry
- Fulfilling general OR management

Figure 10 Activities related to the OR

Adapted from Borges et al. *(2010)*

4.3. The *mezzo* methodology

The *mezzo* methodology combines essential elements from bottom-up micro costing with other elements from bottom-up gross costing. As I referred previously in this Chapter, Tan *et al.* (2009b) concluded that compared to a bottom-up micro costing, a mixed solution would produce accurate estimates as well, especially if it preserved the cost components with a large impact on the total costs. Therefore, Tan *et al.* started from the gold standard bottom-up micro costing to move upwards in the matrix (see Figure 5). In a similar fashion, the *mezzo* methodology starts from bottom-up micro costing and preserves all costs that information systems in place allow to allocate to specific patients, but moves leftwards in the matrix to produce a mixed approach as well, as represented in Figure 11 below:

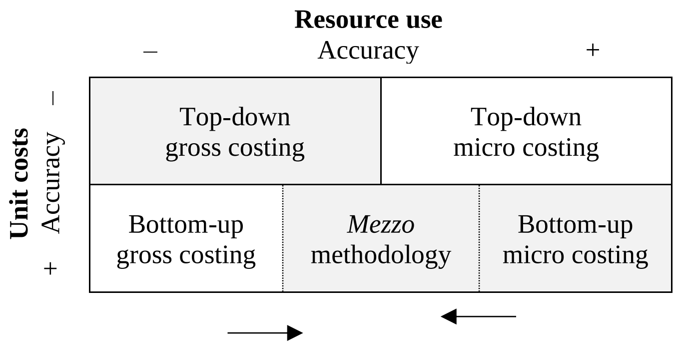

Figure 11 The *mezzo* methodology, resulting from replacing cost components of bottom-up micro costing by components of bottom-up gross costing

The *mezzo* methodology has been designed having in mind two basic principles: the first one is related to the ability to trace individual patients, who are the cost objects; and the second one is to assign all direct costs possible to those cost objects, regarding the information system in place.

Information has been organized in matrix, with individual patients displayed in rows and costs displayed in columns. In addition to costs, information related to the departments of admission and inpatient stay, as well as the destination of discharge, has been added.

Cost estimates have been organized into three areas: emergency department (when applicable), operating room (for surgical DRGs) and ward (inpatient stay). Each area has been further disaggregated, in order to detail the cost estimates per cost components. The elected cost components have been the following, per area: emergency department – physicians, nurses, diagnostics, drugs and overheads; operating room – nurses, anesthesia, materials, drugs and overheads; ward – physicians and nurses, diagnostics, drugs and overheads.

Figure 12, together with the following tables displaying partial cost estimates for patients classified into DRG 164, are used to represent the *mezzo* allocation model.

The *Mezzo* Allocation Model								
Episode nr.	Patient nr.	Dept.	Admission	Discharge	ED	OR	Ward	Total costs
Episode nr. E1	Patient nr. P1	General Surgery	ED	Home	Table 3.1	Table 3.2	Table 3.3	TC E1
Episode nr. E2	Patient nr. P2	Pediatrics Surgery	ED	Home				TC E2
Episode nr. E…	Patient nr. P…	…	…	…				TC E…
Episode nr. En	Patient nr. Pn	General Surgery	ED	Home				TC En

Figure 12 The *mezzo* allocation model

Abbreviations: ED, Emergency Department; OR, Operating Room.

Emergency Department						
Episode nr.	Physicians	Nurses	Diagnostics	Drugs	Overheads	Total ED costs
Episode nr. E1	14,34	12,96	44,61	0,00	15,08	86,98
Episode nr. E2	68,44	40,21	206,21	0,00	60,61	375,47
Episode nr. E…	…	…	…	…	…	…
Episode nr. En	4,37	3,95	0,00	20,75	4,60	33,67
Mean	62,32	38,67	79,69	9,19	56,51	246,39
$\frac{\text{Cost}}{\text{Total costs}}\%$	25	16	32	4	23	

Table 2.1 Partial ED costs for patients classified into DRG 164

Operating Room						
Episode nr.	Nurses	Anesthesia	Materials	Drugs	Overheads	Total OR costs
Episode nr. E1	147,12	159,17	182,86	20,31	97,51	606,97
Episode nr. E2	80,25	86,82	182,86	20,31	53,19	423,42
Episode nr. E…	…	…	…	…	…	…
Episode nr. En	187,24	202,58	182,86	20,31	124,10	717,09
Mean	182,38	197,32	182,86	20,31	120,88	703,74
$\frac{\text{Cost}}{\text{Total costs}}\%$	26	28	26	3	17	

Table 2.2 Partial OR costs for patients classified into DRG 164

Ward						
Episode nr.	LoS	Physicians and nurses	Diagnostics	Drugs	Overheads	Total ward costs
Episode nr. E1	8	2.297,15	119,85	558,88	1.141,33	4.117,20
Episode nr. E2	8	1.202,36	119,85	47,35	750,15	2.119,71
Episode nr. E…	…	…	…	…	…	…
Episode nr. En	1	330,63	119,85	0,00	148,10	598,57
Mean	7,2	1.962,90	219,50	283,23	1.076,08	3.541,70
$\frac{\text{Cost}}{\text{Total costs}}\%$		56	6	8	30	

Table 2.3 Partial ward costs for patients classified into DRG 164

Calculations have been made for 2009, the single year with ABC estimates. Direct costs comprise drugs and diagnostics, whether requested by emergency department or ward. Data on this type of costs has been extracted from information systems in use at the pharmacy, lab and radiology. Data has also been extracted from the general information system in order to obtain costs for a set of intermediate services, including cardiology tests, physiotherapy, blood and blood products and vascular lab tests. Indirect costs, or overheads, encompass all costs that cannot be directly traced to individual patients, such as other technical staff, consumables, laundry, facilities management, energy, depreciation and amortization, and were taken from cost accounting spreadsheets.

Figure 13 summarizes the methodology used to estimate all cost components mentioned above:

Costing Methodology

Cost	Driver

Emergency Department

$$\text{Medical staff} = \text{Cost of physicians per patient} * \frac{\text{Total ED episode time}}{\text{Mean time episode in specific ED}}$$

$$\text{Diagnostics} = \text{Cost of tests of an individual patient (direct costs)}$$

$$\text{Drugs} = \text{Cost of drugs of an individual patient (direct costs)}$$

$$\text{Nursing} = \text{Cost of nursing per patient} * \frac{\text{Total ED episode time}}{\text{Mean time episode in specific ED}}$$

$$\text{Overheads} = \text{Overhead costs per patient} * \frac{\text{Total ED episode time}}{\text{Mean time episode in specific ED}}$$

Notes: Costs of medical and nursing staff and overheads are related to the applicable ED; medical staff costs in ED include Emergency OR medical staff costs

Operating Room

$$\text{Nursing staff} = \text{Cost of nursing per surgery} * \frac{\text{Total surgery time}}{\text{Mean surgery time in specific OR}}$$

$$\text{Materials} = \text{Cost of materials per surgery}$$

$$\text{Drugs} = \text{Cost of drugs per surgery}$$

$$\text{Anesthesia} = \text{Cost of anesthesia per surgery} * \frac{\text{Total surgery time}}{\text{Mean surgery time in specific OR}}$$

$$\text{Overheads} = \text{Overhead costs per surgery} * \frac{\text{Total surgery time}}{\text{Mean surgery time in specific OR}}$$

Notes: Medical staff costs in Emergency OR are included in ED medical staff costs; all costs are related to the applicable OR; drug consumption in OR by individual patients started being registered from September 2009 onwards

Ward

$$\text{Medical and nursing staff} = \text{Cost of medical and nursing staff per bed day} * \text{LoS}$$

$$\text{Diagnostics} = \text{Cost of tests of an individual patient (direct costs)}$$

$$\text{Drugs} = \text{Cost of drugs of an individual patient (direct costs)}$$

$$\text{Overheads} = \text{Overhead costs per bed day} * \text{LoS}$$

Note: Costs of medical and nursing staff and overheads are related to the applicable inpatient department

Figure 13 Costing methodology

Abbreviations: ED, Emergency Department; LoS, Length of stay; OR, Operating Room.

All costs were apportioned to individual patients, thus preserving the full cost basis underlying both the *mezzo* methodology and the ABC costing exercise undertaken for that year. Therefore, there is no isolation of costs of unused capacity. This feature is relevant in hospital management, since hospitals maintain spare capacity so they can manage elective admissions and emergency together, implying some sort of "inefficiency" and generating higher unit costs (Street and Dawson, 2002).

Generally, labor costs were apportioned to individual patients considering the relative consumption of services provided by physicians, nurses and other technical personnel. The hospital's cost accounting provides information on mean costs incurred with physicians and nurses per patient treated in the emergency department (general and pediatrics) and per inpatient day in each applicable ward (general surgery, pediatrics, etc.). Thus, the whole bundle of staff costs is equally distributed by patients and by inpatient days, irrespectively of the actual time spent per treatment. Taking time as a proxy for resource consumption, I estimated the labor cost of individual patients treated in the emergency department by multiplying the mean cost of physician (or nurse) by the rate between a particular episode time and the mean episode time. One can argue that it would be preferable to use real attendance times, but those would require tracking the emergency episode, recording the moment when a physician takes charge of the patient and the moment when he asks for the collaboration of a different specialist and leaves the patient in a new waiting phase, and such records are not available in the hospital information system. Besides, it is a fact that such time record would release data on operational performance indicators such as throughput rate, mean service rate per busy physician/nurse, utilization factor (*i.e.*, the fraction of time individual physicians/nurses are busy, or the fraction of the system's capacity that has been utilized on average), and, conversely, the time during which the system remained idle (Hillier and Lieberman, 2005) and it could be combined with cost accounting to improve the whole internal management information system, but it would also require rethinking and redesigning the information system as a whole.

Concerning labor costs in wards, the reasoning is the same: cost of medical and nursing staff per bed day is collected from the cost accounting maps and the estimate for an individual patient is obtained by multiplying that unit cost by his/her length of stay.

The costs of diagnostics and drugs are easily traceable to individual patients, once they are tagged to the patient identification number. However, it is easier in the case of drugs, because quantities and related costs are available at the pharmacy’s software application. Estimates for the cost of diagnostics require a further step: after collecting the quantities of internal services provided (the number of X-rays and particular lab tests, for instance), also tagged to the patient identification number, it is necessary to value those services. Since cost accounting provides the weighted average cost for all clinical support departments (imaging and laboratory, for instance), combining this information with a weighting matrix which takes into consideration the relative use of resources and complexity of every diagnostic test or procedure, it is possible to put a value on diagnostics done internally. Such a matrix is publically available in the form of a spreadsheet as an appendix to the law that establishes the price of diagnostics to be acquired by the MoH to private healthcare providers. Therefore, by integrating this spreadsheet in the global costing exercise, estimates for the cost of diagnostics done internally for individual patients can be automatically generated and allocated.

Figure 14 bellow exemplifies how the cost of a specific test has been estimated. The estimate has been performed in relation to episode 9000162, identified in cell B3. The information system in place at the hospital displays the type and the quantity of diagnostic and therapeutic tests that have been internally provided to the patient in episode 9000162, together with the diagnostic code associated to each test. This code is almost in the same format as the one present in the publically available spreadsheet issued by the MoH already referred, except for the prefix in one capital letter. Therefore, column C has been added, preserving the five characters at the right in the string, which corresponds to removing the first character in the string.

Taking the first test in Figure 14 as an example, one verifies that relevant data is instantly available from the information system, such as the ancillary clinical support section that has performed the test (identified with number 1 in Figure 14), the test code (number 2), the description of the test (number 3) and, finally, how many of those tests have been performed (number 4). Data processing began by inserting column C and adding the spreadsheet by the MoH to the Excel book. Then, both spreadsheets were related by using the *VLOOKUP* function, which returned the relative weight (number 5) in column H. Therefore, in order to put a monetary value into those particular tests, there was only missing the cost per standardized test, a piece of information that was also regularly produced by the hospital's cost accounting. The cost per standardized test is shown in the lower part of Figure 14 (number 6). At last, the costs incurred by the hospital in providing the test used as an example to the patient in episode 900162 (number 7) are estimated by the expression Q*W*C, where Q represents the quantity, W the relative weight associated to the test, and C the unit cost per standardized test performed by the applicable ancillary clinical support section.

	A	B	C	D	E	F	G	H	I
1									
2		Episode	Diagnostic code	Equipment	Diagnostic code	Diagnostic description	Diagnostic Q	Weight	Cost
3		9000162	31077	201 - Anatomia Patologica	B31077	Exame Macroscopico E Hi	1	26,6	119,85
4			21101	20201 - Bioquimica	A21101	Acido Urico S/U/L	1	0,2	0,54
5			21140	20201 - Bioquimica	A21140	Albumina, S	3	0,2	1,50
6			21396	20201 - Bioquimica	A21396	Calcio Total, S/U	1	0,2	0,54
7			21513	20201 - Bioquimica	A21513	Cloretos, S/U/L	4	0,2	2,00
8			21620	20201 - Bioquimica	A21620	Creatinina, S/U	4	0,2	2,00
9			21976	20201 - Bioquimica	A21976	Fosforo Inorganico, S/U	1	0,3	0,65
10			22076	20201 - Bioquimica	A22076	Glucose, Doseamento, S/U	4	0,2	1,85
11			22357	20201 - Bioquimica	A22357	Magnesio, S/U	1	0,4	0,81
12			22617	20201 - Bioquimica	A22617	Potassio, S/U	4	0,2	1,85
13			22669	20201 - Bioquimica	A22669	Proteina C Reactiva, S	2	0,8	3,46
14			22679	20201 - Bioquimica	A22679	Proteinas Totais, S/U/L	3	0,3	1,96
15			22793	20201 - Bioquimica	A22793	Sodio, S/U	4	0,2	2,00
16			22949	20201 - Bioquimica	A22949	Ureia, S/U	4	0,2	2,00
17			24209	20202 - Hematologia	A24209	Hemograma Com Formula	4	1,1	13,74
18		9000162 Total					41		154,74

J	K	L
	Cost per standardized test	
	. Anatomia Patológica	4,50
	. Bioquímica	2,25
	. Hematologia	3,14

Figure 14 Methodology used to estimate the costs of diagnostic and therapeutic tests

In turn, overheads were apportioned to individual patients on a time-driven basis. The method used to do that apportion is straightly similar to the one described above for staff costs. Cost accounting maps provide overhead costs per average patient in the emergency department and per day of inpatient stay. Thereby, concerning wards, the costing process is done by adding all overhead cost components and multiplying the sum by the inpatient stay (in days). In relation to the emergency department, the sum of all overhead cost components is weighted by the relative length of the episode (in hours/minutes) compared to the mean time episode in specific emergency department.

4.4. Sampling methods used for large DRGs

The *mezzo* methodology has been applied to the whole population of DRGs 164 and 166, given its small dimension, but samples have been used in relation to the remaining DRGs. All samples comprised at least 30 observations (episodes), in order to ensure the application of *the central limit theorem* (Reis, 1997; Tabachnick and Fidell, 2013). In addition, a few episodes had to be removed from the analysis, on account of missing data. Table 3 displays the dimension of populations and samples for all DRGs under study:

Dimension of Population and Sample		
Description	Population n	Sample m
DRG 14	717	50
DRG 88	257	30
DRG 164	25	22
DRG 165	211	30
DRG 166	23	22
DRG 167	602	50

Table 3 Dimension of population and sample for all DRGs under study

When generating the samples, it must be ensured the matching between populations and samples in relation to a variable of major importance in cost allocation: the LoS, namely the LoS observed in different hospital departments. The *mezzo* methodology, as is also the case of the model deployed in CHSJ and the most commonly cost designs reported in the literature (Epstein and Mason, 2006; Tan *et al.*, 2009b), uses time-related variables to apportion overheads to cost objects. In the ED, it is the episode time that helps in that process, while in the OR the same role is played by total surgery time and, finally, in the ward, it is the LoS that determines the allocation of overheads to individual patients.

Commonly, LoS is the elected driver when a single allocation basis is used to cost apportionment (Jackson, 2000; Thibadoux *et al.*, 2007). Having in mind the relevance of LoS in cost system design, Chapman (2015) refers to LoS as “the classic metric”. Therefore, on a theoretical stand, one might expect that a relevant part of total costs would be attributed to patients through LoS. At the same time, overheads would naturally differ from one inpatient department to another, implying that estimates for an individual patient would be one if that inpatient stay occurred in a certain department and a different one if it occurred in another.

This question is of utmost importance in the design of my research, because under comparison are estimates obtained for the entire population of each specified DRG with estimates generated from subsets of those populations. Stated in other words, we are aiming to extract information over the entire population of each DRG under study by using data related to only a strict part of that population: the sample (Levy and Lemeshow, 1999; Murteira, 2007; Daniel and Cross, 2014).

However, such exercise of “statistical inference” is only valid if each sample represents the population from which it was extracted. Combining this requirement with what I have just said about the variability among inpatient departments, simple random sampling is not adequate for the purpose of my research. In turn, stratified random sampling would be impractical, because I must ensure the representativeness of the sample in relation to inpatient days spent at each department and not in relation to patients, turning the stratification prior to the sampling hard to accomplish (cf. Levy and Lemeshow, 1999, and Daniel and Cross, 2014). Instead, I decided upon the multi-step sampling (Murteira and Antunes, 2012). This procedure worked as follows: in step one, I randomly generated a simple sample of about eighty percent of the desired number of observations; then, in step two, I compared the distribution of observations and the distribution of the entire population; I continued by randomly selecting patients from underrepresented LoS in phase three; and, finally, I compared again sample and population in terms of LoS.

Figure 15 displays schematically the global process of sampling and statistical inference:

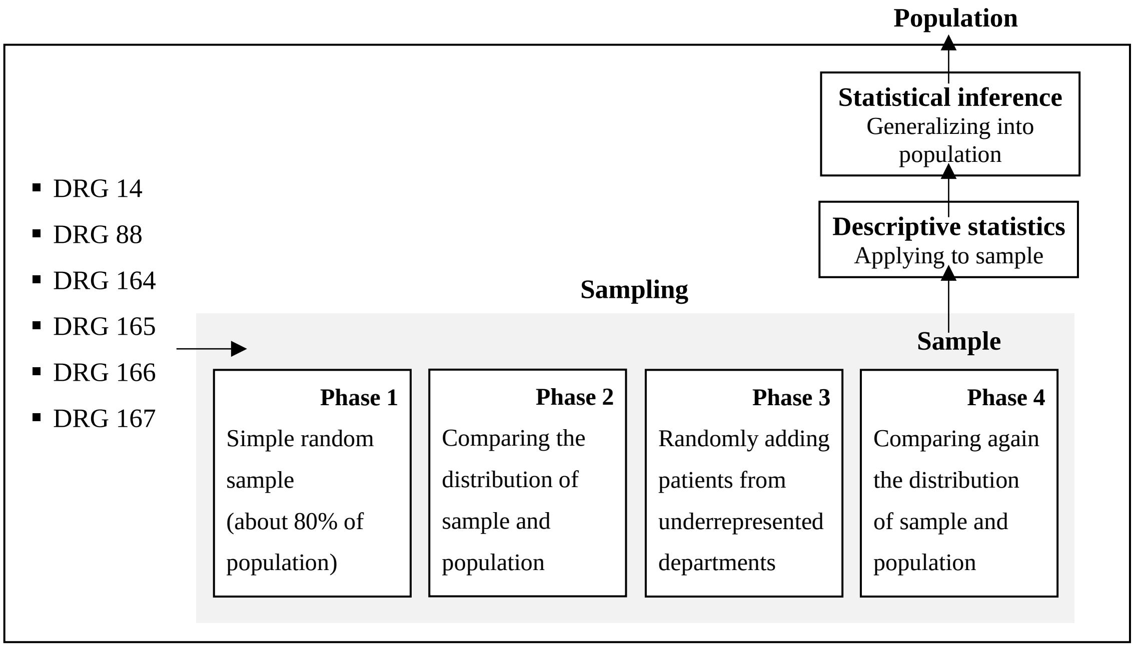

Figure 15 Sampling and statistical inference

Tables 4.1 to 4.4 characterize both the population and the sample and allow for comparisons between them.

Comparison between Population and Sample – DRG 14					
Description	Internal Medicine	Stroke Unit	Neurology	Other	Total
Population					
Inpatient days	4.805	1.011	794	135	6.745
Inpatient days (%)	71%	15%	12%	2%	100%
Average stay	8,2	3,5	9,9		
Sample					
Inpatient days	339	73	63	0	475
Inpatient days (%)	72%	15%	13%	0%	100%
Average stay	8,1	3,8	12,6		

Table 4.1 Comparison between population and sample for DRG 14

Comparison between Population and Sample – DRG 88				
Description	Internal Medicine	Pneumology	Other	Total
Population				
Inpatient days	1.883	316	83	2.282
Inpatient days (%)	83%	14%	3%	100%
Average stay	8,5	10,5		
Sample				
Inpatient days	214	43	0	257
Inpatient days (%)	83%	17%	0%	100%
Average stay	8,9	7,2		

Table 4.2 Comparison between population and sample for DRG 88

Comparison between Population and Sample – DRG 165					
Description	Pediatrics	Pediatrics Surgery	General Surgery	Gynecology	Total
Population					
Inpatient days	142	531	188	4	865
Inpatient days (%)	16%	61%	22%	0%	100%
Average stay	1,7	6,8	3,9		
Sample					
Inpatient days	18	68	31	0	117
Inpatient days (%)	15%	58%	26%	0%	100%
Average stay	1,6	6,8	3,4		

Table 4.3 Comparison between population and sample for DRG 165

Comparison between Population and Sample – DRG 167					
Description	Pediatrics	Pediatrics Surgery	General Surgery	Other	Total
Population					
Inpatient days	237	809	398	10	1.454
Inpatient days (%)	16%	56%	27%	1%	100%
Average stay	1,3	3,4	2,2		
Sample					
Inpatient days	22	60	33	0	115
Inpatient days (%)	19%	52%	29%	0%	100%
Average stay	1,4	3,2	2,2		

Table 4.4 Comparison between population and sample for DRG 167

In all cases, the weights of inpatient days by department for each sample are very similar to the weights of inpatient days by department related to the population. Therefore, in all cases the sample matching has been ensured.

4.5. Comparison of estimates: analysis of the results

Earlier in this Chapter, I presented comparisons of cost estimates in the literature using the classification of methodologies proposed by Tan *et al.* (2009b). Likewise, I will compare the estimates obtained through the *mezzo* methodology and ABC, on the one hand, and compare cost estimates with prices set through the DRG system in place in Portugal, on the other hand, relying on the same classification.

All results from applying the *mezzo* methodology and ABC, together with statistical data on LoS and prices paid to CHSJ through the Portuguese DRG system[7] are summarized in Table 5 bellow:

DRG	***Mezzo***		**ABC**		**LoS**			**Prices**	
	m	Cost estimates	n	Cost estimates	Sample	Pop.	Port.	P132 and P839/A	CHSJ
14	50	3.568,32	717	3.649,53	9,5	9,5	8,6	1.874,35	1.747,08
88	30	2.925,91	257	2.805,00	8,6	8,7	8,6	1.483,28	1.382,56
164	22	4.491,83	22	2.728,00	9,4	9,4	9,9	4.011,08	3.891,55
165	30	2.493,53	211	1.159,46	3,9	4,1	5,3	3.383,03	3.282,21
166	22	2.996,25	22	1.904,47	6,2	6,7	6,2	2.166,93	2.102,35
167	50	1.761,57	602	825,55	2,3	2,4	3,2	1.750,22	1.698,06

Table 5 Summary of results

Notes and abbreviations:
14: Stroke.
88: Chronic obstructive pulmonary disease.
164: Appendectomy with complications and co morbidities.
165: Appendectomy with complications and without co morbidities.
166: Appendectomy without complications and with co morbidities.
167: Appendectomy without both complications and co morbidities.
n: Population.
m: Sample.
Pop.: Population.
Port.: *Portaria*.
P132: *Portaria* 132, and P839/A: *Portaria* 839/A.
Cost estimates: mean costs per patient, in Euros.
LoS is measured in days.

[7] The legislation which established prices for 2009 was the *Portaria 132/2009*, issued in January 30th, with amendments by the *Portaria 839-A/2009*, issued in July 31st.

In order to make the comparison simpler to perform, Tables 6.1 and 6.2 extend the information presented in the preceding table to the standard deviation and calculates the percentage deviation from both ABC estimates and DRG prices in comparison to the estimates produced using the *mezzo* methodology.

DRG	***Mezzo* Descriptive Statistics**				**Comparison *Mezzo*/ABC**		
	Mean	Std. dev.	m	LoS	n	ABC cost estimates	**Δ%**
14	3.568,32	2.153,39	50	9,5	717	3.649,53	**-2**
88	2.925,91	1.191,88	30	8,6	257	2.805,00	**4**
164	4.491,83	1.585,45	22	9,4	22	2.728,00	**65**
165	2.493,53	1.129,45	30	3,9	211	1.159,46	**115**
166	2.996,25	1.637,82	22	6,2	22	1.904,47	**57**
167	1.761,57	564,42	50	2,3	602	825,55	**113**

Table 6.1 Descriptive statistics and comparison between the *mezzo* methodology and ABC

Notes and abbreviations: see Table 5.

The cost estimates produced by ABC and the *mezzo* methodology are clearly similar in regard to medical DRGs, *i.e.*, DRG 14 and 88. In fact, the mean value obtained for DRG 14 using the *mezzo* solution is 3.568,32, only 2% below 3.649,53, the mean value of the ABC estimates; and the mean value for DRG 88 corresponding to the *mezzo* solution is 2,925.91, only 4% above the ABC estimate of 2,805.00. However, there are relevant differences in relation to surgical DRGs (164 to 167). The cost estimate for DRG 164 through the *mezzo* solution is 4,491.83, 65% above the ABC estimate of 2,728.00; for DRG 165, the *mezzo* solution estimate is 2,493.53, 115% higher than the ABC estimate of 1,159.46; for DRG 166, the *mezzo* solution provided an estimate of 2,996.25, 57% higher than the estimate produced by ABC of 1,904.47; finally, the *mezzo* solution estimate for DRG 167 corresponds to 1,761.57, 113% over the estimate from ABC, of 825.55.

DRG		Portarias 132 and 839/A						CHSJ			
	Mezzo Est.	DRG Type	Relative W. (w)	Price w∗C	**Δ%**	LoS	Relative W. (w)	% Eq. Pt. (E)	Price w∗C∗E	Δ%
14	3.568,32	M	0,7822	1.874,35	**90**	8,6	0,7822	0,9321	1.747,08	**104**
88	2.925,91	M	0,6190	1.483,28	**97**	8,6	0,6190	0,9321	1.382,56	**112**
164	4.491,83	S	1,6739	4.011,08	**12**	9,9	1,6739	0,9702	3.891,55	**15**
165	2.493,53	S	1,4118	3.383,03	**-26**	5,3	1,4118	0,9702	3.282,21	**-24**
166	2.996,25	S	0,9043	2.166,93	**38**	6,2	0,9043	0,9702	2.102,35	**43**
167	1.761,57	S	0,7304	1.750,22	**≈**	3,2	0,7304	0,9702	1.698,06	**4**

Table 6.2 Comparisons between the *mezzo* methodology, national prices and CHSJ

Notes and abbreviations: C, National base (mean) price; Relative W., relative weight; % Eq. Pt., % of equivalent patients, in terms of medical patients and surgical patients; M, Medical; S, Surgical.

Looking to Table 6.2 and comparing now the estimates produced using the *mezzo* methodology with prices enforced by law, the situation gets inverted. Materializing, for medical DRGs estimates are about twice the price paid to the Hospital (104% higher in the case of DRG 14 and 112% in relation to DRG 88). Conversely, the differences are narrow in what concerns to surgical DRGs: the *mezzo* estimates compared to ABC estimates are 15% higher in the case of DRG 164, 24% lower in the case of DRG 165, 43% higher concerning DRG 166 and only 4% higher for DRG 167.

Besides comparisons between alternative costing methodologies, the employed *mezzo* solution may be further characterized by evaluating the relative weights of cost components in relation to total costs. Checking Table 7 below we verify that direct costs represent the larger percentage, ranging from 67% in the case of DRG 88 to 76% in relation to DRG 167. Conversely, overheads are, in every case, equal or lower $\frac{1}{3}$ of total costs, ranging from 24% in the case of DRG 167 to 33% for DRG 88. Yet, personnel costs with physicians and nurses account for about half of total costs, implying that the assignment of these costs to specific patients will partially determine the accuracy of cost estimates.

Cost Components %						
DRG	Physicians and nurses	Diagnostics	Drugs	Anesthetists	Materials	Overheads
14	55	14	2			29
88	54	10	3			33
164	50	7	7	4	4	28
165	48	8	2	8	8	26
166	48	8	3	5	7	29
167	44	9	3	9	11	24

Table 7 Cost components relative weights

5. Discussion

Bottom-up micro costing is considered the methodology that produces the most reliable estimates for inpatient costs (Tan *et al.*, 2009b). Nevertheless, bottom-up micro costing, as bottom-up methodologies in general, are not as widely used as one could expect (Tan *et al.*, 2009b; Chapman and Kern, 2012), given the time and resources, both technological and human, required to collect and process data. One question of research interest then emerges: to what extent is it possible to combine the preferred methodology with alternative approaches and still deliver reliable cost estimates?

Research has been mainly concerned with comparisons between alternative and mutually exclusive approaches, especially contrasting bottom-up micro costing with the remaining ones. Chapko *et al.* (2009) compared estimates obtained through top-down gross costing and bottom-up micro costing; Larsen and Skjoldborg (2004) extended their comparison to a third bottom-up gross costing alternative; and Clement *et al.* (2009) compared estimates using top-down micro costing and bottom-up micro costing. However, some authors proposed a slightly different view, comparing results between single approaches and the combination of methodologies. Tan *et al.* (2009b) compared a bottom-up micro costing method with a mixed approach, combining elements of both bottom-up micro costing and top-down gross costing and concluded that total cost estimates were equally reliable. In a similar fashion, Mishra *et al.* (2001) created a mixed approach, this time combining bottom-up micro costing with bottom-up gross costing, in order to compare results to those of the top-down gross costing enforced by law in Norway, and found that for the particular DRGs under study the funding system was able to pay hospitals properly for their services.

Likewise, I created a *mezzo* methodology, also starting from the best methodology available and combining it with elements drawn from bottom-up gross costing. Such a research design is comparable to those of Tan *et al.* (2009b) and Mishra *et al.* (2001) in the way that all of them consider mixed approaches and all start from the preferred methodology. However, there are also differences in relation to both studies. Contrarily to Tan *et al.* (2009b), I consider elements from bottom-up micro costing, instead of top-down micro costing; and compared to Mishra *et al.* (2001), I extend the comparison to a third level of estimates, obtained through a single bottom-up micro costing method (ABC).

Regarding the comparison between the *mezzo* solution and ABC, my research produced contrasting results. In relation to medical DRGs, the estimates were clearly coincident, supporting the argument by Tan *et al.* (2009b) that restricting bottom-up micro costing to cost components with large impact on total costs would still deliver reliable cost estimates. Conversely, estimates for surgical DRGs diverged significantly from ABC estimates, appealing for further analysis of these differing results.

However, my findings do not fully conform to the suggestion by Tan *et al.* (2009b) that bottom-up gross costing might not be a suitable alternative to bottom-up micro costing. In fact, the *mezzo* methodology inserts elements from that methodology into the *gold standard* and produces very similar cost estimates for medical DRGs, thus becoming a feasible alternative solution.

Interestingly, the other axis of comparison produced diametrically different results. Like Chapko *et al.* (2009), Larsen and Skjoldborg (2004) and Mishra *et al.* (2001), I also included the price paid to hospitals in my study, through the mandatory top-down gross costing model in place in all jurisdictions at stake. In the hospital stand, this comparison should attain the best attention, because the vast majority of its revenues comes from the DRG funding. In fact, DRG payment accounts for about 75% to 85% of total inpatient revenues in countries such as Germany and Portugal, and the situation is similar in most European countries (Tan *et al.*, 2011; Mateus, 2011). All mentioned studies have found conformity to a large extent between the price paid to hospitals and cost estimates. My research also suggests conformity between the price paid to the Hospital and the *mezzo* cost estimates, but only in relation to surgical DRGs. On the contrary, cost estimates are almost twice the value received by the Hospital for medical DRGs. This last finding gets even more relevant if we recall that *mezzo* cost estimates and ABC estimates are coincident.

Such a relevant difference in regard of a decisive topic for both hospital financial balance and the global operation of a national healthcare system may signal the need for further investigation on the fairness of the DRG weights adopted in Portugal.

Throughout Europe, governments came to realize that cost accounting systems were a kind of *raw material* essential to operate a reimbursement mechanism based on DRGs (Tan *et al.,* 2011; expression in italic added). Accordingly, hospitals might be over- or underpaid for specific DRGs, if data provided by cost accounting is imprecise (Tan *et al.*, 2011; Quentin *et al.*, 2011).

When cost accounting is used for internal management, hospitals themselves have powerful incentives to timely produce information of high quality (Jackson, 2001). In this case, hospitals might be interested in developing enhanced cost accounting systems, although expensive to install and maintain, and central authorities might as well benefit from better prepared information. Considering this case, Jackson (2001) emphasizes that detailed cost accounting at the patient level is above all prepared for improving the hospitals' efficiency, but also produces information for recalibrating DRG weights as a *convenient spin-off* (Jackson, 2001, p. 159). Accordingly, investment in improved cost accounting systems might return information for internal management, and, in addition, invaluable information on relative resource weights for case-mix funding at a very small cost.

In order to be useful for both hospital management and to determine/adjust values for paying hospitals for their services, cost information should reveal differences between individual patients and base the construction of economically homogeneous DRGs (Quentin *et al.*, 2011). However, many European countries are not able to extract cost information at the patient level, and this is a major reason why some of them use a set of imported weights to operate their DRG systems. Portugal, Ireland and Spain use weights from abroad, and calibrate them by using aggregate data on costs, mostly generated at the departmental level (Quentin *et al.*, 2011).

Portugal was the *front-runner* in Europe in operating a DRG-based hospital payment system (Geissler, 2011, p. 12), in 1988, the very same year in which Australia started its own process of implementing the DRG system (Wiley, 2011; Cots *et al.*, 2011). Values for each DRG were defined using the relative weights from the State of Maryland, in the USA. The problem is that when relative weights are imported, they do not necessarily reflect national practice patterns (Cots *et al.*, 2011) and might bias all calculations about values for each DRG. By using the Maryland cost weights, it is assumed that "Portuguese hospitals have the same patterns of service use as hospitals in Maryland", or in other words, "an identical profile of treatment in Portugal and in Maryland in the United States" (Mateus, 2011, p. 394).

While many countries originally imported DRG systems as a starting point and further developed their own systems, such as Finland, France, Germany, Australia and some Canadian provinces (Jackson, 2001; Geissler, 2011; Quentin *et al.*, 2011), Portugal, Ireland and Spain are still operating the DRG system using imported weight, from the US (Portugal and Spain) and Australia (Ireland). Nevertheless, Ireland is undergoing a pilot test with the objective of improving cost accounting systems to the patient level (Blunt and Bardsley, 2012; Chapman *et al.*, 2013; Vogl, 2013) and inform price setting on their own cost structure.

In Portugal, where "calculation of national cost weights suffers from the inexistence of data relating to per-patient costs in NHS hospitals" (Mateus, 2011, p. 393), attempts to adapt the Maryland cost weights to the Portuguese treatment profiles are made through the validation by a panel of clinical experts, when convened by the Portuguese national regulatory body.

As one has seen, the initiatives to implement patient level costing have been either abandoned in the case of the Hospital under study in my research case, or are taking too long to be presented and generalized to all hospitals in the Portuguese *Serviço Nacional de Saúde* (SNS, the Portuguese “equivalent” to the British NHS). In this context, a methodology like the *mezzo* solution presented here might help in introducing patient level costing and afterwards inform fairer price setting.

Chapter Two
Extracting Additional Value from Cost Estimates

1. Introduction

Literature suggests that cost accounting needs to evolve as a way to get more visible in hospital settings. On the one hand, it must go beyond the estimation of mean costs and offer richer information for managing in clinical and economical terms a particularly complex sector. If cost accounting manages to offer information in an understandable and helpful way to the professionals involved, it will be more likely to be part of their routines. On the other hand, there is plenty of information stored in modern hospital information systems, that can be brought into cost accounting systems and allow for new approaches, such as the one used in this Chapter, which combines cost accounting with cluster analysis.

I found that the case of CHSJ provided a good opportunity to explore these issues. Starting from cost accounting estimates obtained for the same set of DRGs considered in Chapter One by using the *mezzo* methodology, I now turn to employ cluster analysis in order to render the estimates more meaningful for two distinct groups of users: those involved in reviewing clinical activity and in managing the hospital; and those at central authorities (the government, MoH departments and regulators).

After the literature review, I introduce cluster analysis, namely its main concepts and the sequence of stages involved. Then I fully present and interpret cluster analysis for DRG 14 in the main text, while the output for DRGs 88 and 167 are made available in Appendix 2. Data used are still related to CHSJ, however this time for the year 2013, the last one with data available when this stage of the research started.

2. Extending cost accounting: a literature review

In the previous Chapter, I have argued that cost accounting information may be of limited value when the cost object is different from individual patients. Regarding the inpatient stay, in the case of the mandatory model for Portuguese public hospitals, cost estimates only inform about mean costs for inpatients and inpatient days. However, even improved cost accounting models built on bottom-up approaches such as ABC can only provide mean estimates for inpatient costs if the cost objet corresponds to single DRGs. In the latter, hospital managers and clinical directors may found that the mean cost of a given DRG is high but they will fail to understand why (Chapman *et al.*, 2013).

Some authors suggest that real improvements can be achieved if cost accounting can manage to induce a shift of concerns from means to variance. Tan *et al.* (2009b; 2011) argue that by analyzing the variability around mean values can provide meaningful insights on subpopulations. Chapman *et al.* (2013, p. 5) refer to this analysis as a type of "benchmarking inside the organization", which, as every benchmark techniques, can compare practices and results as well as to assist in reviewing the variation in costs between clinical teams.

Interestingly, Christensen (2010) suggests that an important role has been absent from accounting systems: the role of providing information about *the error terms*. This author argues that it becomes more difficult to extract value from accounting when accounting reports cannot capture and reflect the market valuation, in the case of financial accounting, and cannot reflect the structures of production, which perfectly pervade the nature and objectives of cost accounting. I argue that *the error terms* envisaged by Christensen may correspond in hospital cost accounting to the variation around mean costs per DRG and that, as proposed by Christensen, cost accounting improves when its structure reflects the structure of production and that alternative sources of information should be integrated into cost accounting systems.

Literature abundantly reports the inability of cost accounting to make part of medical expertise and help on improve both medical care and resource consumption (Carnett, 1999; Schrijvers *et al.*, 2012; Gebreiter; 2017). Gebreiter (2017) gives the example of one clinical director who states that if the focus is on quantity rather on quality he will look at the system more as a threat than a helping hand. As many authors have reported (Abernethy and Vagnoni, 2004; Nyland and Pettersen, 2004), Gebreiter (2017, p. 304) recalls that the reluctance of clinicians to welcome accounting information reflects the traditional notions of autonomy as well "as the implicit, intuitive and essentially unquantifiable art" of their profession.

Therefore, the only chance for cost accounting to make its way in order to inform medical thought and action is to play a "more subtle and indirect" role (Gebreiter, 2017, p. 301). Stated in other words, cost accounting should be presented to clinicians in more familiar and understandable forms, closer to the operations-level models of clinical practice (Thibadoux *et al.*, 2007; Gebreiter, 2017).

Kurunmäki (1999; 2004), Kurunmäki *et al.* (2003) and Lehtonen (2007) report how cost accounting entered the clinical domain in the Finnish setting and enlarged the medical expertise with cost accounting notions. Another Nordic country, Sweden (Ballantine *et al.*, 1998; Aidemark, 2001; Scarparo, 2006), observed a similar willingness on behalf of physicians to acquire notions of efficiency and cost accounting principles, but this behavior does not, by far, represent an European common reality. On the contrary, the narratives of resistance to the introduction of cost accounting into the clinical practice have been the rule in England (Kurunmäki *et al.*, 2003; Jacobs, 2005), Scotland (Scarparo, 2006; Jackson *et al.*, 2014), Germany (Jacobs *et al.*, 2004; Jacobs, 2005) and Italy (Jacobs *et al.*, 2004; Jacobs, 2005), among other countries. However, some authors found mixed results in relation to hospitals in Norway (Nyland *et al.*, 2009) and Italy (Macinati, 2010).

As commonly stated in many studies about the conflict between attempts to introduce cost accounting as part of NPM reforms and clinical autonomy (Scarparo, 2006) reforms had little impact over the thought and practice of the majority of clinicians in England, Scotland and other European settings, but a noteworthy change must be stressed, as they have raised the interest of clinicians on the standardization of clinical activity, operations management and clinical governance (Thibadoux *et al.*, 2007; Gebreiter, 2017).

Such a change was driven by the emergence of *care pathways* in many countries, such as the UK, Germany, the Netherlands, the United States, Australia and Canada (Carnett, 1999; Thibadoux *et al.*, 2007; Schrijvers *et al.*, 2012; Conrad and Uslu, 2012; Chapman *et al.*, 2014; Jackson *et al.*, 2014; Gebreiter, 2017). The medical autonomy along with defensive medicine had led to large variations in clinical practices and that was seen as contributing to inefficiency and rising costs (Thibadoux *et al.*, 2007).

This understanding by Gebreiter (2017) is fully supported by the clear emergence of *care pathways* throughout the British NHS (Schrijvers *et al.*, 2012; Conrad and Uslu, 2012; Chapman *et al.*, 2014; Jackson *et al.*, 2014), and many other countries such as the Netherlands (Schrijvers *et al.*, 2012) and the United States (Carnett, 1999; Thibadoux *et al.*, 2007). Care pathways may be understood as a tool really close to the medical domain, as they reveal the sequence of clinical decisions. In this sense, they could be envisaged as modernized models of clinical practice, sustained by improved ways of collecting and processing data around the treatment of patients. Together with hospital managers and consultants, clinicians started to define “the nature and timing of clinical interventions to be performed for specific conditions, against which actual practice could subsequently be compared” (Gebreiter, 2017, p. 304). Such a movement was visible from the mid-1980s onwards in countries such as the UK and the United States and was strengthened in the 1990s. It has been seen has a response to the introduction of DRGs and PPS (Thibadoux *et al.*, 2007; Gebreiter, 2017).

Regarding the way in which care pathways have been built, in spite of all reported resistance, they emerged in the mainstream medical discourses in Britain (*e.g.*, Kitchiner *et al.*, 1996; Johnson, 1997; Campbell *et al.*, 1998; and Riley, 1998; as cited in Gebreiter, 2017). This was made possible for, at least, two reasons: care pathways were related to the improvement of the quality of clinical care and they followed the rise of Evidence-Based Medicine (EBM) or Evidence Based Best Practices (EBBP), a new approach that emerged in the 1990s by the hands of a group of clinicians, medical researchers and epidemiologists (Thibadoux *et al.*, 2007; Gebreiter, 2017). Accordingly, care pathways would be based on best practices and, at the same time, help clinicians in their daily practice as well as assist clinical directors in reviewing variation. Particularly, care pathways would contribute to the standardization of clinical practice, avoid duplicate and unnecessary tests and replace costly treatments by similarly effective but less costly alternatives (Quentin *et al.*, 2011; Chapman *et al.*, 2014). More recently, there has been a renewed interest in considering individual patients as the cost objects in hospital cost accounting systems and following their path across the hospital. This approach has been motivated by improvements in hospital information systems and is known as *clinical costing* (Jackson, 2000). As such, clinical costing is a suitable way to verify the application of care pathways, or, stated in other words, the observation of previously defined best practices.

Having individual patients as cost objects and following their pathways throughout the hospital might reach beyond means and enlarge the contribution of cost accounting to the understanding of variance. As I have just referred, such a cost design may induce change from inside the hospitals, as desirable (Porter and Lee, 2013), because cost accounting becomes closer to the medical practice and may stimulate the interest of clinicians. However, as I have argued in Chapter One, this cost design may as well serve the purposes of central authorities of fairly financing hospitals for their services. In fact, the accurate estimate of costs per DRG requires information on the treatment of individual patients that are grouped into a certain DRG, otherwise estimates for costs – as well as prices – can only be obtained through assumptions (Blunt and Bardsley, 2012).

In spite of the DRG system attempt to group patients with similar costs, by definition, there seems to be a substantial variation inside DRGs (Blunt and Bardsley, 2012). Part of that variation may reflect differences in clinical practices, but other part may be due to the way in which DRGs have been defined (Blunt and Bardsley, 2012). In a case study, Blunt and Bardsley (2012) found that only one sixth of patients presented cost estimates in line with the value paid to the hospital for their treatment.

Therefore, besides the ability of bottom-up based cost accounting systems to inform practical decision at the clinical level, their importance can be extended to the policy level (Jackson, 2000). Noteworthy, the analysis of cost data within a given DRG could suggest the creation of further DRGs (Chapman *et al.*, 2013).

Nevertheless, when considering individual patients as costs objects, a new problem arises: individual estimates are useful for analysis as they cope with diversity, but they also tend to lead to an overload of information. From a managerial standpoint, facing 1 mean cost or 500 cost estimates (the DRG that I will take as an example in this Chapter comprises 563 patients) provide the same (little) information. There is the need to obtain clear and instant images from a general mass.

As I have mentioned earlier in this Section, Christensen (2010) argues that accounting systems should give more attention to the analysis of variance and that other sources of information should be combined to accounting in order to best inform decision making. On the one hand, the problem is that “the accounting model is linear, whereas the world is hardly linear” (Christensen, 2010, p. 1828). Usually, unit costs assume a linear cost function and, thus, accounting numbers cannot reflect the variability that occurs in the operational setting of a firm or a hospital. Relating specifically to cost accounting, Christensen (2010) acknowledges ABC as a finely tuned system, because it “mirrors the production technology of the firm”, but also stresses the fact that ABC still considers a linear cost function. On the other hand, Christensen (2010) argues that not all relevant information for decision making is included in the accounting system, and, therefore, alternative information sources should be considered in combination with accounting.

I follow the argument by Christensen (2010) and consider that it is fully applicable to cost accounting in the hospital setting. One example may be the mandatory Portuguese cost accounting model for public hospitals, which provides information on mean costs per inpatient, but does not provide insights on how treatments have been carried out and on how medical decisions have impacted costs in relation to specific patients or DRGs. Another example may be the pilot ABC project launched by the Portuguese MoH. In this case, cost estimates will be directly available for individual DRGs, but not for individual patients and, as a consequence, the variability inside each DRG will not be known. I also consider that cost accounting, as a set of techniques born in the industry setting and portraying the rationale of scientific management, should evolve with the contribution of areas such as operations management, operations research, data mining and information systems. In particular, I have presented in Chapter One cost estimates that have benefited from improved information systems and I attempted to build a costing model close to the medical practice. Now, in Chapter Two, I will attempt to extend the boundaries of cost accounting and apply a data mining technique on cost estimates produced by cost accounting for individual patients. As a result, the *raw material* is still provided by cost accounting, but the technique of analysis is imported from data mining.

The main aim of this Chapter is to answer the second research question. Thus, I will organize cost accounting estimates into meaningful subsets for clinicians and hospital managers, on the one hand, and for policy makers on the other hand. Such an organization of information should make accounting information more useful for understanding and reviewing clinical practice inside the hospital as well as to better inform the DRG classification and the hospital funding. In this way, I aim to contribute to extend to cost accounting the argument by Christensen (2010) that (financial) accounting system should be enlarged in order to accommodate data and techniques imported from other areas of knowledge as well to propose a combination of cost accounting numbers with a data mining technique which supports the claim by this author that cost accounting systems are improved when they can absorb and reflect the structure of production, in a way understandable for the professionals involved. I also claim that this reinterpretation of cost accounting can: help health professionals to better identify their practices with accounting figures, as suggested by Jackson (2000), Porter and Lee (2013) and Gebreiter (2017) in relation to care pathways in the 1980s/1990s and, more recently, to clinical costing; allow change to strategically come from inside the organization, as proposed by Porter and Lee (2013); contribute to the willingness of the medical profession to embrace cost accounting, as cost accounting appears to be less strange and distant to their understanding and routines, as advanced by Thibadoux *et al.* (2007).

3. Introducing cluster analysis

Regarding companies and other organizations we can easily identify problems that are hard to solve if managers do not find a way to organize information about those problems into meaningful parts. For instance, companies cannot connect with every potential costumer and then a solution may be dividing the market into groups with similar needs and wants (segments) and select which one or ones to target (Reis, 1997; Arabie and Hubert, 1994, as cited in Jain, 2010; Sarstedt and Mooi, 2014). The same reasoning applies to academic research, whether in physical or social sciences, where “the researcher is searching for a ‘natural’ structure among the observations” (Hair *et al.*, 2010, p. 415).

It is a fact that market researchers often rely on their practical knowledge, industry practice and common sense to form market segments. However, there is always a high level of subjectivity when using these methods (Sarstedt and Mooi, 2014) and the same goal might be achieved using cluster analysis.

This is the most commonly used technique to form segments (Reis, 1997; Hair *et al.*, 2010) and it is a powerful means to understand and learn from data (Jain, 2010). The objective of this technique is to find homogeneous groups of objects, called *clusters*, grouping the objects which share many characteristics and are, at the same time, very dissimilar to other objects placed in the remaining clusters (Reis, 1997; Barbara, 2000; Halkidi and Vazirgiannis, 2001). Therefore, the researcher is attempting “to maximize the homogeneity of objects within the cluster while also maximizing the heterogeneity between the clusters” (Hair *et al.*, 2010, p. 415).

Cluster analysis always produces statistical results, even in the absence of a logical basis for clusters (Hair *et al.*, 2010; Jain, 2010; Gama *et al.*, 2017). Thus, to undertake this problem, first of all, the researcher should have a theoretical basis underlying the whole research process, involving reasons to form *those obtained* groups and what variables can logically explain why objects end up in one particular group (Hair *et al.*, 2010).

While complying in the essential theoretical and methodological aspects, not every author proposes exactly the same stages or phases when conducting a cluster analysis (*e.g.*, Jain *et al.*, 1999; Hair *et al.*, 2010; Gama *et al.*, 2017). I will organize my study mainly after the proposals by Hair *et al.* (2010) and Sarstedt and Mooi (2014). Figure 16 displays all the stages that I will go through when conducting the cluster analysis and it resembles, especially, the flow chart by Hair *et al.* (2010).

I will apply cluster analysis to DRG 14, because it is simultaneously the DRG with the highest number of cases among the six DRGs studied in Chapter One and one out of the two DRGs, together with DRG 88, that produced the closest cost estimates compared to the alternative ABC methodology. Anyway, I could have chosen any other of the studied DRGs.

4. Conducting the cluster analysis

Figure 16 depicts the stages involved in conducting my cluster analysis. It is essentially based on the decision diagram proposed by Hair *et al.* (2010), with some rearrangements in line with the slightly different approach proposed by Sarstedt and Mooi (2014).

At the beginning of the clustering process, I must explain how using such a technique can help on answering the second research question.

In Chapter One, I proposed a *mezzo* methodology to estimate costs of individual patients. However, when evaluating how estimated costs may reveal accordance or deviation from the best practices and serve as a proxy to understand clinical pathways, the bigger picture turns too broad to interpret and serve as a tool to assist both department direction and top management.

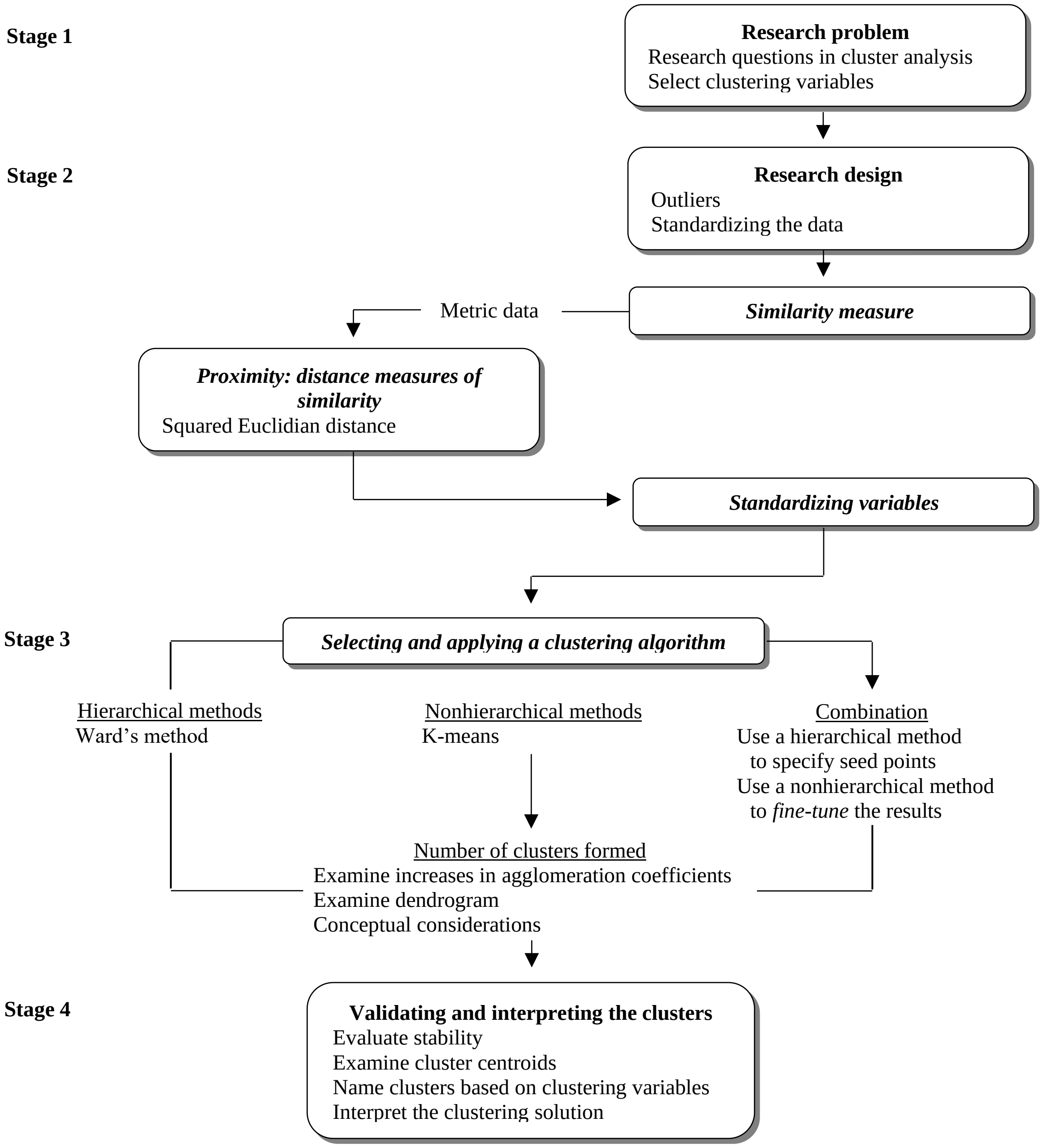

Figure 16 Conducting a cluster analysis

Adapted from Hair et al. *(2010)*

4.1. First stage design: characterizing the research problem

By introducing cluster analysis, the cost data processed in an earlier phase (as in Chapter One) may now be organized into homogeneous groups and provide guidance to discuss some points of utmost importance for research question two. First of all, a DRG is homogeneous by definition; therefore, if cluster analysis reveals homogeneous subgroups, while applied to an individual hospital, it may point to possible inefficiencies in the Portuguese DRG framework design. In second place, patients within a DRG are supposedly similar and generate somewhat equal costs; if cluster analysis reveals large subgroups, in terms of individuals or costs, it will be identifying areas of concern. Finally, as stressed by Hair *et al.* (2010, p. 427), the underlying structure of data within the formed clusters is “a means of revealing relationships among the observations that typically is not possible with the individual observations”. Stated in other words, patients represented next to each other may suggest patterns of deviations from best practices and established guidelines and call the attention of directors and managers.

The selection of clustering variables is the other important decision to take in stage 1. In the previous Chapter I have organized calculations in relation to the areas where care has been provided to patients: emergency department, operating room (for surgical DRGs) and ward (inpatient stay). This research design follows the course of patients throughout the hospital and, at the same time, presents cost estimates accordingly to the internal organization of hospital care provision, thus, making information on costs more understandable and actionable. Consistently, the clustering variables will be emergency costs (X_1) and ward costs (X_2) for medical departments and emergency costs (X_1), operating room costs (X_3) and ward costs (X_2) for surgical departments.

Following the diagram in Figure 16, we are now entering the second stage. All that I have just stated in relation to stage 1 is common to all the six cluster analysis that I am going to perform, and the same applies to many issues from stage 2 to the end of the process. Such are the cases of decisions on the choice of the distance measure of similarity, on the standardization of variables and on the selection of a clustering algorithm. I am going to fully present the cluster analysis related to DRG 14 along this Chapter, while the results of the remaining DRGs will be presented in Appendix.

4.2. Second stage design: research design in cluster analysis

At this second stage, the relevant issues to decide are related to the detection of outliers, the selection of a similarity measure and the standardization of variables.

The questions raised in the sphere of research design in cluster analysis do not provide definitive answers (Jain *et al.*, 1999; Barbara, 2000), making cluster analysis "as much an art as a science" (Hair *et al.*, 2010, p. *490*). Cluster analysis seeks structure in the data and is very sensitive to decisions about the clustering algorithm, but it is also sensitive to decisions made at this stage, such as the case of outliers (Barbara, 2000; Hair *et al.*, 2010).

4.2.1. Detection of outliers

Outliers may be either truly aberrant observations that are not representative of the population or representative observations of small or insignificant segments within the population (Hair *et al.*, 2010). If not removed, in the first case the actual structure may be distorted and the derived clusters may not represent the actual population structure; in the second case the relevant segments in the population will not be represented as accurately as possible. Therefore, outliers have to be identified and removed before the partitioning process.

Hair *et al.* (2010) propose a combination of graphical and empirical approaches. The first ones have the advantage of being simple and somewhat intuitive, but they become harder to interpret in the presence of a large number of observations or variables. Thus, there is the need to introduce another approach, based on measures of similarity. Single observations that differ from the others are the first candidates to be considered outliers. We can evaluate that difference using distances from each observation to the overall population centroid, since larger distances mean less similar observations.

Figure 17 shows a scatter plot of the entire population. Episodes 321, 186 and 212, as well as episode 464 are very dissimilar to the other observations, thus becoming the most obvious potential outliers.

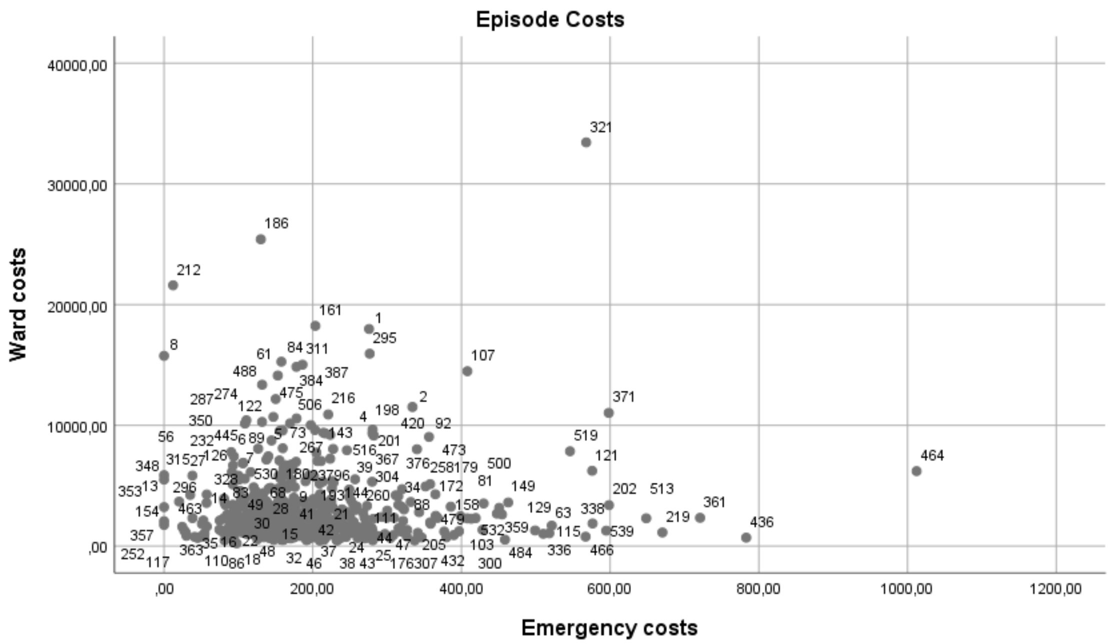

Figure 17 Scatter plot for the entire population of DRG 14

The empirical approach that we are going to use in addition to the graphical analysis was proposed by Hair *et al.* (2010) and requires a spreadsheet to rank the observations with higher dissimilarity.

The reasoning underlying this approach is the following: using the Euclidian distance to measure distance from each observation to all the other ones and assuming that the data follow a conventional distribution, we may consider that a typical episode corresponds to the central tendency (*i.e.*, the mean) of each variable.

Therefore, after profiling the variables on Table 8, I will rank on Table 9 the ten episodes with largest dissimilarity.

Descriptive Statistics for Cluster Variables					
Variables	n	Minimum	Maximum	Mean	Std. Dev.
X_1 Emergency costs	563	0,00	1.012,11	196,02	111,35
X_2 Ward costs	563	225,90	33.439,09	3.136,79	3.279,60

Table 8 Descriptive statistics for cluster variables

Largest Dissimilarity Values for Identifying Potential Outliers						
	Dif. from mean		Squared dif. from mean		Dissimilarity	
Episode	X_1 EC	X_2 WC	X_1 EC	X_2 WC	∑ dif. sq.	√ of total
13023614	371,75	30.302,30	138.198,74	918.229.238,09	918.367.436,83	30.304,58
13013423	(65,89)	22.273,56	4.341,27	496.111.666,03	496.116.007,30	22.273,66
13015122	(183,89)	18.466,42	33.814,42	341.008.788,24	341.042.602,66	18.467,34
13011400	7,45	15.104,24	55,43	228.137.948,98	228.138.004,41	15.104,24
12041072	79,67	14.846,77	6.347,99	220.426.636,41	220.432.984,40	14.846,99
13022061	80,49	12.795,01	6.478,65	163.712.239,26	163.718.717,91	12.795,26
12043409	(196,02)	12.620,15	38.422,38	159.268.083,65	159.306.506,03	12.621,67
13005129	(38,28)	12.134,97	1.465,47	147.257.496,32	147.258.961,79	12.135,03
13022975	(9,90)	11.890,55	98,03	141.385.090,31	141.385.188,34	11.890,55
13028201	(18,10)	11.711,14	327,70	137.150.878,84	137.151.206,54	11.711,16

Table 9 Largest dissimilarity values for identifying potential outliers

The construction of Table 9 begins by subtracting the mean to every episode in relation to both variables. The mean-centered values obtained in that way may represent a dissimilarity value for each episode, when compared to a typical one. In the next step, the differences are squared to avoid the problem of positive and negative values. Then, the squared differences are summed across the variables and finally, the estimates of dissimilarity are obtained through the square root of that sum.

Nevertheless, more important than the absolute value of dissimilarity is the relative decrease in dissimilarity. In fact, the episodes 13023614 (labeled 321 in the plot above), 13013423 (186) and 13015122 (212) show much higher values than all the other ones. Such a difference is more evident in the first two cases, but it is still high until the fourth episode. Conversely, from this episode onwards the decrease from one episode to the next is much slower.

On the other hand, there are only three episodes with costs above 15.000, but there are many ones positioned between 9.000 and 15.000, signalizing an area for further analysis. Otherwise said, distances between each of the three most dissimilar episodes and between the three of them and the remaining ones are very large, but distances between the next episodes are relatively narrow and there are several episodes with costs close to each other.

In conclusion, the episodes 13023614, 13013423 and 13015122 were considered outliers and will not be included in the partitioning process.

4.2.2. Similarity measure

Thinking about assessing distance between pairs of objects, the first idea that comes to our minds is drawing a straight line between them. This type of distance is referred to as *Euclidian distance*, or *straight-line distance*, and it is the most commonly used (Jain *et al.*, 1999; Sarstedt and Mooi, 2014). Taking into consideration that both variables are metric, Euclidian distance or squared Euclidean distance are adequate measures of similarity. In addition, both are the default similarity measure in statistical packages (Hair *et al.*, 2010). I decided to use squared Euclidian distance to undertake my cluster analysis.

4.2.3. Standardizing variables

The problem with standardization is that most cluster analysis using distance metrics is quite sensitive to different scales or magnitudes among the variables (Jain *et al.*, 1999; Barbara, 2000; Hair *et al.*, 2010). Otherwise, the variable with larger scale tends to dominate the other one when calculating proximity (Reis, 1997; Gama *et al.*, 2017). Regarding the research design, organizing cost estimates accordingly to the hospital internal organization, the absolute variation of ward costs (variable X_2) is much greater than the variation of emergency costs (variable X_1) and this would clearly distort the analysis results (Sarstedt and Mooi, 2014; Gama *et al.*, 2017). The way to solve this problem is by standardizing the data prior to the analysis.

Standardizing variables, *i.e.*, converting each variable to standard scores by subtracting the mean and dividing by the standard deviation, is the most common form of standardization (Reis, 1997; Barbara, 2000; Hair *et al.*, 2010). This option is provided by all computer statistical packages, such as the Statistical Package for the Social Sciences

(SPSS), and standard scores are also represented as *Z scores*. Through this process, each raw score is converted into a standardized value with a mean of 0 and a standard deviation of 1, thus eliminating the bias introduced by the differences in the scales of the two variables.

4.3. Third stage design: selecting and applying a clustering algorithm

In the present stage the very partitioning process gets started. The decisions to make at this stage are related to the clustering procedure (or algorithm) and the number of clusters to be formed.

4.3.1. Introducing clustering algorithms

As I will soon describe, clustering algorithms are organized into *hierarchical methods* and *nonhierarchical methods*. Notably, k-means, a nonhierarchical method, is preferable to hierarchical methods, because it is less affected by outliers and it is less demanding in computational terms (Sarstedt and Mooi, 2014). For instance, Sarstedt and Mooi (2014) suggest this method for samples or populations above 500 individuals or objects. But, unfortunately, it requires the pre-specification of the number of clusters to be formed (for the rest, one of the most demanding problems to be solved in implementing cluster analysis). The researcher may have the notion of how many clusters shall be formed, based on theory, previous research or practical questions. Nevertheless, this may not be the case, or the researcher may need to assess the fitness of his/her beliefs before applying k-means.

In order to solve this problem, the two sets of methods may be used in combination, under a two-step process. Following Barbara (2000), Hair *et al.* (2010) and Sarstedt and Mooi (2014), I will start by using a hierarchical method to identify a possible set of cluster solutions and I will afterwards use those solutions as an input to run a nonhierarchical method. Stated in other words, after identifying the adequate number of clusters, or an adequate set of candidates for the *correct* number of clusters, I will *fine-tune* the analysis using the method that literature refers as the most appropriate clustering method to employ in relation to the research configuration and objectives.

One must have in mind that the decision over a specific clustering algorithm will determine how clusters will be formed. The functioning of every clustering algorithm always involves optimizing a given criterion, like minimizing the within-cluster variance or maximizing the distance between the objects or clusters. Likewise, the algorithm can also assess the (dis)similarity between objects in a newly formed cluster and the remaining ones (Sarstedt and Mooi, 2014).

There are many alternative algorithms available, and they are usually categorized into *hierarchical* and *nonhierarchical methods*, along with the combination of both sets of methods (Barbara, 2000; Jain, 2010; Hair *et al.*, 2010).

Further, hierarchical methods are subdivided into *agglomerative* and *divisive methods* and the analysis produces a tree-like structure (Sarstedt and Mooi, 2014; Gama *et al.*, 2017). In agglomerative methods, each observation starts as a cluster itself. Then, the method will measure distance between all pairs of objects and sequentially merge the objects accordingly to their similarity. In step 1, the two most similar clusters are merged and form a new cluster at the bottom of the hierarchy. Repeating the process in the next step will merge another pair of clusters and ascend to a higher level in the hierarchy. Thus, this step-by-step process goes on and establishes a bottom-up hierarchy of clusters (Jain, 2010; Sarstedt and Mooi, 2014).

Conversely, divisive methods start by considering all objects as a single cluster, which is gradually divided until each observation corresponds to an individual cluster. Thus, in both methods, clusters on a higher level of the hierarchy encompass all clusters from a lower level, in such a way that once an object is assigned to a given cluster, there is no possibility of reassigning it to another cluster (Barbara, 2000; Gama *et al.*, 2017). As I will refer promptly, this is a major distinction in relation to alternative nonhierarchical methods. The graphical representation of hierarchical clustering is the *dendrogram* or tree graph (Jain *et al.*, 1999; Barbara, 2000) and the level at which the tree is cut provides a different clustering of the data (Halkidi and Vazirgiannis, 2001). This graph is useful and is available in statistical packages, but it becomes cumbersome with large datasets.

Regarding hierarchical clustering, I will only mention agglomerative methods, because they are the most used by researchers and are commonly used by default by statistical packages. Relying on Hair *et al.* (2010) and Sarstedt and Mooi (2014), I now briefly present the most popular methods:

Single linkage or *the nearest-neighbor*: the distance between two clusters corresponds to the shortest distance from any member in one cluster to any member in the other one;

Complete linkage or *the furthest neighbor*: in opposition to the first method, the distance between two clusters is based on the longest distance between any member in one cluster to any member in the other one;

Average linkage: differently from previous methods, distance is not based on extreme values (thus considering only pairs of observations, the closest or the furthest) but it is based on all members of the clusters. Therefore, the distance between two clusters is equal to the average distance between all pairs of both cluster's members and, as a consequence, this method is less affected by outliers and tends to generate clusters with small within-cluster variation;

Centroid: every time that a group is formed a new geometric center, the centroid, is calculated. The calculations are made by computing the average values of the clustering variables of all members of the group and the distance between two groups is equal to the distance between their centroids. This means that when a member is added to an existing cluster the centroid changes and thus may produce confusing results. Yet, this method is less affected by outliers than the other hierarchical methods.

Ward's method: this method differs from all the presented hierarchical methods because similarity is defined not by a single measure of distance but rather by the sum of squares within one cluster for all variables. Thus, when choosing what clusters to combine next, the method assesses the combination of clusters that minimizes the within-cluster sum of squares, considering the whole range of separate clusters. In other words, the next member to merge is the one that increases the overall within-cluster variance to the smallest possible level.

Now that I have just finished presenting the most popular hierarchical methods, I have to decide which one to apply, so that I might implement my cluster analysis.

The Ward's method tends to create clusters that are homogeneous and quite equal in size (Hair *et al.*, 2010; Sarstedt and Mooi, 2014) and therefore it seems the most adequate method to conduct the hierarchical clustering phase. In addition, it is considered the proper hierarchical model when dealing with large populations, such as the case of DRGs 14, 88 and 167, and especially in the case of DRG 14, whose population is above 500 individuals.

Nevertheless, as the Ward's method is quite sensitive to the presence of outliers (Hair *et al.*, 2010; Sarstedt and Mooi, 2014), as hierarchical algorithms in general (Barbara, 2000; Gama *et al.*, 2017), I must be particularly careful towards the identification and removal of outliers prior to running the clustering procedure. This is one of the reasons why I have so extensively described above how I removed outliers in DRG 14, and I will come back to this discussion when discussing the results of another methodology also used, among other purposes, to identify potential outliers: the agglomeration schedule.

4.3.2. Employing hierarchical methods

On step 1, I am going to perform my hierarchical clustering procedure. As I have just mentioned, I am going to use the Ward's method, combined with the squared Euclidian distance as the chosen similarity measure.

Hierarchical methods involve deciding over a number of clusters that may ascend to *n*-1 solutions (*n* represents the number of observations). Whether agglomerative or divisive, these methods create a treelike structure that can be represented by a dendrogram. This graphical representation is quite understandable and it is very useful for small populations but turns much more difficult to interpret and use for large populations. Therefore, I will use the dendrogram for DRGs with small populations and I will display in appendix the dendrogram for DRG 164 (Appendix 3), the first one with a small population, but I am going to rely on two other alternative methodologies to identify the initial range of cluster number solutions. The first one – which I may refer to as *the stopping rule* – was proposed by Hair *et al.* (2010) and it is based on the information provided by the agglomeration schedule, while the second one is based on *the variance ratio criterion* (VRC), initially proposed by Calinski and Harabasz (1974) and equally used by Sarstedt and Mooi (2014).

4.3.2.1. Searching for additional outliers

By running the hierarchical clustering algorithm on the elected software package (SPSS), one obtains the agglomeration schedule, which is partially reproduced in Table 10 and in Table 11 (from columns 1 to 6).

The schedule displays the stage where observations are combined to form successive clusters. For instance, in stage 550 observations 9 and 21 are combined to create a new cluster. The clustering process ends in stage 559, when observations from cluster 9 are combined with all the other ones to form a single cluster.

The schedule is also revealing in relation to two other meaningful and interrelated topics: on the one hand, information about when a cluster first appears as well as the joint agglomeration coefficient indicate how far that cluster is from the initial merging; and, on the other hand, observations that come up at the very end of the process and show very large coefficients may suggest the presence of outliers.

Agglomeration Schedule						
	Cluster combined			*Stage cluster first appears*		
Stage	Cluster 1	Cluster 2	Coefficients	Cluster 1	Cluster 2	Next stage
1	142	248	,000	0	0	383
2	124	261	,000	0	0	341
…	…	…	…	…	…	…
…	…	…	…	…	…	…
548	14	17	123,154	539	527	553
549	121	461	135,502	528	0	551
550	9	21	149,934	526	547	555
…	…	…	…	…	…	…
…	…	…	…	…	…	…
558	9	63	766,749	557	551	559
559	1	9	1.118,000	556	558	0

Table 10 Partial agglomeration schedule for DRG 14 using the Ward's method

Looking at stage 549 one can see that observations 121 and 461 are combined to form a cluster. But that same line displays important information: it is only at stage 549, a late stage not far from the end of the clustering process, that observation 461 joins a cluster for the first time. This suggests that observation 461 is relatively different from the other 559 observations and may signal a potential outlier.

In order to help me to decide whether considering observation 461 an outlier or not, I will present again the scatter plot for DRG 14, after the first removal of outliers, already done at the beginning of the research design. Notice that there is not a complete correspondence in the labeling of the observations between this plot and that one of Figure 17, since I have removed three initial observations, numbered 321, 186 and 212 in Figure 17. As a consequence, all observations above 186 have been renumbered.

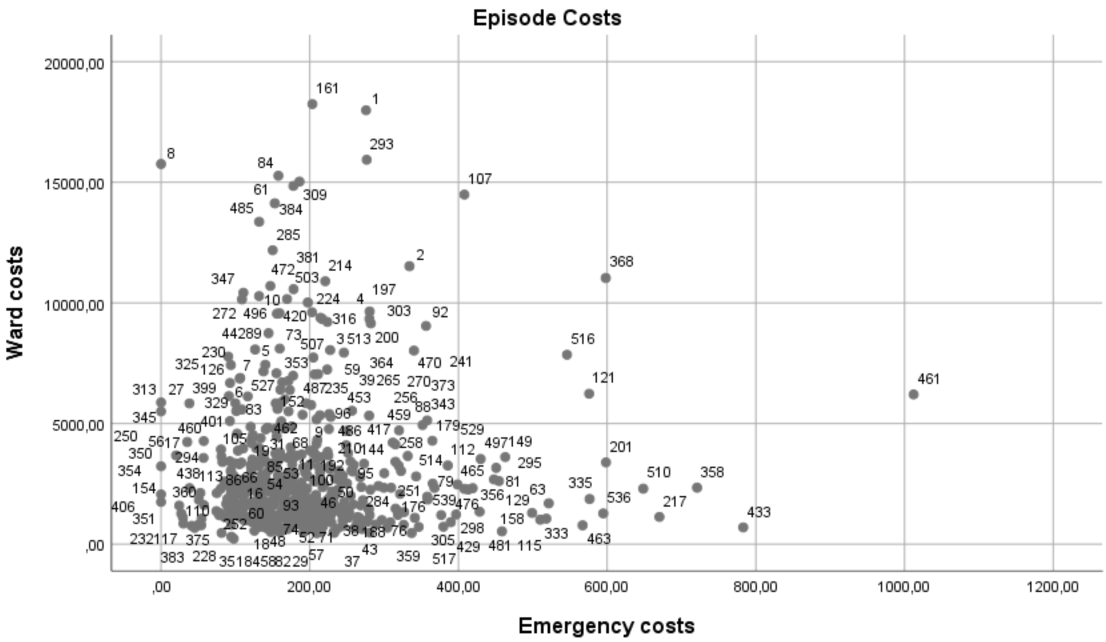

Figure 18 Scatter plot for DRG 14, after the initial removal of outliers

4.3.2.2. How many clusters to choose? Assessing the initial number of clusters through the Ward's method and *the stopping rule*

After the removal of outliers, I may now address the fundamental questions in cluster analysis: how many clusters should I consider?

I must have in mind that, at this point, I am not yet looking for the final solution, but I have to identify an operable preliminary set of cluster solutions that will form the basis for nonhierarchical clustering.

Starting with *the stopping rule*, I need to rearrange the agglomeration schedule presented in Table 10. Thus, I retained columns from one to four and added four other columns, which aim to measure and compare the increase in heterogeneity between stages, or, in other words, the increase in heterogeneity when a new observation is merged to form a new cluster. The new arrangement of the agglomeration schedule is shown in Table 11.

Agglomeration schedule (partial)							
Stage	Cluster 1	Combined with cluster	Coeff.	Nr. of clusters after combining	Diff.	Proportionate increase in heterogeneity to next stage	***Stopping rule***
549	9	21	137,586	10	14,657	10,7%	Too many clusters for analysis.
550	63	121	152,243	9	18,914	12,4%	Increase is larger than the previous stage, arguing against combination.
551	11	18	171,157	8	23,935	14,0%	Again, increase is larger than the previous stage, arguing against combination.
552	11	14	195,092	7	27,053	13,9%	Increase is relatively small, favoring combination to 6 clusters.
553	1	2	222,145	6	46,893	21,1%	Increase is larger than the previous stage, favoring 6 to 5 clusters.
554	12	63	269,038	5	80,848	30,1%	Increase is relatively large again, favoring 5 clusters over 4 and thus suggesting a possible stopping point at 6 clusters.
555	1	3	349,886	4	87,742	25,1%	Increase is relatively small, favoring combination to 3 clusters.
556	9	11	437,628	3	272,258	62,2%	Corresponds to the highest increase. Besides, a 2 cluster solution may have limited value for analysis. This may be an alternative stopping point.
557	9	12	709,886	2	351,834	49,6%	Represents a decrease but is still above the average. Besides, a 1 cluster solution has no meaning.
558	1	9	1.061,720	1			The 1 cluster solution is not meaningful.

Table 11 Partial agglomeration schedule for DRG 14
using the Ward's method, together with *the stopping rule*

The partial agglomeration schedule displays no more than ten possible cluster number solutions. By definition, a DRG is a homogenous group and therefore it is not supposed to encompass a large number of subgroups. Then, we shall not need to add more stages to the agglomeration schedule.

In column “Proportionate increase…”, I calculated the relative changes when moving from one stage to the next. Low percentages mean that the clusters being merged are rather homogeneous, whereas high percentages mean that the new combination is merging quite different clusters and so the previous cluster solution is preferable to the new one. For example, moving from stages 449 to 455 shows an increase of heterogeneity of 10,7%, the lowest value in the table, while moving from stage 554 to stage 555 represents an increase in heterogeneity of 30,1%, which is a quite large increase compared to the previous values.

The question then is how to assess what are low and high increases and, although being a rough guide, the average proportionate increase may be useful for this purpose. But interpret the relative increase in heterogeneity imply some other considerations as well.

On the one hand, it is necessary to retain that when approaching the end of the table the agglomeration coefficient gets naturally larger. On the other hand, the range of possible cluster solutions must be manageable and meaningful regarding the research objectives. The latter means that too many or too few clusters, *i.e.*, the ten-cluster solution at the top of Table 11 or the two-cluster solution at the bottom, may have limited value in identifying relevant subgroups for further analysis within the supposedly homogeneous DRG 14.

Compared to the average proportionate increase of 26,6%, the movements from stage 550 to 551 (12,4%), 551 to 552 (14,0%), 552 to 553 (13,9%), 553 to 554 (21,1%) and 555 to 556 (25,1%) are candidates to be part of the initial set of possible cluster solutions.

Since most of the candidates are located between the movements from stage 550 to 551 and 553 to 554, one shall get a closer look to this part of the table. The relative increase associated with the movement from stage 550 to 551 (12,4%) is larger than the previous one (10,7%), thus arguing against combination. Again, the relative increase related to the movement from stage 551 to 552 (14,0%) is larger than the previous one (12,4%), repeating the argument against combination. On the contrary, the next movement reveals a relative increase slightly lower than the preceding one (13,9% against 14,0%). Therefore, in relative terms, a six-cluster solution induces less additional heterogeneity than a seven-cluster solution, indicating a possible stopping point. This conclusion is reinforced by the last movement within this subset, from stage 553 to 554. In fact, there is a new and marked increase in the heterogeneity, with a shift from 13,9% to 21,1%. In sum, regarding this subset of possible cluster solutions, six clusters seem to be the preferable clustering configuration.

In turn, a solution with only three clusters seems to be an alternative to consider, as the relative increase in heterogeneity from stage 555 to stage 556 is, again, below the average.

A graphical approach can be added to complement the analysis:

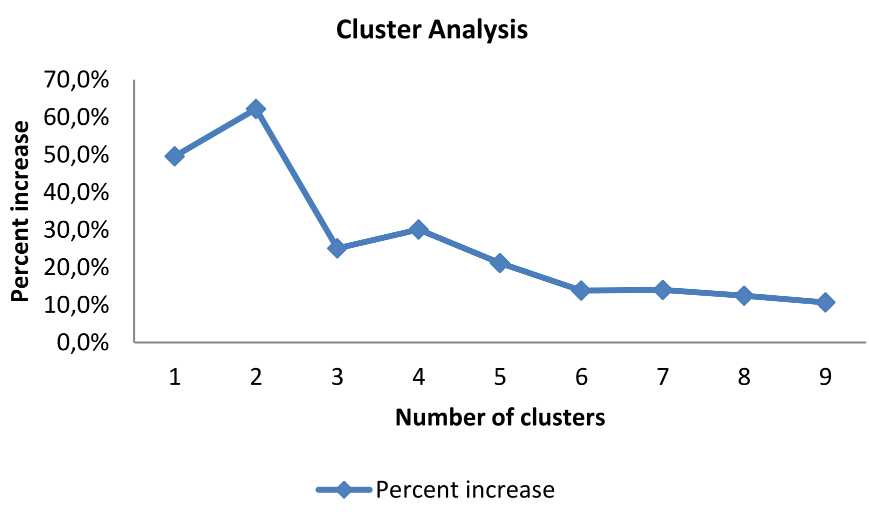

Figure 19 Percent change in heterogeneity

The percent change in heterogeneity is relatively low in the tail of the series reproduced in Figure 19. However, as I have stated, nine or even eight clusters may be too many segments for a supposedly homogeneous population, as one expects by the very notion of a DRG. Therefore, moving leftwards one detects a slight fall in the proportionate increase in heterogeneity in relation to a six cluster solution, pointing out a possible adequate set of segments for DRG 14. From this point, the percent change in heterogeneity raises continuously until the shift from four to three clusters, when the first downward move in the relative heterogeneity appears. This means that a three cluster solution may be tested as an alternative configuration.

A final step is still needed to assess the validity of the two alternative solutions that I have identified through hierarchical clustering. Thus, in Table 12 and Figure 20, I profile the clustering variables for both solutions in order to confirm that the differences between clusters are distinctive and significant regarding the research objectives. I will start by profiling the variables for the six-cluster solution and after proceed for the three-cluster solution.

Means from Hierarchical Cluster Analysis						
	Mean values per cluster number					
Variable	1	2	3	4	5	6
X_1 Emergency costs	207,44	167,98	233,12	129,62	365,18	595,18
X_2 Ward costs	11.735,69	6.177,45	1.773,99	2.132,66	2.713,77	2.930,48
Cluster sizes	31	52	153	270	38	15

Means from Hierarchical Cluster Analysis								
	Mean-centered values per cluster number							
Variable	1	2	3	4	5	6	*F*	Sig
X_1 Emergency costs	13,11	-26,36	38,78	-64,72	170,85	400,84	452,714	,000
X_2 Ward costs	8.731,48	3.173,24	-1.230,22	-871,55	-290,44	-73,73	390,112	,000
Cluster sizes	31	52	153	270	38	15		

Table 12 Profile of six clusters from hierarchical cluster analysis for DRG 14

I will take the *F* statistics from one-way ANOVA presented in the far right of the lower part of Table 12 to examine the distinctiveness, *i.e.*, to evaluate if the formed six clusters are significantly different in relation to the clustering variables. In the performed one-way ANOVA, the independent variable has been cluster membership (the affiliation to each cluster generated by the Ward's method), while the dependent variables have been the two clustering variables. Given the high value of the significant F statistics there is initial evidence that all of the six clusters are distinctive from each other.

A further evaluation of the cluster's means in relation to the two clustering variables may benefit from the graphical representation in Figure 20 below.

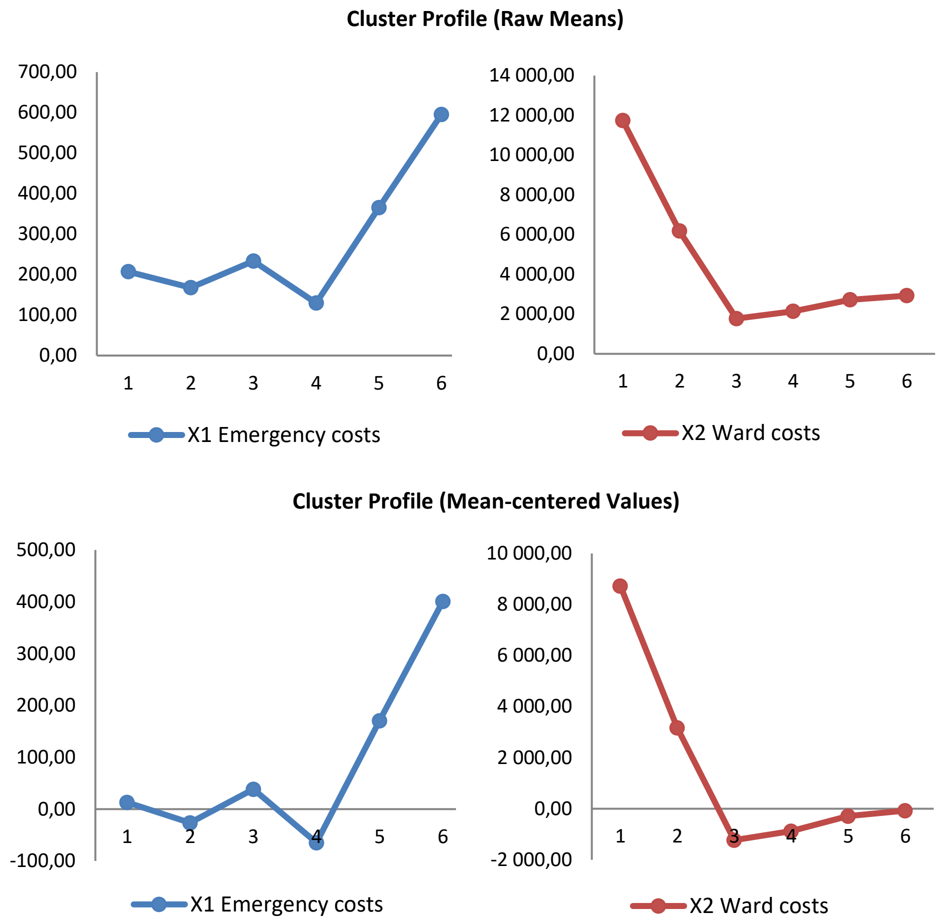

Figure 20 Profile of six clusters from hierarchical cluster analysis for DRG 14

The upper part and the lower part of Figure 20 provide two alternative ways to compare the cluster means. The upper part uses raw means, while the lower part is based on mean-centered values. Since conclusions are similar when using one configuration or the other, I will focus on the upper part, thus comparing the cluster's raw means.

In addition to comparing the cluster's means, I will also briefly characterize each cluster, in reference to the size (number of observations comprised) and the relative value of cost estimates for both clustering variables.

Cluster 1 comprises 31 observations (see Table 12) and is characterized by a relatively low mean on X_1 Emergency costs, but shows the highest mean on X_2 Ward costs, with approximately twice the value of the second highest cluster. Cluster 2 encloses 52 observations, displays the second lowest mean on X_1 but, at the same time, the second largest mean on X_2. It is interesting to note that means on clusters 1 and 2 are among the lowest on all segments on X_1, but concerning X_2 their values are several times above the remaining segments. From Table 12 one retains that there are two large clusters in terms of observation. Those are the cases of clusters 3 and 4, with 153 and 270 observations, respectively. Cluster 3 is characterized by a relatively low (whether higher than the two previous clusters) mean on X_1 and the lowest mean on X_2. Cluster 4 presents the lowest mean on X_1, together with a relatively low mean on X_2. With 38 observations, cluster 5 reveals a mean on X_1 markedly above the four previous clusters, while registering a relatively low mean on X_2. Finally, cluster 6 comprises 15 observations and it is mostly distinguished by the highest value on X_1, as the mean on X_2 is relatively low.

I will preserve an interpretation of these results for the moment when I finish the cluster analysis for DRG 14. Nevertheless, there are already two substantial conclusions to retain: first, each of the six clusters presents fairly distinctive characteristics; and second, all of the six clusters comprehend a number of observations that justify an individual analysis of each of them. In fact, along with two major clusters which might represent the essential population of DRG 14, we find other clusters with a number of episodes and total cost estimates large enough to be studied and understood.

I will now repeat the analysis in relation to the alternative three-cluster solution, through Table 13 and Figure 21.

Means from Hierarchical Cluster Analysis								
	Mean values per cluster number			Mean-centered values per cluster number				
Variable	1	2	3	1	2	3	*F*	Sig
X_1 Emergency costs	182,72	167,06	430,28	-11,62	-27,28	235,94	319,859	,000
X_2 Ward costs	8.253,42	2.002,93	2.775,10	5.249,21	-1.001,28	-229,11	484,775	,000
Cluster sizes	83	423	53	83	423	53		

Table 13 Profile of three clusters from hierarchical cluster analysis for DRG 14

Again, there is initial evidence that the differences among the three segments are significant, regarding the *F* statistics in Table 13 above. Proceeding to the analysis of the means, I will also make use of the graphical portrayal in Figure 21 and focus on mean values, instead of the alternative mean-centered values.

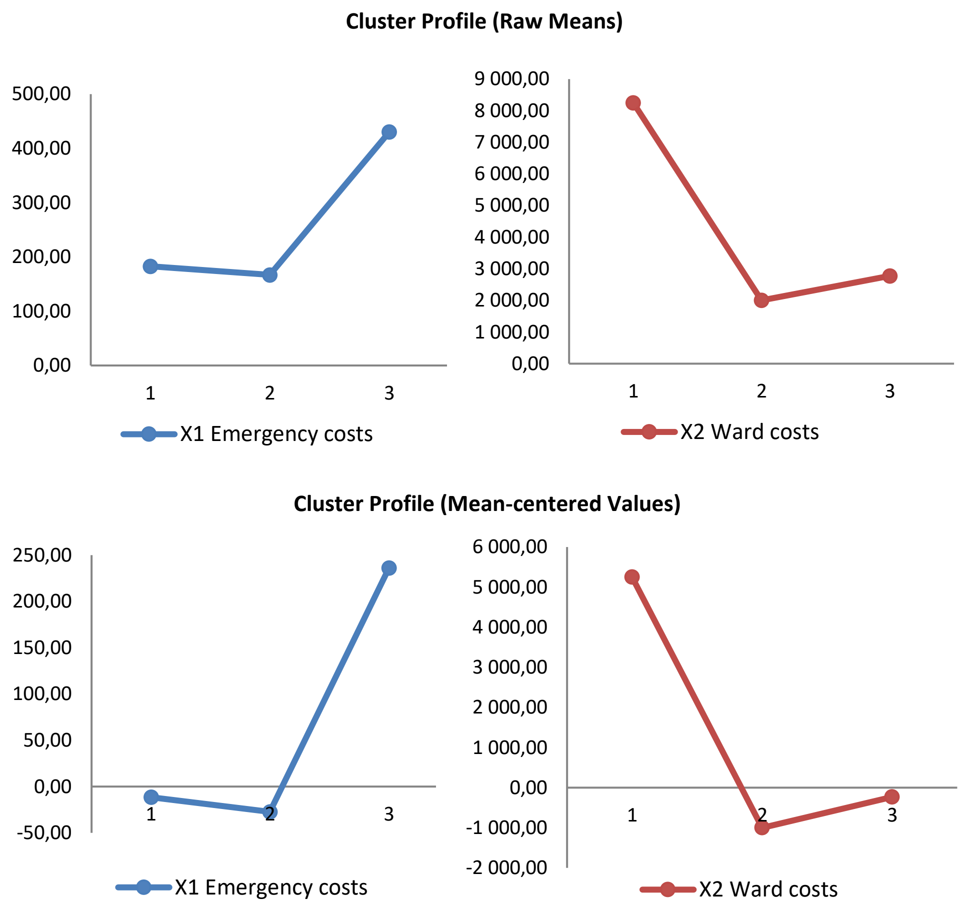

Figure 21 Profile of three clusters from hierarchical cluster analysis for DRG 14

Cluster 1 contains 83 episodes and exhibits contrasting values for the means on variables X_1 Emergency costs and X_2 Ward costs. In fact, while the former is relatively low, the latter is the highest, at a large distance from the other segments. Cluster 2 comprises 423 episodes, about ¾ of total population, and its means are the lowest in relation to both X_1 and X_2. At last, cluster 3 contains 53 episodes and also depicts contrasting values for means on X_1 and X_2, except for this time it is the mean on X_1 that largely exceeds means on other segments, while the mean on X_2 is relatively low.

The graphical representation of both solutions in Figures 22 and 23, depicting six and three segments, can help in interpreting and visualizing how the cost estimates for episodes in DRG 14 have been organized accordingly to hierarchical clustering.

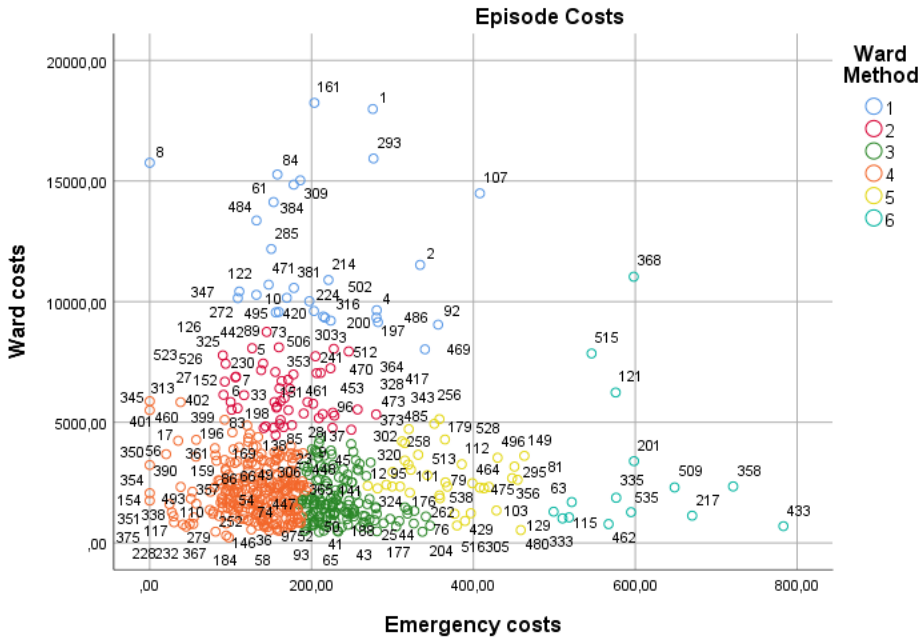

Figure 22 Scatter-plot of a six-cluster solution for DRG 14 after a hierarchical procedure (Ward's method)

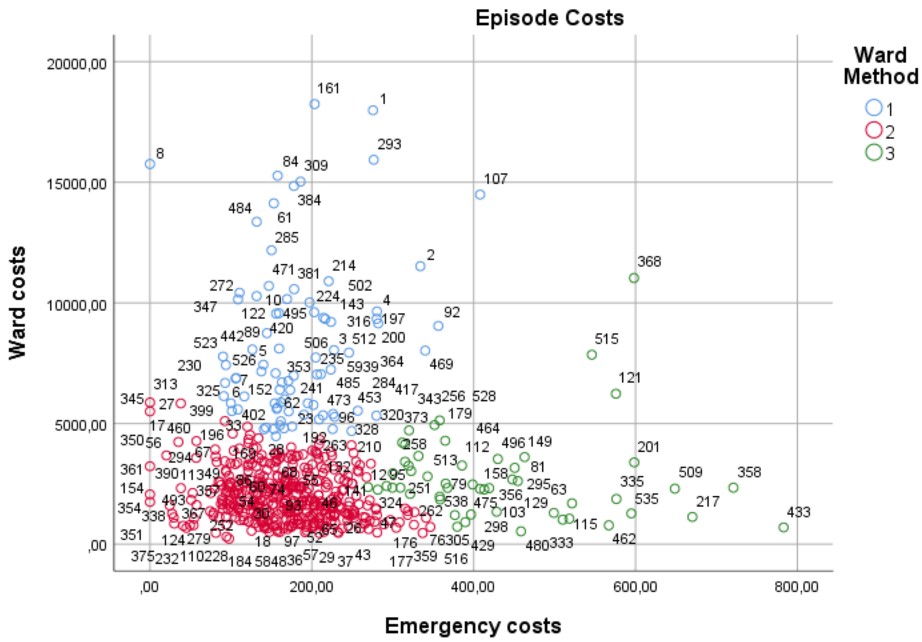

Figure 23 Scatter-plot of a three-cluster solution for DRG 14 after a hierarchical procedure (Ward's method)

4.3.2.3. Reassessing the initial number of clusters by using the Ward's method and *the variance ratio criterion* (VRC)

Following *the stopping rule*, I identified two possible set of clusters for DRG 14 (a six-cluster and a three-cluster solutions), to carry forward to nonhierarchical clustering. However, before moving on to nonhierarchical analysis, I will also apply the VRC and compare results to those of *the stopping rule*.

The VRC works as follows (Sarstedt and Mooi, 2014):

Let me present a solution with *n* objects and *k* segments. Then, the VRC is given by the expression:

(1) $VRC_k = (SS_B/(k-1))/(SS_w/(n-k))$,

where SS_B is the sum of the squares between the segments (*i.e.*, the overall between-segment variation) and SS_w corresponds to the squares within the segments (*i.e.*, the overall within-segment variation).

The VRC is actually the *F* statistics of a one-way ANOVA, being *k* the number of factor levels, what makes the criterion easily computed through SPSS with a few additional calculations (Sarstedt and Mooi, 2014). Those additional calculations involve getting the value for w_k, measuring the incremental variation for each segment, as follows:

(2) $$w_k = (VRC_{k+1} - VRC_k) - (VRC_k - VRC_{k-1}).$$

The criterion application ends by choosing *k* as the number of segments that minimizes the value in w_k (Sarstedt and Mooi, 2014).

Looking at the expression which allows me to calculate w_k, I can observe that the minimum number of possible solutions is three. Although pointed as a disadvantage of the criterion (Sarstedt and Mooi, 2014), it does not interfere with my research, because as I have said about *the stopping rule*, a solution of only two segments has limited meaning regarding my research objectives.

Having in mind the cluster solutions suggested by the application of *the stopping rule*, as well as practical considerations around exceeding eight segments, I will evaluate different solutions, ranging from three to eight segments. In reality, there is the need to run an analysis for nine segments, in order to be able to calculate w_8. Therefore, I extended the previous analysis based on the Ward's method to the remaining alternative solutions, with two, four, five, seven, eight and nine segments and the ANOVA output for each of these analysis is presented in Appendix 1.

Taking the *F* statistics from Tables 12 and 13, together with the values released in Appendix I, I am able to calculate both the VRC and w_k:

VRC		
Number of clusters	VRC	W_k
2	945,404	
3	804,634	106,743
4	770,607	91,950
5	828,530	-43,627
6	842,826	-39,058
7	818,064	35,288
8	828,590	-18,281
9	820,835	

Table 14 Values for VRC and w_k

The values for w_k have been calculated using the expression (2) above. For example, for k = 3, w_k results in:

(3) $w_3 = (770{,}607 - 804{,}634) - (804{,}634 - 945{,}404) = 106{,}743.$

The lowest values for w_k appear for five, six and eight segments, in this order, and thus they are only partially coincident with the application of *the stopping rule*. Since I have already run a hierarchical analysis for six segments and I consider eight segments a too large solution regarding the research objectives, I am now going to use the Ward's method to run a hierarchical analysis for the remaining five-cluster solution.

Means from Hierarchical Cluster Analysis					
	Mean values per cluster number				
Variable	1	2	3	4	5
X_1 Emergency costs	207,44	167,98	233,12	129,62	430,28
X_2 Ward costs	11.735,69	6.177,45	1.773,99	2.132,66	2.775,10
Cluster sizes	31	52	153	270	53

Means from Hierarchical Cluster Analysis							
	Mean-centered values per cluster number						
Variable	1	2	3	4	5	*F*	Sig
X_1 Emergency costs	13,11	-26,36	38,78	-64,72	235,94	340,344	,000
X_2 Ward costs	8.731,48	3.173,24	-1.230,22	-871,55	-229,11	488,186	,000
Cluster sizes	31	52	153	270	53		

Table 15 Profile of five clusters from hierarchical cluster analysis for DRG 14

As I have done in relation to three-segment and six-segment solutions, I will divide my brief analysis about the alternative five-segment configuration in two parts. I will start by examining the distinctiveness in regarding to the value and the significance of the *F* statistics in Table 15 and then compare cluster's means and interpret the solution with support from the graphical representation in Figure 24.

In relation to distinctiveness, the *F* statistics is, again, significant and presents a high value, thus providing initial evidence each cluster is distinctive.

Figure 24 below profiles raw means and mean-centered values for the five-segment solution:

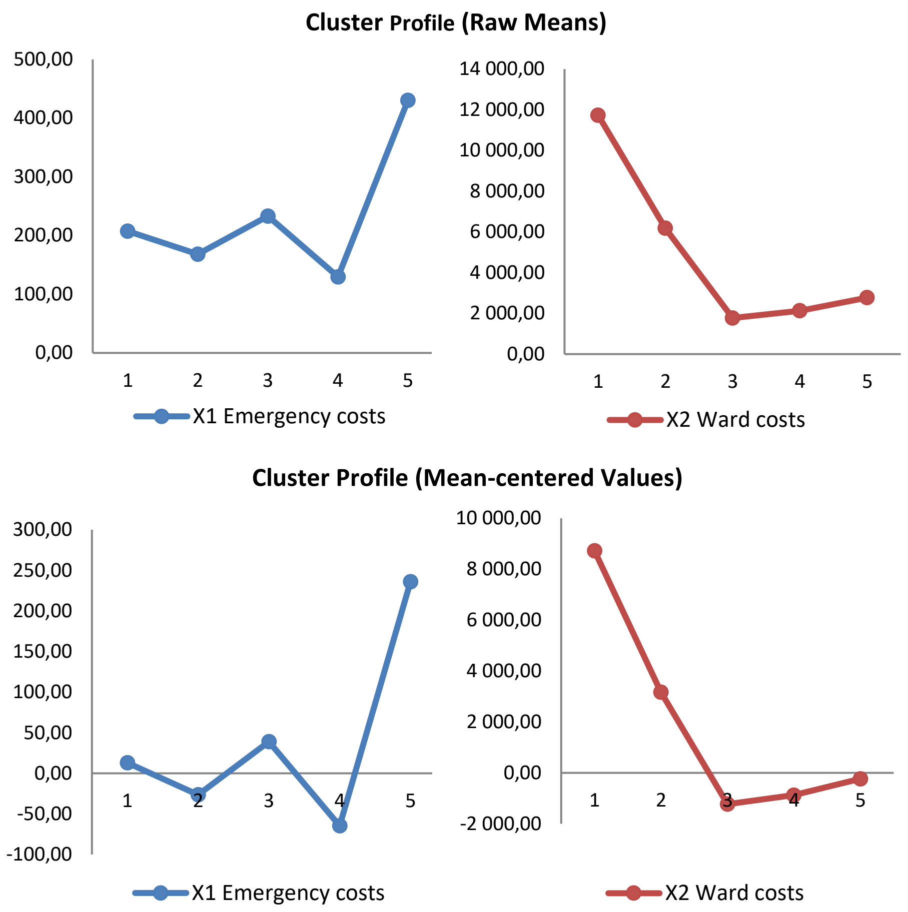

Figure 24 Profile of five clusters from hierarchical cluster analysis for DRG 14

It is worthwhile noting that there is a single difference between the solutions with six and five segments. Actually, when moving from one configuration to the other the first four segments remain unchanged. The novelty is confined to the final part of the clustering process, in which segments 5 and 6 from the six-segment solution are merged into a single one.

Therefore, the *new* cluster 5 comprises 53 observations and, like the former clusters 5 and 6 in the six-segment solution, is characterized by a much higher mean on X_1 than the other segments, together with a relatively low mean on X_2.

As a consequence, the scatter-plot above is only slightly different from the one depicted in Figure 25:

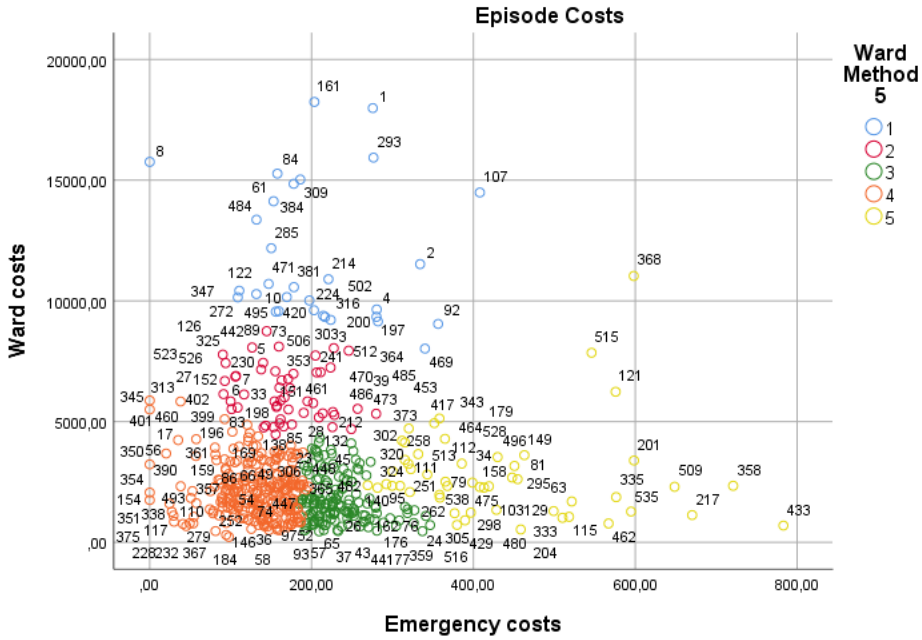

Figure 25 Scatter-plot of a five-cluster solution for DRG 14 after a hierarchical procedure (Ward's method)

4.3.2.4. Deciding on the final number of clusters to carry to nonhierarchical clustering

Following the scheme in Figure 16, I am almost entering the nonhierarchical methods. This second set of methods is reported as "superior to hierarchical methods as it is less affected by outliers" (Sarstedt and Mooi, 2014, p. 297) and it is particularly useful in the presence of large datasets of more than 500 observations, as is the case of DRG 14, because it is less computationally demanding (Sarstedt and Mooi, 2014).

However, these methods require the indication of the number of clusters right from the beginning of the clustering process. Thus, I have to decide which one of the three solutions retained from the hierarchical phase shall be used as an input for the definite nonhierarchical clustering.

In that decision, one must bear in mind that there is no unquestionable way or a precise rule of thumb to select *the* solution (Jain, 2010; Gama *et al.*, 2017). On the contrary, “the data can often only provide rough guidance regarding the number of clusters you should select” (Sarstedt and Mooi, 2014, p. 294). Therefore, the decision shall be driven by practical considerations subject to the research objectives. Stated in other words, I must identify a certain number of clusters that can assist the department directors and managers in better knowing the cost consequences of the clinical pathways of inpatients, in the case, belonging to DRG 14. The cluster analysis may help in identifying large and homogeneous subgroups that together represent the large majority of cases, along with other subgroups that diverge from the mainstream and arouse concern.

Regarding what I have just said, the three-cluster solution does identify a large and essential subgroup which encompasses 423 out of the 563 episodes classified into DRG 14 in 2013 (including the 4 outliers that have been removed before the clustering process). However, I consider the two remaining clusters (with 83 and 53 episodes) too large to study in depth.

In fact, both the five-cluster and the six-cluster solutions keep the ability to identify the trend beneath clinical procedures and the associated costs. For that to happen I just need to put together clusters 2, 3 and 4. This junction leaves aside two or three other subgroups large enough to simultaneously justify concern and allow digging data in order to understand why these episodes are so different from those grouped into major clusters 2, 3 and 4.

Interestingly, the difference between the five-cluster and six-cluster configurations has to do only with two clusters at the *tail* of the graphical representation in Figures 25 and 22, respectively, looking alongside the *X* axis. All the remaining clusters are absolutely equal in the two configurations. I consider the six-solution the preferable choice, because the information is preserved in the essential while department directors and managers may sequentially start studying the farthest cluster (the most dissimilar episodes in relation to the emergency costs) and then move into the cluster graphically located next to that one.

4.3.3. Proceeding to nonhierarchical methods

The other important group of clustering procedures that I have been referring to and I am going to use in combination with the Ward's method is both known as *nonhierarchical* or *partitioning* methods. Within this group, different clustering algorithms have been proposed, but the most notably used is **k-means** (Jain, 2010; Gama *et al.*, 2017). This method follows a totally distinctive principle of grouping objects. Instead of using distance measures such as the squared Euclidian distance, the homogenous groups are formed on the basis of within-cluster variation. The aim of the method is to divide the data into parts in order to minimize the within-cluster variation (Barbara, 2000; Gama *et al.*, 2017).

4.3.3.1. Fine-tuning results through k-means

K-means works as follows: in the first moment, objects are randomly assigned to a given number of segments (there is the need to pre-specify the number of segments); afterwards, an interactive process is conducted, successively reassigning objects to other cluster, while it is possible to reduce the overall within-cluster variation. The within-cluster variation can be described as the squared distance from each object to the center of the associated cluster (Barbara, 2000; Sarstedt and Mooi, 2014).

As one can see, objects may be reassigned to other clusters during the process, contrarily to hierarchical methods, in which objects are affiliated once and for all to a certain cluster. Thus, one will not get a treelike structure or a hierarchy, and that is why the method is labeled as *nonhierarchical*.

By default, k-means generates random centers to start the clustering process. In practice, SPSS works a little differently, because it picks one observation as the cluster center. Still, cluster centers are randomly generated.

This is a question of utmost importance, because if one accepts the randomly generated *seed points* (*i.e.*, the initial cluster centers), the procedure at use is regarded as more inefficient than hierarchical procedures (Hair *et al.*, 2010). In fact, the benefits of k-means can only be fully achieved with the use of adequate pre-specified seed points (Barbara, 2000) and, along with identifying the adequate number of cluster, this is the reason why I have decided to use a combination of hierarchical and nonhierarchical methods in the fashion described in stage 3 of Figure 16.

Having decided the number of clusters, I may now start to use the k-means method. The previous hierarchical analysis gives another contribution to this phase, because I can pick the cluster means and use them as input for running k-means. However, SPSS requires some data specification to do this. Such specification is exhaustively explained in Sarstedt and Mooi (2014).

When SPSS performs a clustering procedure, like the Ward's method or k-means, a new variable is added to the dataset, containing the affiliation of each observation to its corresponding cluster (cluster membership). Such information can then be used for multiple purposes, like counting or aggregating observations per cluster[8].

The new aggregated dataset contains the variable's means (displayed in Table 16 below) for each of the 6 clusters and now I am able to specify the seed points and start k-means clustering.

---

[8] In SPSS, data aggregation is available through the option Data ► Aggregate. This option opens a dialog box in which one chooses the cluster membership (created through the Ward's method for 6 clusters, as I have decided in the hierarchical phase) as the *break variable* and move the standardized variables *ZEmergency* and *ZWard* into the *Summaries of variables* box. In the variables' names, *Z* stands for *standardized* and it is automatically added by SPSS when variables are standardized. Finally, the aggregated variables were placed in a new dataset, which I labeled as *aggregate*, and some concluding changes have been operated in this new file in order to put it in the right operational format, as suggested by Sarstedt and Mooi (2014).

Means for Standardized Variables		
Ward Method 6 [CLU6_2]	*Z*Emergency	*Z*Ward
1	,11	3,15
2	-,25	1,14
3	,34	-,45
4	-,60	-,32
5	1,54	-,11
6	3,62	-,03

Table 16 Means for standardized variables
ZEmergency and *ZWard*

If I have done the same data processing in relation to the non standardized variables I would obtain the results shown in Table 12.

I then applied k-means clustering by specifying the number of clusters and using the aggregated dataset[9]. The k-means output is shown in Tables 17 to 19, reporting the initial cluster centers, final cluster centers and ANOVA, respectively, as well as in Figure 14, depicting the distribution of the observations and the clusters' composition.

Initial Cluster Centers						
	Cluster					
	1	2	3	4	5	6
Score Z: Emergency costs	,10565	-,25236	,33857	-,60039	1,53671	3,62335
Score Z: Ward costs	3,15332	1,14468	-,44664	-,31703	-,10703	-,02871

Table 17 Initial cluster centers for k-means procedure with 6 clusters for DRG 14

[9] K-means clustering was performed by selecting the option Analyze ► Classify ► K-means Cluster and by using the dialog box to begin the process. The dialog box was the interface that synthesized the input information that led through the clustering process. The information included the specification of variables (standardized variables were moved into the *Variables* box) and there was the need to specify "6" as the number of clusters as well as to select *Read initial* and choose the dataset *aggregate*, which I had prepared in advance. Before starting the analysis, I also requested some essential statistics, like the cluster affiliation, the initial cluster centers and the ANOVA table.

Final Cluster Centers						
	Cluster					
	1	2	3	4	5	6
Score Z: Emergency costs	,06553	-,32984	,12831	-,73836	1,47934	3,62335
Score Z: Ward costs	3,19806	1,05297	-,42371	-,34242	-,24549	-,02871

Table 18 Final cluster centers for k-means procedure with 6 clusters for DRG 14

Starting by initial and final cluster centers, one can verify that observations have been reassigned during the process, reducing the overall within-cluster variation.

Contrarily to hierarchical clustering, the k-means output includes an ANOVA of the cluster centers (Table 19), which I am now going to use in order to evaluate the significance of clustering variable differences.

ANOVA						
	Cluster		Error			
	Mean square	df	Mean square	df	*F*	Sig.
Score Z: Emergency costs	82,600	5	,165	553	501,637	,000
Score Z: Ward costs	88,626	5	,207	553	427,899	,000

Table 19 ANOVA output for k-means procedure with 6 clusters

There are two relevant conclusions to retain: in first place, all the clustering variables' means differ significantly across at least two of the six segments, because Sig. $\leq$ 0,05 in both cases, thus rejecting the null hypothesis; and in second place, the *F* statistics present even higher values than in previous hierarchical clustering (cf. Table 10), corroborating the ability recognized to nonhierarchical methods to create clusters that are usually more distinctive than happens when following hierarchical procedures.

Finally, the scatter-plot in Figure 26 at the top of the next page provides a visually appellative localization about the observations and the cluster membership.

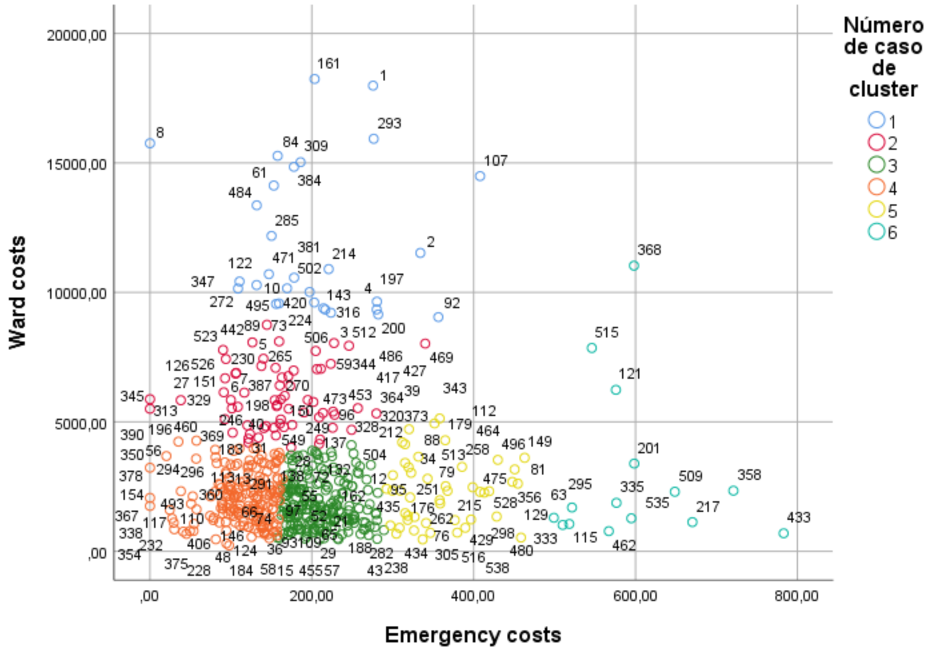

Figure 26 Scatter-plot of six clusters for DRG 14 using k-means

A closer look at the variables' means is helpful to characterize the cluster solution that resulted from k-means clustering. As I did in relation to the Ward's method, although presenting both means and mean-centered values in Table 20, I will focus only on the former for a brief comment.

Means from Nonhierarchical Cluster Analysis						
	Mean values per cluster number					
Variable	1	2	3	4	5	6
X_1 Emergency costs	203,02	159,44	209,94	114,41	358,86	595,18
X_2 Ward costs	11.859,49	5.923,67	1.837,46	2.062,41	2.330,62	2.930,48
Cluster sizes	30	66	213	188	47	15

Means from Nonhierarchical Cluster Analysis								
	Mean-centered values per cluster number							
Variable	1	2	3	4	5	6	*F*	Sig
X_1 Emergency costs	8,68	-34,90	15,60	-79,93	164,52	400,84	501,637	,000
X_2 Ward costs	8.855,28	2.919,46	-1.166,75	-941,81	-673,59	-73,73	427,899	,000
Cluster sizes	30	66	213	188	47	15		

Table 20 Profile of six clusters from k-means clustering for DRG 14

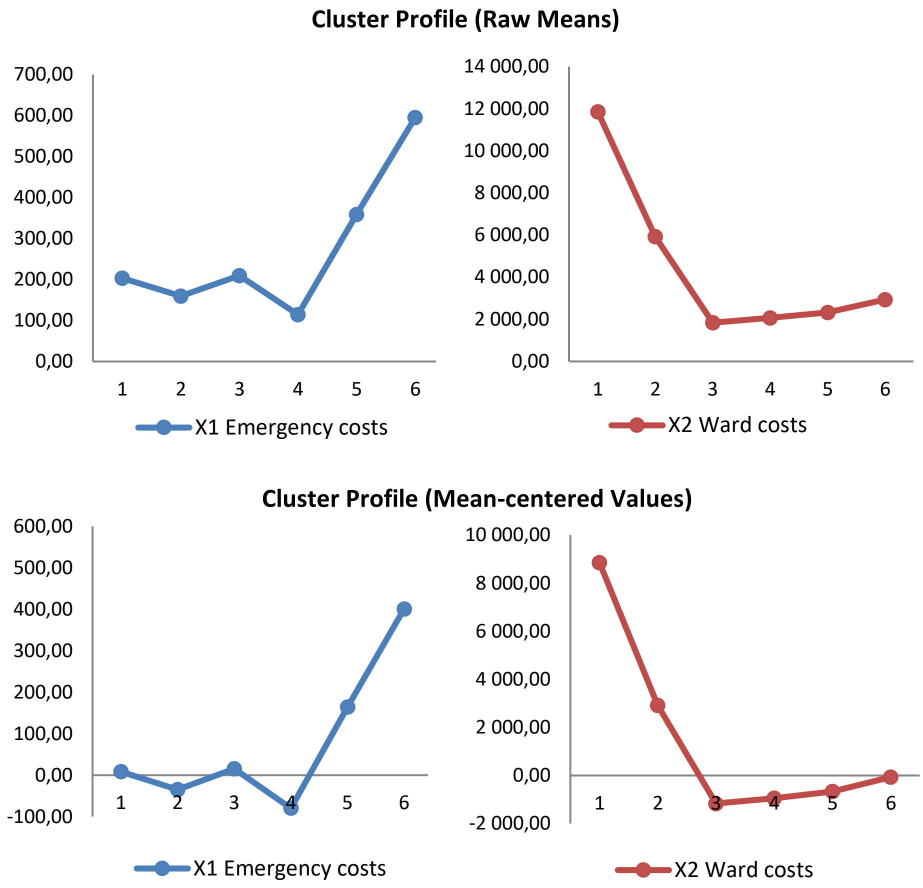

Figure 27 Profile of six clusters from k-means clustering for DRG 14

Cluster 1 comprises 30 episodes and presents a relatively low mean on X_1 Emergency costs, but the highest mean on X_2 Ward costs, at a large distance from all the others. Cluster 2 contains 66 episodes and exhibits a relatively low mean on X_1, together with the second highest mean on X_2. Cluster 3 is the largest one, with 213 episodes; like the preceding segments, cluster 3 presents a relatively low mean on X_1 and it is mostly distinguished by the lowest mean on X_2. Conversely, the lowest mean on X_1 belongs to cluster 4; this cluster is the second largest, with 188 episodes, and also presents the second lowest mean on X_2. Cluster 5 contains 47 episodes and presents a relatively high mean on X_1, although a relatively low mean on X_2. At last, cluster 6 is the smallest one, with 15 episodes; this cluster is mostly characterized by the highest mean on X_1, while exhibiting a relatively low mean on X_2.

4.4. Fourth stage design: validating and interpreting the clusters

In the third stage design I identified an initial cluster solution, obtained through the Ward's method, and an alternative *fine-tuned* solution, created using k-means. On the one hand, being confronted with two somewhat distinctive configurations, there is the need to validate those results; and on the other hand, the cluster analysis is a means and not an end, and thus I need to interpret the organization of raw data provided by cluster analysis, having in mind the research objectives. These are, essentially, the problems that I will address in this final stage design.

4.4.1. Validating the clusters

There are no universal clustering techniques applicable to discover patterns on large sets of data (Barbara, 2000; Jain, 2010) and all available techniques are heuristics, *i.e.*, they can only provide an approximation to the optimal solution (Zeng *et al.*, 2002, as cited in Gama *et al.*, 2017). Also, "there is no best clustering algorithm", because each clustering algorithm imposes a structure on the data (Jain, 2010, p. 659) and the existence of many alternatives easily confounds the researcher (Jain *et al.*, 1999). Therefore, the researcher "needs to try competing and diverse approaches to determine an appropriate algorithm for the clustering task at hand" (Jain, 2010, p. 659).

Regarding the nature of cluster analysis that I have just referred, the intervention of the researcher acquires an improved importance. On the one hand, he/she needs to be acquainted with the very nature of cluster analysis and have a deep understanding of the used techniques, and on the other hand he/she must have a background or expertise on the subject under study (Jain *et al.*, 1999; Barbara, 2000; Gama *et al.*, 2017). The higher understanding the researcher has about the *raw* information, the more probable becomes the possibility of finding the true structure of the data (Jain *et al.*, 1999; expression in italic added).

Together with the researcher expertise, the validation and interpretation of competing cluster solutions can benefit from visualizing the results. In two dimensions, "humans perform competitively with automatic clustering procedures" (Jain *et al.*, 1999, p. 268) and even in the case of three dimensions the visualization of the data set helps the researcher to check and validate the clustering results (Halkidi and Vazirgiannis, 2001).

The research produced outputs that could be represented in two dimensions, as is the case of medical DRGs such as DRG 14, or in three dimensions, as is the case of surgical DRGs. Scatter-plots of possible cluster solutions have been thoroughly used in this Chapter in order to help on understanding, interpreting and labeling the clustering results. When I had to decide on the number of clusters obtained through the Ward's method to carry to the definitive k-means clustering, the decision was simultaneously based on the application of a specific technique (the VRC) and on the research objectives, namely by assessing how the cluster solutions could inform the department directors and managers about the patterns of costs and medical procedures. However, the choice between the competing five-cluster or six-cluster configurations was finally made after the suggestive visualization of the scatter-plot for both solutions. I will also provide in Appendix 2 scatter-plots for the remainder medical DRG (88), as well as for the surgical DRG with the largest population (167).

As I have stated, expertise and the ability to visualize the formed clusters are decisive for validating and interpreting the results. Nevertheless, several approaches have been proposed in the literature for a further assessment of the validity of the cluster solution (Halkidi and Vazirgiannis, 2001; Hair *et al.*, 2010; McIntyre *et al.*, 1980, as cited in Hair *et al.*, 2010; Sarstedt and Mooi, 2014; Jain and Dubes, 1988, as cited in Gama *et al.*, 2017). Those include running different clustering procedures and checking changes on affiliations of objects (Hair *et al.*, 2010; Sarstedt and Mooi, 2014); using different distance measures in hierarchical clustering and evaluating how they affect the stability of results (Sarstedt and Mooi, 2014); splitting the dataset into two halves and analyzing each of them separately (Hair *et al.*, 2010; Sarstedt and Mooi, 2014); also for the two halves, using the cluster centers obtained for one half as the initial centers for the other half (McIntyre *et al.*, 1980, as cited in Hair *et al.*, 2010); constructing a *validity index definition*, which takes account the clusters' compactness and the density between clusters (Halkidi and Vazirgiannis, 2001); computing *cluster validity indices*, based on *internal*, *relative* or *external* criteria, where indices based on *internal criteria* assess the fit between the structure imposed by the clustering algorithm and the structure of the data, indices based on *relative criteria* compare multiple clustering solutions generated by different algorithms in relation to a given aspect (like stability), and indices based on *external criteria* match the clustering solution to a pre-specified structure, *i.e.*, the *true* class labels (Jain and Dubes, 1988, as cited in Jain, 2010 and in Gama *et al.*, 2017).

Regarding the use of cluster validity indices, although some authors stress its relevance as a quantitative and objective way of validation (Jain, 2010; Gama *et al.*, 2017), Halkidi and Vazirgiannis (2001) remind that they are obtained at high computational costs. In addition, Jain (2010, p. 657) points out a somewhat puzzling question: typically, *relative criteria* are used to assess the clustering results, “but if the true labels are available, why even bother with clustering?”

For these reasons, and also for practical considerations, as I have already run two cluster analysis, I elected the comparison of clustering results as the preferred means to validate the results, or in other words, to assess *stability*. Furthermore, I will check if the final solution obeys to a set of desirable characteristics, as proposed by Tonks (2009, as cited in Sarstedt and Mooi, 2014) and Kotler and Keller (2011, as cited in Sarstedt and Mooi, 2014).

Relying on the results provided by the Ward’s method and k-means, I can check whether two different clustering methods yield comparable segments, with the same composition, or, at least, with only a few changes (Hair *et al.*, 2010; Sarstedt and Mooi, 2014). Columns 2, 3, 6 and 7 in Table 21 below will be used for this purpose.

Comparison of Cluster Membership								
	Ward's method				K-means			
Cluster	n	%	X_1 mean	X_2 mean	n	%	X_1 mean	X_2 mean
1	31	5,5%	207,44	11.735,69	30	5,4%	203,02	11.859,49
2	52	9,3%	167,98	6.177,45	66	11,8%	159,44	5.923,67
3	153	27,4%	233,12	1.773,99	213	38,1%	209,94	1.837,46
4	270	48,3%	129,62	2.132,66	188	33,6%	114,41	2.062,41
5	38	6,8%	365,18	2.713,77	47	8,4%	358,86	2.330,62
6	15	2,7%	595,18	2.930,48	15	2,7%	595,18	2.930,48
	559	100,0%			559	100,0%		

Table 21 Comparison of cluster membership by the Ward's method and K-means for DRG 14

In broad terms, both configurations are convergent in four aspects: 1) there are two large groups, which encompass the vast majority of episodes; 2) there are four other groups, much smaller than the two main ones; 3) the two smallest clusters yield almost precisely the same results; and 4) the migration of episodes is greater among clusters 2 up to 5, and involves especially the large clusters 3 and 4.

The comparison may benefit from the graphical distribution provided by Figures 22 and 26. The confrontation between these Figures confirms that the two most extreme clusters, 1 and 6, are the most stable. Indeed, there is no change at all in cluster 6, while only one episode leaves cluster 1 from the Ward's method to k-means. The scatter-plot is also visually elucidative in relation to cluster 2, because it is easy to see that it enlarges *at the expense of* clusters 3, 4 and 6. Right in the middle of the scatter-plot one can observe a broad movement of episodes from clusters 4 to 3, *i.e.*, the two main ones. At last, it is visible that cluster 5 receives some episodes from cluster 3, while only a few episodes leave this cluster in the opposite direction.

The same conclusions can be drawn by using Table 22 below, with improved accuracy. This table lists in column one the clusters that loose episodes from the Ward's method into k-means clustering; column two identifies the clusters that receive episodes coming from clusters listed in column one; finally, column three quantifies the episodes that move from one cluster to another.

Stability		
Initial cluster (Ward's method)	Final cluster (k-means)	Number of reassigned episodes
1	2	1
3	2	2
	5	11
4	2	11
	3	71
5	3	2
		98

Table 22 Evaluating stability

In assessing stability I must notice that when using different techniques, it is usual to find differences in the clustering results, even when the solution is adequate (Sarstedt and Mooi, 2014). The main point here is to establish an upper limit to define "usual". Sarstedt and Mooi (2014) refer 20% as a rule of thumb and stress that this percentage is likely to increase along with the number of clusters; similarly, Hair *et al.* (2010) consider that when less than 10% of the observations are reassigned to a different cluster it is a very stable solution, between 10 and 20% it is a stable solution, and between 20 and 25% it is a somewhat stable solution.

Results in Table 22 meet these criteria. In fact, 98 out of 559 episodes have changed cluster affiliation, thus representing 17.5%. Accordingly, there is evidence of stability of results in the cluster analysis performed on DRG 14.

One can also evaluate stability checking whether some desirable characteristics are present in the final solution (Kotler and Keller, 2011 and Tonks, 2009, as cited in Sarstedt and Mooi, 2014). Especially, it must be *substantial*, *accessible*, *actionable*, *parsimonious*, *familiar* and *relevant*. In fact, the final solution is *substantial*, because all segments are large enough to provide information for action; *accessible*, because there is a easy way to get access to the complete clinical files; *actionable*, as it is possible to identify patterns of care than can be encouraged or discouraged in the future; *parsimonious*, because there is only a few segments to handle; *familiar*, as the majority of episodes are similar and only a few segments are differentiated; and *relevant*, because new information has been added in relation to conformity or deviation from best practices, clinical protocols and resource consumption.

4.4.2. Interpreting the clusters

The second and last problem in this final stage is related to the interpretation of results. At the end of this stage, I must be able to label the clusters and briefly describe the nature of each one of them, although I may state that the interpretation of results is more than just providing a description, it is also a means of validating the results (Gama *et al.*, 2017). In order to support this stage, two fundamental aspects emerge: the need for expertise in relation to employing cluster analysis and identify meanings for both the clusters and the possible relations among them; and the aid of graphical visualizations of the clusters, which are of great value for easily and intuitively observing the clustering results (Jain *et al.*, 1999; Barbara, 2000; Halkidi and Vazirgiannis, 2001; Gama *et al.*, 2017).

One can identify two large clusters that I may refer to as the *backbone* of DRG 14. Together, these clusters represent about ¾ of total episodes. To a large extent, there is a coincidence between the observations and the concept of DRG, because the vast majority of episodes are similar in terms of cost estimates for both the emergency department and ward, thus reflecting similar patient conditions and patterns of care.

However, besides that broad area of conformity, cluster analysis highlighted a small set of segments which are substantially different. For department directors and managers these results suggest that in most cases the established guidelines have been followed, but also identify other cases that suggest deviation. Taking into consideration what I have stated about stability, these four deviating segments are large enough to justify an in depth study about patients at stake.

Analyzing the final cluster configuration in relation to cost estimates, one can verify that clusters 3 and 4, the two main ones, comprise many episodes with relatively low costs either in the emergency department and the ward. Clusters 1 and 2 dramatically raise the ward cost estimates, while clusters 5 and 6 show the same trend in relation to the emergency department cost estimates.

Interestingly, clusters 1 and 2, on the one side, and 5 and 6 on the other side, unfold a contrasting behavior: low emergency costs on clusters 1 and 2 are followed by high ward costs, while high emergency costs on clusters 5 and 6 are followed by relatively low ward costs.

The interpretation of the cluster solution requires an effort to catalogue the segments. At the same time, the interpretation gets richer and more suggestive when adding a label to every segment.

I will naturally start by clusters 3 and 4, the main ones. Together, these clusters comprise ¾ of the population and suggest conformity with the expected homogeneous nature of a DRG. Therefore, I may label these clusters as *representative* of DRG 14.

The labeling process may get clearer if I go now looking for extreme values (Hair *et al.*, 2010). I find the highest mean costs on cluster 1 and looking closer I also find that high costs are due to the ward. Consequently, I may label cluster 1 as *particularly high ward costs profile*. Likewise, cluster 6 is best characterized by the highest emergency department costs and in line with this profile I may label it as *particularly high ED costs profile*.

By now, there are only clusters 2 and 5 remaining. Both are the second highest in relation to each area: cluster 2 shows high costs regarding the ward and cluster 5 shows high costs in relation to the emergency department. Preserving the graduation, I may label cluster 2 as *high ward costs profile* and cluster 5 as *high ED costs profile*.

I may emphasize that DRG 14 proved to be a good example to stress the importance of cluster analysis as an exploratory tool to organize and add value to raw data. In fact, over 2013, a population of 563 episodes was attached to a single tag, thus suggesting that all of them were somewhat similar, but one would only need the basic statistics to find out that afterwards the episodes ranged from total costs of 225.90 to 34,451.20 Euros. Before so many episodes and as stressed by Hair *et al.* (2010), picking only the most expensive or selecting randomly a few ones, would be of limited value to inform department directors and managers about care patterns and its consequences in terms of resource consumption. On the contrary, cluster analysis may segment observations into subgroups that are more valuable to evaluate care and resource consumption.

Moreover, the cost estimates are the sum of emergency costs with ward costs and, as we have seen, there is no univocal correspondence between the two components (high emergency department costs may be linked to low ward costs and the contrary is also true). This observation implies that an unorganized analysis of individual episodes would be confusing and it would be certainly difficult to identify trends among data.

I have similarly applied cluster analysis to the remainder DRGs, following the same methodological aspects described in this Chapter. In Appendix 2, I present the main output of those analysis for two other DRGs: 88 and 167, including all the tables and figures that helped me to go through all steps required to perform cluster analysis, as I did in relation to DRG 14. I decided to consider these additional DRGs in appendix for the two following reasons: first, cost estimates obtained in Chapter One for DRG 88 using alternative costing methodologies were very similar, like in DRG 14; and second, surgical DRGs introduce some important issues, as they encompass a third variable. In fact, they imply three-dimensional plots and contribute as well to evidence the capacity of methods such as “the largest dissimilarity values for identifying potential outliers” and the analysis of “cluster profiles (means)” in order to apply cluster analysis. I elected DRG 167 to exhibit in appendix, as the surgical DRG with a larger population.

4.5. Discussion

In this Chapter, I applied cluster analysis to cost estimates obtained through the *mezzo* methodology presented in Chapter One. Current improvements in information systems not only made available more sophisticated cost accounting systems but also contributed to make use of tools *imported* from other areas, such as statistics and data mining, in order to extend the usefulness of cost accounting.

The *mezzo* methodology proposed in Chapter One has been designed in order to follow individual patients throughout their stay at the hospital. The information “attached” to each patient captures the cost consequences of treatments employed, including the LoS, drugs and examinations. On the one hand, these costs can “mirror” the economic effects of clinical decisions, and, on the other hand, they are built upon components which are familiar to both physicians and mangers.

However, without organization, it gets hard to analyze a large population, such as the 563 episodes classified into DRG 14 at CHSJ for the year 2013. By applying cluster analysis, I identified six segments that better characterize those patients. Together, two clusters represent ¾ of total patients, suggesting conformity to a large extent with the very notion of a *homogeneous* DRG. Nevertheless, the remaining patients still represent ¼ of the population, signalizing the need for both reviewing clinical decisions – at the internal level – and assessing the effective homogeneity of the DRG classification concerning DRG 14 – at the national level.

At the internal level, adding cluster analysis to cost estimates produced by management accounting provided a means to find subgroups within DRG 14. These subgroups can be further analyzed in order to look for patterns of care. For instance, professionals in charge of reviewing activity can dig into “*cluster 1 – particularly high ward cost profile*” and try to understand what turns the treatment of these patients so expensive within the wards. As the *mezzo* methodology stores and processes information about the costs of main treatment elements, it can be found that, besides physical and psychological conditions of individuals, the reasons for the particularly high costs are the LoS, selective examinations (including duplication) or drugs. Effective treatment decisions can then be compared to pre-defined protocols and deviations can be found.

The approach used in this Chapter took into consideration some concerns repeatedly addressed in the literature. On the one hand, there was the need to tackle the problems of estimating costs and further organizing the estimates in a *language* understandable for those involved in operations and management – physicians, department and clinical directors, and managers –, as it might contribute to lower the many times reported reluctance from physicians to get involved in costing practices (Abernethy and Vagnoni, 2004; Nyland and Pettersen, 2004; Schrijvers *et al.*, 2012; Gebreiter, 2017). Indeed, literature reports how a steady tradition of using cost accounting as an effective tool for decision making emerged in countries where physicians were taught on costing theory and were involved in the design of costing systems, such as the cases of Finland and Sweden (Kurunmäki, 1999b; 2004; Kurunmäki *et al.*, 2003; Lehtonen, 2007). On the other hand, even in countries where the physicians' commitment towards cost accounting showed to be limited, as were the cases of the UK, the Netherlands, Germany, the USA, Australia and Canada, there has been a growing interest about following *care pathways* as a means to enforce the standardization of clinical practice and clinical governance (Carnett, 1999; Thibadoux *et al.*, 2007; Schrijvers *et al.*, 2012; Conrad and Uslu, 2012; Chapman *et al.*, 2014; Jackson *et al.*, 2014; Gebreiter, 2017).

Care pathways are built upon best practices and help to define treatment protocols, which, in turn, can guide the standardization of clinical practice and avoid duplicate or unnecessary examinations. As these modernized models of clinical practice are sustained in clinical evidence, they are a very close tool for physicians to establish the desired sequence of decisions and to define patterns against which it is possible to find deviations (Quentin *et al.*, 2011; Chapman *et al.*, 2014; Gebreiter, 2017).

In the same vein, the combined use of cost estimates for individual patients and cluster analysis rendered a further (re)classification of patients that can help on evaluating care pathways. In fact, I have just mentioned that two clusters (2 and 3) represent together about ¾ of the entire population of DRG 14 and a closer look at Figure 26 shows how these clusters are placed side by side in the plot. Therefore, these two large clusters are likely to reflect *regular* practices and patient conditions which might reflect as well that they reflect *protocols* and *best practices*. Conversely, the other clusters are likely to reflect deviations from best practices and especially those which comprehend patients with particularly high costs at the wards or at the emergency department (1 and 6) signalize deviations with priority in understanding the reasons for such behavior.

Therefore, the approach used in this Chapter is able to address the analysis of variance, instead of focusing on the mean – as usual in many cost accounting systems, including the mandatory Portuguese model for public hospitals – and, in this vein, it is a response to claims in the literature in this regard (Tan *et al.*, 2009b; 2011; Christensen, 2010; Chapman *et al.*, 2013). An additional argument can be added, with particular relevance in healthcare: this approach is a means to present accounting numbers in a more familiar way to physicians, thus raising the possibilities of involving physicians in a change towards more sophisticated information systems and inducing change from inside organizations, as proposed by Porter and Lee (2013).

At the national level, the contribution from cost accounting, in general, comes from its ability to maintain a fair set of prices for inpatient care, and that requires – as I have stressed in Chapter One – both building a set of economically homogeneous DRGs and processing accurate cost estimates that attach a relative weight to each DRG.

Questions related to generating cost estimates were addressed in Chapter One. In turn, issues addressed in Chapter Two can render insights into the consistency of the DRG classification, *i.e.*, about how economically homogeneous are, in fact, the DRGs.

The construction and the revision of a DRG system, including the classification and the definition of relative weights, follows a complex and demanding work, based on large patient datasets, statistics and medical expertise[10]. Indeed, this process is so demanding that countries like Portugal and Spain still rely on weights imported from abroad[11].

It is not the aim of this research to assess the appropriateness of the DRG classification and the set of weights at use in Portugal. Furthermore, regarding the research design, *i.e.*, involving a single hospital and a few DRGs (in the case of DRG 14, presented in the main

[10] The basic principles of the DRG system are explained in page 20.
[11] Cf. page 60.

text, unrelated to the rest), it is not possible to generalize conclusions about the consistency of the DRG classification and related weights. Nevertheless, results obtained in this research may be used to assess how economically homogeneous are the studied DRGs, in particular DRG 14.

In relation to DRG 14, for the CHSJ and the year 2013, results evidenced that about ¼ of cost estimates were significantly apart from the majority of ¾, what might pose the question whether differences are due to deviant clinical procedures or to inappropriate DRG classification. It might as well question how fairly CHSJ would be reimbursed for treating patients classified into DRG 14.

These results are somewhat in line with a case study by Blunt and Bardsley (2012), as these authors, using as well cost estimates for individual patients and assessing the homogeneity of a set of DRGs, found considerable differences between costs and prices. However, one might state that ¾ of patients would be fairly paid in relation to DRG 14, while Blunt and Bardsley concluded that the same applied to only $\frac{1}{6}$ of patients considered in their case study.

In spite of the incapacity to generalize conclusions from a case study, the results presented in this Chapter evidence the further usefulness of cost estimates obtained through more sophisticated management accounting systems, as in the case of Chapter One. In fact, the (re)organization of cost estimates identified areas of conformity together with areas of concern for internally reviewing activity and costs. At the national level, the replication of approaches such as the one employed in this Chapter may shed light into the fairness of hospital reimbursement.

Chapter Three

Is it Worth Improving Management Accounting in Hospital Settings? Decisions and Hesitations on the implementation of MAS in CHUSJ

1. Introduction

Healthcare has been a stable sector for most of the twentieth century in Western countries. Two types of reasons may have contributed to this. On the one hand, physicians hold a dominant position within hospitals and were strong enough to influence policy makers in order to maintain the focus on the core nature of hospitals as care providers. On the other hand, central authorities ensured the global functioning of the sector through their multiple roles of owner, main funder and regulator (Scott *et al.*, 2000; Street and Dawson, 2002; Besharov and Smith, 2014).

Traditional insights of institutional theory provided explanations for this longstanding stability (Meyer and Rowan, 1977; DiMaggio and Powell, 1983; Zucker, 1987). Central authorities used their nature as owners and legislators to exert coercive pressures over hospitals, powerful professional associations issued norms that kept the focus on medical practices (normative pressures) and hospitals paid particular attention to how their peers managed to comply with central requirements (mimetic pressures).

More recently, however, those earlier formulations have been put into question as stability has been replaced by growing heterogeneity and change (Friedland and Alford, 1991; Seo and Creed, 2002; Thornton and Ocasio, 2008; Greenwood *et al.*, 2014). New approaches have been proposed, reorienting the research focus into the action of multiple actors inside and outside organizations. Notably, *institutional logics* became a key concept, contextualizing the behavior of individuals and organizations within social, historical and institutional dimensions (Friedland and Alford, 1991; Scott *et al.*, 2000; Thornton and Ocasio, 2008; Thornton *et al.*, 2012).

The *historical dimension* of institutional logics helps to explain how healthcare, once anchored in medical professionalism, became permeable to market principles. A body of literature on institutions addressed the transformation of public hospitals and other healthcare units into *hybrid organizations*, subject to a dual character of caring for the wellbeing of people under a business management style (Waldorff, 2013; Arman *et al.*, 2014; Vickers *et al.*, 2017). In Europe, including Portugal, these transformations were part of the NPM reforms.

Further developments of institutional theory point out the complexity of organizations and of their processes of choice, notably through the action of the *social entrepreneur*, the champion who leads change from the inside (Battilana *et al.*, 2009; Major *et al.*, 2018) and the processes of *selective choice*, which powerful actors strategically put in place in order to pursue their own goals (Pache and Santos, 2010; 2013; Guerreiro *et al.*, 2012).

In this Chapter, I start with a thorough review of developments in institutional theory, and namely its linkages to the health sector, which constitutes the object of analysis in the present dissertation. I aim to contribute to this literature by evaluating the experience of HSJ under a particularly complex context of economic turbulence and international interference over the Portuguese Government, which may drift away the attention of actors from problems such as the implementation of improved management accounting systems, such as ABC. I address the relation of authority and power exerted by central authorities over hospital boards and how those relations interconnect with other actors, inside and outside hospitals.

Indeed, I argue that a more holistic understanding of how hybridity and associated processes, *e.g.*, selective choice function, is of order. In prior literature addressing change in health units, such as hospitals and primary care centers, the intervention from the government, *i.e.*, its intentions and the way policies are implemented, are seen as clear for everyone involved, as well as the reaction from powerful professionals who perceive the menace to their relative position in the sector (Reay and Hinings, 2009; Vickers *et al.*, 2017). Literature proposing selective choice has gone further, attributing to powerful actors the ability to interpret the governments' intentions and decisions and to strategically position themselves to attack or counterattack (Pache and Santos, 2010; Guerreiro *et al.*, 2012). Therefore, prior research has focused on apparently “clear-cut” situations, but the case under study encompasses the analysis of a period, or context, of confusion and complexity, which may render selective choice difficult. The hesitations, the abandonment of ABC and its substitution by an equally sophisticated information system in CHUSJ may be understood under this light.

After this brief introduction, I will begin this Chapter with the literature review on early and current developments in institutional theory, especially focusing on institutional logics. I will present the key concepts of this perspective and afterwards I will propose a theoretical framework that systematizes five of those concepts, with the aim of helping to explain how an organization that has gone through a process of hybridization puts in place mechanisms of selective choice. By applying the theoretical framework to the case of CHUSJ and to how it tackled the sophistication of management accounting systems, three distinct periods emerged, suggesting that the intervention of relevant stakeholders in the field might have gone differently in those periods and selective choice might have been adjusted as well by the Hospital. Then I will present the case of CHUSJ, organized into the referred three periods, either recurring to documents and previous literature or to material obtained through interviews with personalities with links to the Hospital and to key stakeholders involved, providing views on the case from different angles. At the end of the case description, I will immediately present a table with the application of the theoretical framework, summarizing findings in the light of the five concepts that make up the framework and considering the three distinct periods. Finally, I will end the Chapter with the Discussion Section.

2. Developments in institutional theory

This Section is about the developments in institutional theory, from the early studies which emphasized stability and were focused at the macro level, to contemporary approaches on institutional logics, which emphasize action and are concerned with what happens inside organizations.

2.1. Early studies on the cultural and institutional dimensions of organizations

Some authors place the origins of management accounting alongside the birth of the first manufactures in the beginning of the Industrial Revolution (Johnson and Kaplan, 1987). Seen as part of the information systems processed to inform decision making and subject to the assumption of rational behavior of economic agents, research on management accounting has been guided for a long time by the aim of devising optimal models for decision making (Major and Ribeiro, 2018). Therefore, this earlier body of management accounting research is part of the economic theory, specifically, neo-classical economics.

In opposition to perspectives based on the rationality of economic agents and economic models that optimize the relation cost/efficiency (Scapens, 1994; Guerreiro *et al.*, 2012; Major and Ribeiro, 2018), a new approach emerged in the 1970s, extending the analysis to culture and the social and institutional dimensions of organizations and their environments (Moll *et al.*, 2006; Thornton and Ocasio, 2008).

Under this new perspective, organizations are seen to be subject to pressures coming from both the outside and the inside. Pressures exerted by the state or professions would legitimate the actions and behaviors of the organization’s professionals, increasing the ability of the organization to survive (Zucker, 1987; DiMaggio and Powell, 1983). DiMaggio and Powell (1983) viewed the effect of pressures from the state and professions as such that they replaced the market in the rational and bureaucratic process of building organizations (Greenwood *et al.*, 2014). Yet, DiMaggio and Powell came to a paradox: those in charge of the organizations strive for innovations that can differentiate the organization from their peers and bring competitive advantages but, in the end, contribute to make organizations identical or *isomorphic* with their institutional environment.

DiMaggio and Powell (1983) identified three types of mechanisms of isomorphism: coercive, mimetic and normative. Coercive mechanisms are due to political influence and the problem of achieving legitimacy; mimetic mechanisms emerge in response to uncertainty; and normative mechanisms are related with the role played by professions (DiMaggio and Powell, 1983; Ribeiro and Scapens, 2006; Thornton and Ocasio, 2008).

Nevertheless, much of that isomorphism was found to be only formal. Organizations tended to be identical in appearance, but deeper, a gap (or "decoupling") has often been found between formal structure and activities effectively put in place in daily routines (Meyer and Rowan, 1977; Pache and Santos, 2013). Organizations in modern societies exhibit a complex formal structure, mainly to achieve legitimacy, resources, stability and perspectives of survival. By adhering to practices and procedures which are dominant in society, organizations are enhancing their legitimacy and their chances of survival, but that does not mean they are effectively changing their policies or raising the efficiency of their working procedures (Meyer and Rowan, 1977; Greenwood *et al.*, 2014). Organizations create formal structures ritually, because they are considered rational and adequate by their institutional environment, even incurring in avoidable costs (Meyer and Rowan, 1977), "but do not attempt seriously to implement them at the operational level" (Scott, 2003, p. 279).

This earlier stage of institutional analysis located the main forces which influenced and shaped organizations at a macro level, outside the organization (Thornton and Ocasio, 2008; Kraatz and Block, 2008; Greenwood *et al.*, 2014). Organizations tended to conform to the appropriate behavior, generating conformity and stability, and change, as well, would happen as a blind response to exogenous stimuli, under a top-down fashion (Pache and Santos, 2010; Guerreiro *et al.*, 2012; Micelotta *et al.*, 2017). From such a theoretical stand, the early work on institutions sought to understand how a given organization as a whole could drive a collective effort to achieve collective purposes (Meyer *et al.*, 1993), subject to an institutional environment that combines pressures from societal norms, professional training, accreditation practices and state regulation (Meyer and Rowan, 1977; DiMaggio and Powel, 1983).

Such a quest for legitimacy would render organizations identical (Guerreiro *et al.*, 2012), but the heterogeneity of organizations was obvious (Greenwood *et al.*, 2014). Hence, as Greenwood *et al.* (2014, p. 1206) argue, "institutional theory [needed] refocusing". It was the interest in understanding why and how change is prompted and promoted that led to a shift of concerns towards the analysis of the processes underlying institutional change and their implications for organizations (Dacin *et al.*, 2002), as well as opening space for actors and their action (Seo and Creed, 2002). An additional argument came out of the relevance of organizations in contemporary life, as the organization is "the most important institution in modern society (…). It matters, therefore, that we understand them" (Greenwood *et al.*, 2014, p. 1206).

Concerning this new stage in institutional analysis, Micelotta *et al.* (2017) identify three triggers, corresponding to equal number of somewhat sequential trends of analysis and theoretical construction between 1990 and 2015: the first one highlights the relevance of external shocks, to which organizations respond (top-down change); the second one is generated inside the organization and is centered in the action of entrepreneurial agents (bottom-up change); the third and more recent one relies on the role of improvisations and daily practices, thus also generating bottom-up change.

Through such a diachronic portrayal of institutional analysis, Micelotta and colleagues sought to capture the evolution from enduring socio-cultural structures, whose stable set of meanings, rules and norms served as references for organizations to conform with, to the emergence of "institutional logics". Nevertheless, they were also concerned with what they considered as the mainstream in institutional analysis: each new trigger often led to the disregard of the previous ones.

2.2. Institutional logics

This Section presents the key concepts which have been added to the institutional logics perspective throughout the last thirty years. Although aiming to understand in the final the mechanisms of selective choice that guided CHUSJ through the sophistication of management accounting systems, all concepts presented here are indispensable to build and apply the theoretical model that I will propose in the final of this literature review.

2.2.1. A new focus on political actions from individuals and organizations

The definition of institutional logics was first presented by Alford and Friedland in 1985, but it really gained momentum after the seminal work of the same authors in 1991 (Friedland and Alford, 1991). In line with several authors (Guerreiro *et al.*, 2012; Besharov and Smith, 2014; Miller and French, 2016), I will follow the definition proposed by Thornton and Ocasio (1999, p. 804), which, in turn, is based on Friedland and Alford (1991), with contributions from Jackall (1988): institutional logics are "the socially constructed, historical patterns of material practices, assumptions, values, beliefs, and rules by which individuals produce and reproduce their material subsistence, organize time and space, and provide meaning to their social reality".

Friedland and Alford (1991) perceived society in a nonfunctionalist, nondeterministic manner. Criticizing the organizational homogeneity as well as the mechanisms that were alleged to render isomorphism, they claimed the need to study why the institutional arenas were shaped as they were, opening space for understanding transformation as much as the routinization of interests. In their view, the main reason for the inability of institutional analysis to provide explanations for both the configuration of institutions at a certain moment of time and how new forms were developed was the lack of attention to adaptive political actions of individuals and organizations.

Equally important was the need to relate that behavior of individuals and organizations with society itself. Behavior should be contextualized within social, historical and institutional constraints, and the main research trends were not able to capture such constraints, and the relations and nuances that they brought about. Therefore, the theories which "retreat from society", such as the neo-classical economics that had produced "elegant, deductive, and transhistorical models [where] individuals make independent, rational choices to maximize their utility" (Friedland and Alford, 1991, pp. 233 and 235) but had not addressed where and how the utility and preferences of individuals were formed, "begin to fail" (Thornton and Ocasio, 2008, p. 105).

Another relevant distinction from neo-classical theory is about how rationality was conceived. In fact, Friedland and Alford (1991) transported to their perspective the inner complexity of society. Instead of a single entity, society was envisaged as a set of interdependent institutional domains (or orders); accordingly, instead of a single rationality, each of these domains had its own sense of rationality (Thornton *et al.*, 2012; Guerreiro *et al.*, 2012). In other words, each domain had a central logic that was familiar to their individuals and gave meaning to their actions (Friedland and Alford, 1991; Thornton and Ocasio, 2008; Guerreiro *et al.*, 2012).

Thus, it is possible to understand that the institutions of modern Western societies follow distinct and contradictory practices and beliefs (Thornton and Ocasio, 2008; Micelotta *et al.*, 2017). Individuals, groups and organizations belonging to different and contending institutional orders will make use and manipulate their practices and beliefs in their own advantage (Friedland and Alford, 1991; Thornton and Ocasio, 2008; Greenwood *et al.*, 2011). Friedland and Alford (1991) considered that the core institutions of society were made by the capitalist market, the bureaucratic state, democracy, the nuclear family and Christian religion. Each of these institutional orders had a central logic, corresponding to a set of material practices and symbolic constructions that served as organizing principles to inform the behavior of individuals and organizations, by indicating which is valued and the boundaries not to cross. Still, individuals, groups and organizations would try to use institutional orders to their own advantage, by “artfully” reinterpreting symbols and practices (Friedland and Alford, 1991). Stated in other words, institutions not only *constrain* the means and ends of individual behavior but also *provide sources* of agency and change through “cultural resources for transforming individual identities, organizations, and society” (Thornton and Ocasio, 2008, p. 101).

The core institutions of society are simultaneously interdependent and contradictory. By exploring contradictions, individuals and organizations raise political conflicts and transform the institutional structure of society (Friedland and Alford, 1991; Seo and Creed, 2002). Sometimes, the logics that had historically been considered as the most appropriate in a given order (or field) are threatened by the emergence of new ways of thinking and behaving imported from another one, leading to conflicts and struggles between the forces in the field. One of the examples presented by Friedland and Alford (1991) is about healthcare: should access to care be regulated by the state, as it was the tradition, or by the market, as it was becoming visible in Western societies? Scott *et al*. (2000) returned to this question, but added a third variable: the healthcare sector was subject to three contending institutional logics, those of the state, the professional logic of medical care and the market. Their study illustrates how contending logics can coexist and evolve over historical periods.

2.2.2. Organizational fields: the case of healthcare

The healthcare sector is an effective example of the *organizational field*, a key concept in institutional logics and one that is seen by some authors as the most useful level of analysis of institutional issues (Scott *et al.*, 2000; Reay and Hinings, 2005). "Healthcare" is one of the areas of social life with which people are most emotionally involved. It refers to the way resources, including financing, facilities, equipment and people, are organized in order to provide and receive health services. Given the nature and the inner complexity of these services, a set of complex relations between the state, regulators, other funders, primary care units, hospital networks, professionals, patients and families is established within a region or a country.

Other examples of institutional fields are education and justice, also of great value for people. In common, all organizational fields have different actors placed at different levels of the field. Therefore, there are vertical relations between actors, signaling different levels of power, as well as horizontal relations (Reay and Hinings, 2005). Vertical relations may relate to ownership, as the relation between the state and public hospitals, but they may also relate to rules and norms, as the relation between professional bodies and physicians (Scott *et al.*, 2000). Accordingly, on the one side, the ability of individual actors (individuals and organizations) to exercise their power and look for their own interests will depend on their location within society (Thornton *et al.*, 2012); and, on the other side, the boundaries of institutional fields are more cultural and functional than geographical (Scott *et al.*, 2000).

Within an institutional field there are forces acting to maintain stability (Reay and Hinings, 2005). In healthcare, such forces are exerted by the state, regulators and professional bodies, institutions that have power to impose their will. As we have seen above, these actions and results were the focus of earlier institutional theory. However, recent work is more concerned with the dynamics of the field and with the way fields evolve and are reconfigured (Guerreiro *et al.*, 2012; Major *et al.*, 2018).

While relating with each other much more often than with other actors outside the field and sharing beliefs around a common meaning system (Scott *et al.*, 2000), individual actors also hold their own interests and will act to try to accomplish them. Stated in other words, actors may conform to the prevailing institutional logics in the field, compatible with their role and common beliefs, but they are able to interpret those institutional logics and explore their contradictions in order to make their own way (Friedland and Alford, 1991; Seo and Creed, 2002; Reay and Hinings, 2005).

For some time, as institutional logics are shared by actors and some of them detain the means to temporarily constrain the action of the others, the institutional field reveals stability (Friedland and Alford, 1991; Thornton and Ocasio, 2008; Thornton *et al.*, 2012). This is a core point in institutional theory, which stresses the overwhelming weight of the structure of the field over the ability of actors to induce change. Consistently with DiMaggio and Powell's theory of structural isomorphism (1983) there is little space left for individuals to act, because they are limited to "habitual behavior" (Thornton *et al.*, 2012, p. 7) that will lead to conformity. Still, Thornton *et al.* (2012) contend that only coercive isomorphism may be associated to the free willing action of actors, particularly, those actors who pass laws and enact regulations. In the end, the inability of institutional theory to explain agency was precisely the reason for new approaches, including institutional logics, to emerge (Reay and Hinings, 2005; Thornton *et al.*, 2012).

2.2.3. Institutions evolve over time

Changes in organizations and societies occur in a vivid context (Waldorff, 2013). Actors, either individual or collective, interpret their ambitions and ability to act in accordance to their reading of society, its organization, aspirations and functioning, something that is not independent of the historical period they live in. In fact, the institutional logics that form the thinking and behavior of the different actors are inseparable from their moment in history and are transformed over time, along with broader historical movements (Kraatz and Block, 2008).

Change in organizations is likely to reflect broader transformations in the field and in society as a whole. In steady times, especially in the presence of stable technologies and strong regulatory systems, change is likely to be smooth and incremental (Scott *et al.*, 2000; Kraatz and Block, 2008), resulting from the ability of actors to maintain the *status quo* or force subtle shifts in the balance of power within the organization or the field. In this context, actors who are able to combine competencies are better positioned to alter the balance of power in their favor (Kraatz and Block, 2008; Dunn and Jones, 2010). Over long periods of time, incremental change is more likely to occur, maintaining the equilibrium in the field. However, major events may precipitate profound or radical change. Such historical events are likely to be anchored in broad political, social and/or economic arenas, often outside the field (Scott *et al.*, 2000; Reay and Hinings, 2005; Kraatz and Block, 2008; Kyratsis *et al.*, 2017; Major *et al.*, 2018), and encompass significant conflict. While reported as occurring in shorter periods of time (Kraatz and Block, 2008) and involving precise orientations and impositions from the government or other key stakeholders (Scott *et al.*, 2000; Reay and Hinings, 2009), it can be argued that they may lead to a high level of confusion in the field and their effects can be extended over time.

The relevance of temporal variables is stressed in the literature. Micelotta *et al.* (2017) recall the relation between forms of agency and the variables of pacing, sequencing and length to lead the trajectory and outcome of institutional change and contend that more research on understanding the temporal dynamics of change is needed; Major *et al.* (2018)

argue that institutional fields are not static, even if there is an appearance of tranquility on the surface; Pache and Santos (2013) point out the interference of long periods of time over the emergence of competing logics, in such a way that in contexts of transition between competing logics actors may get confused, while they try to "learn to navigate" (Pache and Santos, 2013, p. 996; the term "navigate" is also used with the same meaning by Vickers *et al.*, 2017, p. 1755); Guerreiro *et al.* (2012), following Scott *et al.* (2000), recall how normative controls imposed on organizations within a field vary over time.

All these concerns about the need to position institutional logics, as well as emerging threats to their subsistence, within their historical time are consistent with the initial claim by Friedland and Alford that many studies on organizations and economic subjects are only valid in one period of time (Friedland and Alford, 1991). Therefore, the understanding of how institutional logics settle down, are put into question and are replaced by new ones, seems to be inseparable from the study of the periods within which these changes take place.

The pace of change at the societal level, including healthcare, has clearly intensified in recent decades (Scott *et al.*, 2000; Kyratsis *et al.*, 2017). Scott and colleagues studied the evolution of healthcare in The San Francisco Bay Area and found that after 50 years of stability, from the early 1920s into the 1960s, sequential periods of rapid change have emerged. The early *professional dominance* era, in place until 1965 and characterized by a "well-ordered field, ruled over by a firmly entrenched medical establishment" (Scott *et al.*, 2000, p. xvii), has been replaced by the *federal involvement* era, from 1966 to 1982, one that was characterized by the provision of funds and increased regulation; in turn, this second era gave place to a third and current era of *managerial control and market mechanisms*, from 1983 onwards, distinguished by deregulation, reliance on market forces and the strong presence of large corporations.

The changes from one period to another brought with them – or were the product of – "new rules, new belief systems, and new modes of governance" (Scott *et al.*, 2000, p. xvii). The increasing pace of change was not disconnected from the evolution of society itself, with, for instance, the media opening space for new actors and broadening the horizons of their action. By actors, I refer to the state, professions and organizations, but also to the population in general, as interested consumers of healthcare. As a consequence, the global level of confusion among participants has heightened during all the fifty years period under analysis.

By the end of the period studied by Scott and colleagues, another part of the world was undergoing even more profound changes. After the dissolution of the Soviet Union in 1991, Eastern Europe went through major political, economic and social transformations (Kyratsis *et al.*, 2017). There has been a disruptive shift from a planned economy to a market economy and political pluralism in such a way that former "heavily centralized, bureaucratic, collectivist social systems" gave rise to "systems underpinned by capitalism and liberal democracy" (Deacon, 1992, as cited in Kyratsis *et al.*, 2017, p. 613).

Kyratsis *et al.* (2017) studied the change of logics associated to the medical profession in five Eastern European countries in transition over that time: Estonia, Bosnia and Herzegovina, Slovenia, Moldova and Serbia. Physicians have been under pressure to leave their traditional practices, more focused in a specific clinical domain, and adopt a more general approach, based on the principles of family medicine and closer to the Western practices. Kyratsis and colleagues categorized the former practices and logics as "narrow specialism" and the latter as "generalism". Such a change would imply the ability – and the will – of physicians to reconfigure their expertise, the interaction with their colleagues and the overall view of their profession. The "old" specialized professional logic was to be replaced by a "new" professional logic emphasizing collaborative work as well as the holistic view of the patient, *i.e.*, the patient as a whole, his/her familiar context and their broader social conditions. This evolution led to the emergence of a new type of organizations, able to combine the social focus with a more *efficient* enterprise model.

2.2.4. Hybrid organizations

By the end of the twentieth century, some longstanding stable areas of social life have been challenged. While business and charity, for instance, have been apart from each other, with business reserved to commercial business enterprises and charity to the social, non-profit sector, recent research revealed a new trend of combination of these different logics (Pache and Santos, 2013; Smith *et al.*, 2013; Battilana and Lee, 2014; Fitzgerald and Shepherd, 2018). The result is the social enterprise, a new hybrid form that needs to achieve financial sustainability in order to be able to fulfill its social mission.

The study of hybrid organizations has received increased attention from scholars. These organizations combine a social purpose with a business model, realities that have often been considered incompatible in the past (Greenwood *et al.*, 2011; Battilana and Lee, 2014). To a varying degree, a process of hybridization seems to have occurred in social sectors, like health and education (Waldorff, 2013; Besharov and Smith, 2014; Arman *et al.*, 2014; Vickers *et al.*, 2017), emerging industries like biotechnology and transfer of technology through innovation (Murray, 2010; Miller and French, 2016; Lander, 2016; Thune and Mina, 2016), and innovative ways to give support to people in need (Pache and Santos, 2010; Battilana and Dorado, 2010; Battilana and Lee, 2014).

Innovations in organizational forms within healthcare are an example of the urgency to reconcile the need to answer social needs with financial restraints (Kraatz and Block, 2008; Vickers *et al.*, 2017). Growing expectations by the users together with continuous innovations on technology and new clinical procedures turned healthcare into a prominent object of NPM reforms (Kurunmäki, 2004; Jacobs, 2005; Vickers *et al.*, 2017). Organizations within healthcare must learn to navigate between norms, practices and logics coming from disparate sources such as the state, the private sector and users (Vickers *et al.*, 2017).

Hospitals – in particular – clearly have a social mission to accomplish. Within NPM reforms, this social mission has been understood as better performed under the private sector management style, *i.e.*, under a commercial logic. While not always incompatible, logics coming from such diverse sources are often confusing and contradictory (Pache and Santos, 2013). Still, organizations facing such complex institutional environments can be successful, as they can choose and incorporate elements from different logics

(Pache and Santos, 2013; Vickers *et al.*, 2017), but challenges and difficulties emerge when the level of incompatibility increases (Besharov and Smith, 2014).

In general, civil servants were seen as not having incentives to be innovative (Vickers *et al.*, 2017) and this could be envisaged as a barrier to change. In addition, in the hospital context, physicians were seen to be more loyal to their patients than to management impositions (Nyland and Pettersen, 2004; Llewellyn and Northcott, 2005; Jackson *et al.*, 2014). Also, the introduction of management contents into the medical education was resisted, as medical schools argued that medical education should be non-commercial (Dunn and Jones, 2010).

As an attempt to blend social welfare and commercial logics (Pache and Santos, 2013) a new legal form of hospital governance emerged within NPM reforms in countries such as the UK, and also in Portugal: public hospitals subject to private management principles. Literature addresses this innovation thoroughly, addressing how hospitals remained under the influence of state and managed to acquire legitimacy through private sector like management practices (Pache and Santos, 2013; Vickers *et al.*, 2017).

The new organization form has been promoted as a way to get the best of both worlds. However, it has been involved in controversy from the start. In fact, at the field level, the state *marketed* the change as an improvement in efficiency, but critics understood the same change as a privatization process motivated by ideological reasons, as it would inevitably fragment the universal provision of care (Vickers *et al.*, 2017; italics added). But disparate points of view were also vividly felt within hospitals themselves, opening the space for tensions, especially between managers and physicians (Kurunmäki, 1999a; b; Besharov and Smith, 2014). The traditional dominance of physicians might be questioned, given the need to control budgets and achieve financial savings (Vickers *et al.*, 2017). In addition, in order to bring a commercial logic into hospitals, managers were hired within the private sector (Pache and Santos, 2010; Vickers *et al.*, 2017). For those managers who came from the public sector, this might as well represent an opportunity to join the emerging management practices, leave the bureaucratic restrictions and be more risk-taking (Dunn and Jones, 2010; Vickers *et al.*, 2017). Such a new way of thinking could be extended inside the organization, thus empowering the intermediate structures of power (Vickers *et al.*, 2017). Some innovations in management practices have been purposefully implemented in order to leave behind certain aspects of the public sector culture, then considered old-fashioned, including strict, rigid and hierarchical decisions (Vickers *et al.*, 2017).

The innovation in management practices should, desirably, lead to cooperation between professional groups inside the hospital and to cooperation between hospitals. However, such a change would collide with both sets of cultural beliefs, as managers in the private sector are used to protect their knowledge and physicians are loyal to values associated with care provision and social wellbeing and tend to be distant from management concerns (Besharov and Smith, 2014; Vickers *et al.*, 2017; Major *et al.*, 2018). In this context, where different logics are at stake, the role played by the forces in the field, like users, professional bodies and the state, could be as important as the attitudes of professional groups when trying to preserve their influence and to manage the balance of power.

2.2.5. The need for considering multiple levels of analysis

Decisions taken by organizations are, to a large extent, influenced by other actors in the field, mainly the state and professions (Greenwood *et al.*, 2002; Kraatz and Block, 2008; Pache and Santos, 2010). This is especially true when organizations are dependent on several providers of resources, as is the case in health, education, culture and other social services (Pache and Santos, 2010). On the one hand, there are many interests at stake within social services, from users to the state, as owner, regulator and the main funder (Pache and Santos, 2010). On the other hand, these fields are often fragmented and comprise various organizations of different sizes. To render things even more complex, organizations themselves comprise professionals with different interests and levels of power (Pache and Santos, 2010; Greenwood *et al.*, 2011), which opens space for conflict and pluralism (Dunn and Jones, 2010). As a result, pressures appear in a vertical and horizontal way, from outside and inside the organization (Scott *et al.*, 2000; Greenwood *et al.*, 2011), implying multiple levels of analysis.

Generally speaking, organizations interpret their environment and are likely to privilege the requirements issued by the most influential stakeholders (Pache and Santos, 2010; Guerreiro *et al.*, 2012; Major *et al.*, 2018). However, several factors intermediate between pressures coming from those stakeholders and answers generated by organizations. One of the most important is related to the size of the organization and its place in the field (Greenwood *et al.*, 2011): high-profile "central" organizations, because of their size, resources and differentiation, may be more exposed to pressures than others in the periphery (Greenwood *et al.*, 2011). Another relevant factor lies inside the organization: the balance of power between the main professional groups (Reay and Hinings, 2009; Greenwood *et al.*, 2011). Especially when forces are unbalanced within the organization, the most powerful groups have the opportunity and the incentive either to maintain the *status quo* or to "short-circuit" any attempt of change (Kraatz and Block, 2008).

Vertical relations in the field comprise norms, regulations and procedures which guide organizations. Still, given the underlying cultural nature of organizations, actors inside the organization may interpret them in a different way and act towards the maintenance of stability and in order to gain a sense of continuity (Scott, 2008, as cited in Major *et al.*, 2018; Dunn and Jones, 2010; Major *et al.*, 2018). In this regard, the size of the organization and its position in the field matters (Greenwood *et al.*, 2011). Larger organizations manage more material and human resources and provide more differentiated services to final users. In turn, they are given a central place in the field and their actions are more visible. In addition, larger organizations are likely to solve problems and make decisions at a higher level, negotiating directly with their main stakeholders, but are also subject to higher pressures from internal actors (Greenwood *et al.*, 2011). Conversely, organizations located at the periphery maintain fewer contacts with their peers and central authorities and are not so aware of leading decisions and expectations (Greenwood *et al.*, 2011). Besides, their more limited area of influence and their smaller size makes them less attractive for central authorities and professions to convey their positions to the whole field.

Pache and Santos (2010) and Greenwood *et al*. (2011) proposed two classifications that can help understand the relations that take place in a given field. For Pache and Santos

(2010), conflicts are more likely to emerge in *fragmented* fields. Fragmentation means that there are many uncoordinated organizations, which respond to multiple and uncoordinated authorities located at higher levels in the field. Education in the US and Europe are examples of a fragmented field. On the contrary, in *centralized* fields, such as the military forces, there are a few and coordinated decision makers at the top of the hierarchy. Central authorities retain the ability to constrain the attitudes taken inside organizations, because they have the legal power to do so and they can use financing mechanisms for that same purpose. In turn, normative bodies can issue norms and implement accreditation processes that will guide the intervention by professional groups. The final and more complex class of fields corresponds to the *moderately centralized fields*. Within these fields there are several misaligned actors that cannot determine the evolution of the field on their own, but that are powerful enough to interfere in the decisions taken at all levels of the field. The healthcare sector is an example of this final type of field. The study by Scott *et al.* (2000) highlight the complex nature of healthcare, with the presence of multiple and sometimes confusing funding and regulatory agencies, as well as the dual power exerted at the same time by central authorities and professions.

While considering the work by Pache and Santos (2010) as “the most explicit attempt to provide a framework” for studying the strategies used by organizations in order to face the complexity of a field (Greenwood *et al.*, 2011, p. 348), Greenwood and colleagues also consider that there is not yet a fully developed framework for comparing fields. In order to address that gap, they propose the distinction between mature and emergent fields, two implicit approaches that have been present in recent literature. That distinction might be of major interest for studying a given field, because it brings attention to some features that are usually present in each class of fields. Relationships between collective actors in the field, whether the government, organizations and professional groups, are more stable, formalized and predictable within mature fields, where there is the presence of a single dominant logic or an arrangement of mutually accepted logics. The relevant point here is that increased formalization and shared logics lead to standardization and similar answers from organizations. In opposition, emergent fields are much more open to incoming actors, with new ideas and logics rooted in other fields. Emergent fields are at an early stage in the development of webs or ties among organizations. In turn, organizations are likely to be small and face limited barriers to entering or leaving the field, contributing to the fragmentation of organizations and their links to funders and regulators and allowing for persistent reconfigurations of the field. Again, healthcare is a mature field, but literature provides good examples of how even mature fields like healthcare can evolve over time (Scott *et al.*, 2000; Eldenburg *et al.*, 2017).

3. Problematizing the concept of selective choice and a theoretical framework

As one saw, early formulations of institutional theory addressed how organizations aligned with their external stakeholders in order to achieve legitimacy and chances of survival (Zucker, 1987; DiMaggio and Powell, 1983). Pressures from the state or professional associations would legitimate the actions and behaviors of organizations and would lead to isomorphism with their institutional environment. However, those early formulations studied the relationships between organizations and their main referents somewhat rigidly, concluding that organizations reacted to coercive pressures from the state, normative pressures from professional associations and mimetic pressures from their peers. This approach has been criticized for the lack of a comprehensive theory of action (DiMaggio and Powell, 1991, as cited in Pache and Santos, 2010; Seo and Creed, 2002), and later work has stressed how heterogeneous environmental conditions opened space for organizations to interpret them and strategically decide upon multiple courses of action (Seo and Creed, 2002; Purdy and Gray, 2009; Smith *et al.*, 2013).

Recent research on hybrids suggests that organizations manage their choices carefully and strategically (Reay and Hinings, 2009; Purdy and Gray, 2009; Guerreiro *et al.*, 2012; Pache and Santos, 2013). Organizations are able to prioritize the demands of their stakeholders and pay special attention to those that they perceive as more important (Guerreiro *et al.*, 2012; Pache and Santos, 2013). Through mechanisms of selective choice, organizations can acquire legitimacy and acceptance incurring in lower costs and risks when compared to alternative strategies as decoupling and compromise (Pache and Santos; 2013), and they also actively choose the pressures they want to obey in order to promote their own interests (Guerreiro *et al.*, 2012).

Nevertheless, early research within this line focused more on how top-down pressures affected organizational behavior than on understanding behavior from the inside (DiMaggio and Powell, 1983; Zucker, 1987). Stated in other words, while actively making decisions organizations were seen as unitary and integrated entities (Pache and Santos, 2010). More recently, authors have stressed the need to go into organizations in order to explain how they develop strategies to respond to exogenous institutional pressures and to analyze how internal actors interact and mobilize their power in order to try to guide organizational responses that are favorable to their own interests (Pache and Santos, 2010; Greenwood *et al.*, 2011)

In most cases reported in the literature, internal actors hold divergent interests and are more likely to collide in order to lead the organization as a whole or at least to preserve their status inside the organization (Scarparo, 2006; Kraatz and Block, 2008; Dunn and Jones, 2010; Battilana and Lee, 2014). The healthcare field is certainly one of the most studied, and the conflicts between managers and physicians are well-reported (Kurunmäki, 1999a; b; Cardinaels and Soderstrom, 2013; Jackson *et al.*, 2014). Organizations could best attain their goals if these groups were able to promote adaptation through collaborative efforts, recognizing the existence of mutual dependence and ends. However, especially when forces are not balanced, groups are likely to try to take advantage of their relative positions in terms of power (Kraatz and Block, 2008). Indeed, concerning actors inside the hospital, selective choice comes from their reading of the institutional environment, and how it threatens the *status quo* and provides opportunities to shift the balance of power. Organizations respond strategically to changes in legal forms, norms and recommendations from the government, regulators and professional associations, but organizations are not unitary entities and their strategic decisions will come out of the internal (un)balance of power.

The prediction of how different groups will react when the daily routines of the hospital are broken down by new legal arrangements is not straightforward. On the contrary, reactions can contradict the expected opposition between professional groups. Reay and Hinings (2009), for instance, studied the response to a dramatic change imposed by the provincial government of Alberta, Canada, concerning the introduction of a business-like healthcare logic which legally excluded physicians from the board of directors of the newly created Regional Health Authorities, and transferred attributions from clinicians to other professionals when possible. Such a change has been promoted as a direct challenge to the dominant logic of *medical professionalism*, presented by the government as an unsustainable major source of costs. However, in time, Regional Authorities themselves began to withdraw from the government agenda and found that they could work together with physicians as they similarly dislike some government initiatives. In addition, Regional Authorities were meant to identify new and improved ways of providing care and they found that the best way to accomplish such obligation was to promote pilot tests in collaboration with physicians. Redesigning care was something new for all professional groups and involved, for instance, the creation of multiple teams and the delivery of chronic care in community centers and at home. The authors concluded that although the different actors were able to maintain their independence, managers in Regional Authorities took into great account the opinion of physicians as experts in the core area. In turn, physicians found they could get government support for particular initiatives if they cooperated with intermediate structures representing the state. Thus, contrarily to most cases reported in the literature, managers and physicians established a pragmatic collaboration, on a case-by-case basis, when joint work could both allow both for a degree of autonomy and for the pursuing of common goals.

Another issue with the literature on selective choice may be noted: this literature often assumes that the communication of guidelines and targets by entities at higher levels in a field is well understood by organizations and actors at lower levels, that have the ability to clearly read the pressures from the entities which they are dependent on and know how to act before them (Pache and Santos, 2010; 2013; Guerreiro *et al.*, 2012). This is not straightforward, however. Hospitals, as hybrid organizations, have to comply with orientations coming from diverse entities. In Portugal, for instance, the MoH and its agencies establish a relation of authority or power with hospital boards of directors. Whether governments, intermediate structures of the MoH or regulators, they all hold supervision over issues of dramatic importance for hospitals and hospital management. Besides the appointment of the board of directors and the transmission of guidelines and targets, public authorities are also responsible for funding and licensing healthcare units. The MoH is concerned with the number, quality and timeliness of hospital acts, like consultations, emergency episodes and surgeries. But the MoF is concerned with financial equilibrium. Thus, governmental demands may be difficult to reconcile. In the same vein, professional associations are concerned with the wellbeing of people and the quality of care, but they are certainly also looking for the best working conditions for their affiliates. Again, these goals may be hard to reconcile.

In turn, at lower levels in the field, the hospital interacts with many other stakeholders. Public hospitals are organized into a network, combining the localization, specialization and number of inhabitants. Hospitals linked to each other through this network have obvious contacts, but contacts and benchmark also occur between peers (hospitals of the same size and resources). Links to Academia reflect the highly differentiated academic background of multiple professional groups in the hospital, but they may also represent cooperation, *e.g.*, in teaching, testing new drugs, developing medical devices and creating new accounting models. To some extent, relations with municipalities reveal the attention of local communities with *their* hospital and the importance given to healthcare by people and the media. In fact, relations with the media are relevant to the point that it is usual to see large communication departments within the hospital structure. The hospital is also obviously concerned with their patients and with public opinion. Finally, as one saw, there is the need to look inside the hospital. Besides the relation of authority between the government and the board of directors, decisions within the hospital, whether strategic or operational, are influenced or taken by powerful professional groups, especially physicians, but also managers at intermediate levels of the hospital, nurses and technicians.

Thus, emerging here is a picture of complexity and in order to get to the understanding of the mechanisms of selective choice, I now propose a theoretical framework, based on the main institutional logics concepts addressed in this Section. This framework takes into consideration the causal relationships that are established among the concepts, in short: 1) institutions evolve over time; 2) in the case of healthcare, the evolution transformed healthcare-oriented hospitals into hybrid organizations, subject to a dual character of healthcare providers and business firms; 3) there are several relevant stakeholders, with distinct ties to the hospital, thus requiring multiple levels of analysis; 4) the place in the field matters, as selective choices are distinct in regard of those ties; and 5, selective choices are enacted by the hospital after reading all expectations and pressures made upon it (from the outside and the inside), not forgetting that those expectations and pressures also evolve over time, making the relation between the evolution over time and selective choice a target of scrutiny every time that a major event takes place.

The theoretical model is presented in Figure 28a and 28b. Figure 28a summarizes the causal relationships between the concepts as just described, through two arrows, the first one going sequentially through the five concepts and the second one restarting the whole process, as in a loop. The third and the fourth concepts are placed side by side because organizations act differently in regard of their place in the field. In turn, Figure 28b comprehends a set of questions that helps on assessing the presence and on evaluating the contribution of each concept to explain selective choice.

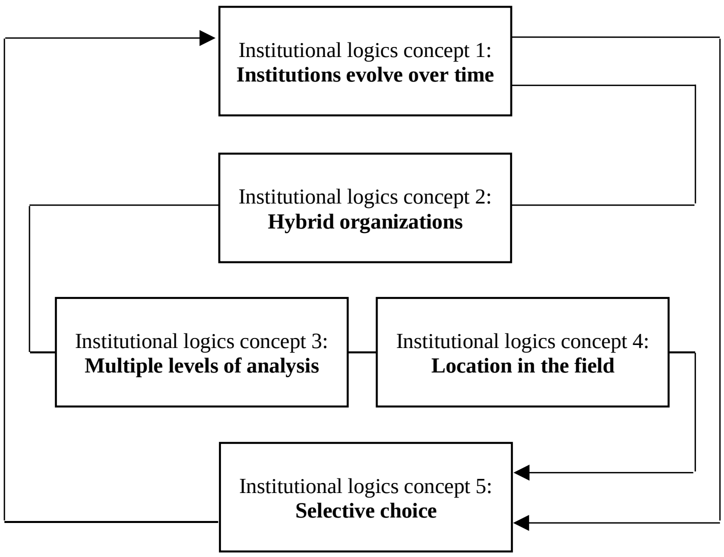

Figure 28a Summary and how to read the theoretical framework

Institutional logics concept 1: institutions evolve over time

Are there historical, cultural or social events or major laws with the ability to trigger change in the field over the period of analysis?

- Identify triggers
- List institutions involved
- Classify change: radical or incremental?
- Evaluate the stability of change
- Check impact on the organization under study

Institutional logics concept 2: hybrid organizations

Did changes alter the very nature or scope of institutions in the field?

- Identify organizations involved
- Identify sets of competing logics (*e.g.*, social welfare and commercial/business)
- Check impact on the organization under study
- Identify source of change: imposed/legal (political action) or triggered from inside (internal processes)?
- Identify professional groups involved
- Check decoupling

Institutional logics concept 3: multiple levels of analysis

Which are the main stakeholders and how do they interact?

- Identify the main stakeholders in the field
- Map interactions among institutions
- Check the subordination of the organization under study (legal, funding, hierarchical) for vertical pressures
- Check interests and power of professional groups inside the organization under study for horizontal pressures

Institutional logics concept 4: location in the field

Where are institutions in the field?

- Classify the field (fragmented to centralized; emergent to mature)
- Place institutions in the field (at the top, at the center and at the periphery)
- Locate the organization under study in the field
- Evaluate the place, size and links of the organization under study to main stakeholders (internal and external)

Institutional logics concept 5: selective choice

What selective choices were made by the organization under study?

- Evaluate expectations made upon the organization under study, by internal and external referents
- Identify pressures from main external referents (isomorphic pressures from the State and professions)
- Evaluate internal interests and actions
- Evaluate the consistency of pressures over time, considering the triggers identified above
- Summarize selective choices
- Assess decoupling

Figure 28b Theoretical framework

By applying the theoretical framework to the case of HSJ I identified three distinct periods during which the combination of the concepts may have led the Hospital to evaluate its environment differently and make equally different strategic choices in regard to the sophistication of management accounting systems. To some extent, this temporal representation acknowledges the over-exposition of HSJ to pressures from the government at the top of the field, compared to pressures coming from other relevant stakeholders. Those stages are displayed in Figure 29 and the next sections are dedicated to studying each of them.

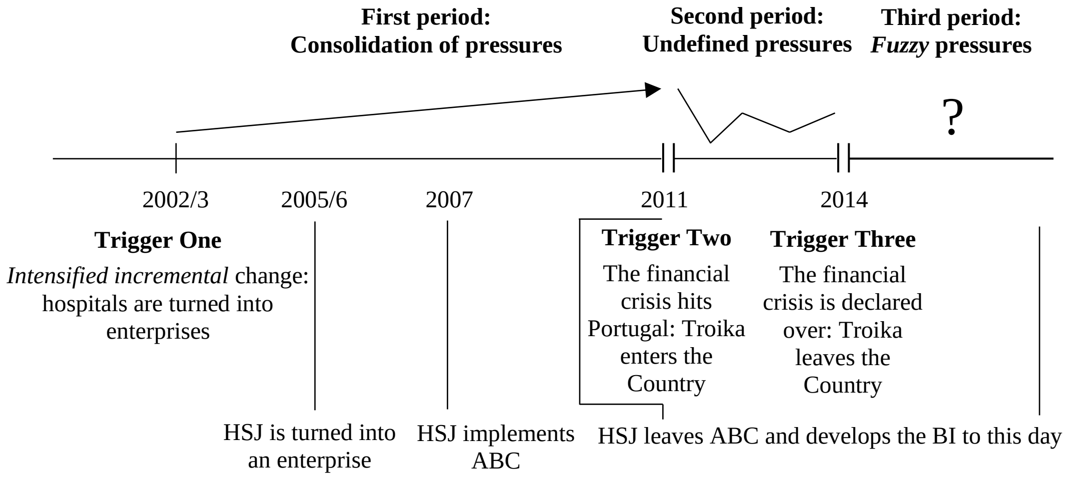

Figure 29 Periods with distinct impact on the sophistication of management accounting systems in hospital settings after corporatization

4. First period: the evolution of the healthcare field in Portugal until 2011 – emergence and consolidation of institutional pressures for the adoption of NPM principles and practices

The first major event that brought the Portuguese healthcare into the spotlight over the current century had its start in 2002/3, when the first public enterprise hospitals were created, as part of the NPM reforms which were being undertaken throughout Europe. Business-like management practices were then introduced and the sophistication of management accounting knew its peak around the years 2007/8, when ABC was tested in public hospitals.

This Section aims at describing how rapidly management models typical from the private sector were spread throughout enterprise hospitals. As far as management accounting is concerned, in 2007, only four years after the creation of the first enterprise hospitals, an ambitious national ABC project was taken as a big step ahead.

4.1. Healthcare-oriented hospitals as the starting point

In the turn of the century, public hospitals in Portugal were part of the public administration and global budgets ensured their regular functioning, much more concerned with care than with financial balance. On the one hand, hospitals were focused on their mission of providing differentiated care to all citizens, and, on the other hand, citizens were increasingly aware of their rights and put more and more pressure over politicians in order to expand the hospitals' capacity to fulfill their expectations and needs (Simões, 2005).

The nature of Portuguese public hospitals at that time was rooted in reforms passed in 1971, even before the Revolution of 1974 (Simões, 2005). Such reforms intensified the role of the State as a major player in promoting health and prevent disease. While more theoretical than with practical consequences, such concerns, advanced for the time and especially for the political regime, were in line with the Revolution's aspirations and were deepened in the years to come (Simões, 2005). During the next three decades, a large consensus has been reached about the nature of the SNS, involving parties from both the left wing and the right wing, without significant ideological turns (Simões, 2005). While gradually loosing importance, the presence of the State as a service provider was maintained, as well as major concerns about promoting access to care.

Concerns about access to care have been the main axis during the period from the first reforms in 1971 to the end of the century (Carapinheiro, 1993; Simões, 2005). Another axis has been rehearsed and knew some developments along the same period, but with much less effective consequences: the management function and the acknowledgment of the hospitals' enterprise nature (Campos, 2003; 2004; Simões, 2005; Varanda, 2004;

Ribeiro, 2004). This was several times transcribed into law (in 1968, 1988 and 1990) but only a few times materialized.

Hospitals had grown in size and complexity and were organized in terms of rationality and efficiency (Carapinheiro, 1993). However, while major laws had prepared hospital settings for innovation in management practices, the notions of “rationality” and “efficiency” were still framed around a dual power structure, *i.e.*, bureaucratic and clinical (Carapinheiro, 1993; see also Barros, 2013). On the one hand, larger hospitals required the contribution of an administrative structure, with improved communication systems and the empowerment of intermediate management structures, but, on the other hand, a “charismatic” second line of command stemmed from the technical capabilities that allowed physicians “to treat patients and save lives” (Carapinheiro, 1993, p. 47).

Comparing both powers, by the turn of the century the medical power was taking the lead in relation to ‘managerial’ concerns (Carapinheiro, 1993). Many issues contributed to the supremacy of medical power. First of all, hospitals grew around the hiring of many more health professionals, organized into clinical services and specialties. Space and new facilities were organized accordingly to clinical requirements as well. But, probably, the major issue was the central role attributed to the *clinical act*, which conditioned all the other decisions taken at the hospital level (Carapinheiro, 1993).

Physicians and nurses controlled together the clinical act, with complementary functions but under medical supervision. Physicians held the intellectual work of diagnosis and therapeutics, while the execution was attributed to nurses (Carapinheiro, 1993). In turn, the jurisdiction over the nurses’ assistants was the only link of the bureaucratic line of command to the clinical act. In turn, the low level of delegation of powers by the MoH to hospital boards limited their ability to define the hospital’s priorities and policies.

Criticism about the inability of the traditional healthcare-oriented hospitals in order to cope with raising costs and the introduction of private sector-like management tools made the healthcare field the privileged stage for NPM reforms in Portugal (Campos, 2003; 2004).

Several limitations were pointed out to hospital management, including the delegation of powers, human resources management, procurement, investment decisions and local pressures. Hospitals were meant to be financially and administratively autonomous entities, but they depended at 90% on funds from the State Budget (Campos, 2003); the configuration of the hospital staff was administratively and centrally decided and all professionals were civil servants, with stable careers and progressions linked to time and not to merit (Campos, 2003; 2004); procurement followed the same legislation as every other public entity, with or without autonomy (Campos, 2003; Simões, 2005); decisions on investment were centrally taken, without effective participation from hospital boards (Campos, 2003; Ribeiro, 2004); and, finally, when new investments were at stake, local pressures led to investments above the necessary and efficient level (Campos, 2003).

4.2. Reforms in healthcare: Portugal followed a broader European movement

The history of the SNS is relatively recent. It has been created after the Revolution of 1974 and it is, to a large extent, inspired by the British NHS (Picoito and Major, 2013). Although some authors relate the emergence of the SNS to the reform operated a few years before, in 1971 (Simões, 2005; Simões and Dias, 2010), the SNS is commonly linked to the Revolution and it is often considered one of the biggest collective achievements that came out of the political transition. In addition, it is regarded as a very important and acquired right of citizenship and its main goals reflect to this day the own nature of the Revolution: ensure access to health at a nearly free cost to all citizens (Mateus, 2010; Lopes, 2010; Oliveira, 2010; Vaz, 2010; Simões *et al.*, 2017).

Following the broader NPM movement in place at other European countries, such as the UK and Finland (Kurunmäki *et al.*, 2003; 2004; Jacobs *et al.*, 2004; Lægreid and Neby, 2016), Portugal rehearsed some attempts of reform, anchored in major laws passed in 1988 and 1990 (Simões, 2005). The most remarkable attempts were the introduction of responsibility centers and the opening of the first corporate hospital in the outskirts of Lisbon in 1995, and a second one in the North of the country, south of Porto, three years later (Campos, 2004; Barros, 2013). The intention of centrally imposing the internal reorganization of public hospitals into responsibility centers was abandoned, but the creation of corporate hospitals made its way and on January 1st 2003, after a change in the referred major laws during the previous year, 34 public hospitals were turned into 31 corporate hospitals. In subsequent years, other public hospitals were turned into enterprises and many were merged, imposing the corporate hospital as the general model for the entire SNS.

Governments made clear their full support to such a far-reaching transformation. As a general rule, public hospitals were facing serious financial defaults and in order to allow effective change and confer a corporate nature to the hospitals involved, the shareholders MoH and MoF subscribed and fully paid the share capital considered necessary to solve existing debts, co-finance new investments and enable a balanced capital structure.

Following this intervention in the financial balance of the hospitals, and also the reinforcement of the management mechanisms under control of the boards of directors, the reimbursement model was dramatically changed. Traditionally, hospitals were funded mainly on the basis of previous years' expenses and very little on their production (Macedo, 2008; Borges *et al.*, 2010; Mateus, 2010; Barros *et al.*, 2011). Thus, budgets were prepared in the easiest way, just adding a certain margin of growth to costs and revenues and not involving internal structures, like medical departments, in the process. Additionally, hospitals faced major problems when trying to get authorization for new investments: to overcome this limitation they often made use of the annual budget, thus deepening their deficits (Campos, 2003).

Changes in the reimbursement model were similar to NPM reforms across Europe and were based on the implementation of the DRG system (Mateus, 2010; 2011; Barros *et al.*, 2011). Up to that point, the MoH got together the roles of main supplier and funder of healthcare. In order to split those roles and to strengthen the new corporate character of public hospitals, the MoH introduced an annual contract[12], which established the activity that each hospital should perform in terms of quantities and prices (Barros *et al.*, 2011; Picoito and Major, 2013).

[12] "*Contrato-programa*".

4.3. The MoH made its voice heard

The presence of the MoH in the beginning of the corporatization process was evident. Besides funding a visit of presidents and clinical directors to four corporate hospitals in Barcelona over an eight-day period, the MoH centralized the major activities concerning negotiation and control in the then created *Unidade de Missão*. This new central body imposed a tight control on the hospital boards through a series of mechanisms: the continuous supervision of the execution of the aforementioned contract, the introduction of a monthly *tableau de bord* covering clinical and financial indicators and the call of all boards to meetings in Lisbon every one or two weeks. The support, but also the pressure, from the *Unidade de Missão* came in many ways, from support in the preparation of budgets to interventions in local sessions scheduled to explain the new model to all professionals. The staff from the *Unidade de Missão* came to be known as "the communication group" (Macedo, 2008).

Initially, this was received with distrust, as the former President of the Central Administration of the Health System (ACSS) pointed out, but things rapidly changed:

> *From the moment that hospitals understood that when they had a doubt and called the* Unidade de Missão *they got an instant answer, they started to give credit to it. In addition, people from the* Unidade de Missão *did not stay at the cabinet, they came to people, to help. The* Unidade de Missão *helped on the strategic plan, on the negotiation with the MoH regional branch, on the interpretation of management data and on the establishment of comparisons with peers, and that started to be seen by institutions as something with great value.*

There was yet another feature that made the *Unidade de Missão* particularly useful: the MoF was just entering the healthcare field, and so the field could sound as strange to the newcomer as the presence of the MoF probably was to the hospitals. In this context, the *Unidade de Missão* has been a single intermediate, who captured the confidence from the MoF and helped hospitals to report information in a common format.

Corporatization has been introduced by the MoH as a response to increasing losses of efficiency (Campos, 2004). Two governments in a row, from both the center-left and the center-right wing parties, envisaged corporatization, along with the management of public hospitals by private entities, as tools for achieving gains in technical efficiency and better resource allocation (Campos, 2003; 2004; Ribeiro, 2004). Business-like management was sought to overcome a set of barriers which was preventing efficiency gains and a better utilization of the SNS hospital network (Ribeiro, 2004). Those barriers comprised the lack of control of public managers over production factors, the inability to link remuneration to individual or collective performance, some confusion in hierarchy and insufficient management accounting information (Campos, 2004).

Within the structures of the MoH there was a shared belief that management control systems (MCS) could enhance the new management model. Members of the consecutive governments from 2002 onwards and its dependent bodies stated that hospital managers should make use of MCS to improve the efficiency of resource allocation and raise the levels of satisfaction of patients and professionals. Through communication channels like interviews in the media or articles published in the *Revista Nacional de Saúde Pública* (Ribeiro, 2004), as well as presentations in courses and conferences, the senior leaders of the corporatization process referred insistently to matters such as planning and control, reform of the internal governance structure and incentive systems (Macedo, 2008). Under the umbrella of the new management model, the boards of directors could reshape the internal structure of their hospitals, introducing, for instance, responsibility centers and decision support services. At the top of the MoH these solutions were considered "modern" and "innovative" and therefore should be seen as an "opportunity"[13].

Human resources, background in management education, as well as the ability to attract managers from the private sector were other concerns of the MoH, as were the incentives systems in place for these professionals. The former president of the *Unidade de Missão* presented an incentives model based on the three following components: individual performance, counting for 60% of the incentive; service performance, counting for 25%;

[13] The Secretary of State for Health at the time in an interview given to the journal *TecnoHospital*, published in the 3rd quarter, 2005.

and hospital performance, counting for the last 15%. This model was the first of its kind towards civil servants and was meant to be part of a larger set of human resource policies such as the introduction of private labor contracts and the revision of the existing careers and wages (Ribeiro, 2004).

4.4. Slowing the pace of change?

The business-oriented management model was launched with a full commitment from the MoH, and the *Unidade de Missão* played, as one saw, an overwhelming role in terms of spreading the use of MCS tools such as strategic planning and control, as well as in promoting a regular benchmarking. The former president of the ACSS and former member of the board of directors of the *Unidade de Missão* recalls the objectives of the corporatization:

> *The initiatives related to corporatization were meant to create management tools which could provide those in charge of public hospitals with the same tools available for any private managed healthcare entity. Provide the same tools to get, in the final, the same performance.*

Such management tools were fully aligned with those identified in the context of NPM reforms carried out in other European countries (Kurunmäki; 1999; Nyland and Pettersen, 2004). Like regular enterprises, hospitals would be paid for their production, instead of receiving a similar value over the years. Therefore, like any regular enterprise, hospitals would have to manage their resources in order to be financially sustainable and would need MC tools for that purpose. The former President of ACSS stressed how the new funding model, combined with the introduction of a mandatory set of MC tools, namely a strategic plan for the long term, as well as an activity plan and an annual budget for the short term, contributed to bring hospital management closer to their private counterparts.

Another aspect of major importance for the former President of ACSS was the increase in the hospitals' autonomy to make decisions on their own. The MoH promoted a delegation of powers to the hospital boards, streamlining the management function and capacitating the boards to decide on investments up to a certain threshold. It was also this delegation that enabled hospitals to “hire the right persons for the right places”, to the point of bringing people with management education and background into the intermediate structures of public hospitals.

Nevertheless, in 2005, only three years after the creation of corporate hospitals, some major changes were introduced in the business-oriented management model by the newly elected government from the center-left wing party. Notably, corporate hospitals assumed a new legal public enterprise status specifically created for that purpose. In addition, the *Unidade de Missão*, as we saw, a central authority of major importance during the initial years of the new model, was extinguished and its roles were split among three entities: Regional Health Administrations, Quality in Health, and Health Information Technology and Finance Management Institute (Picoito and Major, 2013). Later on, in 2007, the two last entities were merged to form the already mentioned ACSS, which continues to this day.

Some professionals holding positions in the board of directors of a corporate hospital at the time saw these changes as a turning point and as a “softening” of the management model (Macedo, 2008). However, a different opinion has been transmitted by the former President of ACSS. In his view, the modification of the legal status was essentially ideological and was restricted to the conversion of share equity into statutory equity, as well as the substitution of the Shareholders’ General Meeting by a mechanism of direct approval of the accounts by the MoH and the MoF. However, in the perspective of this interviewee, the change did not essentially interfere with the functioning of the hospitals.

4.5. Other relevant stakeholders in the field: how did they care for the sophistication of management accounting systems?

Any other stakeholder in the field had the capacity to create so many pressures over HSJ in regard to the sophistication of management accounting systems as the government/ central authorities. However, there were other relevant actors in the field with potential links to the subject, in particular healthcare professions, their associations, the national Accounting Standards Committee and Academia.

In spite of the proliferation of hospital managers that followed corporatization, it did not seem to bring a shift of concerns or new expertise on management accounting. The situation seemed to be similar at the top of the hierarchy – politicians and even people at ACSS, the MoH's branch for management issues –, where "those who really had power showed a preference for maintaining the *status quo*" (Academic B). As professionals in management functions were usually unfamiliar to management accounting, either at the central authority or at the hospitals, what kept being implemented was merely normative, in response to ACSS requirements.

One of the reasons for the limited expertise in management accounting from those who held management positions in public hospital settings might be the training received during their graduate-level or post-graduate-level courses, as it has been proposed by several interviewees. In this domain, the role played by hospital managers was especially relevant.

Careers in Portuguese public hospitals comprised the profession of "the hospital manager", as someone post-graduated by the *Escola Nacional de Saúde Pública* (ENSP), a faculty integrated in the *Universidade Nova de Lisboa*. This School was created in the 1960s, when a group of academics who later would hold the highest positions in the MoH went to study hospital management in France and came back with progressive ideas. Due to this school's culture, more formal and tackling administrative subjects than those related to management, there seemed to be a gap between training at ENSP and at business schools, which could have effects on hospital management. In addition, there was a pressure in the healthcare field in order to appoint these professionals to relevant positions, namely with executive functions in hospital boards. Given the nature of the training received in the post-graduate course, those who were not graduated in economics or management revealed a clear gap when discussing management themes, to the point that they seemed "uncomfortable" when more elaborated subjects like management accounting were under discussion, referred the Member of the board.

Expertise on management accounting could also be brought into public hospitals by professionals with education in economics and management hired in private hospitals. However, this movement usually happened in the opposite direction, *i.e.*, from public to private hospitals and interviews provided no evidence of sophistication of management accounting by replicating cases of success in the private sector.

Inside and outside HSJ, it has not been recognized a particularly dynamic attitude by hospital managers, or that any intervention from their professional association – the *Associação Portuguesa de Administradores Hospitalares* (APAH)[14] – affected strategic decisions and daily routines in management accounting.

Regarding physicians, the way they traditionally faced management subjects was shaped by medical education, which did not encompass a component on management issues. Yet, the situation was starting to change, because post-graduate courses offered by faculties of medicine helped to diminish that gap. Some interviewees stressed how hospital management in general was shaped by the medical action, and how important it would be to rely on improved management accounting systems – as any other manager – as a means to understand and justify costs and output:

> *There was a problem in that a large part of management was kept in the physicians' hands, who were not managers or familiar with [management] issues. When we, economists, talked about figures and cost estimations they thought that we were viewing things from a single economic angle. To make things worse, the economic angle, and, especially, accounting, had a bad name in these settings. This was a mistake, because when we made calculations and when we accurately estimated costs, we did it to gain efficiency, and all involved might profit: the own institution, those who paid and also the citizens.* (President of APHP)

> *Physicians ought to be ready for a system of that kind and they really had to want to embrace management issues. We could not change the physicians' identity; therefore, trying to implement sophisticated management systems without training*

[14] APAH represents hospital managers, post-graduated by ENSP.

> *physicians and without trying to change their mindset* – i.e., *the way they looked at their responsibilities in hospitals, […] was unthinkable […].* (Academic B)

In fact, the involvement of physicians in the sophistication of management accounting and other tools for supporting management would be a consistent matter of concerns for HSJ, contrarily to other hospitals, and, as I will refer in the next sections, that might be a reason for the consolidation of a proactive approach in regard to the innovation in information systems for management.

4.6. The emergence of ABC

In 2007 the MoH launched the project of implementing an ABC-based costing model in 10 public hospitals (Barros *et al.*, 2011; Nunes *et al.*, 2016), with the main objective, in the former Secretary of State's view, of enabling hospitals as well as the MoH/MoF to understand "where and how money had been spent and where and how to avoid inappropriate expenses". This project constitutes a clear example of a specific pressure for NPM reform in hospitals, one that is especially relevant for the present dissertation, since it involves an attempt to change management accounting systems and practices.

The decision to start the project with a limited number of participants was strategically taken in order to better cope with the complexity of the model, test solutions, understand problems, validate results and later on extend the project to the remaining universe of public enterprise hospitals. In sum, stressed the former Secretary of State, the main objective was inseparable from information, *i.e.*, to understand information, but necessarily trustworthy and validated information to be further used by central authorities for supporting political decisions.

Information gathered and processed through the ABC system would, therefore, serve two distinct purposes: on the one hand, to support management accounting and the internal delegation of power and, on the other hand, to improve the definition of prices by the ACSS. In relation to the latter, the ACSS intended to use the output of the ABC project to update and improve the set of weights associated to the Maryland Matrix and allow for a more appropriate list of prices. Recalling that the funding model had been developed in 2002 and had been based in management accounting information related to 2001, it should be “at least, reprocessed and improved”.

The ten enterprise hospitals included in the project were carefully chosen, with the aim to deliver, in the final, pilot tests that could be envisaged by the others as valid solutions to be followed. In order to provide hospitals involved with the necessary funds, the ACSS made available financial resources specifically assigned to the project. Besides funding the project, central authorities also decided to hire a consultancy firm to add technical expertise to the project.

Attempts have been made by central authorities to attract the interest of other hospitals to the point that the rules for hospital funding for the years 2007/2008 included additional funds for those hospitals that showed the will to join the project. While funds available were estimated to cover all expenses only a few hospitals expressed interest in joining the project, recalled the former President of ACSS. Among them, some have gone forward, but others left soon after joining the project.

4.7. HSJ: the responses of a dynamic hospital at the center of the field

When the first corporate hospitals were created in 2002/3, the largest hospitals were strategically left aside, allowing for precious time to learn from the process. When the moment came for HSJ, in 2005/6, a couple of intense years of change were witnessed in this hospital. Indeed, HSJ quickly adhered to NPM principles, to the point of becoming seen as a reference in that regard. An obvious example was the development by HSJ of the most ambitious project ever undertaken by a single hospital in Portugal: the decision to implement a sophisticated management accounting system, based on ABC. The decision was contemporary to the national project, but it was taken internally, based on a thorough belief that decision making should be supported on improved information.

4.7.1. New Management Control at HSJ

As mentioned above, following the introduction of a contract on production and payment between corporate hospitals and the MoH/MoF, together with new management tools and the empowerment of intermediate structures, the boards felt the need to hire people with education in economics and management, in many cases with prior links to the private sector.

In HSJ, the current Management Control Department (MCD) Director integrated "the first wave" of people in those conditions, besides the career hospital managers, who were, "the only professionals with a point of contact between healthcare and economics/ management, eventually". The MCD Director recalled that all 8 professionals hired at that time came from the private sector and not one of them had worked in a hospital before. She also mentioned that all were given functions in operations management, especially in the MCD.

Initially, the MCD delivered a *tableau de bord,* introduced in corporate hospitals by the *Unidade de Missão*, to the board and to clinical departments. At stake was information on costs, production and quality. When the new staff was hired, all clinical departments were distributed among the MCD members and this work intensified. Every single member was held accountable for working closely with a given number of services, assisting in operations and management control functions, such as preparing annual activity plans and budgets, internal contracts on production and variance analysis.

About six months after the recruitment of the new staff for management control functions, and coinciding with the shift from corporate hospitals to public enterprises, the HSJ undertook the most emblematic change in its internal structure: the creation of responsibility centers, known at HSJ as *Unidades Autónomas de Gestão* (UAGs). Responsibility centers were the final achievement of all steps taken before in terms of management control, starting from the introduction of planning and control tools and the establishment of internal contracts and ending with the hiring of people with education in economics and management.

Therefore, the introduction of the UAGs has been smoothed by all the policies that had been gradually implemented at HSJ. When UAGs began operating, “the paradigm changed a little, but management control activities were more or less the same”, stated the MCD Director. In this context, perhaps the creation of a new level of intermediate management between the board of directors and departments, either clinical or support services, has been the most remarkable difference, she said.

Nevertheless, all those years between the beginning of the corporate hospital to the establishment of the UAGs, were years of intense activity:

> *Paradigms have been changed, much direct intervention has been done and many processes which are commonplace today have been triggered at that time. Since I have been here I see a different approach in relation to management and to how to act before deviations from plans.*

4.7.2. “Hybridization” and a giant step towards more sophisticated management accounting systems: the ABC project

The new reimbursement scheme set out in 2002, along with the corporatization of public hospitals, led hospital boards to adopt management concerns typical from the private sector. For the member of the board in charge of the financial area, in a time when hospitals received a fixed amount, regardless of its output, there were no incentives for increasing production or improving the record system in order to obtain more useful information on resource usage and costs. Conversely, within the new model, hospitals could act over production and costs and be financially sustainable.

The Chairman of HSJ shared this perspective and emphasized how the realities before and after the new management model were different:

> *We had one reality before the corporate hospital and a rather different one after. The Hospital used to be paid for what it spent. We got to the end of the year, saw what we spent, and the State put the money here. It did not want to know if the*

money was well or badly spent. But things did change after the corporate hospital. From then on, the State, aware of its necessities of hospital services, whether consultations, admissions and so on, started to buy it from the hospital.

Corporatization transformed Portuguese public hospitals into hybrid organizations, just as it happened in other countries and sectors (Kurunmäki, 1999a; b; Jacobs, 2005; Jackson *et al.*, 2014). The Chairman acknowledged that his Hospital provides services with a "superior social value", but it cannot disregard the budgetary and financial balance.

Given the dual nature of corporate hospitals, the Chairman established comparisons with private hospitals and enterprises from other industries. In his opinion, what was relevant in relation to private hospitals was the attention given to accounting and information on resource usage and costs, much higher in the private sector, because "there is a question which has ever been made and always required an answer: how much does this cost and how much do I get paid for it?" While health has "a social value", private organizations must be fundamentally concerned with their financial situation, otherwise "it would be dramatic for them and they would be forced to close". In relation to the latter, the Chairman used a shoe maker to establish the comparison. On the one hand, if the shoe maker receives an order of a thousand pairs of shoes to deliver in two weeks, it will have to organize its resources to be able to fulfill the order, and "things should be the same in the hospital". On the other hand, to organize the resources could be much harder within the hospital, regarding the diversity of its activity, including emergency, consultations, surgeries, admissions and graduate and post-graduate education.

For corporate hospitals, as well as for every public company, the Chairman continued, the question was not to be profitable but to know the costs of services provided, not only for internal management but also to inform central authorities:

Even assuming that the Hospital provides services of superior value, we have to know their costs. And we must be able to report this to the MoH and the MoF: «what you are requiring causes a loss of such per episode». I have the notion that an intervention such as inserting a valve into the heart is much less invasive and

> *implies less risk than classic surgery, but I also know that the single prosthesis costs 18.000 Euros, while the Hospital gets paid 2.800 Euros. At least, we need to have the notion of the amounts implied in order to be able to transmit them to the MoH and the MoF and report that this activity is underfunded in relation to its actual cost.*

At HSJ, efforts to improve information systems to support a new managerial emphasis knew a remarkable breakthrough when in 2006 the board decided to implement ABC. The decision came after the gradual sequence of events which was shaping the management of enterprise hospitals, namely the full implementation of PPS; the delegation of competencies from the MoH into the hospital boards and, to a lesser extent, from the boards into newly created intermediate structures; the introduction of management control tools such as the business plan, the activity plan and the contract between the hospital and the MoH/MoF; monitoring practices and benchmarking like the *tableau de bord* and joint meetings gathering the MoH/MoF and corporate hospitals; and the recruitment of people with education in economics and management and prior links to the private sector.

To some extent, as the MCD Director referred, the HSJ had come to a moment when "many were interested and involved in activities related to management and analysis". When the project was launched, the initial internal meetings to present the project were restricted to the board, the direction of UAGs and, eventually, directors of clinical as well as support services departments. But people in the corridors talked about how the HSJ was about to launch such a sophisticated system, which the others did not have.

The Chairman recalled that the board of that time made an effort to communicate the goals of the new management accounting system, essentially involving the intermediate structures of the HSJ, and namely the newly created UAGs. Presentations were conducted by the consultancy firm hired to implement the project and were followed by visits to the departments in order to identify the activities which would be the basis for the new ABC project. In the Chairman's opinion, the implementation did not interfere with daily routines, because there had been a special attention to the involvement of people from the

UAGs and the departments. As a result, physicians, nurses and technicians accepted to be part of the project.

Such a strategy of communication and engagement stemmed from the perception of the importance of clinical decisions both in terms of resource usage and of financial equilibrium. Through a more sophisticated management accounting system, it would be possible to deliver cost estimates to the board, UAGs and, crucially, to individual physicians, who have the capacity to determine resource usage through their clinical choices. For the Chairman, there was the need…

> *… to convey the message that the objective was not to restrict clinical freedom, but to know what we are doing, how much we do spend, and to interiorize the notion that the prodigality in treating a patient will constrain resources available for treating other patients and, therefore, realize that he/she is accountable for his/her patient but he/she also holds an institutional accountability for all patients that the HSJ must care for.*

The cultural change triggered in HSJ may have been different elsewhere, stated the Chairman. Improved cost accounting information was not seen as something belonging to economists and accountants, and after an early adverse reaction, cost information was seen as useful:

> *I used to say to the clinical director: when I am performing a consultation and the patient is ahead of me and I pass a prescription, I am doing a cost-benefit analysis. There is no use in passing the optimal prescription if the patient does not have the money to buy the drugs, I am performing bad medicine. I have to adapt my prescription to the individual patient ahead of me, also considering his availability of means. That is the analysis that we must perform, and all we have to do is to convey it to a macro level.*

The involvement of physicians in the creation of a more sophisticated information system right from the beginning seems to have been essential for the generalized acceptance that would be attained. The Chairman recalled that when physicians started to get access to cost estimates of their procedures, at first they got surprised and asked questions about the estimates. But as calculations were demystified, physicians began to understand and use the numbers.

Moreover, the question of how to involve physicians had been carefully handled within the board of directors, and it was understood that since the clinical director combined the role of manager with his clinical background, he was in the best position to lead the participation of his colleagues:

> *A physician as a manager is naturally suspicious, I tell you from my experience as a clinical director. Therefore, if questions are asked by another physician – and it may be the same questions that the manager is asking – people accept them much more easily. And if it is another physician explaining why something is really important, or why a given drug is a better alternative to the drug A, B or C which had been used, because it has the same results at a lower cost, between peers the acceptance is higher.*

In this context, there has been a “unitary” response of HSJ, showing that selective choices were strongly towards NPM. The absence of major internal struggles seems to be the result of a good strategy of communication and clear messages. But this good environment felt around NPM and ABC in particular would soon change, when the international crisis hit the Country, an issue to which I turn in the following section.

5. Second period: confusion and hesitation emerged from the international Crisis, rendering selective choices increasingly difficult

The initial years of the enterprise model proved the steady commitment from central authorities in relation to the process, notably through the powerful *Unidade de Missão* and the national ABC project. Messages conveyed to the healthcare field were clear and easy to interpret: public hospitals were meant to follow a business-like management style and all were invited to join the national ABC project, counting on specific funding for that purpose. Nevertheless, the implementation proved not to be straightforward and the international financial crisis came to shuffle the rules of the game.

In spite of the commitment and funding from central authorities, the implementation of the national project proved to be hard-working and difficult. There were issues of high detail, complexity and human resources behind the softening of the project, as several interviewees acknowledged. Regarding human resources, there were difficulties within the hospitals – where professionals were needed to identify activities – and at the central level, where people required at ACSS for closer follow-up, assistance and building a national database were not available. In addition, contrarily to HSJ, "physicians were not particularly fond of the project" at hospitals involved in the national project, informed Academic B.

However, for the President of ACSS, the historical moment when ABC was tested may add a further explanation for delays and "the lack of consequences" in the end of the implementation. The project was launched in 2007, and the pilot hospitals started working in ABC during the two subsequent years, *i.e.*, precisely the period of the international financial crisis. This fact constrained the assignment of more funds to the project, he argued, and may be one of the reasons that led to the decision of the government to quit the project in 2011 (Nunes *et al.*, 2016).

The international financial crisis severely hit the Portuguese economy, and in particular healthcare, recalled Academic B. In order to face the sudden rise in interest rates for Portuguese debt together with the inability to issue new public debt, the Portuguese Government asked for international assistance. Help came from the so-called *Troika*, composed by the European Commission, European Central Bank and International Monetary Fund, which, in exchange for the bailout, imposed "an unprecedented austerity plan, reducing government deficit and debt" (Major *et al.*, 2018, p. 1213). The rules for the austerity plan were defined through the "Financial Assistance Programme", signed in May 2011 by Portuguese authorities with the European Union and the International Monetary Fund (Banco de Portugal, 2012).

Subject to international financial assistance, the Portuguese government imposed tight control over public expenditure and introduced cuts in the State Budget for healthcare. In addition, the funding model in place since the creation of corporate hospitals lost its main properties as well, to the point that from the beginning of the crisis to this day that link between prices and costs was broken and funding began to be "based on money available at the MoF" (Academic B). Policies decided to tackle the crisis led to another setback in the enterprise model, by (re)centralizing powers in the MoH/MoF.

The purchaser-provider split was one of the biggest changes introduced by the corporate model. Although when the corporatization occurred, in 2002/3, part of the hospital funding was already based on volume of services provided, from then on hospitals began to be fully paid for their production. For that purpose, both the quantities of each type of services and their respective prices were annually set through a contract established between each hospital and the MoH/MoF. In turn, prices for inpatient care were set using the DRG system together with data obtained through the mandatory cost accounting model. However, the austerity measures taken under the agreement with *Troika* seemed to put this mechanism into question. As Academic B noticed:

> *Funds had to be managed in other way and I think that the relation between costs (or costing) and price definition was broken over this period of crisis. Instead of being funded by the logic of the contract established between the hospital and the MoH/MoF, as supposedly was the case from corporatization in 2002/3 onwards, hospitals began to be funded based on the amount that the MoF could afford to pay. Therefore, there was no longer the direct relation between hospital costs, GDH estimates and funding; funds started to come into the hospital based not on prices from the contract but based on money available at the MoF, the Ministry that holds the money.*

Besides macroeconomic effects, austerity also seemed to enter hospital walls and disturb strategic decisions and daily routines. At that time, given her participation as a researcher, Academic B was in a privileged position to witness how the actors inside hospitals dealt with external impositions. She reported that both health professionals and members of the board of directors lost motivation and enthusiasm, including about the use of management accounting, when they came to realize that funds available were inferior to the costs incurred by hospitals. These arguments are coincident with the opinion already expressed by the MCD Director about corridor talks in HSJ about the (partial) lack of usefulness of having advanced (but expensive) management accounting system in place, in face of the rearrangement of the funding rules introduced by austerity, and they are also coincident with the opinion transmitted by the Member of the board.

Another setback in the corporate model, one that was often mentioned during the interviews, was related to the (re)centralization of powers in the MoH and MoF. The former Secretary of State stressed that a high level of autonomy was inseparable from the concept of a “corporate hospital”, but such autonomy was initially given and afterwards removed, in a way that “has not been either linear or incremental” and that was “dependent on external factors”. In turn, the former President of ACSS recalled an emblematic law enacted at that time, which established that enterprise hospitals could only incur in new costs if they already held in cash the amount needed to pay the debt at the due date. Such imposition encompassed all types of costs, from drugs to investment, which, combined with cuts in funding, severely constrained the ability to carry out non essential activities.

The confusion in guidelines and messages coming from central authorities was also evident in more specific aspects such as management accounting and its role in hospitals. Contrarily to the years from 2002/3 to 2007/8, one cannot find a period of steady policies concerning management and management accounting systems in healthcare after the Crisis. Governments would come back to the subject from time to time, but in an erratic way and leading few leads to the field. Many years after the abandonment of the ABC project, those in the field still face erratic and confusing signals coming from the top.

Over the period of the international financial assistance, policies affecting management accounting in hospital settings were contradictory and inconsistent. In the years 2012-2014, for instance, management accounting briefly received a renewed attention from central authorities, as ACSS championed a new project aiming at reconfiguring the mandatory cost accounting model, this time choosing the cooperation from a public university. Interviewees referred that once in place, the improved cost accounting system should support hospital management, reporting and benchmarking, but made no reference to funding issues. Inconsistencies began when the center-right government decided to leave that new project, decided by the previous center-left government after two years of cooperation, and replaced it by a much more ambitious program of implementing SAP in enterprise hospitals. SAP was marketed as a means to promote a qualitative jump in terms of processing, delivering and using management accounting information in hospital settings, but the enormous funds assigned to its implementation were in a clear contrast with the severe financial constraints.

Some hospitals effectively implemented SAP, mainly in the Region of Lisbon, but others, including CHSJ and hospitals in the North, maintained the mandatory model in use. However, the attempt to generalize SAP was only a part of a large supervision from the MoH over hospitals. New benchmarking indicators were then introduced and ACSS intensified the requests for clarification to the hospitals, recalling, to some extent, the initial guidance provided by the *Unidade de Missão*. By then, central authorities seemed to be firmly indicating which expectations hospitals were meant to conform to in order to enact their mechanisms of selective choice. But a new contradictory signal was given in 2014/5, when the intense and direct exchange of information was replaced by simply displaying the indicators in a web platform, owned and operated by ACSS.

Globally, the government's attempt to impose SAP to all enterprise hospitals failed and contributed to the fragmentation of management accounting systems in use. In addition, there is evidence that the implementation of more sophisticated systems has not been part of the government's concerns ever since, because, as the MCD Director stated, it has been her "last contact with management accounting" so far.

The effects of the Crisis on management accounting were not limited to hesitations about which systems to implement. In fact, as mentioned earlier in this Section, the link between cost estimates and prices was broken, as prices started to be defined in face of funds available. This clearly lowered the importance of management accounting to the present day.

Estimates obtained through the mandatory cost accounting model, together with the Maryland Matrix, form the basis of the public hospital reimbursement system in Portugal, in relation to inpatient care. However, as argued by the Member of the Board, currently "the model has no meaning, it has neither scientific nor actual support". He further explained his standpoint:

> *Financial constraints imposed adjustments on the funding model and it is easy for the owner of the model – who, in turn, is also the customer – to adjust it to total funds available in the MoH for buying services to hospitals. The question is that if the scientific basis was maintained there would be a lower volume of services to buy from hospitals, and someone would have to publicly and politically stand for it. There would be no money to buy more, or even to buy the same, and, because of that, the balance has long been abandoned.*

Concerns transmitted by the MoH to the hospitals are only focused on the level of services, complains the Member of the board. Costs are not so important because the MoH is aware that prices paid are below costs, *i.e.*, contracts "already incorporate a deficit, the MoH is putting deficit inside hospitals when contracts are signed". For hospital boards, this message is "terrible", because:

> *Enterprise hospitals had the commitment and the onus of providing a given level of services in order to guarantee the funds they needed to get balanced, and suddenly they got back to the previous public administration logic: in the limit, they can perform no activity and create debt, because, in the end, the MoH will [solve the problem] with* ad hoc *injections of funds.*

What is important, stresses the Member of the Board, is that the message conveyed by the MoH is that everything starts being dismantled and hospitals' concerns, naturally, change as well. To make things worse, he claims, this message is not only read by hospital boards but gets inside hospitals and is interpreted by intermediate structures, like clinical departments or responsibility centers.

In this context, he further argues, as funding loses touch with reality, the relevance of management accounting also decreases. This might be one explanation for the absence of interest around the theme in many hospitals. When the MCD Director established contacts with her peers for other reasons, some colleagues informed her that they did not perform any management accounting, not even once a year as it was the case of CHSJ and constituted the reference to all public hospitals. At best, she added, management accounting is envisaged by hospitals as a legal requirement, or perhaps not even so, judging from the responses that she received from her colleagues.

About the contribution of the mandatory cost accounting model to price setting, she is skeptical and considers that it “may be done once in a while”. She bases her opinion in two aspects: firstly, to her knowledge, CHSJ has not recently reported cost accounting data; and secondly, prices for inpatient care have not been changed over recent years.

6. Third period: *Fuzzy* times remained after the Crisis

The previous periods were characterized by the influence of the government over decisions made on management accounting at the hospital level, with little intervention from other relevant stakeholders also at the top of the field, namely the accounting regulator, professional associations and Academia, all with links to a largely technical subject such as management accounting. Over this third period, the MoH and the MoF no longer sent clear messages to the field regarding the sophistication of management accounting, whether steady as in the first period or contextual, as in the second one, but this time it was the accounting regulator that came to the fore, eventually getting actors in the field even more confused.

6.1. Focus on reversing the Crisis’ social and labor policies, misunderstandings at the top of the field and little attention towards hospital management tools

Political cycles may help to explain the lack of continuity in the enterprise model, argues the former President of ACSS. Priorities depend on political cycles, and diverse priorities have successively been pursued from 2002 onwards, including increased attention to primary care, the introduction of continuous care networks and priority to drugs policy, among others. Every government has its own vision on the health policy and the initial momentum of the enterprise model has been progressively lost, he further argues.

Comparing Portugal to countries from the North of Europe, such as the UK and Finland, Academic B considers that in terms of the presence of market logic and hospitals' accountability, Portugal is still "at light-years distance". On the one hand, this is due to the time when each Country started the process: while in Portugal we can only talk about public enterprise hospitals, in England the trusts date to the 1990s, she informed; on the other hand, she agrees that:

> *In Portugal, not only in the health sector, but particularly in this sector, there is no continuity in the decisions. Every time the government changes, there is a setback, we often get back to past situations and all efforts made in the midst by a given minister of health are eventually lost.*

Over the enterprise period, some projects proved to be of value to guide health policies. One responsibility center has been created at the University Hospitals of Coimbra, one of the Country's largest hospitals, with "extraordinary results", notes the President of APHP. Nevertheless, he stressed, that responsibility center counted on actual autonomy and decision capacity, supported on advanced management information on costs and revenues.

A similar project was launched at another hospital, this time in Lisbon, but it lost momentum during the economic and financial crisis. In a time when the whole hospital and the global SNS were suffering financial constraints it would be counter-productive to allocate funds to a single experiment, considered Academic B.

Rules from the current funding model seem to encourage the creation of responsibility centers, because they are specifically advised and funds are made available for that purpose, but no examples were provided during the interviews and the Member of the Board doubts that they will effectively come to life in the short term, because:

I believe the two shareholders have totally different visions in relation to this subject. The MoH puts enormous pressures on organizations in order to change to such a kind of solution, creating responsibility centers that are more contextualized and directed to handling pathologies; in turn, the MoF fears such a move, because they do not know the consequences that may arise and feel they will lose control. In other words, for the MoF, by giving autonomy they will be losing the control [of] the money tap […] and they dread standing before uncontrolled accounts. I think that at present they are stronger than the MoH and, therefore, headlines will show up and projects will be presented without a real intention of moving forward and assign financial as well as physical means, budgets, chart of accounts, penalties or rewards to the teams.

Discussions between the minister of health and the minister of finance are "always hard to take", agrees the President of APHP, as the former will always ask for more funds while the latter will try to retain the financial means. Nevertheless, this situation may be an opportunity for improved management accounting systems in hospital settings, because the minister of health must have information to prove that:

I am not asking more means just to have more, and I am also not asking more because there is waste, but only because I am truly efficient and citizens' needs require more funds.

Under the rationale of providing hospitals with management skills, which supposedly people within the sector do not have, namely physicians and department directors, supervisory boards have just been made mandatory for hospitals over 50 Million Euros of annual revenues. Academic A understands this new legislation as a subtle move from the MoF to signalize the health sector that "they want their people there". Indeed, it should be noted that supervisory boards are focused on the fulfillment of procedures and general ledger, and that the three members that compose this body are appointed by the MoH and the MoF together.

To this Academic's knowledge, many – if not all – people appointed are inspectors from the MoF, *i.e.*, people with enormous concerns and worries about public procurement and financial issues. This move from the MoF is "brilliant", in his understanding, because it conveys a message to everyone in healthcare, stating that:

> *We are going to bring skills in management and finance and we will impose them in this way.*

This kind of action is susceptible of changing the balance of influence over the sector between the two governmental stakeholders. In spite of the "independence status" that people appointed by the MoF should maintain, in the Academic's analysis "their concerns will be there". Conversely, he sees no similar action from the MoH, which, for instance, is losing the chance to use its power to enhance management accounting and be equipped with the information needed to promote an equal and balanced negotiation.

In his opinion, the situation is very stressing today, due to the generalized lack of time and other resources. On the hospital side, there is no time left after ensuring the availability of funds for the next day, fulfilling reporting requirements, overcoming the decrease from 40 to 35 weekly working hours or handling the effects of physicians' strikes and the lack of anesthetists in operating rooms, among other concerns. Structured measures "[require] time" and he concedes that the present situation brings about that added difficulty. On the MoH side, things do not seem easier. Thinking about which actions the MoH could undertake in order to realize the need to intensify the cooperation with the academy, he suggests that:

> *Probably, the MoH must start by a careful diagnosis of which management areas need qualitative jumps. Taking the example of management accounting, as it is a background theme, the MoH must take the lead and signalize it as an area where a*

> *move forward is necessary. I may not be updated, but some of the over 50 public hospitals do not know what is management accounting. I may be overreacting, but management accounting is done for fulfilling requirements and it is not used as a management tool because hospitals are not aware of its importance.*

Other immediate concerns seem to overlap the attention given to strategic themes:

> *These background questions are usually addressed when people have time to think. At present, we do not need to be an expert on the sector to feel the pressure: we see how budgets are prepared and we know they cannot be put into practice. I have never understood that logic, but it is the logic of these days: budgets that cannot be carried out, a law that requires hospitals to hold in cash the amounts needed to acquire goods or services, but afterwards exceptions are made, because someone is dying in the operating room and needs a prosthesis. I imagine that this everyday life does not leave time for the management team for thinking in broader terms and I guess that structural themes come in second place.*

On the national level, the MoH seems to have no time for defining health policies and identifying strategic areas, argues the President of APHP. One example repeated by the President of APHP and the former Secretary of State is related to the eventual creation of a new central body with direct supervision over hospitals, a sort of a national holding. While such a central body could partially recover the role once attributed to the *Unidade de Missão*, its attributions would be broader, acting like a SNS CEO, in a similar way to what is already in place in the UK.

The relation between the MoH and the MoF could benefit from the creation of such a new structure, argues the former Secretary of State. In his view:

> *The other major player in healthcare is the MoF, which does not understand anything about hospitals and looks at hospitals as any other public enterprise or any other institution from public administration in general. Therefore, the capacity to lead change in hospital settings is lost in the midst of the confusing roles*

attributed to the various MoH agencies. At this stage of maturity of enterprise hospitals, it would make sense to think about something different, but different to the point that the joint management of similar questions could tackle, in the best way possible, management accounting and other strategic areas.

The limited autonomy conferred to hospitals at present, is not in line with the principles of the enterprise model, which is still in place, acknowledged the former President of ACSS. Therefore, in order to cope with this inconsistency, the MoH launched a pilot-project to bring back more autonomy to a group of 11 hospitals. These hospitals have been chosen among the most efficient inside each group and the objective is to evaluate if they are able to control the growth of both debt and payment delays to suppliers. The project was meant to start in 2019 and in the beginning of that year a set of management tools was being prepared. Such tools were very similar to the ones used in 2002 and comprised a medium term strategic plan, as well as the annual activity plan and budget.

On the hospital side, managers are not so sure of this progress and show distrust. The Member of the board has only heard about the project in the news and through public speeches, and, although his Hospital will apparently be part of the pilot group and media news mentioned that the starting date would be two months after the interview, he did not know anything about what was being prepared. Even the Minister of Health had publicly mentioned the project, but without further information, and so the Member of the board classified the project as an “intention”.

Finally, some reforms are being timidly rehearsed in relation to the funding model. At the top of the MoH, there is the awareness that international trends are attempting to link the reimbursement to the quality of services rendered. In terms of the design of the funding model as well of information on costs, this means increased complexity.

Gradually, the funding model is expected to incorporate, at least to some extent, the outcomes obtained and not only the quantity performed. Challenges are huge, because quality and excellence are hard to measure, but progress is being made through the definition of “comprehensive prices”, *i.e.*, a global price to pay for the treatment of pathologies, which comprises all costs, from consultations to drugs, and whose effects on the patient's health are assessed on his/her global health condition and over a given period of time after the intervention.

Funding hospitals through comprehensive prices signalizes hospitals the strategic intention of rethinking acute care. Traditionally, hospitals are organized into clinical departments and patients move from one department to another; however, within this new paradigm, patients acquire a central position, and hospitals must create a new "unit" of analysis and accountancy, named "reference center", that gathers professionals from distinct departments in order work together to provide care to a single patient.

Besides the need for internal reorganization, reference centers and comprehensive prices pose new challenges to management accounting. New costing objects will be needed and especially the allocation of personnel costs using time-related drivers – which is already the major difficulty today – will be critical, stands the Member of the Board. Recently, the ACSS asked for the contribution of large hospitals, including the CHSJ, in order to generate estimates for the initial set of pathologies. The methodology employed in this costing exercise was more sophisticated than the mandatory model, informed the MCD Director, and was focused on the path of the patient in his/her stay at the hospital.

6.2. The other relevant stakeholders at the top: while the accounting regulator sends a signal of difficult interpretation, Academia is still more concerned with health economics than with management accounting

In regard to the role played by professions in the healthcare field during this third period it is noteworthy the intervention by the central regulatory body on accounting. On this subject, there are two recent norms that affect the healthcare field, one related to financial accounting and the other to management accounting[15]. The former intends to extend the transition already undertaken in the private sector from a code law inspired general ledger into a new model based on the adoption of the International Financial Reporting Standards

[15] *Sistema de Normalização Contabilística para as Administrações Públicas – SNC-AP*, and *Norma de Contabilidade Pública* 27 – NCP 27 [Accounting norms relating, respectively, to financial accounting and management accounting in the public sector].

(IFRS); and the latter establishes the basis for management accounting in the public administration in general.

There is work in progress in relation to the transition in the general ledger, but the process is running with delay. At CHSJ, there is the intention to make a more regular use of the mandatory management accounting in combination with the current management system that replaced ABC[16], but people involved are aware of the need to eventually reconcile the two accounting models. Therefore, the Hospital is waiting for the conclusion of the transition at the national level in order to make internal progress later, readjusting its accounting/management system to the new configuration imposed by the accounting regulatory body.

In turn, regulation on management accounting for the public administration in general has been produced in 2015, although a period of transition was foreseen in order to allow organizations to cope with the improved level of complexity. The new regulation expressly recommends ABC as the most adequate system for hospital settings, what might sound puzzling in face of the results of the national ABC project, described above in Section 5. Maybe for that reason, I found no evidence that any public hospital had already implemented ABC, in response to the accounting norm.

In turn, cooperation between the MoH and Academia seems to be below the desirable level and three different reasons might explain this situation: vision/strategy, public procurement and limitation of funds. Regarding vision/strategy, many of those in charge of innovative projects seem not to valorize cooperation with the academic world and consultancy firms with accumulated knowledge in the area, especially outside the Region of Lisbon and the Tagus Valley. This might be a cultural issue, as acquiring services from consultancy firms has long been perceived as unnecessary and superfluous. Current limitations to public procurement might be an additional problem, at least in terms of flexibility and pace of the processes involved in the establishment of partnerships or in the acquisition of services, to the point that recently, under the current public procurement legislation, public/private partnerships have been submitted to high scrutiny. However,

[16] This management system will be further presented in the remainder of this Section.

the lack of well programmed partnerships with public universities was pointed out by the Former Secretary of State as harder to explain, because “they are at hand” and mostly open to joint initiatives as a means to provide post-graduation research with projects of value for the whole society. Finally, financial constraints do not leave many funds available for innovative management projects after the allocation of funds to priority areas such as human resources and drugs.

On the side of Academia, there is “a long way to go” in order to bring the world of practitioners – those who make decisions, such as the MoH, hospitals and even consultants – and Academia, argued Academic B. However, inside Academia, not all areas are at the same stage in relation to the collaboration with the health sector. There is a close relationship between the ENSP and hospitals/MoH in regard to economic subjects and there are many published studies on healthcare sustainability, even regular studies, published by the European Observatory on Health Systems and Policies. The same does not hold for management accounting, she regretted.

Academic B believed that the situation is clearly different in the UK, where many studies are carried out by leading academics with the active involvement of the Chartered Institute of Management Accounting (CIMA). Leading academics have worked continuously with CIMA and this has been a major vehicle to reach hospitals. She highlighted the scientific studies and reports that are being done on the applicability of sophisticated management accounting tools in healthcare, advising, or not, their implementation.

In the Portuguese context, management accounting has not yet acquired the visibility of health economics. Academic B noted a clear contrast between Portugal and other European countries, such as the UK:

> *While in the UK there are people who actively study these subjects and are heard, in Portugal, I think that the only people who are heard are the Colleagues from health economics. They produce a highly valuable knowledge, but that is not the point, the point here is that there are two distinct approaches: one, at the micro*

level, more hands-on, management focused; and another at the macro level, related to the sector as a whole. I have been thinking whether the domination from this people has not hampered the further development of more micro management processes inside hospitals and more micro management training in our Country.

She feared that the strong presence and influence from health economists may lead the concerns of all stakeholders in the healthcare field to a macro approach, focusing the debate on issues such as national accounts and deficits and less on management practices and accounting tools. The large audience conferred to economic themes may damage the image of other scientific areas, namely accounting:

While in the UK leading academics are heard and even appear in newspapers and on the TV, in Portugal those we see on TV are the economists. They convey a huge knowledge and we need them, but we also need other people, with a more micro, management approach. While that does not come true – and it may take some decades – there is the need to send leading academics abroad or wait for young researchers to reach the top of central authorities and public hospitals.

Some interviewees stressed that training in management accounting in Europe privileges the strategic value of information. The same happens currently in Portugal in relation to top schools in economics and management, but for many years those schools – and polytechnic schools to this day – provided education mainly focused on financial accounting, its techniques and normative requirements. Drawing a parallel between this education and the recruitment for enterprise hospitals from 2002 onwards, professionals who were hired for management positions were given attributions in the financial area, but only to perform a normative work, subject to pressures on periodic report coming from an enormous number of entities. Stated in other words – as Academic B fears – information produced by hospitals is not internally used for management purposes, but it is only sent upwards to central authorities due to normative issues and mandatory reports. Summarizing her concerns, she admitted that:

[…] Accounting is only regarded as a technique and not a strategic tool in hospital settings.

This longstanding technical emphasis given to accounting may be an explanation for the *status* attributed to this area in Portugal. In spite of all the accumulated knowledge and the excellence of technical training, the scientific component was missing. Accordingly, accounting is perceived as missing the scientific nature and, therefore, it is ranked below economics or finance. In this purpose, Academic B alerts for the negative connotation to the area and even to the designation. When thinking about executive training, schools of economics and management as well as business schools never use the designation “Management Accounting”: they prefer to use “Management Control”, and she believes that consultants follow a similar approach. Expressions such as “Management Control” or “Strategic Control” are used in order to drive management accounting away from the more normative and technical nature conferred to accounting. She also stated that this is different from the UK, where management accounting and management accountants have a role perceived as more prestigious than in Portugal. By contrast:

> *In Portugal, management accounting is perceived as [pause] second class, third class.*

These ideas are coincident with those of Academic A. The term “second category” was also used by him when describing the attractiveness of management accounting for those who have just finished their graduation. He further suggested that:

> *It is much easier to sell the idea of working on strategy or marketing, those are appellative things; [Management Accounting is] more arid, but this does not mean that we, at Academia, do not have the mission of selling well the interest on management accounting. I believe that we have not been happy with it. When a newcomer hears “who wants to work at the Strategy Department?”, he/she might get enthusiastic with it, but what is not usual is to hear someone say “what I really want is to work at the Management Accounting Department”.*

Both Academics agree that, at least to some extent, it is Academia’s fault, because it lacks the ability to raise awareness about the fundamental issues on management accounting, even though education at universities is being progressively changed, to the point that currently management accounting subjects are tackled in a more open, argumentative and strategic way. However, the last step – transferring knowledge from universities to organizations – is still to be undertaken, also because people in charge of public hospitals are not always the best prepared for the function: they are not selected on the basis of their capacities, but for political reasons, and this might continue to be the common practice for a long time.

6.3. CHUSJ at present: do sophisticated management tools encompass management accounting and ABC?

It should be noted that HSJ was not involved in the national ABC project: its decision to invest in this system was individual and proactive, and thus one would expect this particular hospital to be more prepared and motivated to move the project forward. However, when in February 2014 the Board of directors who granted the interviews took office, the ABC project did not seem to capture much attention.

As the Member of the board pointed out:

> *When we met with the previous board of directors in order to get acquainted with the ongoing most important issues, the ABC project at HSJ was not mentioned, it was a dead matter.*

The ABC, implemented in HSJ as a tool for assisting the management of the enterprise hospital, was abandoned – similarly to the hospitals involved in the national project – after a single year of cost estimates (2009). The reasons seemed to be linked to cost-benefit considerations: professionals within HSJ commented this decision in the corridors, suggesting that maintaining the project was too costly, in terms of human resources and information systems. Considering the dimension of data processed and stored as well as the need for constant updates, the outcomes were not worthwhile.

These opinions seem to mirror the position held at a higher level in the Hospital hierarchy. The Chairman was direct when he referred that quitting ABC was a decision motivated by “pure budget constraints”, *i.e.*, it was a contextual decision, compelled by the financial crisis. However, the opinion transmitted by the Member of the board was even closer to the corridor talks. The comparison between the costs incurred with the project, which required the participation of a consultancy firm and was very demanding in terms of timings and the contribution from the hospital staff, with the value added for decision making, weighted in the decision. The Member of the board further argued that…

> *The Hospital could fall into a scenario where all information seemed to be solid and relevant, but after, its usefulness for day-to-day decisions would be restricted, nearly null, because everything that could be positively influenced by the results of the ABC project was not possible. Stated in other words, understanding deviations and merits would not allow us either to internally punish or reward or to influence central authorities to fairer fund our activity, by proving that actual costs were higher than prices.*

Today, the output of the ABC project is sometimes revisited and used. Nevertheless, this usage is only residual, when an analysis is being carried out and someone reminds that a comparison with the ABC estimate can be useful. But, as stressed by the Member of the board, "it is only a *by the way*, it is not something fundamental for the work being undertaken". Summarizing his view on the project, he added that:

> *The true potential of the project [would be] to trigger action, with internal and external consequences.*

Even so, HSJ seems to have deeply embodied its new culture of enterprise hospital. Back in 2002, the dual nature of corporate hospitals triggered new needs for information and while in the national setting there were breakthroughs and setbacks, HSJ looked for alternative ways to get steady tools to support the management function.

Regarding the core business of a hospital, the Chairman acknowledged that activity indicators must come first, in order to optimize the outcomes of clinical activity. Nevertheless, he argued, there was no way "to hide the need to contain costs, to be more efficient, perform the same production with lower costs or increase the production with the same costs". These new concerns about costs and efficiency triggered the need for a new type of information, otherwise,

"it would be like sailing by sight, being in high sea without a compass".

Following management practices typical from the private sector, the board had the intention to use the improved information system in order to unfold the contract established with the MoH/MoF and to extend it inside to intermediate management structures. The intention was to adopt an annual budget, even if it was a virtual one, to pervade professionals with management concerns and induce a cultural change. As a result, the accounting and economic nature of costing did not decrease the interest of health professionals, whether physicians, nurses or technicians, on cost information, because "when a new need is created we must provide an answer".

After letting ABC fall, the CHSJ did not take long to try to implement an alternative way to provide that answer. It came out in the form of an innovative way of processing and delivering data on activities performed and associated costs: a new integrated information system, technologically based on artificial intelligence, that has definitely contributed to the *avant-garde* image conferred to CHSJ to this day. For the Director of MCD, this system, currently known inside and outside CHSJ as "BI" (from *Business Intelligence*), was triggered "first and foremost" by the strong will of the board of directors, who interpreted the BI as a powerful tool for managing the Hospital.

Creating the BI was "a strategic decision, taken because of a strong belief that an improved information system was indispensable to support the management function", continued the MCD Director. The stimulus for the creation of the BI was the need to provide management teams with a more agile work capacity to extract and transform information and, afterwards, to deliver it to the directors of medical departments, *i.e.*, "the operational managers". Both the management teams and operational managers would get information reported in a pre-defined layout in order to assist daily work and act either to correct or motivate their colleagues.

Initial developments of the BI platform came out of a “pure and simple” management orientation. The main goal at that time was to deliver indicators related to management, accounting, operations, finance and human resources. It was only 4 or 5 years later that a new area was added to the platform – included in the platform but not necessarily built upon the previous “management” layer, stressed the MCD Director –, this time for clinical purposes, in order to assist physicians and other health professionals in their interaction with patients.

Current developments in the BI seem to be led by the clinical will, argued the Member of the board. On the one hand, clinical concerns took the lead because they “always come first”, as happens in the case of the evolution from clinical departments as the main organic units into *reference centers*. These reference centers correspond to clinical teams in charge of a given pathology and thus are innovatively organized into a matrix format, requiring data crossing the traditional boundaries of departments in order to follow a given pathology. Such a reconfiguration poses many challenges to information systems, such as the need to make clinical data available in real time to all health professionals involved, or the need to provide information on costs and revenues, in order to negotiate budgets and set targets for those teams. Also, reference centers have received support from the MoH, which allowed the Member of the board to complete his sentence: “clinical will and superior orientations always come first”. Strategic matters are decided by central authorities and afterwards they are communicated to the hospitals, in a top-down fashion. When a project such as that involving the implementation of reference centers is launched, concerns are more about the clinical feasibility of the project, *i.e.*, whether there are physicians and clinical cases available, and not so much on whether the hospital has the capacity to add an economic and financial perspective to the project.

All staff with management functions as well as health professionals have access to the BI. Some queries imply training and expertise from users, especially when particular studies are required to support management decisions, but most information needed is already available in pre-specified formats, like a *tableau de bord*. This is especially true in the case of clinical information. Physicians could not spend much time interacting with the computer to get clinical information, stressed the MCD Director. On the contrary, added the Chairman, the aim is to develop technology that can perform routine activities and free physicians for spending more time with patients.

The BI has received much attention from all healthcare stakeholders, including patients. The Chairman acknowledged that this did not happen by accident:

> *I must confess that it also involved a communication strategy. Being recognized for innovation is important both for creating an institutional culture and for inflating confidence in the population that comes to the Hospital. It is something that takes too long to be achieved but that can be readily destroyed. This pride and sense of belonging cannot be an exclusive of the professionals and must be extended to the community.*

Answers from the interviewees with links to CHSJ revealed a shared enthusiasm around the BI. The MCD Director summarized the efforts made by diverse professional groups to get to the current BI capacities, including IT engineers, professionals with education in economics and management hired over the enterprise period, hospital managers and physicians. However, she stressed the full support from the Board and the commitment from the "management team", *i.e.*, the professionals with education in economics and management, who "spontaneously got involved and felt the project as their own".

Progress made in the BI could help to overcome the limitations that led to the abandonment of the ABC project at CHSJ, considered the Member of the Board. Besides helping physicians to try to react and to control areas such as infection by cross-checking data, information stored in the BI could be of much value for internally supporting the management function, while it could be as well a powerful tool for improving a mandatory management accounting model, informing price setting and establishing national comparisons. Priority has been given to clinical issues within the BI, because the management area has been suffering from a lack of empowerment, added the Member of the Board. In his opinion, the capabilities of a tool such as the BI would be strongly explored if it was extended to the universe of public hospitals and every hospital felt the pressure from their peers. At present, he regrets…

> *It is a single experience, which does not reach a critical dimension.*

At this state of affairs, the point is “where does management accounting stand at CHSJ?” As one has seen, CHSJ is known for being especially dynamic and proactive in managerial terms. Proofs of that are the ABC project and the BI. Yet, while the BI is steadily used and updated, the ABC project has been dropped and intentions to give back importance to management accounting, by using the mandatory model as accurate as possible, are still being postponed. Therefore, CHSJ seems to have given great value to management accounting, but it also seems that currently it is not a priority.

The need for improved management accounting and information systems seems to have been put into question by the evolution of the enterprise model. Within CHSJ, the board had the intention to empower middle structures by using information provided by more sophisticated tools, such as the ABC and the BI, but current attributions do not allow the board to stimulate an enterprise mindset and reward merit, to the point that improved data is of limited value. The Chairman complained that:

> *In a time when – it is no secret – hospitals have limited autonomy, there is an excessive centralism.*

Management accounting seems to be away from both strategic decisions and daily routines. The MCD Director confessed that it is not part of her major concerns, in terms of analysis or information exchange. To this day, it is not a reality that professionals at the Hospital understand. They know that “it is about costs” and that it is related to activity, but “no one talks about it in day-to-day life”, it is not a daily issue. Therefore, management accounting is used more to solve a specific problem than as a management tool spread all over the organization.

In addition, the mandatory model in place is exactly the same that she found when she joined the MCD, and she is not aware of intentions to introduce right away any changes. On the hospital side, from her standpoint, management accounting is mostly envisaged as a legal requirement, and many hospitals do not even perceive it in that way, as they confess that they do not perform the model, as we saw above.

Nevertheless, there has been the will at CHSJ, at least over the last three years, to get back the importance of management accounting. This intention is not as ambitious as the ABC project, since it is focused on the improvement of the mandatory model in place. However, the MCD Director acknowledges that they have already started and stopped so many times that it is no more than an intention. Although counting on the support from the Board and on the commitment from the MCD and the Financial/General Ledger Department, she admits that resources are scarce and there is the need to replace professionals who are leaving the Hospital. Yet, the major hurdle is related to all kinds of problems hanging over the MCD and the Financial Department, from daily subjects to monthly or annual reports:

> *We are losing a thousand and one things, and management accounting is one of them.*

But she also stresses how "strikes after strikes, the [issue of the] 35 hours, repositions of nights and supplements" affected the routines and implied an extra effort to explain to the MoH and the MoF why some figures are under or above expectations, plus "constant interactions asking for further explanations and correction plans". She regrets that all at the Hospital, from the Board to the management support services:

> *[Are] absorbed by this megalomaniac machine that stifles us, sometimes because of things that are not worthwhile, but we are forced to report.*

Summarizing her view on the current state of management accounting at the CHSJ, she realizes that in spite of the internal interest, "it is no priority for any part involved".

Before moving to the Discussion Section, I am now going to present the output of the application of the proposed theoretical framework to CHUSJ. It summarizes the previous sections and helps on reading the Discussion.

As a general theoretical framework, that aims to be useful for future studies on hybrids as well, some concepts will provide more insights than others. For instance, I will often repeat "the same as in the previous period" in regard to hybrids over the second and the third periods, because in the case of CHUSJ the formal hybridization happened in the first period, and was no longer changed in the remaining periods. Things could have gone differently in other situations, giving more relevance to these cells in the table.

Application of the theoretical framework to CHUSJ			
Application and actions	**First period: consolidation of pressures**	**Second period: undefined pressures**	**Third period: *fuzzy* pressures**
1. Are there historical, cultural or social events or major laws with the ability to trigger change in the field over the period of analysis?			
Identify triggers	Public hospitals were turned into enterprises in 2002/3 HSJ was transformed into enterprise in 2005	*Troika* entered the Country in 2011	*Troika* left the Country in 2014 and Crisis was declared over
List institutions involved	▪ Government (MoH and MoF) ▪ Corporate hospitals ▪ HSJ	The same as in the previous period	The same as in the previous period
Classify change	Intensified incremental in 2002/3 Incremental in 2005	Radical	Undefined
Evaluate the stability of change	Steady/consolidation	Undefined/unstable	Unclear
Check impact on the organization under study	HSJ was turned into an enterprise in 2005 HSJ implemented ABC in 2007	CHSJ created the BI from 2011 onwards	CHUSJ kept developing the BI to this day

(continued)

Table 23 Application of the theoretical framework to CHUSJ (continued)

Application of the theoretical framework to CHUSJ			
Application and actions	**First period: consolidation of pressures**	**Second period: undefined pressures**	**Third period: *fuzzy* pressures**
2. Did changes alter the very nature or scope of institutions in the field?			
Identify organizations involved	Public hospitals turned into public enterprises	The same as in the previous period	The same as in the previous period
Identify sets of competing logics	Social welfare was combined with commercial/business	The same as in the previous period	The same as in the previous period
Check impact on the organization under study	HSJ involved since 2005	HSJ involved	HSJ involved
Identify source of change	Imposed/legal (steady political action) Decisions about ABC made internally at HSJ	Imposed/legal (erratic political action) Decision about the BI made internally at CHSJ	Imposed/legal (unclear political action) Issuing of accounting standards by the accounting regulator Decision about keeping developing the BI made internally at CHUSJ
Identify professional groups involved	▪ At the national level: boards of directors ▪ At HSJ: board of directors, physicians, middle managers and IT engineers	The same as in the previous period	The same as in the previous period
Check decoupling	HSJ effectively implemented ABC	CHSJ effectively implemented the BI	CHUSJ effectively maintained the BI

(continued)

Table 23 Application of the theoretical framework to CHUSJ (continued)

Application of the theoretical framework to CHUSJ			
Application and actions	**First period: consolidation of pressures**	**Second period: undefined pressures**	**Third period: *fuzzy* pressures**
3. Which are the main stakeholders and how do they interact?			
Identify the main stakeholders in the field	▪ Government (MoH and MoF) ▪ Professions and regulators ▪ Academia ▪ HSJ ▪ HSJ's professionals ▪ Hospital network and peers ▪ Municipalities ▪ Private hospitals ▪ Patients ▪ Media and public opinion	The same as in the previous period	The same as in the previous period
Map interactions among institutions	MoH and MoF own public hospitals ACSS supervises financial issues Hospitals (including HSJ) depend on central authorities administratively and for funding Hospitals depend on professions and regulators for norms (including on management accounting) Municipalities, patients, media and public opinion always follow healthcare with the highest interest	The same as in the previous period	The same as in the previous period

(continued)

Table 23 Application of the theoretical framework to CHUSJ (continued)

Application of the theoretical framework to CHUSJ			
Application and actions	**First period: consolidation of pressures**	**Second period: undefined pressures**	**Third period: *fuzzy* pressures**
3. Which are the main stakeholders and how do they interact?			
Check the subordination of the organization under study (legal, funding, hierarchical) for vertical pressures	Hospitals (including HSJ) depend on central authorities (MoH, MoF, ACSS, ARS) administratively and for funding They depend on professions and regulators for norms (including on management accounting)	The same as in the previous period	The same as in the previous period
Check interests and power of professional groups inside the organization under study for horizontal pressures	Professionals – especially physicians, middle managers and IT engineers – were involved in ABC	Professionals – especially physicians, middle managers and IT engineers – were involved in the BI	The same as in the previous period

(continued)

Table 23 Application of the theoretical framework to CHUSJ (continued)

Application of the theoretical framework to CHUSJ			
Application and actions	**First period: consolidation of pressures**	**Second period: undefined pressures**	**Third period: *fuzzy* pressures**
4. Where are institutions in the field?			
Classify the field	Moderately centralized Mature	The same as in the previous period	The same as in the previous period
Place institutions in the field	▪ At the top – MoH, MoF, ACSS, ARS, accounting regulator ▪ At the center – large teaching hospitals, including HSJ ▪ At the periphery – small and medium hospitals, municipalities, private hospitals, patients, media and public opinion	The same as in the previous period	The same as in the previous period
Locate the organization under study in the field	At the center	The same as in the previous period	The same as in the previous period
Evaluate the place, size and links of the organization under study to main stakeholders (internal and external)	▪ Large ▪ Central, dynamic and proactive ▪ With direct access to central authorities and prestige over peripheral stakeholders	The same as in the previous period	The same as in the previous period

(continued)

Table 23 Application of the theoretical framework to CHUSJ (continued)

Application of the theoretical framework to CHUSJ

Application and actions	First period: consolidation of pressures	Second period: undefined pressures	Third period: *fuzzy* pressures
5. What selective choices were made by the organization under study?			
Evaluate expectations made upon the field and the organization under study	Corporate hospitals were meant to use private-sector like management tools and were guided through that process Larger hospitals (including HSJ) were strategically left for a second phase, when they could benefit from lessons already learnt and save resources	In 2013, a few hospitals (not including HSJ) were invited to take part in the improvement of the mandatory cost accounting system In 2014, all hospitals were expected to implement SAP	All hospitals were expected to implement ABC CHUSJ was expected to help on the construction of "comprehensive prices"
Identify pressures from main external referents (isomorphic pressures from the State and professions) (continued)	The *Unidade de Missão* helped to get the newly corporate hospitals familiar with management tools typical from the private sector … and get the best from those who were arriving with education and experience in management The minister's office and senior leaders of corporatization used several communication channels to signalize the importance of work in progress Planning and control and responsibility centers were presented as "modern" and "innovative"	The national ABC project was abandoned in 2011 The link between prices and the mandatory cost accounting system was broken, as prices started to be decided after funds made available to the MoH's budget by the MoF Tensions emerged between the MoH and the MoF, with the balance of power tending towards the latter In 2013, the government decided to improve the mandatory cost accounting system, with the support of a university	SAP was only adopted by some hospitals, mainly in the Region of Lisbon and Tagus Valley, contributing to the fragmentation of management accounting systems in use In 2015, the Portuguese accounting regulator issued a norm on cost accounting expressly recommending the implementation of ABC in hospital settings The funding model is being progressively – yet timidly – changed in order to encompass the quality of services rendered, through the introduction of "comprehensive prices"

(continued)

Table 23 Application of the theoretical framework to CHUSJ (continued)

Application of the theoretical framework to CHUSJ			
Application and actions	**First period: consolidation of pressures**	**Second period: undefined pressures**	**Third period: *fuzzy* pressures**
5. What selective choices were made by the organization under study?			
Identify pressures from main external referents (isomorphic pressures from the State and professions)	The MoH launched a national project on the implementation of ABC, with the support of a consultant firm	In 2014, the government abandoned this second project and tried to generalize SAP	CHUSH was invited to participate in generating cost estimates for applying those prices
Evaluate internal interests and actions	There was a deep commitment from the board with the implementation of private sector-like management principles and tools, including the creation of responsibility centers and the unprecedented ABC project The objectives were clearly transmitted to middle management structures, with particular attention towards senior physicians Hired professionals with education in economics/management and experience in the private sector were immediately integrated Physicians were involved right from the start and showed interest and acceptance	The ABC project was abandoned, but all the previous interest on the sophistication of information systems for operations and management was transferred to the much estimated and internally thought and created BI	The internal and external success reached by the BI – it received several national awards and it is generally envisaged as a breakthrough – is proudly shared within CHSJ

(continued)

Table 23 Application of the theoretical framework to CHUSJ (continued)

Application of the theoretical framework to CHUSJ			
Application and actions	**First period: consolidation of pressures**	**Second period: undefined pressures**	**Third period: *fuzzy* pressures**
5. What selective choices were made by the organization under study?			
Evaluate the consistency of pressures over time, considering the triggers identified above (continued)	There were steady pressures, visible and clear for all the field Besides "a helping hand" for implementing management principles and tools new to the sector, the *Unidade de Missão* also acted to rapidly impose the NPM reforms to public hospitals NPM reforms knew their peak with the national ABC project	Crisis opened a period of contradictory signals, with each new decision made at the political level reversing the previous one Financial restraints overlapped management reforms	The new center-left wing government with support from left wing parties that came out of the post-Crisis elections was deeply concerned with rapidly reversing major policies taken during the Crisis with reflection on social and economic arenas, but the first policy with impact on enterprise hospitals – *i.e.*, the intention to get back the enterprise model for a set of hospitals – was presented only by the end of its mandate The HSJ's board of directors is only aware of this policy by reading the news, as it has not been informed yet, two months away from its kick-off Many impositions were put on the hospitals as a result of those policies, drifting away their attention and efforts from management (including accounting) issues

(continued)

Table 23 Application of the theoretical framework to CHUSJ (continued)

Application of the theoretical framework to CHUSJ			
Application and actions	**First period: consolidation of pressures**	**Second period: undefined pressures**	**Third period: *fuzzy* pressures**
5. What selective choices were made by the organization under study?			
Evaluate the consistency of pressures over time, considering the triggers identified above			The intervention from regulators and professional associations was finally visible, but the norm on management accounting recommended ABC, in disregard of previous failed experiences There is no evidence today that any hospital has already started to implement ABC in response to the accounting norm

(continued)

Table 23 Application of the theoretical framework to CHUSJ (continued)

Application of the theoretical framework to CHUSJ			
Application and actions	**First period: consolidation of pressures**	**Second period: undefined pressures**	**Third period: *fuzzy* pressures**
5. What selective choices were made by the organization under study?			
Summarize selective choices	Having entered the enterprise process only in the second wave, the HSJ rapidly proved to be conform to superior expectations, as it rapidly implemented the tools previously brought into the field by the *Unidade de Missão*, and it went further with no delays, by creating responsibility centers Taking advantage of its central position in the field, the HSJ decided on its own to implement ABC, evidencing the whole field that in a few years it went through all new management tools and implemented the most sophisticated management accounting system that existed	HSJ did not implement SAP Financial restraints advised against maintaining an expensive system such as ABC, but HSJ found a new way of keeping on top of modernity: the BI	HSJ kept developing the BI, as it was being increasingly acknowledged and awarded Both the Board and those in charge of the BI presented the system to the whole field, from the MoH and public hospitals to private hospitals While proudly tagging the BI as “made in CHUHSJ”, there is the will to help their peers to start similar systems Giving the best attention to the BI is also a part of a communication strategy, that aims to foster a sense of belonging to HSJ and inflate confidence in the population that comes to the Hospital A renewed attention to management accounting (*i.e.*, to the cost mandatory model) is being thought, but only when the process with the financial accounting norm is over

(continued)

Table 23 Application of the theoretical framework to CHUSJ (continued)

Application of the theoretical framework to CHUSJ			
Application and actions	**First period: consolidation of pressures**	**Second period: undefined pressures**	**Third period: *fuzzy* pressures**
5. What selective choices were made by the organization under study?			
Assess decoupling	Decoupling is not apparent, as a management culture seems to have been inflated into HSJ's professionals Management tools were implemented gradually but steadily, growing on the requirements and complexity Thus, desire to have better information is apparent	Decoupling is not apparent as well, because in spite of retreating from ABC, like in the national project, the HSJ began promptly to build the BI, even considered to go beyond ABC in terms of providing information for management and clinical activity (understood as a sort of operations management) and shared by the board and all professional groups involved Thus, desire to have better information is apparent	Decoupling is still not apparent, because the BI is growing in capacity and usefulness Thus, desire to have better information is apparent

Table 23 Application of the theoretical framework to CHUSJ

7. Discussion

Traditional insights of institutional theory provided explanations for the stability that characterized healthcare in Portugal, from the early 1970s to the end of the century, through the combined role of the State, professional associations and hospitals, accountable for, respectively, coercive, normative and mimetic pressures (Meyer and Rowan, 1977; DiMaggio and Powell, 1983; Zucker, 1987). But those early insights, by highlighting the role exercised by forces outside the organization and treating organizations as single entities with a unified response provided little guidance to understanding change and divergent behavior as happened about the creation of corporate hospitals (Seo and Creed, 2002; Thornton and Ocasio, 2008; Kraatz and Block, 2008; Pache and Santos, 2010; Greenwood *et al.*, 2014; Micelotta *et al.*, 2017). Conversely, new insights introduced by institutional logics added further theoretical concepts to institutional analysis that can help on understanding the many aims, events and interventions that shaped the creation and the evolution of enterprise hospitals and their use of management tools, particularly more sophisticated management accounting systems. I proposed and applied a theoretical model that systematized some fundamental concepts of institutional logics, namely the *evolution over time* (or *historical contingence*); *hybrid organizations* (enterprise hospitals and particularly the HSJ, in the case); *multiple levels of analysis* and the *location* of the stakeholders in the field (healthcare, in the case), needed to frame their action and exercise mechanisms of *selective choice* in order to achieve their own interests.

Over a long period, from 1971 to the turn of the century, hospitals in Portugal were regarded as rather differentiated units, which relied on accumulated clinical knowledge as well as on sophisticated technologies to provide care to all citizens (Carapinheiro, 1993; Simões, 2005; Barros and Simões, 2007). In spite of this orientation to the social purpose of providing care, there was a growing and shared belief that hospitals had an "enterprise nature" and a long legislative process knew its peak in 2002/3, when corporate hospitals were created. Thus, public enterprise hospitals in Portugal resulted from a thorough and incremental process, through which all stakeholders involved were interiorizing and accepting changes, as they were gradually coming to the fore. On the one hand, the balance of the field has been maintained, as suggested in previous literature (Scott *et al.*, 2000; Kraatz and Block, 2008; Dunn and Jones, 2010). On the other hand, it gave the opportunity to smooth and gradually introduce and insert a new managerial logic into the dominant medical professionalism logic, creating the conditions for the collective actors in the field to get prepared and mutually accept the emergence of enterprise hospitals. This intentionally gradual process, led by central authorities, supports the argument by Greenwood *et al*. (2011) that change in a mature field such as healthcare is more predictable and formalized than in emergent fields.

The theoretical framework proposed for this Chapter started by questioning which major events could trigger change in the healthcare field, starting by looking for changes at the broader level of society, economy, technology, and also legislation, as proposed in previous literature (Greenwood *et al.*, 2002; Kraatz and Block, 2008; Battilana *et al.*, 2009; Major *et al.*, 2018). While recognizing that there were major laws preparing the way for enterprise hospitals to emerge, none is comparable in practical effects to the intense intervention from the government in the years 2002/3. In fact, the legislation issued in 2002 came in a time when actors in the field were discussing how to turn hospitals into what they *truly* were – and everyone was already convinced of that –, *i.e.*, enterprises that needed managerial tools to be well governed. In fact, the pace of change was rapidly increasing, but the next move went even further, when the newly elected government decided to follow the shorter trek in the 2002 legislation and created the corporate hospitals.

The previous means that after an enduring process that lasted for decades, change has been clearly intensified, when the main stakeholders in the field were prepared to accept the *somewhat radical* transformation of the social estimated hospitals into corporations, as the elected solution simply turned hospitals into corporations, like in any commercial sector. This research evidences that corporatization was the trigger for a new period of intense and steady pressures from central authorities, which guided change and sent clear messages to the field – and corporate hospitals in particular – about what modern management meant for them. It also evidences a twofold reality: on the one side, those pressures were permanent, intense and a clear proof of what those at the top of the field did valorize; and, on the other side, the pressures were some kind of *materialization* of all that everyone in the field expected to happen *one day*.

Following the theoretical framework, corporate hospitals were the trigger that finally transformed healthcare-oriented hospitals into *hybrid organizations*, conforming to the concept developed in previous literature on institutional logics to characterize the dual nature of organizations subject to distinct – and many times conflicting – purposes and logics, essentially combining social aims with a management emphasis (Pache and Santos, 2013; Smith *et al.*, 2013; Battilana and Lee, 2014; Fitzgerald and Shepherd, 2018).

The HSJ entered this process only a few years later – in 2005/6 – in the midst of a clear consolidation of the enterprise model and pressures from the MoH and the MoF towards modern and innovative business-like management techniques. The new hybrid nature seems to have been rapidly acquired and interiorized, as years of intense activity first led to the creation of responsibility centers – a pioneer movement still tagged to HSJ to the present – and then to the unprecedented decision to implement ABC.

This last decision was taken independently of a similar pilot-project, driven by the MoH and involving ten hospitals from distinct health regions in two phases. In this regard, decisions at HSJ were taken in face of the relations existing between the Hospital and a particular set of stakeholders – namely, its owners at the top of the field and its professionals – and on the central spot where HSJ stands in the field, as proposed in the third and fourth institutional logics concepts in the theoretical framework.

The HSJ decided to implement ABC on its own and invested a considerable amount of resources, both financial and human, instead of taking part in the national project. Such a far-reaching decision is only likely to be within reach of a large teaching hospital, positioned at the center of the field, which granted an increased ability to act, as suggested by Greenwood *et al.* (2011). Besides resources and the vision of the board, there must be needed a political bargaining power only accessible to large organizations to justify such an outstanding decision before the MoH/MoF.

By investing in the ABC, the HSJ could be strategically proving to the MoH and the MoF its commitment to the sophistication of management tools, as they were pointing the way, and moving in that direction by using its own resources could both enforce that commitment and make use of its central position, as just referred. Using the lenses of the final institutional logics concept of the theoretical framework, this might represent a strategic move in order to signalize alignment with key referents, as suggested in the literature on selective choice (Pache and Santos, 2010; 2013; Guerreiro *et al.*, 2012). However, it is not apparent that those who were leading the Hospital were just willing to convey a message, revealing decoupling between the conveyed message and their real efforts, as reported in previous literature (Meyer and Rowan, 1977; Boxenbaum and Johnsson, 2008; Guerreiro *et al.*, 2012). On the contrary, what is apparent is a desire of having better information for management, providing an example of clear hybridization. This reading is enforced by the way the main professionals groups were brought into the ABC implementation, carefully aligning the aims of the Hospital with their active collaboration and avoiding internal struggles. This alignment led to a unitary response within the HSJ, contrarily to other situations reported in the literature (Kurunmäki, 1999a; b; Scarparo, 2006; Kraatz and Block, 2008; Scott, 2008; Dunn and Jones, 2010; Pache and Santos, 2010; 2013; Greenwood *et al.*, 2011; Cardinaels and Soderstrom, 2013; Arman *et al.*, 2014; Major *et al.*, 2018).

One might argue that the unitary response could have been made easier by the lack of intervention on the sophistication of management accounting by the other relevant stakeholders at the top of the field. In fact, there are many situations reported in the literature about how internal actors actively seek anchorage and guidance on their external referents (Scott *et al.*, 2000; Greenwood *et al.*, 2002; Dunn and Jones, 2010; Pache and Santos, 2010; 2013; Greenwood *et al.*, 2011; Tracey *et al.*, 2011; Waldorff, 2013; Besharov and Smith, 2014; Vickers *et al.*, 2017). Greenwood *et al.* (2011, p. 318) refer to this matter as a way for internal actors “to gain endorsement from important referent audiences” and stress how professional associations are particularly active in leading change in favor of their members. These arguments are equally stressed by Dunn and Jones (2010), Pache and Santos (2010; 2013), Guerreiro *et al.* (2012) and Besharov and

Smith (2014), and might be related to professional associations, regulators and also, Academia.

At this point, one has already run through all the institutional logics concepts that form the theoretical framework and found that a large teaching Hospital at the center of the healthcare field clearly became a hybrid organization and implemented a sophisticated management accounting system. While following the trend that was intensively felt within the field towards the sophistication of management tools, the need for better information for management seemed to be a genuine aim, shared within the hospital, which culminated with the implementation of ABC. But is it that simple?

Literature abundantly stresses that institutional logics are historically contingent (Thornton and Ocasio, 1999; Scott *et al.*, 2000; Thornton, 2002; Kraatz and Block, 2008; Dunn and Jones, 2010; Greenwood *et al.*, 2011, Pache and Santos, 2013) and that justifies the organization of the concepts along the theoretical framework – the evolution over time is the one at the top – as well as the second arrow, emerging from the fifth concept to the first one (again), as in a loop.

A second trigger precipitated change, with some distinct features from the first one. In fact, the first trigger represented the intensification of the pace of the ongoing state of affairs, which can be essentially compared to the incremental/transformative sort of change proposed in the dual classification by Kraatz and Block (2008). Corporatization was the last of many steps towards the creation of enterprise hospitals, it was triggered from inside the field and it was not anchored in broader social movements, as that was a normal period in political and economic terms. It also opened an enduring period of NPM reforms in healthcare that lasted almost a decade. In spite of all these points in common with one of the classes proposed by Kraatz and Block, the research case would be better characterized if positioned between the two opposite sorts of change, like in the classification of *moderately centralized fields* by Pache and Santos (2010). A middle classification such as *intensified incremental change* could better give a meaning to the transformation of public hospitals in Portugal in the years 2002/3. This arguing is also a means to respond to claims in the literature about the need to better understand the effects of time variables in change processes (Pache and Santos, 2010, Micelotta *et al.*, 2017). By contrast, the second trigger is a clear example of radical change, as in the dual classification by Kraatz and Block: as a consequence of the international Crisis, *Troika* entered the Country and imposed heavy political and financial restraints, with a large impact in healthcare. This time, the events that precipitated change were born outside the field, in the broader economic and social environment, and this period was shorter than the previous one. Besides matching the features presented by Kraatz and Block in regard to radical change, they are also coincident with the description of how major historical events can "create tensions and contradictions" in several fields (Major *et al.*, 2018, p. 1202)[17].

Subject to international financial assistance, the Portuguese government imposed tight control over public expenditure and introduced cuts in the State Budget for healthcare. The funding model in place since the creation of corporate hospitals lost its main properties and policies decided to tackle the crisis led to another setback in the enterprise model, by (re)centralizing powers in the MoH/MoF.

Combined, the policies of introducing "administrative" cuts on funding, regardless of information on costs, and restricting the hospitals' autonomy lowered the importance of management accounting in hospital settings. In addition, as in similar situations described in previous literature (Vickers *et al.*, 2017), within the crisis context, it became difficult to continue assigning funds to the project, as well as to provide ACSS and other central authorities with staff required for assisting hospitals and evaluating progress in the implementation. These policies acted as a signal from the MoH/MoF about the low level of priority attributed onwards to management accounting.

Such a drastic change of priorities regarding management principles and tools was vividly felt inside HSJ. Although recognizing the importance of the cost estimates obtained through ABC for improving operational and financial management, the HSJ would need to continue to assign considerable funds and human resources to ensure its functioning. But this time, signals coming from the highest level in the field would not advise further

[17] Major and colleagues were referring to Brexit.

expenses. For the time being, indications from the State were clear and were generally followed, providing evidence, again, that response to change in mature fields is more stable and predictable than in emergent ones, as suggested by Greenwood *et al.* (2011).

But the situation rapidly lost clarity, and over the period of the international financial assistance, policies affecting management accounting in hospital settings were contradictory and inconsistent. First, ACSS championed a new project aiming at reconfiguring the mandatory cost accounting model, this time choosing the cooperation from a public university. But then, inconsistencies began when the center-right government decided to leave that new project, decided by the previous center-left government after two years of cooperation, and replaced it by a much more ambitious program of implementing SAP in enterprise hospitals. SAP was marketed as a means to promote a qualitative jump in terms of processing, delivering and using management accounting information in hospital settings, but the enormous funds assigned to its implementation were in a clear contrast with the severe financial constraints (cf., *e.g.*, Vickers *et al.*, 2017).

Globally, the government's attempt to impose SAP to all enterprise hospitals failed and contributed to the fragmentation of management accounting systems in use. In addition, there is evidence that the implementation of more sophisticated systems has not been part of the government's concerns ever since, because, as the MCD Director stated, it has been her "last contact with management accounting" so far.

But things have gone differently inside CHSJ. It is true that CHSJ retreated in relation to ABC, but that does not mean that it had lost confidence in the role of information within the enterprise hospital. Over the period of the external intervention and contrarily to the Government, the Hospital proved to have a steady understanding about the role of information: it should be timely and internally available as the only way to allow for actual internal delegation of powers and help to improve clinical activity.

As I have referred above in this Discussion Section, there had been a unitary response within the Hospital regarding ABC. This was an accomplishment, as it contradicted previous experiences and induced a predisposition to accept more sophisticated information systems.

It was in this regard that CHSJ internally developed the successor of ABC: the equally sophisticated BI. As before, it was a decision taken internally, it resulted from the need to provide the *hybrid* hospital with enhanced management tools, and it fitted what was progressively evident: CHSJ was a front-runner in what concerns to management innovation. The ability to be collectively innovative was built around internal dynamics that involved the relevant professional groups and the Hospital's image was proudly shared.

On the one hand, the strategy of communication and involvement avoided internal conflicts, as happened in many cases (Kurunmäki, 1999a; b; Scarparo, 2006; Pache and Santos, 2013, Cardinaels and Soderstrom, 2013; Besharov and Smith, 2014; Lander, 2016), and fostered cooperation inside the organization, as also happened in other situations reported in the literature (Reay and Hinings, 2005; 2009; Vickers *et al*., 2017). On the other hand, again, this enforces the argument by Greenwood *et al.* (2011) and Besharov and Smith (2014) that size and the place in the field matter, as it was the second time that considerable human and financial resources were allocated to enhanced management tools. One could expect that a time of crisis would not advise such investments, as reported in the literature and just referred above, and allocating funds to non core activities, especially by a Hospital that did not follow the indication to implement SAP, was only accessible to a large hospital with bargaining power.

The third period evidenced contrasting behavior from stakeholders at the top of the field in comparison to the two previous ones. On the one hand, the government sent steady messages to the field during the first period and in spite of constantly diverging between short-lived projects over the second one, there had always been a communication of its intentions to the field. Such communication enabled hospitals to interpret the will of the government and act strategically, as in the case of HSJ towards ABC, but also of those that joined the national ABC project or implemented SAP. This clear relation between key stakeholders at the top and organizations in the field is central in previous literature on hybrids and selective choice, as actors in the field are able to interpret expectations made upon them and take the actions that best promote their interests (Reay and Hinings, 2005; 2009; Battilana and Dorado, 2010; Tracey *et al*., 2011; Pache and Santos, 2010; 2013; Guerreiro *et al.*, 2012; Waldorff, 2013; Battilana and Lee, 2014; Arman *et al*., 2014; Miller and French, 2016; Lander, 2016; Thune and Mina, 2016; Vickers *et al.*, 2017; Fitzgerald and Shepherd, 2018). However, this research provides evidence of a period when this clear relation has been cut and actors in the field run short of references to allow them to *read and act strategically*, as assumed in previous literature. In fact, the government seemed to be deeply concerned to rapidly reverse labor, economic and financial policies related to the Crisis, but very few could be captured from the field in relation to the sophistication of management tools, as the only *signals* were the timid introduction of *comprehensive prices*, which required a complex construction and would advise the hospitals' internal reorganization and the *reintroduction of the enterprise model*, only decided close to end of the mandate and poorly communicated to the hospitals involved.

On the other hand, while this third period continued without evidencing a major role by professional associations, this time there has been a move on the side of the accounting regulator, which issued a norm recommending the implementation of ABC. If there were no signals either from the government or professional associations, the signal from the accounting regulator might have sounded puzzling to the hospitals, given the previous failed experiences, and added smoke to the vagueness at the top of the field. Again, this finding contradicts the ability of actors in the field to read messages and act strategically assumed in previous literature, as just referred.

At the CHUSJ, there was only the intention to perform the mandatory cost accounting model in the best possible way and recovering ABC was not part of the plans. However, this time one cannot argue that going against the recommendation in the norm was made possible by its central place in the field, as suggested in previous literature (Greenwood *et al.*, 2011; Besharov and Smith, 2014) and already discussed above, as none hospital, to my knowledge, has already started to implement ABC, four years after the issuing of the accounting norm.

Considering the three distinct periods together, this thesis also contradicts the argument by Dunn and Jones (2010) and Pache and Santos (2013), that especially on the long run internal conflicts are likely to emerge. Generally, these authors argue that different professional groups keep their own identity and resources, even if they temporarily cooperate towards achieving a common goal that emerges from their new hybrid nature. Stated in other words and relating to hospitals, physicians and managers could contribute to the implementation of sophisticated management accounting systems, because both groups would benefit from more information made available and be more confident in relation to a hybrid world that is new to physicians (enterprises) but also to managers coming to the field (healthcare). This thesis contributes to the literature as well by providing some explanations for the longstanding common/unitary response given by CUHSJ since it was transformed into an enterprise hospital. In the first place, the total absence of action from professional association in regard to the sophistication of management accounting and tools in the national arena left professional groups inside the Hospital without external referents to rely on, contrarily to what is assumed in the model by Pache and Santos (2010) and what happened in many situations abundantly reported in the literature (Dunn and Jones, 2010; Pache and Santos, 2013; Greenwood *et al.*, 2011; Guerreiro *et al.*, 2012; Waldorff, 2013; Besharov and Smith, 2014). In the second place, the CHUSJ effectively implemented and used new management tools, continuously improving them to the present day instead of promoting decoupling, contrarily to other cases also reported in the literature (Townley, 2002; Dunn and Jones, 2010; Guerreiro *et al.*, 2012). In the third place, the CHUSJ managed to do so by promoting dialogue and combination of efforts for all relevant professional groups – physicians, managers and IT engineers – with full and active support from all boards of directors which followed one another, as in the argument by Kraatz and Block (2008) that bringing the diverse groups to the dialogue is the *intelligent adaptation of organizations to new environments*. Communication and joint work seemed to be a key point to, in a row, launch the UAGs, implement ABC and create BI, always keeping on top of modernity and making *all* inside the Hospital proud of modernity created inside CHUSJ. Finally, in the fourth place, keeping modernity and orientation to modern techniques can be a way of gaining legitimacy by resorting to 'higher' values of rationality and good management, that *insulate* CHUSJ from 'waves' in the field. However, this continuity of action, in disregard of those “waves” in the field, might only be at reach of large organizations, as it is the case of CHUSJ, and it has been suggested by Greenwood *et al.* (2011, p. 341, emphasis in the original), by stating that “size, in this sense, provides an organization with a measure of *immunity* from institutional pressures”.

Conclusions

1. General conclusions

Management accounting systems as an essential tool for planning and control grew in importance for Portuguese public hospitals when these were turned into enterprises in the early 2000s. Regarding the limitations of information provided by the mandatory cost accounting model (restricted to mean costs), both the MoH/MoF and the HSJ decided to invest in the sophistication of management accounting by implementing ABC. However, both stepped back and abandoned the projects.

My first research objective came out of the also first reason given by HSJ for this decision: the complexity and the high costs of maintaining ABC. On the one hand, ABC estimates were available for 2009, and, on the other hand, the Hospital had created the BI, a sophisticated information system that could provide detailed data on patients and their stay for that year. I thus designed a *mezzo* methodology that assigned all direct costs to individual patients, as in ABC, and apportioned indirect costs essentially based on time drivers. In turn, this *mezzo* methodology would be easy to operate and implying little added costs, as it would be, to some extent, a spin-off of the BI. This design corresponds to the combination of bottom-up micro costing with bottom-up gross costing and the comparison between ABC estimates and a *mezzo* methodology designed in this way had never been presented in previous literature. Results were clearly aligned in relation to medical DRGs, which means that if a *mezzo* methodology is able to assume the same characteristics of ABC in regard to cost components with large impact on total costs – *i.e.*, the assignment to individual patients of costs with drugs, materials and examinations – cost estimates are likely to be reliable, as proposed by Tan *et al.* (2009b). Besides contributing to the literature by confirming this argument by Tan *et al.* (2009b) and extending previous comparisons between alternative methodologies (Mishra *et al.*, 2001; Larsen and Skjoldborg, 2004; Chapko *et al.*, 2009; Clement *et al.*, 2009) this research goes further and evidences that, contrarily to what has also been argued by Tan *et al*. (2009b), estimates can be similar when relying on bottom-up gross costing to complement bottom-up micro costing, *i.e.*, when relying on the hospital sections' cost data available through the mandatory cost accounting model in combination with records of time spent on the main clinical procedures.

Conversely, estimates were not aligned in relation to surgical DRGs. The reason for this may be the absence of information storage about specific materials used in the operating room in 2009. Materials (*e.g.*, prosthesis) can have a great impact on total costs and are likely to vary from patient to patient and even from surgeon to surgeon.

The other line of comparison, between cost estimates and national prices, rendered similar figures, but only in relation to surgical DRGs. Regarding medical DRGs, there was a huge difference, with cost estimates representing almost twice the value received by HSJ. This last finding contradicts conformity found in previous literature (Mishra *et al.*, 2001; Larsen and Skjoldborg, 2004; Chapko *et al.*, 2009) and raises concerns about the fairness of the pricing system, especially relevant for hospitals and in a time when they were meant to be financially sustainable as regular enterprises, since inpatient care accounts for about 75% to 85% of total inpatient revenues in European countries, including Portugal (Tan *et al.*, 2011; Mateus, 2011).

Advancing for my second research objective, the further use of cost estimates obtained through the *mezzo* methodology by applying cluster analysis revealed the ability to internally readdress the use of the DRG system and externally calibrate the weights that, in the end, determine prices for inpatient care and account for the financial balance of enterprise hospitals.

Internally, moving inside the DRG *black box* is a means to provide those in charge of the clinical departments and of the hospital as a whole with a deeper understanding on clinical procedures followed and on the related costs. Without an approach similar to the one proposed in this thesis, all patients classified into a single DRG are supposed to receive similar care and cause similar costs, but, for instance, ¼ of cost estimates for patients grouped into DRG 14 in 2013 were significantly apart from the majority of ¾, and ¼ is a large enough figure to raise concerns and advise clinical review.

This approach is also a more familiar way to present cost figures to physicians, because they unfold the mean cost per DRG and make estimates more understandable and closer to the clinical practice. A large group is alike to represent alignment with established protocols and best practices, while a group apart from this one is alike to signalize deviation, probably resulting from diverging LoS, examinations or drugs. In this vein, it is a way to attract physicians to management issues and foster cooperation between physicians and managers. Literature suggests that this cooperation is more likely to happen when physicians are involved and when the IT infrastructure is used to build more sophisticated information system that can bring figures for simultaneous use by physicians and managers (Lehtonen, 2007; Porter and Lee, 2013), and HSJ, as I will soon recall, is a good example of this. It is, at the same time, a way to lower the physicians' resistance towards accounting numbers, often reported in the literature (Abernethy and Vagnoni, 2004; Nyland and Pettersen, 2004; Schrijvers *et al.*, 2012; Gebreiter, 2017).

Finally, claims have been made in the literature about the need to improve management accounting in order to drift away from the mean, as mean costs are too strict to mirror the operational settings of complex organizations, such as large enterprises, factories, and, also, hospitals (Tan *et al.*, 2009b; 2011; Christensen, 2010; Chapman *et al.*, 2013) and this thesis is also a response to those claims.

In turn, at a national stand, replicating this approach could better shed light to the Portuguese reality and allow for both the assessment of the consistency of the DRG classification and the establishment of fairer cost weights. Portugal still relies on imported weights, what might not fairly represent the Country's clinical procedures and might bias the definition of DRG prices (Mateus, 2011; Cots *et al.*, 2011).

Once more, this is especially true for enterprise hospitals, that are supposed to be well governed and financially balanced. If there is a significant bias in the definition of prices, that balance might be put into question. Recalling the results from the reorganization of cost estimates provided by cluster analysis just referred, only ¾ of estimates were close enough, which might lead to conclude that ¼ of patients received deviant clinical acts and/or that only ¾ of patients were fairly paid to HSJ in relation to DRG 14 in the year 2013.

Moving into the third research objective, this thesis contributes to the literature by proposing a theoretical framework for use when hybridization is at stake, including the long term effects of hybridization, in times when it is not yet fully consolidated. This theoretical framework systematizes five concepts of the institutional logics perspective, ending with the attempt to capture explanations for mechanism of selective choice promoted by the organization under study, including the assessment of the presence of decoupling.

This thesis contributes to the literature as well by applying the theoretical framework to the case of CHUSJ in order to try to understand the reasons for the progresses and setbacks observed in this large Hospital, that clearly acquired and interiorized its condition of an enterprise hospital that needed sophisticated management tools – like ABC in a moment in time – but then stepped back. That theoretical framework led to the identification of three distinct periods, over which the actions of key stakeholders at the top of the field varied in intensity and clarity and put pressures on the field, including on CHUSJ. However, due to the *intelligent* strategy[18] followed by all boards of directors who were in charge from the moment that it was transformed into an enterprise hospital, of involving all relevant professional groups in the sophistication of management tools – including management accounting but not only – and benefiting from its central localization in the healthcare field that granted bargaining power towards its owners, CHUSJ went on introducing disruptive management tools.

Literature suggests that actors are able to interpret the intentions and expectations from key stakeholders, especially in fields such as healthcare, where hospitals are dependent on the state as owner and the main provider of resources (Pache and Santos, 2010; Guerreiro *et al.*, 2012; Besharov and Smith, 2014). However, this thesis contributes to the

[18] *Intelligent*, as proposed by Kraatz and Block (2008) for organizations facing new environments.

literature by providing evidence that in particularly complex times, confusion may emerge and the message gets *fuzzy*, both from the government, that conducts inconsistent policies or takes no action, and from hospitals, that change decisions, lower the pace of change or prefer to wait for clearer indications. My research also found similar contradictions from other stakeholders located in high levels of the healthcare field, namely accounting regulators, central authorities with supervision on accounting and professional associations, which led to delays in accounting reforms and lowered the interest about management accounting. In the case, the position of CHUSJ towards management accounting became *fuzzy* not so much because of complexity or internal struggles, but because of the confusing signals coming from the key stakeholders.

This thesis also contributes to the literature by providing evidence that confusion in *fuzzy periods* may hamper the message to flow between key stakeholders at high levels in the field and organizations, *i.e.*, in periods of economic and/or political turbulence key stakeholders with power and authority may lose the capacity to transmit their will to organizations and, in parallel, organizations may get short of references to frame their action. But it further evidences that confusion/fuzziness introduced in particularly complex periods of turbulence as a result of major events that had triggered confusion outside the field, extensively addressed in the literature (Scott *et al.*, 2000; Reay and Hinings, 2005; Kraatz and Block, 2008; Kyratsis *et al.*, 2017; Major *et al.*, 2018), may persist in the field even when the turbulence is over and those major events are already solved at the broader societal level. In CHUSJ, keeping modernity and the orientation to modern techniques is still a way of gaining legitimacy by resorting to "higher" values of rationality and good management. Even if people at CHUSJ are not able to read the intentions of the key stakeholders, they are aware that their Hospital occupies a central place in the field and that such modernity feeds its *avant-garde* image. The point is that the sophisticated management accounting system that HSJ once truly implemented when NPM reforms advised ABC has no place in that modernity.

2. Limitations and suggestions for future research

First of all, as a case study, it is not possible to make a statistical generalization from the just referred conclusions.

In addition, while getting access to interviewees with long-lasting links to healthcare, who provided me with an experienced and nuanced vision from almost all angles with relation to the issue of sophisticating management accounting, I did not have the opportunity to obtain the opinion from an important stakeholder, many times referred: the physicians, whether senior physicians or service directors. The same is also true in regard to professional associations of physicians and managers, as well as in regard to the accounting regulator, other relevant stakeholders that, by action or omission, also exerted influence on decisions made in the field, including by CHUSJ.

While trying to avoid problems of insider research, namely trying not to express my own opinion about any subject under discussion or any question put to each interviewee, four of them knew my prior links to the sector. Given all the experience of the interviewees and the fact that I had never worked with anyone of them, I feel that I might have reached this important intent.

Finally, still in relation to the methodologies employed, although I used, indeed, a set of documents, I could have relied more on documental analysis in order to confront reports from central authorities such as the National Audit Court with the information obtained through the interviews.

Regarding more practical issues, I compared estimates obtained through the *mezzo* methodology with the ones of ABC for the year 2009, because this was the single year with ABC estimates. Unfortunately, the HSJ only started to relate materials used in surgeries to individual patients by the end of that year. This might be a reason to explain the deviation between the estimates for surgical DRGs in Chapter One.

All calculations that allowed the estimates in Chapter One were made using spreadsheets, which made calculations a time-consuming exercise that did not allow to extend the analysis to more DRGs. With some level of IT automation and integration with the BI, data could be easily processed and the *mezzo* methodology could be further compared to more ABC estimates and prices.

Suggestions for future research start from some of the just referred limitations. An extended use of data available in hospital information systems and an improved linkage between management accounting and IT capabilities could raise more interest towards the sophistication of management accounting systems. Little research has been produced in relation to this subject in Portugal. The intensification of academic research in this area could strengthen the importance of management accounting and raise it to the level that health economics evidences. It would be as well a means to get the attention of the accountants' professional association towards management accounting and lead to the issuing of technical reports anchored in academic methods as it happens in the UK (*e.g.*, Northcott and Llewellyn, 2004; Chapman and Kern, 2010; Blunt and Bardsley, 2012).

Another suggestion is the application of the proposed theoretical model to other cases of hybridization, as a means to try to understand the mechanisms of selective choice put in place by those organizations faced with change.

This thesis evidences the relevance of the pressures from the MoH and the MoF over the hospitals in order to influence or even guide their decisions about implementing more sophisticated management accounting systems. As these ministries own the hospitals, the dynamics of the pressures from the government and the hospitals' responses could be addressed under the theoretical lens of the agency theory. Agency theory could also be integrated in the proposed theoretical framework, especially concerning the concepts of multiple levels of analysis, location in the field and selective choice.

Finally, this thesis provides evidence as well that the undefined pressures which started when the Crisis hit Portugal, turned even more confusing when the Crisis was declared over and the Country got its previous economic indicators back. Thus, extending the analysis to the coming years, both in the case of steady economic growth or recession, may provide further explanations for the difficulties in the communication between the government and hospitals.

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Appendix 1 – ANOVA output from hierarchical cluster analysis for DRG 14

ANOVA						
		Sum of squares	df	Mean square	*F*	Sig.
Emergency costs	Between groups	13154,000	1	13154,000	1,199	,274
	Within groups	6110924,890	557	10971,140		
	Total	6124079,290	558			
Ward costs	Between groups	2685782457	1	2685782457	944,205	,000
	Within groups	1584380827	557	2844489,814		
	Total	4270163283	558			

Table A1.1 ANOVA output for Ward's method with two segments

ANOVA						
		Sum of squares	df	Mean square	*F*	Sig.
Emergency costs	Between groups	4322518,675	3	1440839,558	443,874	,000
	Within groups	1801560,615	555	3246,055		
	Total	6124079,290	558			
Ward costs	Between groups	2726428682	3	908809560,7	326,733	,000
	Within groups	1543734601	555	2781503,786		
	Total	4270163283	558			

Table A1.2 ANOVA output for Ward's method with four segments

ANOVA						
		Sum of squares	df	Mean square	*F*	Sig.
Emergency costs	Between groups	4352762,911	4	1088190,728	340,344	,000
	Within groups	1771316,379	554	3197,322		
	Total	6124079,290	558			
Ward costs	Between groups	3326441282	4	831610320,5	488,186	,000
	Within groups	943722001,2	554	1703469,316		
	Total	4270163283	558			

Table A1.3 ANOVA output for Ward's method with five segments

ANOVA						
		Sum of squares	df	Mean square	*F*	Sig.
Emergency costs	Between groups	4925361,019	6	820893,503	378,015	,000
	Within groups	1198718,271	552	2171,591		
	Total	6124079,290	558			
Ward costs	Between groups	3531782664	6	588630444,0	440,049	,000
	Within groups	738380619,2	552	1337646,049		
	Total	4270163283	558			

Table A1.4 ANOVA output for Ward's method with seven segments

ANOVA						
		Sum of squares	df	Mean square	*F*	Sig.
Emergency costs	Between groups	5215426,476	7	745060,925	451,799	,000
	Within groups	908652,814	551	1649,098		
	Total	6124079,290	558			
Ward costs	Between groups	3532250597	7	504607228,2	376,791	,000
	Within groups	737912686,1	551	1339224,476		
	Total	4270163283	558			

Table A1.5 ANOVA output for Ward's method with eight segments

ANOVA						
		Sum of squares	df	Mean square	*F*	Sig.
Emergency costs	Between groups	5216468,609	8	652058,576	395,139	,000
	Within groups	907610,681	550	1650,201		
	Total	6124079,290	558			
Ward costs	Between groups	3676421131	8	459552641,4	425,696	,000
	Within groups	593742152,2	550	1079531,186		
	Total	4270163283	558			

Table A1.6 ANOVA output for Ward's method with nine segments

Appendix 2 – Main output of cluster analysis for DRGs 88 and 167

2.1. Output of cluster analysis for DRG 88

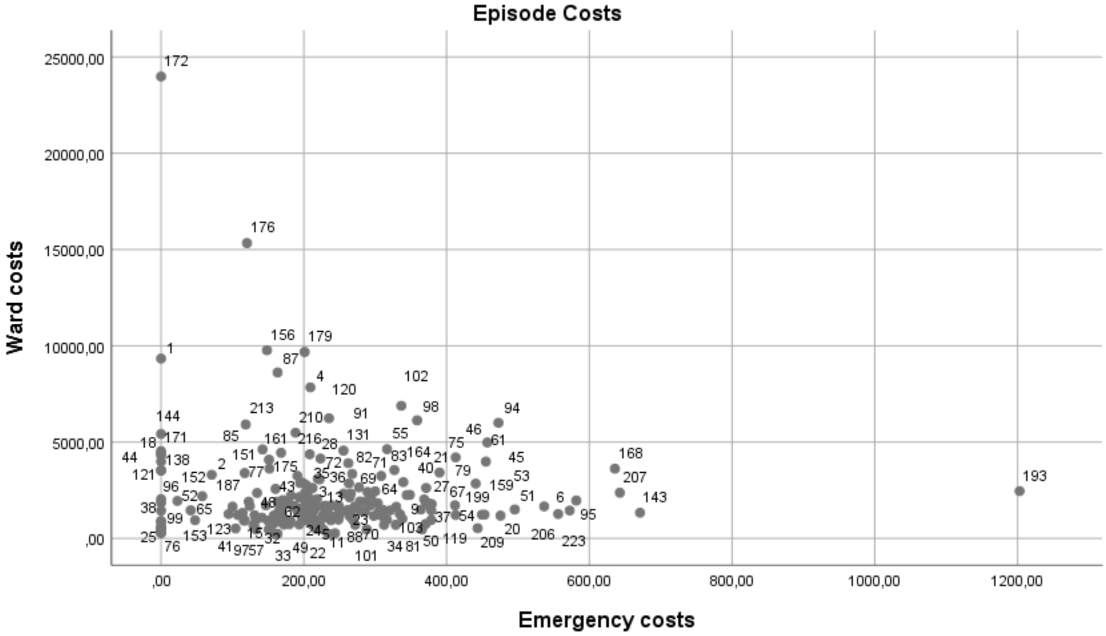


Figure A2.1 Scatter plot for the entire population of DRG 88

Descriptive Statistics for Cluster Variables					
Variables	n	Minimum	Maximum	Mean	Std. Dev.
X_1 Emergency costs	223	0,00	1.202,89	228,84	145,43
X_2 Ward costs	223	225,73	23.982,64	2.207,20	2.382,11

Table A2.1 Descriptive statistics for cluster variables

Largest Dissimilarity Values for Identifying Potential Outliers						
	Dif. from mean		Squared dif. from mean		Dissimilarity	
Episode	X_1 EC	X_2 WC	X_1 EC	X_2 WC	∑ dif. sq.	√ of total
13033742	(228,84)	21.775,44	52.365,64	474.169.702,15	474.222.067,79	21.776,64
13034132	(108,46)	13.128,23	11.762,99	172.350.410,16	172.362.173,15	13.128,68
13027923	(80,47)	7.565,25	6.475,64	57.232.973,27	57.239.448,91	7.565,68
13034798	(21,71)	7.472,35	767,57	55.836.019,96	55.836.787,53	7.472,40
12042879	(228,84)	7.131,21	52.365,64	50.854.127,44	50.906.493,08	7.134,88
13011234	(65,55)	6.411,57	4.297,24	41.108.203,70	41.112.500,94	6.411,90
12044540	(19,66)	5.634,79	386,61	31.750.810,85	31.751.197,46	5.634,82
13014114	107,69	4.680,43	11.597,24	21.906.382,61	21.917.979,84	4.681,66
13017309	6,38	4.031,09	40,70	16.249.663,29	16.249.703,99	4.031,09
13013322	129,92	3.924,58	16.878,26	15.402.336,97	15.419.215,23	3.926,73

Table A2.2 Largest dissimilarity values for identifying potential outliers

Agglomeration Schedule						
	Cluster combined			*Stage cluster first appears*		
Stage	Cluster 1	Cluster 2	Coefficients	Cluster 1	Cluster 2	Next stage
1	44	138	,000	0	0	182
2	104	212	,000	0	0	7
…	…	…	…	…	…	…
…	…	…	…	…	…	…
213	3	10	75,122	211	208	216
214	6	191	91,264	202	0	219
215	2	21	116,081	206	212	217
…	…	…	…	…	…	…
…	…	…	…	…	…	…
219	3	6	295,064	218	214	220
220	1	3	440,000	217	219	0

Table A2.3 Partial agglomeration schedule for DRG 88 using the Ward's method

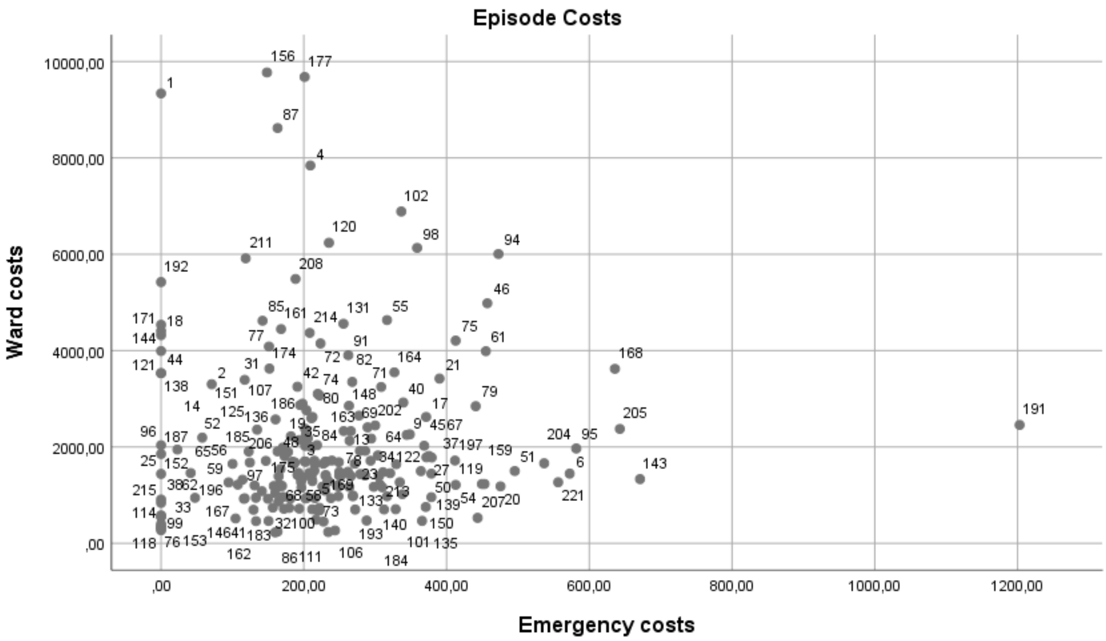


Figure A2.2 Scatter plot for DRG 88, after the initial removal of outliers

Agglomeration schedule (partial)							
Stage	Cluster 1	Combined with cluster	Coeff.	Nr. of clusters after combining	Diff.	Proportionate increase in heterogeneity to next stage	***Stopping rule***
210	46	120	46,434	10	6,551	14,1%	Too many clusters for analysis.
211	3	9	52,985	9	7,080	13,4%	Increase is relatively small, but there are still too many clusters for analysis.
212	21	46	60,065	8	15,057	25,1%	Increase is larger than the previous stage, arguing against combination.
213	3	10	75,122	7	16,697	22,2%	Increase is relatively small, favoring combination to 6 clusters.
214	6	20	91,819	6	24,817	27,0%	Increase is larger than the previous stage, favoring 6 clusters over 5 and thus suggesting a possible stopping point at 6 clusters.
215	2	21	116,636	5	29,683	25,4%	Increase is relatively small, favoring combination to 4 clusters.
216	3	25	146,319	4	34,714	23,7%	Again, increase is relatively small, favoring combination to 3 clusters.
217	1	2	181,033	3	68,969	38,1%	Increase is relatively high. Besides, a 2 cluster solution may have limited value for analysis. This may be an alternative stopping point.
218	3	6	250,002	2	144,801	57,9%	Corresponds to the highest increase. Besides, a 1 cluster solution has no meaning.
219	1	3	394,803	1			The 1 cluster solution is not meaningful.

Table A2.4 Partial agglomeration schedule for DRG 14 using the Ward's method, together with *the stopping rule*

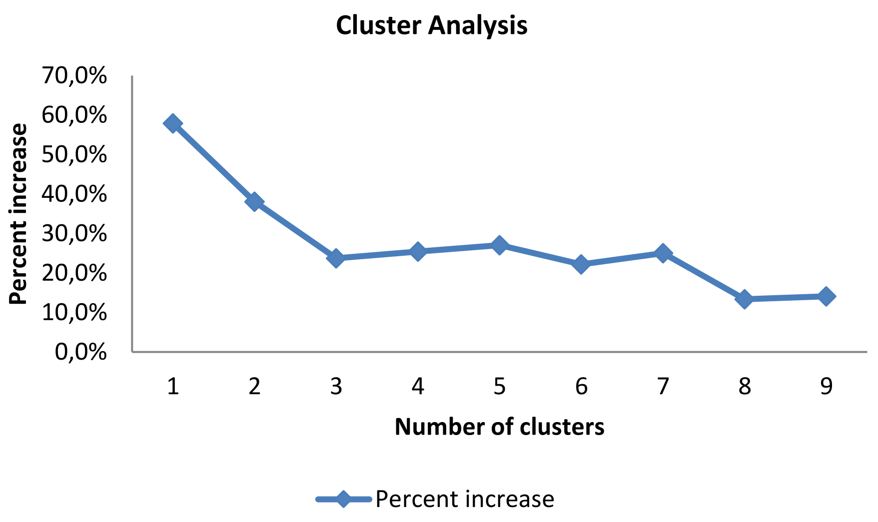


Figure A2.3 Partial agglomeration schedule and *the stopping rule*

Means from Hierarchical Cluster Analysis						
	Mean values per cluster number					
Variable	1	2	3	4	5	6
X_1 Emergency costs	144,39	61,65	208,66	407,09	317,63	9,98
X_2 Ward costs	9.050,23	4.093,10	1.526,73	1.356,10	4.624,39	998,92
Cluster sizes	5	13	129	37	19	17

Means from Hierarchical Cluster Analysis								
	Mean-centered values per cluster number							
Variable	1	2	3	4	5	6	*F*	Sig
X_1 Emergency costs	-81,55	-164,29	-17,28	181,14	91,69	-215,97	101,544	,000
X_2 Ward costs	7.002,82	2.045,69	-520,68	-691,31	2.576,98	-1.048,49	192,715	,000
Cluster sizes	5	13	129	37	19	17		

Table A2.5 Profile of six clusters from hierarchical cluster analysis for DRG 88

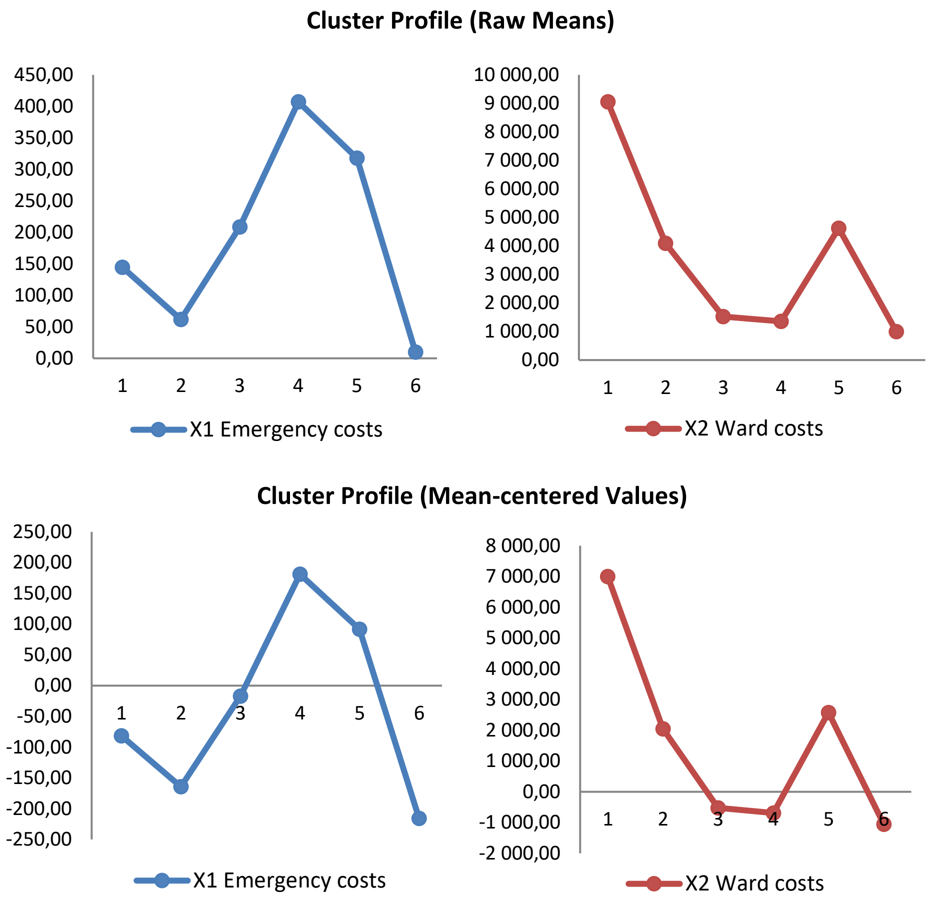


Figure A2.4 Profile of six clusters from hierarchical cluster analysis for DRG 88

Means from Hierarchical Cluster Analysis								
	Mean values per cluster number			Mean-centered values per cluster number				
Variable	1	2	3	1	2	3	*F*	Sig
X_1 Emergency costs	204,28	185,52	407,09	-21,66	-40,42	181,14	72,139	,000
X_2 Ward costs	5.035,81	1.465,28	1.356,10	2.988,40	-582,14	-691,31	205,482	,000
Cluster sizes	37	146	37	37	146	37		

Table A2.6 Profile of three clusters from hierarchical cluster analysis for DRG 88

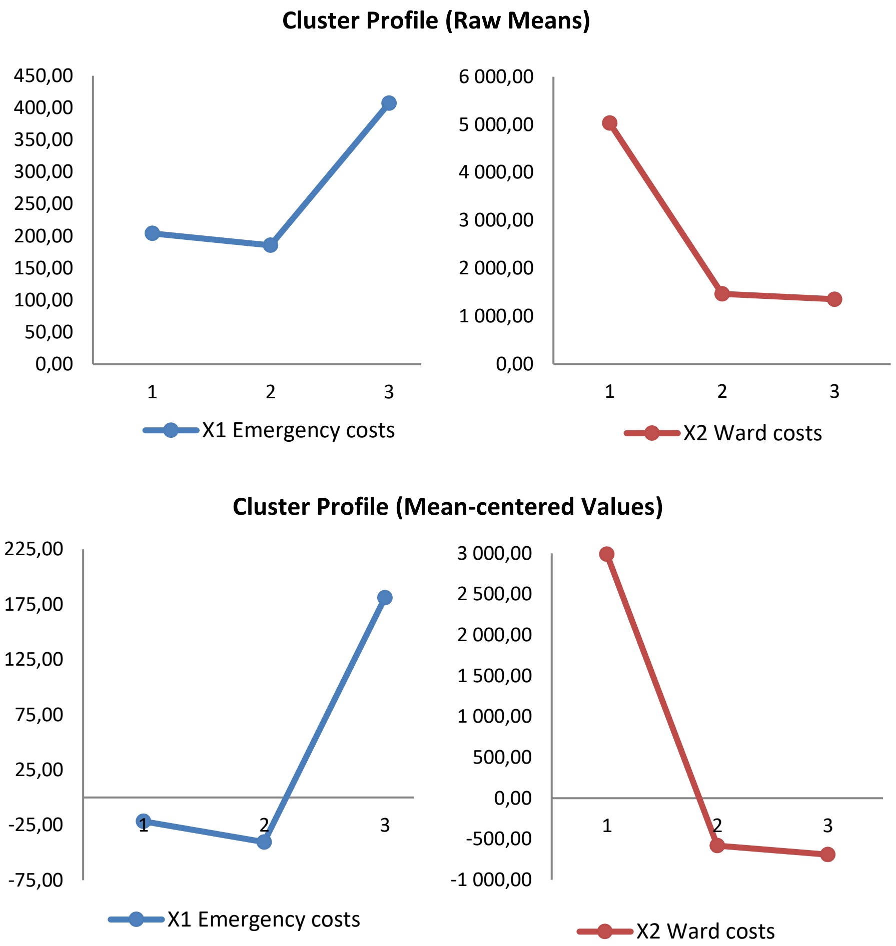


Figure A2.5 Profile of three clusters from hierarchical cluster analysis for DRG 88

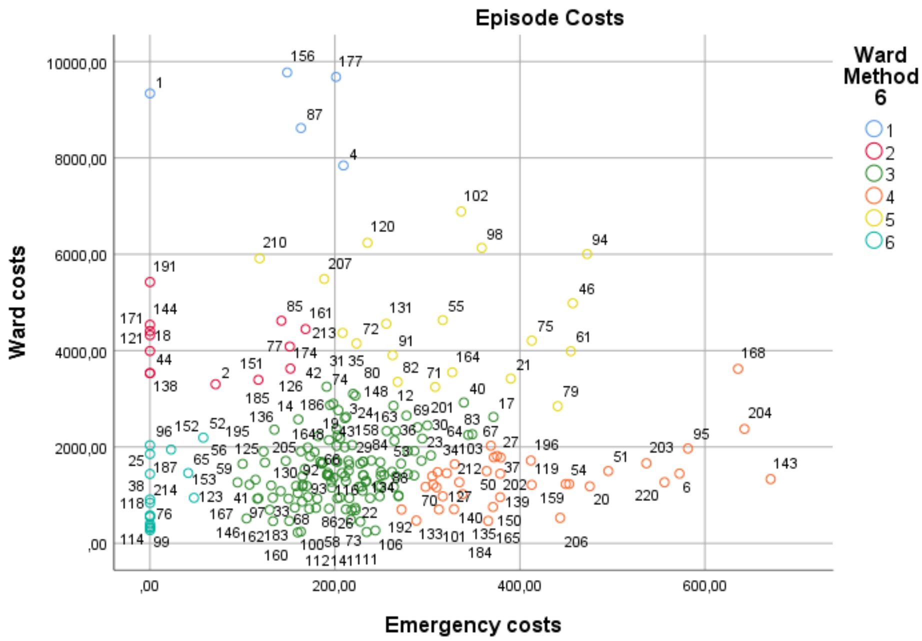


Figure A2.6 Scatter-plot of a six-cluster solution for DRG 88 after a hierarchical procedure (Ward's method)

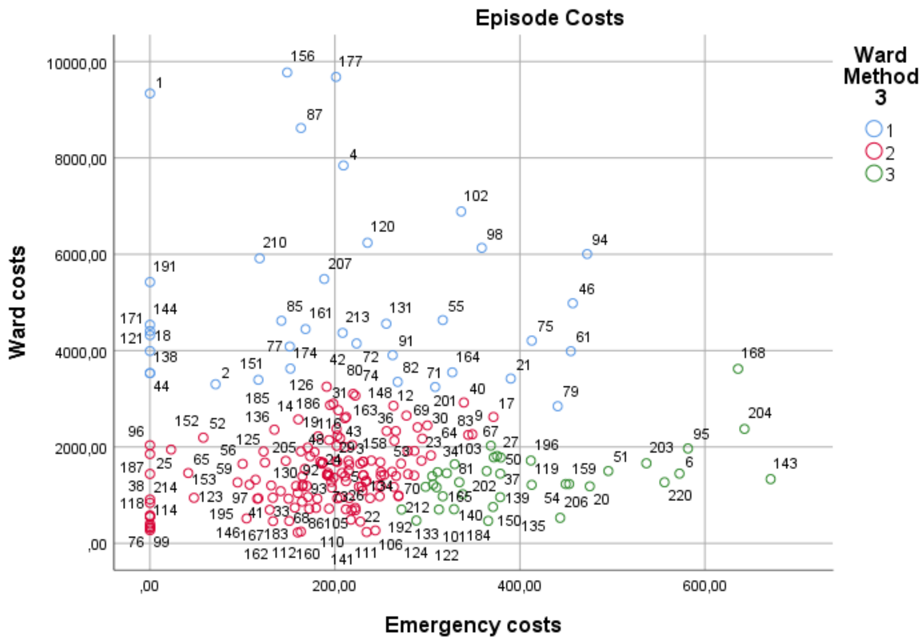


Figure A2.7 Scatter-plot of a three-cluster solution for DRG 88 after a hierarchical procedure (Ward's method)

ANOVA						
		Sum of squares	df	Mean square	*F*	Sig.
Emergency costs	Between groups	20863,443	1	20863,443	1,243	,266
	Within groups	3659959,957	218	16788,807		
	Total	3680823,400	219			
Ward costs	Between groups	397236718,5	1	397236718,5	411,803	,000
	Within groups	210288891,3	218	964627,942		
	Total	607525609,7	219			

Table A2.7 ANOVA output for Ward's method with two segments

ANOVA						
		Sum of squares	df	Mean square	*F*	Sig.
Emergency costs	Between groups	1490699,856	3	496899,952	49,007	,000
	Within groups	2190123,543	216	10139,461		
	Total	3680823,400	219			
Ward costs	Between groups	490756890,1	3	163585630,0	302,602	,000
	Within groups	116768719,6	216	540595,924		
	Total	607525609,7	219			

Table A2.8 ANOVA output for Ward's method with four segments

ANOVA						
		Sum of squares	df	Mean square	*F*	Sig.
Emergency costs	Between groups	2083631,304	4	520907,826	70,120	,000
	Within groups	1597192,096	215	7428,800		
	Total	3680823,400	219			
Ward costs	Between groups	494941411,4	4	123735352,8	236,295	,000
	Within groups	112584198,4	215	523647,434		
	Total	607525609,7	219			

Table A2.9 ANOVA output for Ward's method with five segments

ANOVA						
		Sum of squares	df	Mean square	*F*	Sig.
Emergency costs	Between groups	2918140,233	6	486356,706	135,828	,000
	Within groups	762683,166	213	3580,672		
	Total	3680823,400	219			
Ward costs	Between groups	500104415,3	6	83350735,89	165,272	,000
	Within groups	107421194,4	213	504324,856		
	Total	607525609,7	219			

Table A2.10 ANOVA output for Ward's method with seven segments

ANOVA						
		Sum of squares	df	Mean square	*F*	Sig.
Emergency costs	Between groups	3082811,898	7	440401,700	156,126	,000
	Within groups	598011,502	212	2820,809		
	Total	3680823,400	219			
Ward costs	Between groups	520084901,6	7	74297843,08	180,135	,000
	Within groups	87440708,18	212	412456,171		
	Total	607525609,7	219			

Table A2.11 ANOVA output for Ward's method with eight segments

ANOVA						
		Sum of squares	df	Mean square	*F*	Sig.
Emergency costs	Between groups	3083526,133	8	385440,767	136,160	,000
	Within groups	597297,267	211	2830,793		
	Total	3680823,400	219			
Ward costs	Between groups	539549105,7	8	67443638,21	209,346	,000
	Within groups	67976504,09	211	322163,526		
	Total	607525609,7	219			

Table A2.12 ANOVA output for Ward's method with nine segments

VRC		
Number of clusters	VRC	W_k
2	413,046	
3	277,621	209,413
4	351,609	-119,182
5	306,415	33,038
6	294,259	18,997
7	301,100	28,320
8	336,261	-25,916
9	345,506	

Table A2.13 Values for VRC and w_k

Means from Hierarchical Cluster Analysis				
	Mean values per cluster number			
Variable	1	2	3	4
X_1 Emergency costs	144,39	213,64	185,52	407,09
X_2 Ward costs	9.050,23	4.408,56	1.465,28	1.356,10
Cluster sizes	5	32	146	37

Means from Hierarchical Cluster Analysis						
	Mean-centered values per cluster number					
Variable	1	2	3	4	*F*	Sig
X_1 Emergency costs	-81,55	-12,30	-40,42	181,14	49,007	,000
X_2 Ward costs	7.002,82	2.361,14	-582,14	-691,31	302,602	,000
Cluster sizes	5	32	146	37		

Table A2.14 Profile of four clusters from hierarchical cluster analysis for DRG 88

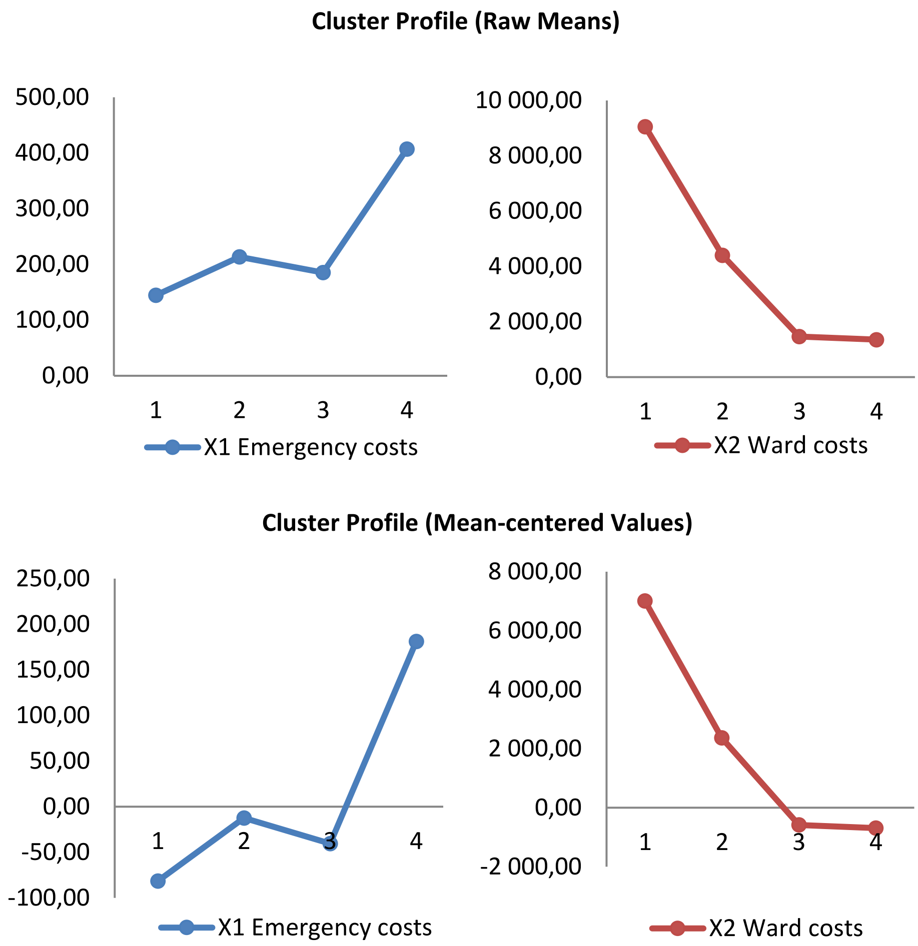


Figure A2.8 Profile of three clusters from hierarchical cluster analysis for DRG 88

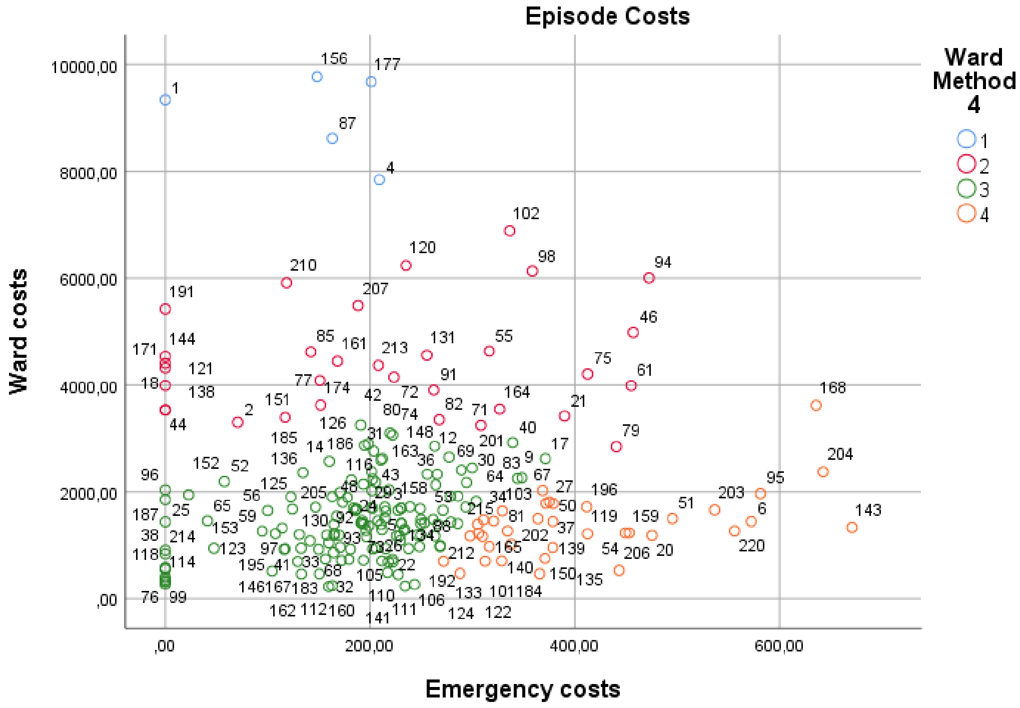


Figure A2.9 Scatter-plot of a four-cluster solution for DRG 88 after a hierarchical procedure (Ward's method)

Means for Standardized Variables		
Ward Method 6 [CLU6_1]	ZEmergency	ZWard
1	-,59	4,21
2	-1,16	1,23
3	-,15	-,31
4	1,22	-,42
5	,60	1,55
6	-1,52	-,63

Table A2.15 Means for standardized variables *ZEmergency* and *ZWard*

Initial Cluster Centers						
	Cluster					
	1	2	3	4	5	6
Score Z: Emergency costs	,59258	-1,16282	-,14960	1,21807	,60153	-1,51902
Score Z: Ward costs	4,21238	1,22975	-,31440	-,41706	1,54942	-,63198

Table A2.16 Initial cluster centers for k-means procedure with 6 clusters for DRG 88

Final Cluster Centers						
	Cluster					
	1	2	3	4	5	6
Score Z: Emergency costs	,59258	-1,07723	-,00979	1,52567	,63891	-1,08640
Score Z: Ward costs	4,21238	1,26899	-,31976	-,23498	1,50880	-,64177

Table A2.17 Final cluster centers for k-means procedure with 6 clusters for DRG 88

ANOVA						
	Cluster		Error			
	Mean square	df	Mean square	df	*F*	Sig.
Score Z: Emergency costs	26,331	5	,202	214	130,406	,000
Score Z: Ward costs	36,468	5	,176	214	207,544	,000

Table A2.18 ANOVA output for k-means procedure with 6 clusters

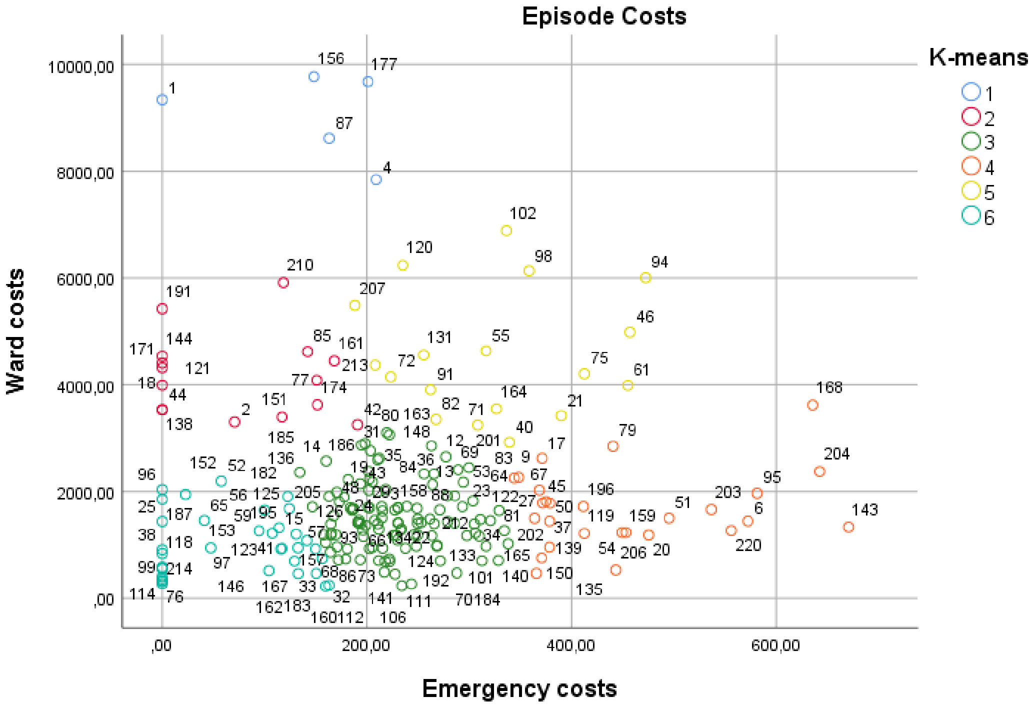


Figure A2.10 Scatter-plot of six clusters for DRG 88 using k-means

Means from Nonhierarchical Cluster Analysis						
	Mean values per cluster number					
Variable	1	2	3	4	5	6
X_1 Emergency costs	144,39	74,07	228,94	451,71	323,06	72,74
X_2 Ward costs	9.050,23	4.158,32	1.517,82	1.658,72	4.556,88	982,64
Cluster sizes	5	15	119	27	18	36

Means from Nonhierarchical Cluster Analysis								
	Mean-centered values per cluster number							
Variable	1	2	3	4	5	6	*F*	Sig
X_1 Emergency costs	-81,55	-151,87	3,00	225,77	97,12	-153,20	130,406	,000
X_2 Ward costs	7.002,82	2.110,91	-529,59	-388,69	2.509,47	-1.064,77	207,544	,000
Cluster sizes	5	15	119	27	18	36	5	15

Table A2.19 Profile of six clusters from k-means clustering for DRG 88

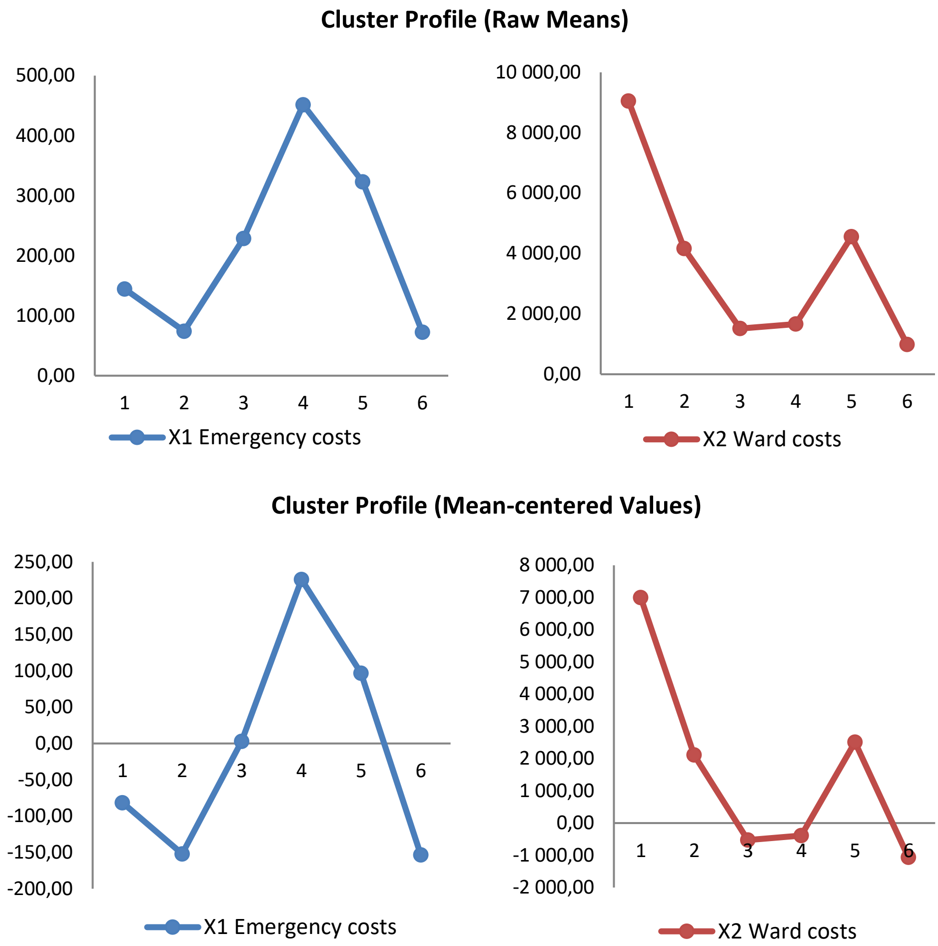


Figure A2.20 Profile of six clusters from k-means clustering for DRG 88

Comparison of Cluster Membership								
	Ward's method				K-means			
Cluster	n	%	X_1 mean	X_2 mean	n	%	X_1 mean	X_2 mean
1	5	2,3%	144,39	9.050,23	5	2,3%	144,39	9.050,23
2	13	5,9%	61,65	4.093,10	15	6,8%	74,07	4.158,32
3	129	58,6%	208,66	1.526,73	119	54,1%	228,94	1.517,82
4	37	16,8%	407,09	1.356,10	27	12,3%	451,71	1.658,72
5	19	8,6%	317,63	4.624,39	18	8,2%	323,06	4.556,88
6	17	7,7%	9,98	998,92	36	16,4%	72,74	982,64
	220	100,0%			220	100,0%		

Table A2.21 Comparison of cluster membership by the Ward's method and K-means for DRG 88

2.2. Output of cluster analysis for DRG 167

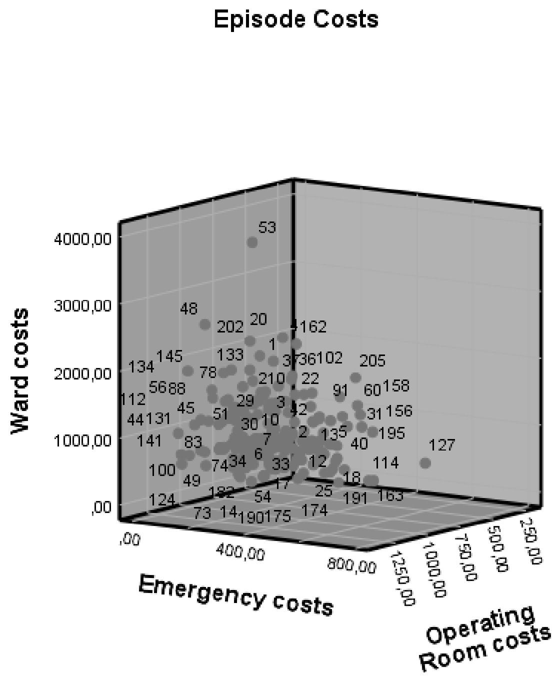


Figure A2.12 Scatter plot for the entire population of DRG 167

Descriptive Statistics for Cluster Variables					
Variables	n	Minimum	Maximum	Mean	Std. Dev.
X_1 Emergency costs	216	11,51	722,73	155,75	123,59
X_2 Ward costs	216	284,59	1.263,18	734,94	190,52
X_3 Operating Room costs	216	287,86	3.621,62	828,77	457,71

Table A2.22 Descriptive statistics for cluster variables

Largest Dissimilarity Values for Identifying Potential Outliers								
	Dif. from mean			Squared dif. from mean			Dissimilarity	
Episode	X_1 EC	X_3 OR	X_2 WC	X_1 EC	X_3 OR	X_2 WC	∑ dif. sq.	√ of total
13013683	(76,29)	(21,62)	2.792,85	5.819,66	467,41	7.800.014,99	7.806.302,06	2.793,98
13012337	(138,58)	209,04	1.647,22	19.203,39	43.697,54	2.713.326,80	2.776.227,73	1.666,20
13000962	(20,87)	(135,82)	1.344,45	435,42	18.446,99	1.807.544,71	1.826.427,11	1.351,45
13040632	(77,16)	(4,85)	1.327,51	5.954,28	23,49	1.762.271,62	1.768.249,39	1.329,76
13033306	(11,92)	(222,90)	1.209,15	142,11	49.684,72	1.462.036,93	1.511.863,77	1.229,58
13028103	(93,19)	436,16	1.086,30	8.683,95	190.238,73	1.180.051,55	1.378.974,23	1.174,30
13041207	363,81	127,03	1.066,43	132.357,87	16.135,67	1.137.279,59	1.285.773,13	1.133,92
13006689	(131,83)	(198,39)	985,10	17.378,12	39.359,49	970.428,02	1.027.165,63	1.013,49
13018610	(88,09)	172,41	931,95	7.760,59	29.724,06	868.522,19	906.006,84	951,84
13014771	439,63	274,98	762,23	193.277,94	75.613,35	581.001,86	849.893,15	921,90

Table A2.23 Largest dissimilarity values for identifying potential outliers

Agglomeration Schedule						
	Cluster combined			*Stage cluster first appears*		
Stage	Cluster 1	Cluster 2	Coefficients	Cluster 1	Cluster 2	Next stage
1	82	95	,000	0	0	3
2	11	18	,001	0	0	130
…	…	…	…	…	…	…
…	…	…	…	…	…	…
186	76	131	53,956	174	160	191
187	112	125	56,541	172	0	203
188	14	34	59,129	181	159	205
189	12	31	61,977	152	151	202
190	33	144	64,913	176	157	197
191	76	143	68,007	186	0	201
192	38	101	71,251	169	137	199
…	…	…	…	…	…	…
…	…	…	…	…	…	…
212	2	38	502,447	210	211	213
213	1	2	639,000	209	212	0

Table A2.24 Partial agglomeration schedule for DRG 167 using the Ward’s method

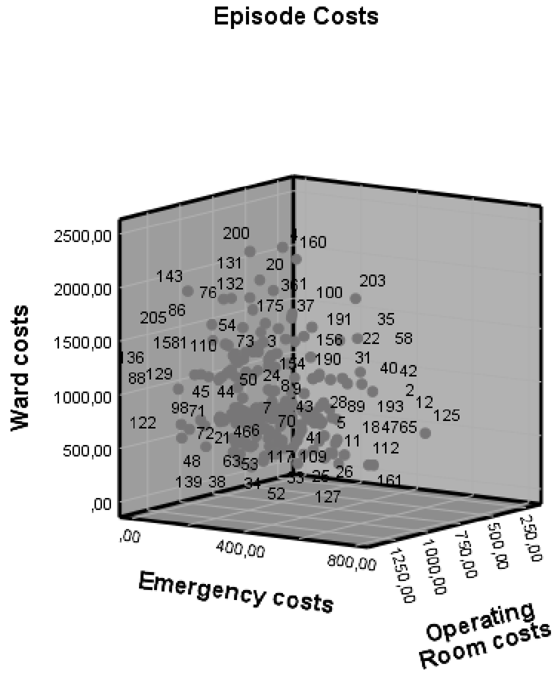


Figure A2.13 Scatter plot for DRG 167, after the initial removal of outliers

Agglomeration schedule (partial)							
Stage	Cluster 1	Combined with cluster	Coeff.	Nr. of clusters after combining	Diff.	Proportionate increase in heterogeneity to next stage	***Stopping rule***
204	38	48	157,929	10	15,178	9,6%	Too many clusters for analysis.
205	6	14	173,107	9	16,872	9,7%	Increase is larger than the previous stage, arguing against combination.
206	1	3	189,979	8	17,526	9,2%	Increase is relatively small, favoring combination to 7 clusters.
207	2	5	207,505	7	25,537	12,3%	Increase is larger than the previous stage, favoring 7 to 6 clusters.
208	40	58	233,042	6	36,379	15,6%	Increase is consecutively higher than the previous stage, thus suggesting a possible stopping point at 7 clusters.
209	1	44	269,421	5	46,619	17,3%	Same comment.
210	2	6	316,040	4	71,968	22,8%	Same comment.
211	38	40	388,008	3	114,439	29,5%	Same comment. In addition, this is the highest increase and a 2 cluster solution may have limited value for the intended analysis.
212	2	38	502,447	2	136,553	27,2%	Represents a decrease but is still above the average. Besides, a 1 cluster solution has no meaning.
213	1	2	639,000	1			The 1 cluster solution is not meaningful.

Table A2.25 Partial agglomeration schedule for DRG 167 using the Ward's method, together with *the stopping rule*

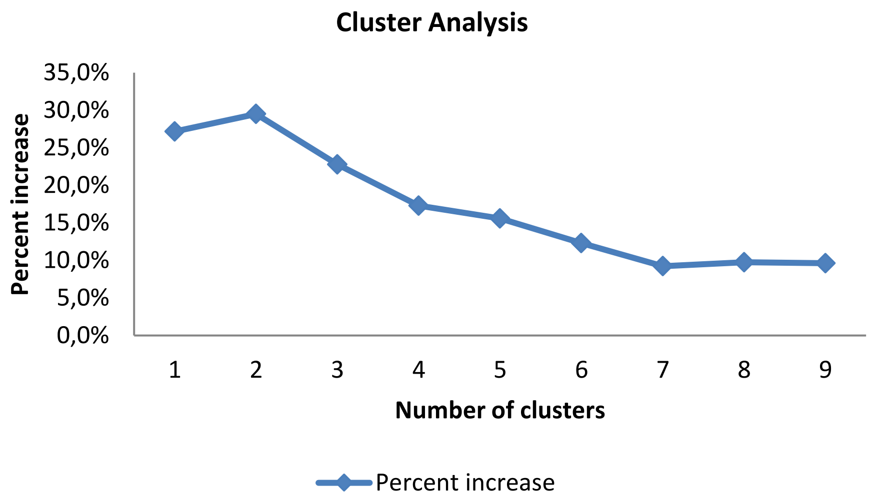
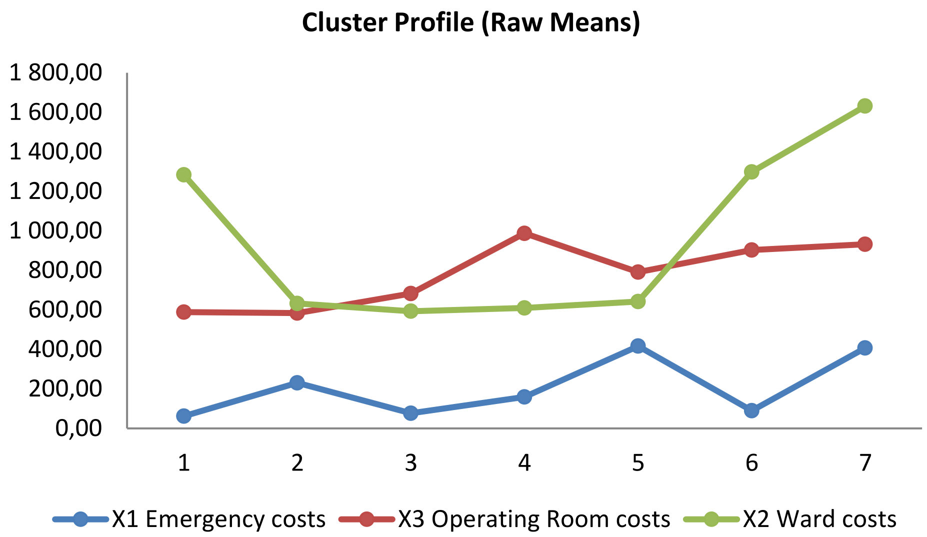


Figure A2.14 Partial agglomeration schedule and *the stopping rule*

Means from Hierarchical Cluster Analysis							
	Mean values per cluster number						
Variable	1	2	3	4	5	6	7
X_1 Emergency costs	61,76	230,10	76,64	159,77	416,20	89,37	407,57
X_3 Operating Room costs	588,21	583,65	682,51	987,55	790,35	902,06	932,37
X_2 Ward costs	1.282,96	632,42	592,81	609,86	642,21	1.298,28	1.631,31
Cluster sizes	31	46	58	34	17	23	5

Means from Hierarchical Cluster Analysis									
	Mean-centered values per cluster number								
Variable	1	2	3	4	5	6	7	*F*	Sig
X_1 Emergency costs	-95,00	73,35	-80,12	3,02	259,45	-67,38	250,82	106,787	,000
X_3 OR costs	-145,85	-150,41	-51,56	253,48	56,29	167,99	198,30	60,398	,000
X_2 Ward costs	474,94	-175,60	-215,21	-198,16	-165,81	490,26	823,29	59,641	,000
Cluster sizes	31	46	58	34	17	23	5		

Table A2.26 Profile of seven clusters from hierarchical cluster analysis for DRG 167



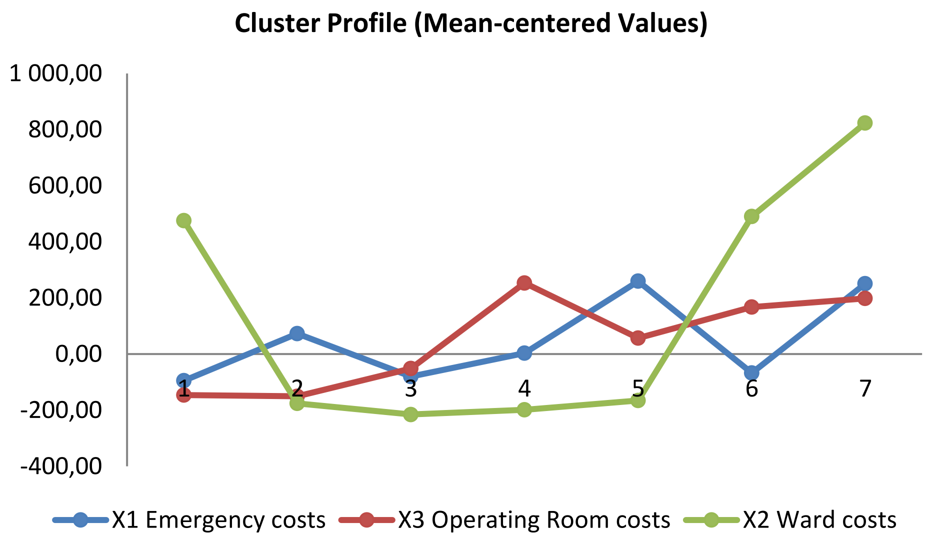


Figure A2.15 Profile of seven clusters from hierarchical cluster analysis for DRG 167

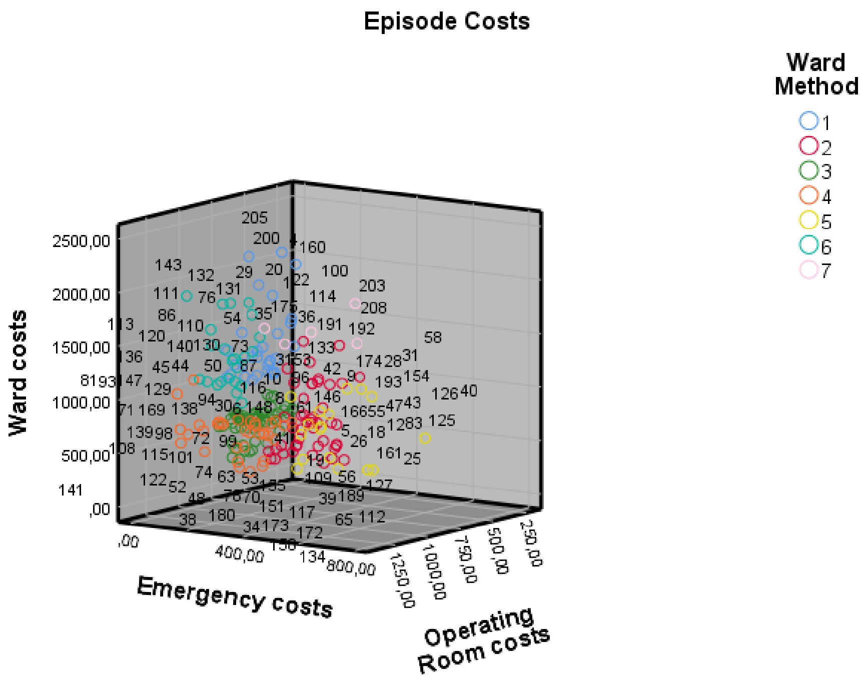


Figure A2.16 Scatter-plot of a seven-cluster solution for DRG 88 after a hierarchical procedure (Ward's method)

ANOVA						
		Sum of squares	df	Mean square	*F*	Sig.
Emergency costs	Between groups	2463109,394	6	410518,232	106,787	,000
	Within groups	795763,239	207	3844,267		
	Total	3258872,633	213			
Operating Room Costs	Between groups	4938520,490	6	823086,748	60,398	,000
	Within groups	2820928,148	207	13627,672		
	Total	7759448,637	213			
Ward costs	Between groups	21817025,10	6	3636170,850	59,641	,000
	Within groups	12620273,43	207	60967,504		
	Total	34437298,53	213			

Table A2.27 ANOVA output for Ward's method with seven segments

ANOVA						
		Sum of squares	df	Mean square	*F*	Sig.
Emergency costs	Between groups	500370,480	1	500370,480	38,455	,000
	Within groups	2758502,153	212	13011,803		
	Total	3258872,633	213			
Operating Room Costs	Between groups	10710,252	1	10710,252	,293	,589
	Within groups	7748738,385	212	36550,653		
	Total	7759448,637	213			
Ward costs	Between groups	16742550,15	1	16742550,15	200,592	,000
	Within groups	17694748,38	212	83465,794		
	Total	34437298,53	213			

Table A2.28 ANOVA output for Ward's method with two segments

ANOVA						
		Sum of squares	df	Mean square	*F*	Sig.
Emergency costs	Between groups	983624,245	2	491812,123	45,609	,000
	Within groups	2275248,388	211	10783,168		
	Total	3258872,633	213			
Operating Room Costs	Between groups	2946058,732	2	1473029,366	64,572	,000
	Within groups	4813389,905	211	22812,274		
	Total	7759448,637	213			
Ward costs	Between groups	17110554,61	2	8555277,303	104,184	,000
	Within groups	17326743,92	211	82117,270		
	Total	34437298,53	213			

Table A2.29 ANOVA output for Ward's method with three segments

ANOVA						
		Sum of squares	df	Mean square	*F*	Sig.
Emergency costs	Between groups	1848574,864	3	616191,621	91,754	,000
	Within groups	1410297,769	210	6715,704		
	Total	3258872,633	213			
Operating Room Costs	Between groups	3309335,673	3	1103111,891	52,056	,000
	Within groups	4450112,964	210	21191,014		
	Total	7759448,637	213			
Ward costs	Between groups	17993764,75	3	5997921,584	76,599	,000
	Within groups	16443533,78	210	78302,542		
	Total	34437298,53	213			

Table A2.30 ANOVA output for Ward's method with four segments

ANOVA						
		Sum of squares	df	Mean square	*F*	Sig.
Emergency costs	Between groups	2452753,318	4	613188,330	158,979	,000
	Within groups	806119,315	209	3857,030		
	Total	3258872,633	213			
Operating Room Costs	Between groups	3560032,733	4	890008,183	44,295	,000
	Within groups	4199415,905	209	20092,899		
	Total	7759448,637	213			
Ward costs	Between groups	18034010,83	4	4508502,707	57,444	,000
	Within groups	16403287,70	209	78484,630		
	Total	34437298,53	213			

Table A2.31 ANOVA output for Ward's method with five segments

ANOVA						
		Sum of squares	df	Mean square	*F*	Sig.
Emergency costs	Between groups	2462821,658	5	492564,332	128,702	,000
	Within groups	796050,975	208	3827,168		
	Total	3258872,633	213			
Operating Room Costs	Between groups	4860598,247	5	972119,649	69,752	,000
	Within groups	2898850,390	208	13936,781		
	Total	7759448,637	213			
Ward costs	Between groups	18037110,21	5	3607422,042	45,752	,000
	Within groups	16400188,32	208	78847,059		
	Total	34437298,53	213			

Table A2.32 ANOVA output for Ward's method with six segments

ANOVA						
		Sum of squares	df	Mean square	*F*	Sig.
Emergency costs	Between groups	2465003,682	7	352143,383	91,377	,000
	Within groups	793868,951	206	3853,733		
	Total	3258872,633	213			
Operating Room Costs	Between groups	4941670,029	7	705952,861	51,610	,000
	Within groups	2817778,608	206	13678,537		
	Total	7759448,637	213			
Ward costs	Between groups	24616544,24	7	3516649,177	73,765	,000
	Within groups	9820754,289	206	47673,565		
	Total	34437298,53	213			

Table A2.33 ANOVA output for Ward's method with eight segments

ANOVA						
		Sum of squares	df	Mean square	F	Sig.
Emergency costs	Between groups	2471213,028	8	308901,628	80,396	,000
	Within groups	787659,605	205	3842,242		
	Total	3258872,633	213			
Operating Room Costs	Between groups	5018552,957	8	627319,120	46,919	,000
	Within groups	2740895,680	205	13370,223		
	Total	7759448,637	213			
Ward costs	Between groups	26937581,31	8	3367197,664	92,040	,000
	Within groups	7499717,221	205	36583,986		
	Total	34437298,53	213			

Table A2.34 ANOVA output for Ward's method with nine segments

VRC		
Number of clusters	VRC	W_k
2	239,340	
3	214,365	31,019
4	220,409	34,265
5	260,718	-56,821
6	244,206	-0,868
7	226,826	7,306
8	216,752	12,677
9	219,355	

Table A2.35 Values for VRC and w_k

Means from Hierarchical Cluster Analysis					
	Mean values per cluster number				
Variable	1	2	3	4	5
X_1 Emergency costs	73,52	230,10	76,64	159,77	414,24
X_3 Operating Room costs	721,89	583,65	682,51	987,55	822,63
X_2 Ward costs	1.289,49	632,42	592,81	609,86	867,00
Cluster sizes	54	46	58	34	22

Means from Hierarchical Cluster Analysis							
	Mean-centered values per cluster number						
Variable	1	2	3	4	5	*F*	Sig
X_1 Emergency costs	-83,23	73,35	-80,12	3,02	257,49	158,979	,000
X_3 OR costs	-12,18	-150,41	-51,56	253,48	88,57	44,295	,000
X_2 Ward costs	481,47	-175,60	-215,21	-198,16	58,98	57,444	,000
Cluster sizes	54	46	58	34	22		

Table A2.36 Profile of five clusters from hierarchical cluster analysis for DRG 167

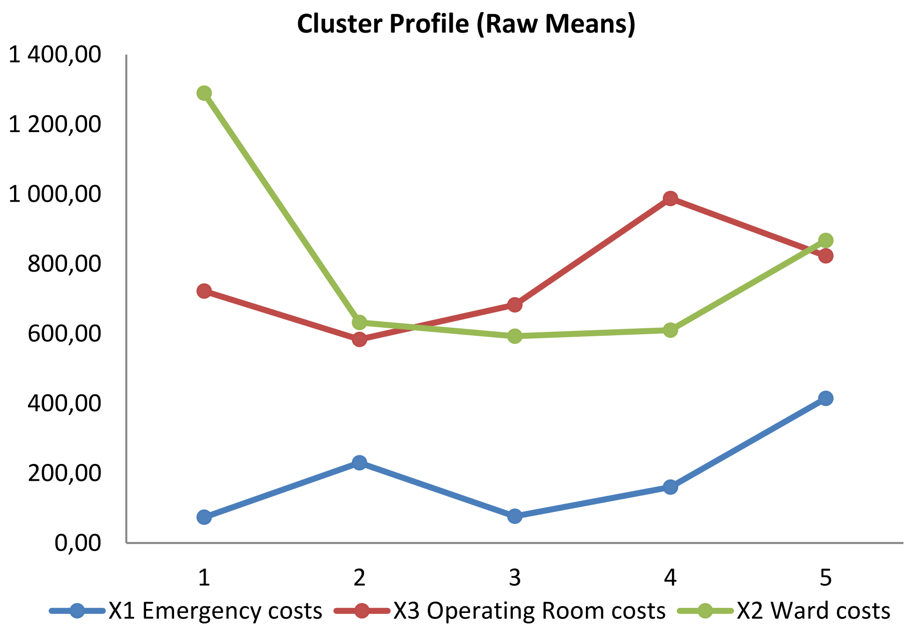


Figure A2.17a Profile of five clusters from hierarchical cluster analysis for DRG 167 (raw means)

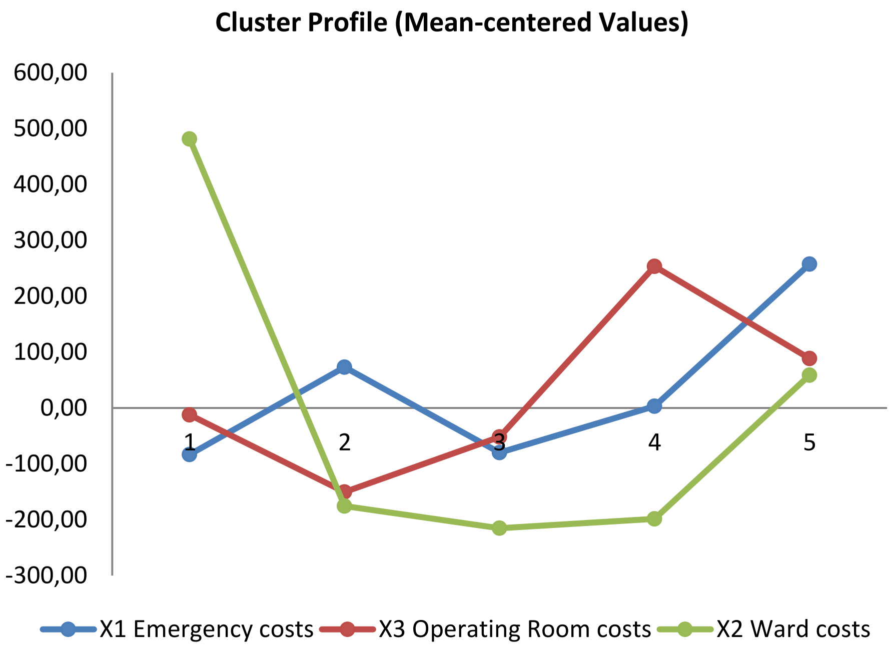


Figure A2.17b Profile of five clusters from hierarchical cluster analysis for DRG 167 (mean-centered values)

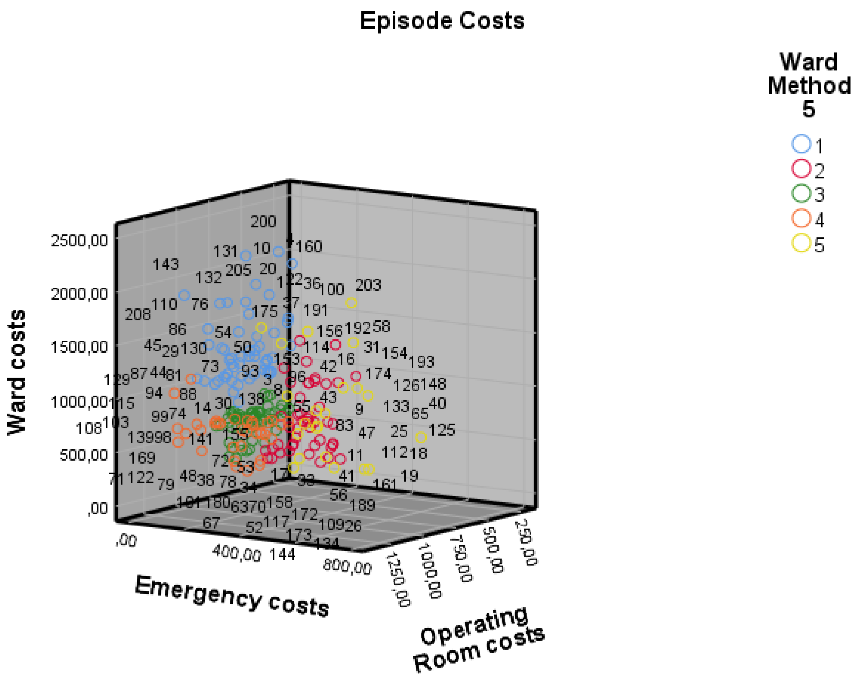


Figure A2.18 Scatter-plot of a five-cluster solution for DRG 167 after a hierarchical procedure (Ward's method)

Means from Nonhierarchical Cluster Analysis						
	Mean values per cluster number					
Variable	1	2	3	4	5	6
X_1 Emergency costs	61,76	230,10	76,64	159,77	414,24	89,37
X_3 Operating Room costs	588,21	583,65	682,51	987,55	822,63	902,06
X_2 Ward costs	1.282,96	632,42	592,81	609,86	867,00	1.298,28
Cluster sizes	31	46	58	34	22	23

Means from Nonhierarchical Cluster Analysis								
	Mean-centered values per cluster number							
Variable	1	2	3	4	5	6	*F*	Sig
X_1 Emergency costs	-95,00	73,35	-80,12	3,02	257,49	-67,38	128,702	,000
X_3 OR costs	-145,85	-150,41	-51,56	253,48	88,57	167,99	69,752	,000
X_2 Ward costs	474,94	-175,60	-215,21	-198,16	58,98	490,26	45,752	,000
Cluster sizes	31	46	58	34	22	23		

Table A2.37 Profile of six clusters from hierarchical cluster analysis for DRG 167

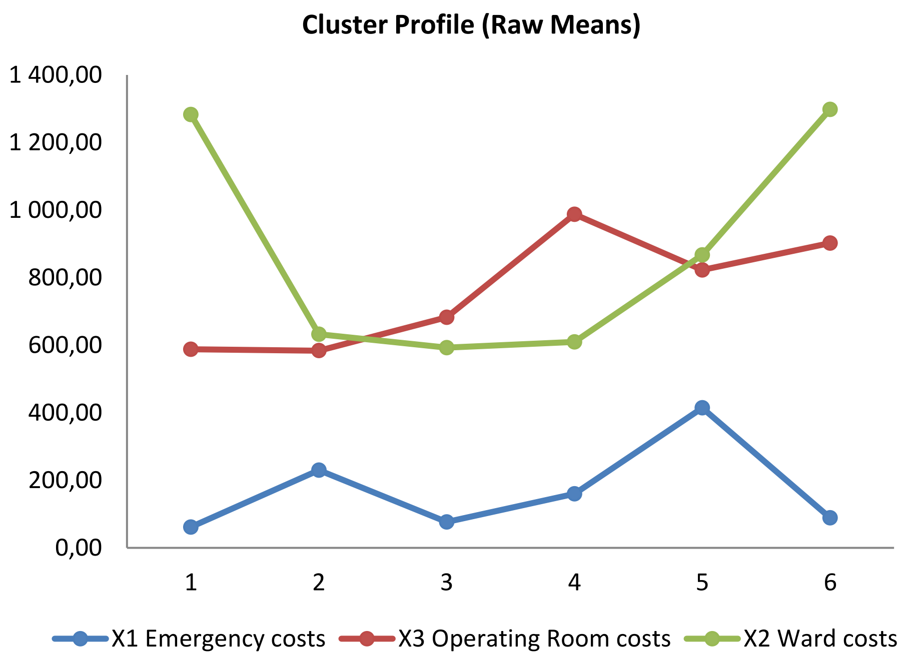


Figure A2.19a Profile of six clusters from hierarchical cluster analysis for DRG 167

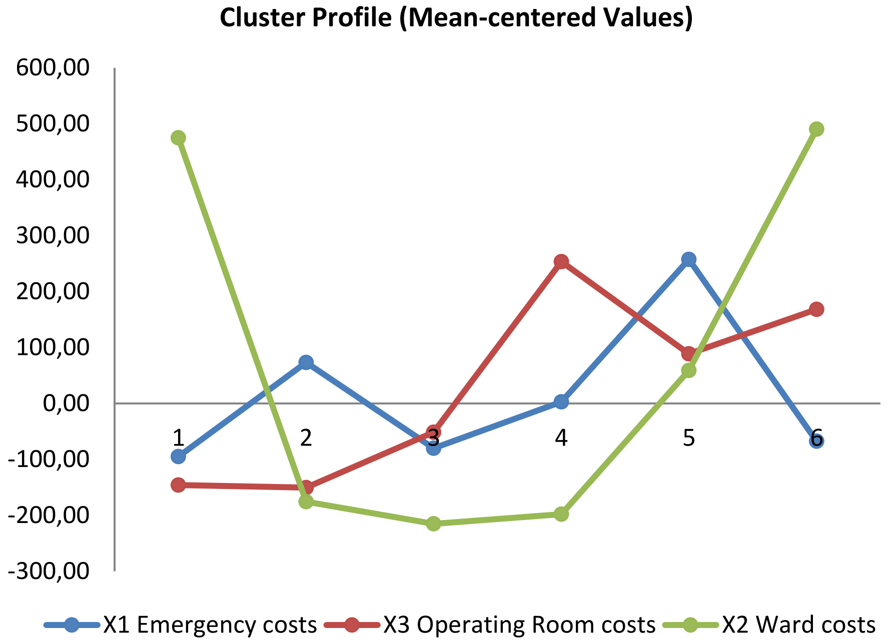


Figure A2.19b Profile of six clusters from hierarchical cluster analysis for DRG 167

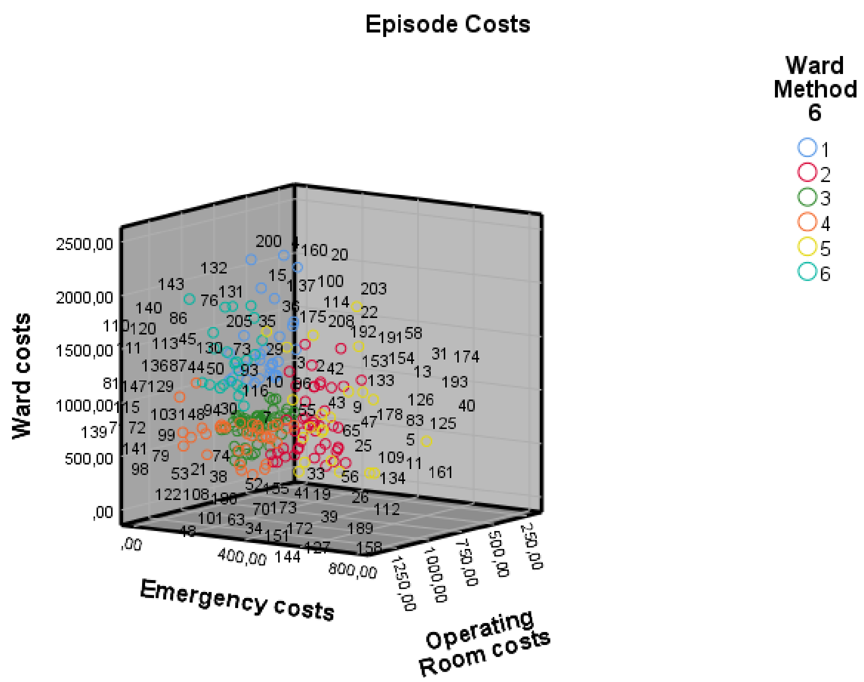


Figure A2.20 Scatter-plot of a six-cluster solution for DRG 88

after a hierarchical procedure (Ward's method)

Means for Standardized Variables			
Ward Method 7 [CLU7_1]	ZEmergency	ZOperatingRoom	ZWard
1	-,77	-,76	1,18
2	,59	-,79	-,44
3	-,65	-,27	-,54
4	,02	1,33	-,49
5	2,10	,29	-,41
6	-,54	,88	1,22
7	2,03	1,04	2,05

Table A2.38 Means for standardized variables
ZEmergency, *ZOperatingRoom* and *ZWard*

Initial Cluster Centers							
	Cluster						
	1	2	3	4	5	6	7
Score Z: Emergency costs	-,76800	,59300	-,64769	,02438	2,09752	-,54475	2,02775
Score Z: Operating Room costs	-,76417	-,78805	-,27012	1,32807	,29492	,88017	1,03898
Score Z: Ward costs	1,18118	-,43671	-,53522	-,49282	-,41238	1,21928	2,04753

Table A2.39 Initial cluster centers for k-means procedure with 7 clusters for DRG 167

Final Cluster Centers							
	Cluster						
	1	2	3	4	5	6	7
Score Z: Emergency costs	-,56434	,61465	-,63799	,05349	2,10509	-,64571	2,02775
Score Z: Operating Room costs	-,91236	-,93144	-,27822	1,15651	,29531	,87345	1,03898
Score Z: Ward costs	1,34960	-,45294	-,53797	-,58689	-,48194	1,06558	2,04753

Table A2.40 Final cluster centers for k-means procedure with 7 clusters for DRG 167

ANOVA						
	Cluster		Error			
	Mean square	df	Mean square	df	*F*	Sig.
Score Z: Emergency costs	25,797	6	,281	207	91,720	,000
Score Z: Operating Room costs	23,678	6	,343	207	69,103	,000
Score Z: Ward costs	24,704	6	,313	207	78,948	,000

Table A2.41 ANOVA output for k-means procedure with 7 clusters

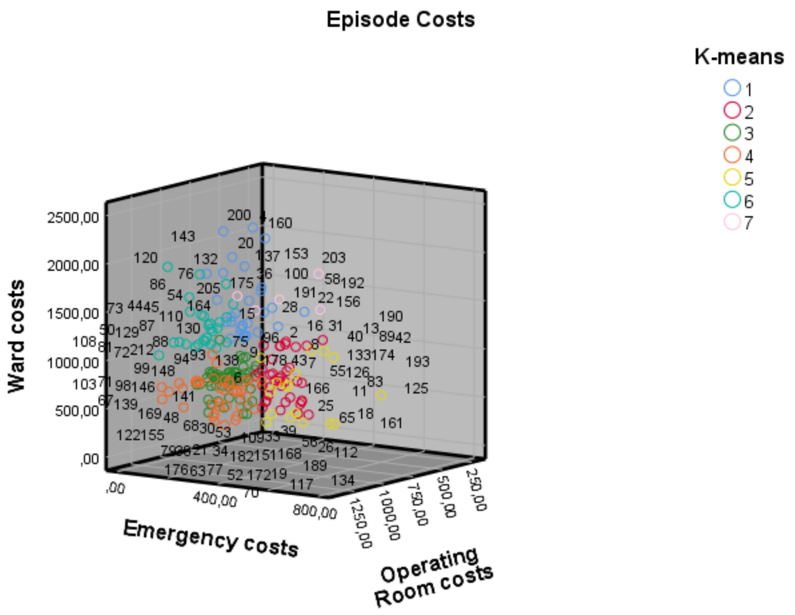


Figure A2.21 Scatter-plot of seven clusters for DRG 167 using k-means

Means from Nonhierarchical Cluster Analysis							
	Mean values per cluster number						
Variable	1	2	3	4	5	6	7
X_1 Emergency costs	86,95	232,78	77,84	163,37	417,14	76,88	407,57
X_3 Operating Room costs	559,93	556,29	680,96	954,80	790,43	900,77	932,37
X_2 Ward costs	1.350,68	625,89	591,71	572,03	614,23	1.236,48	1.631,31
Cluster sizes	30	38	58	39	17	27	5

Means from Nonhierarchical Cluster Analysis									
	Mean-centered values per cluster number								
Variable	1	2	3	4	5	6	7	*F*	Sig
X_1 Emergency costs	-69,81	76,03	-78,92	6,62	260,38	-79,87	250,82	91,720	,000
X_3 OR costs	-174,14	-177,78	-53,10	220,74	56,36	166,71	198,30	69,103	,000
X_2 Ward costs	542,66	-182,13	-216,31	-235,99	-193,78	428,46	823,29	78,948	,000
Cluster sizes	30	38	58	39	17	27	5		

Table A2.42 Profile of seven clusters from k-means clustering for DRG 167

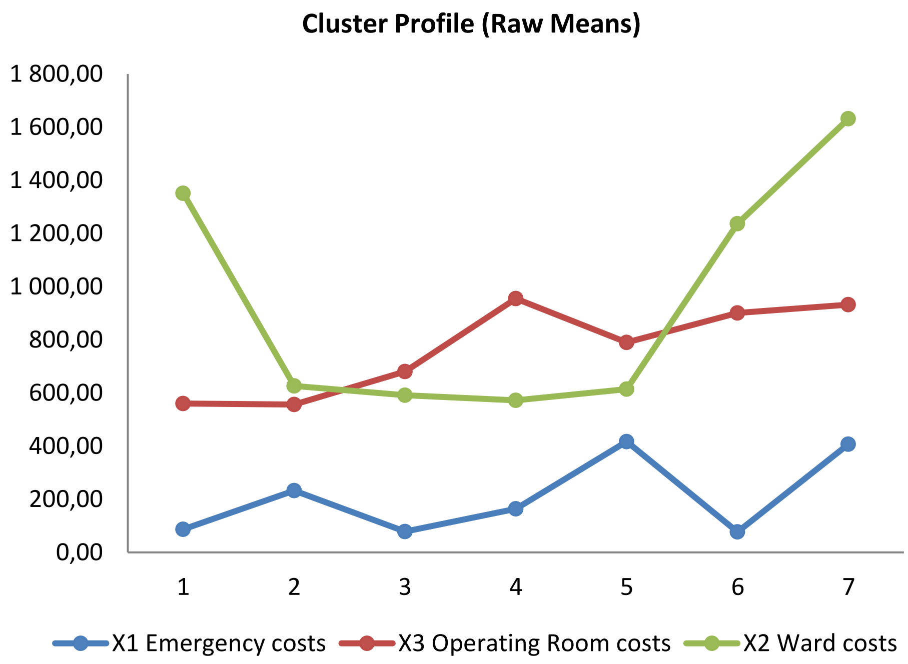


Figure A2.22a Profile of seven clusters from k-means clustering for DRG 167

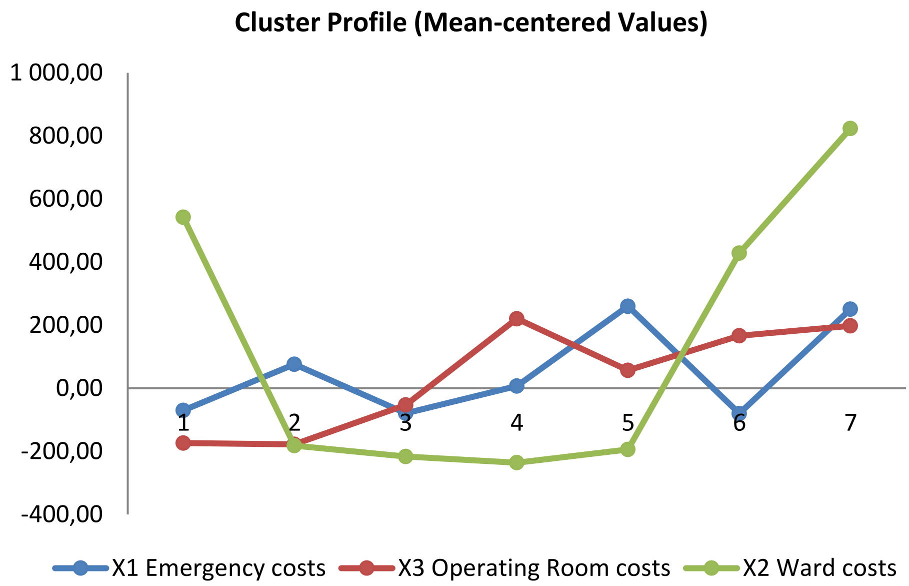


Figure A2.22b Profile of seven clusters from k-means clustering for DRG 167

Comparison of Cluster Membership

	Ward's method					K-means				
Cluster	n	%	X_1 mean	X_2 mean	X_3 mean	n	%	X_1 mean	X_2 mean	X_3 mean
1	31	14,5%	61,76	588,21	1.282,96	30	14,0%	86,95	559,93	1.350,68
2	46	21,5%	230,10	583,65	632,42	38	17,8%	232,78	556,29	625,89
3	58	27,1%	76,64	682,51	592,81	58	27,1%	77,84	680,96	591,71
4	34	15,9%	159,77	987,55	609,86	39	18,2%	163,37	954,80	572,03
5	17	7,9%	416,20	790,35	642,21	17	7,9%	417,14	790,43	614,23
6	23	10,8%	89,37	902,06	1.298,28	27	12,6%	76,88	900,77	1.236,48
7	5	2,3%	407,57	932,37	1.631,31	5	2,3%	407,57	932,37	1.631,31
	214	100,0%				214	100,0%			

Table A2.43 Comparison of cluster membership by the Ward's method and K-means for DRG 167

Stability			
Initial cluster (Ward's method)	Final cluster (k-means)	Number of reassigned episodes	
1	3	1	
	6	6	
2	1	4	
	3	4	
	4	2	
	5	1	
3	2	2	
	4	3	
4	6	2	
5	2	1	
6	1	2	
	4	2	
		30	$\frac{30}{214} = 14\%$

Table A2.44 Evaluating stability

Appendix 3 – Dendrogram for DRG 164

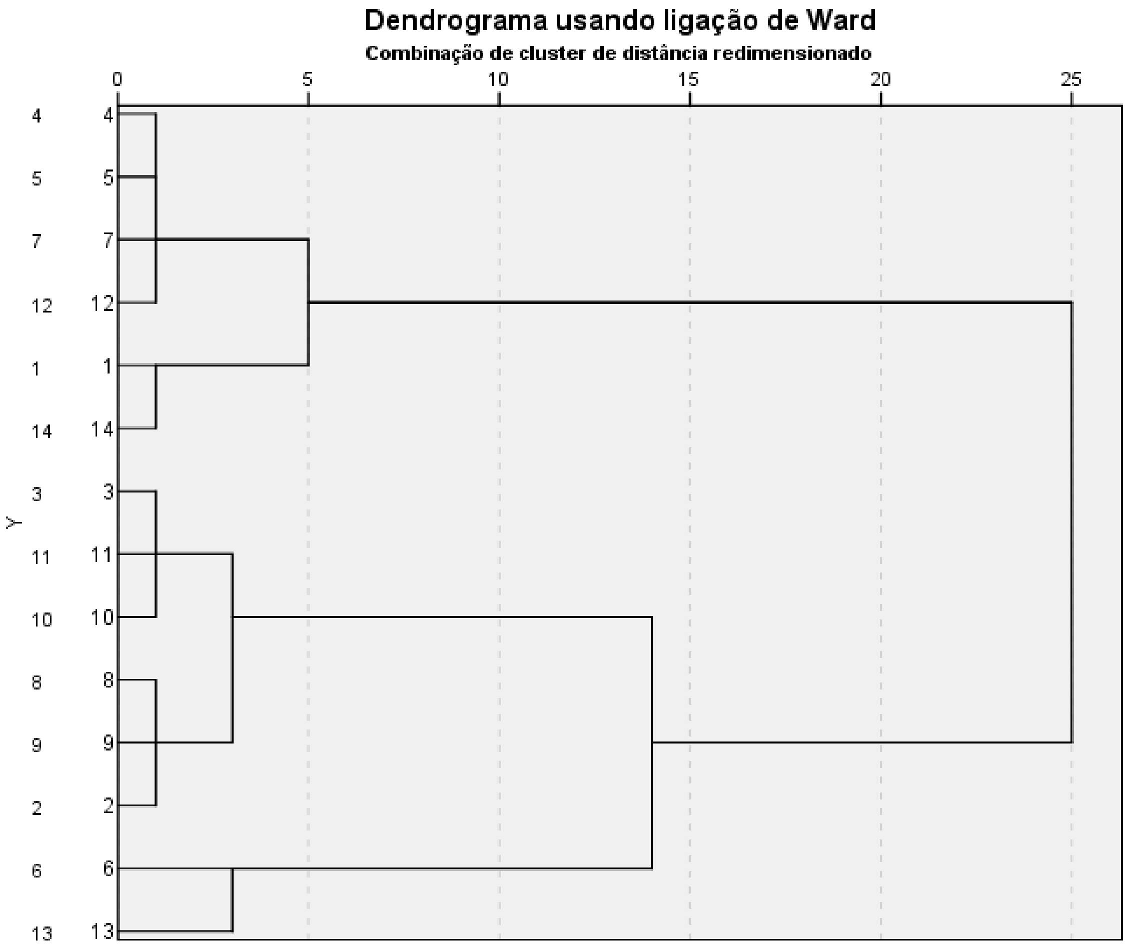


Figure A3.1 Dendrogram for DRG 164

Appendix 4 – List of interviews

Interviewees	Month	Last
Chairman	October 2018	46 min.
Member of the board in charge of the financial area	October 2018	1 hour and 53 min.
Director of the Management Control Department	November 2018	1 hour and 24 min.
Academic A	November 2018	1 hour and 22 min.
Former Assistant Secretary of State for Health	December 2018	49 min.
Academic B	December 2018	2 hours and 28 min.
President of The Association of Private Hospitalization	January 2019	2 hours and 3 min.
President of The Central Authority for Health Systems	February 2019	1 hour and 24 min.

Table A4.1 List of interviews

Appendix 5 – Script for semi-structured interviews

<u>Member of the board in charge of the financial area</u>

Part I: About the context

1. As a former member of the Regional MoH Agency, thus in charge of health policies, and also considering your long lasting relation with healthcare, do you believe that management accounting (MA) is a matter of interest for a large number of hospitals?

   If **not**, what reasons may explain such a distance?

2. Has MA been the subject of conferences, workshops and seminars? What entities are chairing those events?

   Topics:

   - ACSS;
   - ARS;
   - APAH;
   - A single hospital.

3. Is there evidence of a growing interest in relation to MA from central authorities (ACSS, in this case)?

   Topics:

   - Increased pressure on the fulfillment of closing dates;
   - Additional information request.

4. In the current configuration, does the mandatory cost accounting model for public hospitals provide relevant information for decision making?

5. The MoH launched in 2007 a project on the implementation of a more sophisticated MA model, ABC-based, involving 10 public hospitals.

   Are the results of that project publicly available?

   If **not**, what may explain why results are not released?

   Has the project been presented to all public hospitals?

6. The corporatization of public hospitals in Portugal represented a period of change and empowerment of the hospital boards. How would you evaluate the present autonomy of the boards of directors in decision making?

   In your opinion and generally speaking, the changes that took place at a very fast pace from 2002 onwards stemmed from central imposition, from the hospitals' willingness to change, or from the combination of both reasons?

   Did change in the management model have impact on MA?

   If **not**, which may be the reasons?

7. The enterprise model brought managers with prior links to the private sector into healthcare. Did these new actors triggered changes in MA?

   Topics:

   - Focus from the MoH/MoF on financial data;
   - Benchmarking based on both financial and activity data;
   - Prior links to the financial area;
   - New managers were not familiarized with MA practices in the private sector.

8. The current funding model reintroduced an emblematic policy, which has been attempted and abandoned by previous governments: the creation of responsibility centers.

   Do you expect changes in the hospitals' organization? Can such changes enhance MA in these settings?

9. Estimates delivered by the mandatory cost accounting model, combined with the Maryland Matrix, form the basis for funding inpatient care. Do you consider that such a method ensures a fair hospital funding?

   Is this theme discussed at CHSJ? What about among different boards of directors?

10. In your opinion, which factors may contribute for a higher level of sophistication in MA systems in hospital settings?

Part II: About CHSJ

11. Some years ago, the HSJ implemented a more sophisticated cost accounting system than the one required from public hospitals. The project was concluded, the HSJ obtained cost estimates for individual patients as it was the objective and considered that the results were relevant for management purposes, but decided not to maintain the project for the following years. In your opinion, what reasons may have given rise to this decision?

    Topics:

    - Information systems;
    - Technical skills of MCD staff;
    - Lack of human resources to assign to the system's maintenance;
    - Costs incurred with an external consultant;
    - Time required from physicians, nurses and technicians to update the activity list and cost drivers.

12. The possibility of testing alternative solutions has been ever since considered?

    If **so**, suggested by the board of directors, UAGs or department directors?

    If **not**, what reasons may lower the relevance of management accounting at HSJ?

13. The CHSJ is acknowledged by its avant-garde use of data mining techniques and it holds a very comprehensive and consolidated Business Intelligence (BI) system. During the exploratory interview you mentioned that electronic records are made by security reasons and also to support healthcare provision, stressing as well that BI delivers cost information as a side result. Do you consider that such knowledge might serve as a basis for intermediate costing solutions, at least partially able to overcome the reasons which led CHSJ to quit the previous project?

14. Do you consider that MA makes part of concerns, analysis and daily decisions by those in charge of intermediate structures (UAGs, department directors, head nurses, etc.)?

    Topics:

    - Budgets and internal negotiation;

- Variance analysis;
- Discussions within UAGs and departments;
- Investment proposals;
- Enrollment in post-graduate studies or proposals for internal training.

15. Do people in charge of UAGs and clinical departments link management autonomy to a kind of “internal financial report”? Do they show interest in knowing or “claim” the report of their “accounts”?

    Topics:

    - UAG’s or clinical department’s “income statement”.

<u>Chairman</u>

Part I: About the context

1. Considering your long lasting relation with healthcare and as a former chairman and clinical director, do you believe that MA is a matter of interest for a large number of hospitals?

   If **not**, what reasons may explain such a distance?

2. In the current configuration, does the mandatory cost accounting model for public hospitals provide relevant information for decision making?

3. Do you consider that the MoH is closely following innovative MA and BI projects developed by hospitals?

   If **so**, is it available for co-financing such projects and extending them to other hospitals?

4. The creation of corporate hospitals represented a moment of change. How do you evaluate the corporate model’s evolution from its beginning to the present?

   Did the corporate model contribute to bring MA closer to private sector systems?

   If **not**, why?

5. Cost estimates delivered by the mandatory cost accounting model, in articulation with the Maryland Matrix, are used as the basis for funding inpatient care. Do you consider that such a method ensures a fair hospital funding?

6. The MoH launched a pilot-project in order to introduce activity costing in 10 public hospitals. Among other objectives, the project aimed at improving "significantly the knowledge about what prices to establish".

   Have the results of that project been released?

   Have those results been discussed with hospital boards of directors?

   How do you interpret the length of the project?

7. In your opinion, possible improvements in MA will arise from hospitals' action or from central imposition?

   What factors may contribute for such improvements?

Part II: About CHSJ

8. Some years ago, the HSJ implemented a more sophisticated cost accounting system than the one required from public hospitals. In order to help in the implementation a consultancy firm was hired. How did the Hospital involve its staff in the project?

   Did the board of directors make an effort to communicate the aims of the project?

   How would you characterize the interest from physicians, nurses and technicians about the project?

   Did the project interfere with departments' daily routines?

9. Did the MoH show interest in following the development of the new costing system? And what about the other hospitals?

10. Do you consider that the new system contributed to the visibility and the *avant-garde* image associated to the HSJ?

11. The project was concluded, the HSJ obtained cost estimates for individual patients as it was the objective and considered that the results were relevant for management

purposes, but decided not to maintain the project for the following years. In your opinion, what reasons may have given rise to this decision?

Topics:

- Information systems;
- Technical skills of MCD staff;
- Lack of human resources to assign to the system's maintenance;
- Costs incurred with an external consultant;
- Time required from physicians, nurses and technicians to update the activity list and cost drivers.

12. The CHSJ is acknowledged by its avant-garde use of data mining techniques and it holds a very comprehensive and consolidated Business Intelligence (BI) system. Electronic records are made by security reasons and to support healthcare provision, but they provide as well data on costs. Do you consider that such knowledge might serve as a basis for intermediate costing solutions, at least partially able to overcome the reasons which led CHSJ to quit the previous project?

13. Do you consider that MA makes part of concerns, analysis and daily decisions by those in charge of intermediate structures (UAGs, department directors, head nurses, etc.)?

    Topics:

    - Budgets and internal negotiation;
    - Variance analysis;
    - Discussions within UAGs and departments;
    - Investment proposals;
    - Enrollment in post-graduate studies or proposals for internal training.

14. Do you consider that the calculative nature of cost estimation may lower the interest from physicians, nurses and technicians in relation to MA?

    Have the professionals been showing interest in knowing or discussing the methods used in the estimation of activity costs?

    If **so**, which are those professional groups?

If **so**, by newly-specialist physicians, senior physicians or physicians in management positions (department directors, clinical director's assistants, clinical director)?

15. Which factors might contribute to capture the attention of health professionals and middle managers for MA?

    Topics:

    - Management course units in the first degrees in medicine, nursing and health technologies;
    - Internal training in management and accounting;
    - Sponsorship of post-graduate studies in management;
    - Encouragement of MA by the Portuguese Medical Association;
    - Benchmarking UAGs' "accounts";
    - Benchmarking peer hospitals' accounts;
    - Creation of incentive systems, linking incentives to UAGs' outcomes.

<u>MCD Director</u>

Part I: About the context

1. Is the MA reporting period similar to that of financial accounting?

   Do central authorities often request further explanations or additional information on MA?

2. Do central authorities organize training, workshops or seminars on MA subjects?
3. How often do MCD directors from different hospitals discuss and ask for help on MA subjects?
4. How would you describe the way managers and MCD directors benchmark different hospitals' costs (for instance, inside peer groups)?
5. Do you think that the MoH/MoF pay attention to such benchmarking practices?

   Is the hospital questioned about it when its costs are above the peer group's average?

Do central authorities disclose some sort of ranking or organize public sessions in order to benchmark hospital costs?

6. Regarding MA, how would you classify the presence and intervention from entities representative of hospital professionals and regulators, such as the APAH, the Portuguese Medical Association, the Portuguese Accounting Standards Board and the Certified Accountants Association?
7. In relation to Academia, what is your opinion about education in management accounting within post-graduate studies in health management?
8. Is there continuity about the standards for preparing and reporting management accounting or have the practices been submitted to substantial change?

   How do you assess the impact of corporate hospitals on this issue?
9. Do you think that management accounting practices in the private sector capture the attention from those in charge of management control departments in public hospitals?
10. Globally, do you consider that management accounting is understood mainly as a tool to support hospital management or as a funding mechanism?

Part II: About CHSJ

11. The CHSJ is acknowledge for the introduction of new management models – such as the UAGs –, and for the development of a sophisticated business intelligence (BI) tool.

    In your opinion, which were the factors that contributed the most to the development of the BI tool?

    Topics:

    - Clinical information;
    - Taking part in MoH projects, about clinical information;
    - Information to support management (costs and financial results).
12. Did the creation of middle management structures trigger changes in internal report on costs?

If **so**, how did it happen?

If **not**, what reasons might have prevented changes?

13. Some years ago, the HSJ implemented a more sophisticated cost accounting system than the one required from public hospitals. In order to help in the implementation a consultancy firm was hired. How did the Hospital involve its staff in the project?

    How would you characterize the interest from distinct professional groups about the project?

    Did the project interfere with departments' daily routines?

14. The project was concluded, the HSJ obtained cost estimates for individual patients as it was the objective and considered that the results were relevant for management purposes, but decided not to maintain the project for the following years. In your opinion, what reasons may have given rise to this decision?

    Topics:

    - Information systems;
    - Technical skills of MCD staff;
    - Lack of human resources to assign to the system's maintenance;
    - Costs incurred with an external consultant;
    - Time required from physicians, nurses and technicians to update the activity list and cost drivers.

15. Regarding all the experience and knowledge accumulated from the ABC project, has the chance to test more sophisticated costing solutions ever been proposed, from inside the CHSJ or at suggestion of the MoH?

    If **so**, was it at the suggestion of the board of directors or of those in charge of MCD, IT Department, UAGs or clinical departments?

    If **not**, what reasons may discourage the development of improved management accounting systems in hospital settings?

Former Assistant Secretary of State for Health

1. Considering your long lasting relation with healthcare and as a former member of both the Government and the board of directors of the MoH's regional branch, do you believe that management accounting (MA) is a matter of interest for a large number of hospitals?

   If **not**, what reasons may explain such a distance?

2. Have central authorities dependent on the MoH organized conferences, workshops and seminars on MA?

3. Does the MoH closely follow innovative projects on MA and Business Intelligence (BI) launched by hospitals?

   If **so**, how does it encourage its implementation and what means are used to make those projects familiar to other hospitals?

4. In the current configuration, does the mandatory cost accounting model for public hospitals provide relevant information for decision making?

5. Cost estimates delivered by the mandatory cost accounting model, in articulation with the Maryland Matrix, are used as the basis for funding inpatient care. Do you consider that such a method ensures a fair hospital funding?

6. The MoH launched in 2007 a project on the implementation of a more sophisticated MA model, ABC-based, involving 10 public hospitals.

   Which might have been the objectives of the project?

   Has the project been concluded in the meantime?

   If **not**, what may explain its extension in time?

7. The MoH has ever since considered the possibility of testing alternative solutions?

8. In any case, have been established strategic partnerships involving the MOH, universities and technological partners, public or private, aiming at developing more sophisticated cost accounting systems?

   If **so**, which partner took the lead?

If **not**, what may be preventing the partnerships?

9. Has the distribution of European funds been used to stimulate the hospitals' action in order to develop enhanced information systems and BI similar to the one in place at CHSJ?

10. The corporatization of public hospitals in Portugal represented a period of change. How do you evaluate the evolution of the enterprise management model from its creation to the present day?

    Do you consider that business-like management contributed to bring MA closer to private sector models?

11. The present funding model reintroduced an iconic policy, already experimented and abandoned by previous governments: the establishment of responsibility centers.

    Do you foresee changes in the hospitals' internal organization? Might these changes strengthen the MA's role?

12. Regarding the MoH's organization, do you consider that the distribution of powers is the most suitable strategy in order to provide more proximity and support to MA, either in its present configuration or in case of more sophisticated systems?

13. The MoH has been working with new management models of hospital treatment, like the reference centers for treating certain pathologies.

    Do you believe that these new management models will lead to changes in the MA?

14. Does the MoH monitor the progress in MAS in the remaining European countries?

    Would you highlight any, in particular?

    In your opinion, will possible progress in MA stem from the hospitals' initiative or from the central imposition?

    Which factors might lead to that progress?

<u>Academics A and B</u>

1. On the whole, how would you classify the cooperation between the universities and the HM or individual hospitals towards the management accounting (MA)?

   If **little intense**, which reasons might explain the reduced cooperation level?

2. In relative terms, is the MA's cooperation different from the one which takes place in other technical or scientific areas?

   If **so**, which are the reasons?

3. Compared to the traditional faculties of economics, did the establishment of business schools introduce any change in that cooperation?

4. Are the unofficial appointments between the members of the board and middle managers and their business schools current?

5. Which actions could the faculties take to catch the MoH's or individual hospitals' attention?

   And in the opposite direction?

6. In 2007 the MoH launched a project to implement a more sophisticated costing system, based on ABC, getting 10 public hospitals involved.

   Did the academy take part in this project?

   Are its results known?

   If **not**, what might explain the project's expansion in time?

   Was the project largely promoted throughout the hospitals in general?

7. Which has been the postgraduate supply/offer concerning the health units' management?

   What about the demand?

   What importance does the MA own in that supply?

8. How would you classify the MA's attractiveness as a gateway in a career for those who conclude a degree or a master?

9. For those who graduate in economics, management or accounting and intend to start their career at hospitals or other MoH’s agencies, which framework approach will they have towards MA in comparison with the financial, administrative, logistics, strategic or patient management, among other career options?

10. The hospital managers form a relevant professional group in the public hospitals’ and MoH organisms’ management.

    How do you regard the ENSP’s exclusivity in these professionals’ training?

    How do you interpret both the ENSP’ and the hospital managers’ role in the promotion of MA’s models?

11. How do you regard the relationship between the ENSP’ hospital management course and the postgraduate supply of the other economics and business Schools?

12. The academy owns an indirect means of participating in the financial accounting’s regulation, both applied to the private sector and the public sector through the Committee of Accounting Standards.

    How can the academy influence on the MA, in particular, on the health sector?

13. How do you assess the national scientific production related to MA, comparing to other countries?

14. In your opinion, is the scientific production performed in the MA’s area followed by the members of the boards and middle managers from the MoH and hospitals?

    If **not**, what might explain that distance?

15. In a more general perspective, how would you compare the place occupied by MA in scientific journals with large impact compared to areas like finance and financial accounting?

<u>President of the National Association of Private Hospitals</u>

1. Generally speaking, how would you classify the MA’S role in the framework of the private hospitals’ operational and financial management?

2. Is it possible to identify a common approach by the hospitals in general? Or, in other words, are the MA's models implemented by the different business groups similar among each other?

   If **so**, which reasons might explain that accordance?

3. Which key features would you highlight/point out/stress in the MA's systems of private hospitals?

   Topics:

   - Costing object;
   - Knowledge on costing techniques;
   - Information systems;
   - Professionals' involvement;
   - Advice and explaining doubts on MA by the central services (headquarters or shared services).

4. Do the business groups concentrate the MA'S operation or grant autonomy to their units?

5. Are the professionals from the different sectors encouraged to suggest improvements or to identify new information needs in order to support clinical or management decisions?

6. Is the local implementation of the MA's systems carried out by professionals with management training or by multidisciplinary teams?

   Which professional groups belong to those teams?

   Is there, in the APHP, a global perception of the way how the local implementation of the MA's systems in different units and business groups is made?

7. Do clinical information systems aim, basically, at providing medical information or incorporate intentionally information about periods of time and costs?

   Which professional groups are in charge of the planning of these systems?

   What is its level of integration with the hospitals' remaining information systems (administrative management of patients, human resources, financial accounting and management accounting, invoicing and charges)?

8. Do the associates appeal to the APHP in order to get technical support in relation to MA topics?

9. Are partnerships established between the APHP, universities (including business schools) and technological companies in order to transfer theoretical and technical knowledge on MA to the APHP's associates?

   If **so**, by the initiative of whom/which entities?

10. Is the influence of international academic publications or of the business schools' postgraduate training clear in the MA models followed by the private hospitals?

11. Do you consider that the private hospitals try to attract and retain skilled human resources in MA?

    Is it current the mobility of these professionals among different business groups/ companies?

    And between the public and private hospitals?

12. Is the benchmarking practice usual among the different business groups/companies?

13. Does that practice expand to inside the organization, among different health units?

14. And, within each health unit, do the different departments have their own accounting?

15. Which are the main uses of the information delivered by MA?

    Topics:

    - Budgets and variance analysis;
    - Incentive systems;
    - Internal benchmarking, intra-group and external.

<u>Former President of ACSS</u>

1. Considering your longstanding knowledge in the health sector and your experience in managing hospitals and MoH central agencies, do you believe that the MA is a matter of interest for a large number of hospitals?

If **not**, which reasons may explain such a distance?

2. Has the ACSS organized conferences, workshops and seminars on MA?

3. Do the strategic guidelines established for the ACSS include the adoption of best practices, organizational innovation and performance monitoring?

   These strategic guidelines are oriented to the operational management of the health units?

   Which role might the MA perform in this context?

4. The information systems will be necessary for that evolution and are also under the supervision of ACSS.

   How would you describe, generally speaking, the hospitals' information systems towards their capacity to support the improvement of the operational and financial management?

5. Besides the technical capacities of the information systems, how do you foresee the hospital professionals' performance?

6. Some hospitals, like the CHSJ, have been developing on their own innovating projects, both in regard of BI systems and MA.

6.1. Which perspective does the ACSS have towards these individual actions?

6.2. What impact have these actions had on the ACSS' strategic decisions in the information systems' and from MA's area?

7. In 2007, the HM launched a project on the implementation of a more sophisticated costing system based on the ABC, getting 10 public hospitals engaged.

7.1. Which results would you point out of this project?

7.2. Did this project raise a debate between the ACSS and the hospitals' boards of directors? (note: not only the participants, but all the hospitals)

8. The entities which belong to the SNS are in a transitional stage to the SNC-AP. The accounting standards applied to the MA recommends the ABC's use.

   What is the progress report of this transition?

The two following questions are related to each other and result from two promulgated recent laws:

9. The new hospital management regulation, created in 2017, introduces again the CRI and requires management training and adequate professional experience for the appointment to middle or top management functions at hospitals.

9.1. Which implications might have the CRI's creation on MA?

9.2. Might the management training and the adequate experience cause a change in the MA'S approach at hospitals?

9.3. Do you see any parallelism towards the capacity of recruiting human resources out of the health sector between the corporatization and this new regulation?

10. Still more recent is the strengthening of the autonomy of the entities' management from the SNS enterprise sector.

10.1. After the public hospitals' corporatization initiated in 2002 and, meanwhile, extended to every hospital, how do you interpret this new law initiative?

10.2. This initiative opens the way to an assessment structure and management follow-up. What connection might this structure have on MA?

11. Concerning the institutional cooperation, the ACSS concluded a protocol with the New SBE in 2016.

11.1. Which research areas do the ACSS foresee to become more dynamic?

Topic: Health economics, MA.

11.2. In the implementation of the ABC project referred above, was there an institutional collaboration from Academia?

If **not**, which reasons might explain the absence of cooperation?

11.3. In general terms, how would you classify the institutional cooperation between the ACSS, Academia and other public or private entities?

Which measures could intensify that cooperation?

11.4. Does the ACSS provide a follow-up for the national and international scientific production about health management?

In what way?

12. Does the ACSS follow the evolution of MAS in the remaining European countries?

Would you stress any in particular?

13. In the mentioned interview, you referred that the financial model has been making progress, keeping the importance of the production, but now also bearing in mind performance indicators and comprehensive prices.

On the other hand, the hospitals' funding model, based on the production, seems to have been, somehow, limited in recent years by budget constraints, reducing the importance of the mandatory cost accounting model as a mechanism of price formation.

How do you foresee the progress on the cost accounting mandatory model, taking into consideration these developments in the funding model?

14. The *Unidade de Missão* was a remarkable element of the corporate model created in 2002. To my knowledge, the "rebirth" of the model that is being formed does not contain a solution and a *modus operandi* similar to that of the *Unidade de Missão*.

How would you describe the role played by the *Unidade de Missão* and the way hospitals – each one of them – understood the work performed by the *Unidade de Missão*?