

# **Assessment and control of the internal referral process in a private hospital**

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**Master's Dissertation**

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**Mestrado Integrado em Engenharia e Gestão Industrial**

2019-02-15

# Abstract

Internal referral processes are vital for private hospitals to maintain or even grow among other competitors in the sector. This process involves an integrated perspective of all services and all doctors, reflecting the common goal of retaining patients in future appointments. For this process to have meaningful impacts on customer retention, leading to profits growth, there is the need to assess and control the evolution of referrals, and assess its performance and disclose the current levels of performance. This procedure will help the identification of opportunities for improvement, enabling the achievement of better results.

Without a well-structured approach, supported by the systematic monitoring of carefully defined performance indicators, the implementation of effective policies is hindered. In the hospital studied in this thesis, the situation of referrals is assessed only based on the perceived opinion of healthcare professionals. Wherefore, by defining all related processes and getting the current scenario, it is possible to have means of comparison for future evaluations and disclosure of improvement opportunities. For this, it is imperative to review the available literature to come aware of other examples within the healthcare field that give a framework and more awareness about this challenging area. Furthermore, the customer journey, and all touch-points, are of great value in such a customer-oriented process, enabling the design of systematic approaches for customer loyalty and retention. This not only defines the process in the hospital but also results in defining meaningful performance metrics for assessment and control. The latter can be achieved by developing a dashboard, giving important insights about the performance in a straight and clear way.

This thesis proposes a procedure to analyse referrals between specialties and between doctors from the same specialty. It also develops a set of Key Performance Indicators to monitor this process and presents these indicators in a dashboard.

Lastly, and as expected, the production management department of the hospital holds all necessary results to develop strategies to increase internal referrals events in specific services, or specific doctors, while keeping and improving the good results in the others, instead of developing general actions based on perceived performance.



# Resumo

Os processos de referência interna são vitais para os hospitais privados se diferenciarem dos outros concorrentes do setor. Este processo envolve uma perspectiva integrada de todos os serviços e de todos os médicos, refletindo o objetivo comum de reter pacientes em futuras consultas. Para que esse processo tenha um efeito significativo na retenção de clientes e por consequência no aumento dos lucros, é necessário avaliar e controlar a evolução das referências internas e o desempenho dos médicos e especialidades, de forma a encontrar possíveis fatores que estejam a impedir a obtenção de melhores resultados. Este procedimento ajudará ainda na identificação de oportunidades de melhoria relativamente a este processo.

Sem uma abordagem bem estruturada, conhecida por todos os colaboradores envolvidos e baseada num controlo e avaliação sistemáticos através da definição de métricas de desempenho, qualquer ação relativamente a este processo é comprometida. Na verdade, atualmente esta análise é feita apenas pela recolha de opiniões dos profissionais envolvidos, resultando por isso de percepções. Portanto, ao definir todos os processos relacionados, é possível fazer comparações para futuras ações de melhoria e o seu resultado. Para isso, é importante fazer um estudo da literatura disponível relativa a outros exemplos na área da saúde para que o projeto esteja alinhado com o cenário atual de outras unidades hospitalares. Além disso, a jornada do cliente e todos os pontos de contato do mesmo com o hospital são de extrema importância num processo totalmente orientado para o cliente, permitindo uma abordagem sistemática e focada. Isso não só permite fazer o levantamento dos processos de um cliente no hospital, mas também possibilita a definição de *Key Performance Indicators* (KPI) para a avaliação e controlo do mesmo. Através do desenvolvimento de uma *dashboard*, é possível revelar de forma clara e concisa, informações importantes sobre o desempenho do hospital neste processo.

Esta tese propõe um procedimento para analisar as referências internas, quer entre especialidades quer entre médicos. Apresenta ainda um conjunto de métricas para avaliar e controlar este processo, incluídos numa *dashboard*

Por fim, e como esperado, o departamento de gestão da produção do hospital tem acesso a todos os resultados necessários para desenvolver estratégias no sentido de potenciar os eventos de referências internas em especialidades ou médicos específicos, em vez de desenvolver ações gerais, baseadas numa avaliação perceptual.



# Acknowledgments

This master's thesis is the culmination of 5 years and a half full of experiences and unique people. During these years, there were three countries, spread across two continents, with a more relevant role and all the people who were part of this great trip made it special and unique, teaching me to be a person and a future engineer.

Starting with my hometown, three people have made this project possible, the first is Marta Paúl who opened doors and guided me in relation to a potential project, to her I owe her the conceptualization of this theme and the entry point in the Hospital CUF. With one theme in mind, the director of the Production management department at the hospital, Dr. Célia Rosa, who was always fully dedicated, integrating me into the world of health and teaching everything I learned in this area.

Having a definite idea, I am thankful for having worked with Prof. Dr. Ana Camanho as my supervisor during the last five months, who from the beginning always believed in the project and fought for the achievement of the same with the highest delivery, availability, being an outstanding advisor throughout the implementation of this project. Having been my supervisor in previous stages, finishing this journey under the guidance of Prof. Ana is an honor.

My family is always a milestone. Starting with the greatest example and inspiration, of the person who is always present, giving constant support to be worth for two, I have to mention my gratitude towards my mother who always gave me wings to fly even when I left her anxious and worried, whom I owe all. To my sisters, I am grateful for the constant and genuine joy of my sister Inês and for the example of focus and persistence of my sister Catarina, who daily served as support and motivation. I acknowledge my father for the support he gave me during the project not only as a father but as an engineer and uncle Tiago for all the accompaniment, interest in being abreast and help in the concretization of this project, with ideas and new visions, unraveling me. Special regards to my godfather, always side-by-side, and to Uncles Nuno, Jorge, Catarina, cousins Artur, Arturinho, Nuno, Joana and like siblings Manuel, Madalena, Francisco, and Gonçalo.

There are also the special contributions of the family I chose, my friends and I am lucky to be surrounded by the best. Starting with an appreciation to my two-decades friendships Juliana and Catarina, volleyball friends José Diogo, Francisca, Bárbara in addition to the university friends, especially Francisco, Ricardo, Miguel, Francisca, Maria Manuel, Ana Catarina, Leonor, Maria João, Marina, Filipa, Inês, Vítor, André, and also friends I was lucky to had met in The Netherlands, Gemma, Vibha, Lígia, Jaime and Pedro. Besides, an appreciation is also due to Mariana and João, who I met during summer experiences abroad and have kept in touch ever since. Secondly, a special appreciation to the companions of a lifetime adventure in Angola: Diana, Inês, Mariana, Leonor, and Ana. Lastly, the friends who appeared in the last months and who proved equally important, I am grateful to Gonçalo, Diana, Mónica, Sofia, João and André.

To all the people who have somehow been in touch with me and undoubtedly have left their contribution, however small it may have been but shaped these last few years.



*"Nothing worth having was ever achieved without effort"*

Theodore Roosevelt





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# Acronyms and Symbols

BPMN	Business Process Model and Notation
CLV	Customer Lifetime Value
CUF	Companhia União Fabril
CRM	Customer Relationship Management
ERP	Enterprise Resource Planning
HSE	Health and Safety Environment
HCP	Hospital CUF Porto
HIQA	Health Information Quality Authority
JMS	José de Mello Saúde
KPI	Key Performance Indicator
NHS	National Health System
PCP	Primary Care Provider
PRM	Patient Relationship Management
REE	Referral between specialties
RDE	Referral within the same specialty
SC	Subsequent Consultation
SMP	Specialty Medical Practices
SNA	Social Network analysis
UML	Unified Modelling Language
VBA	Visual Basic Application



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# Chapter 1

## Introduction

### 1.1 Motivation

Excelling in a wide variety of health care services depends highly on retaining customers. Retaining customers is a consequence of, among other things, the efforts regarding referrals between doctors, defined as internal referrals, so controlling the number of occurrences and the overall number of appointments is relevant to develop strategies toward customer retention. Internal referrals are defined as the process of referring a patient or client to other specialists, encouraging them to schedule a new appointment with a certain doctor, based on factors such as trust, medical history, previous experiences and doctor availability. Investing in these procedures enhances customer retention rates by strengthening their relationship with the health care provider. In fact, after an appointment, patients have two options: to continue the process in the same health care facility or to check other options.

Measuring the performance of internal referral procedures permits further analysis of specialties and doctors' practices, so that concrete strategies are implemented when opportunities for improvement arise. In this context, the purpose of this project is to assess and control the internal referrals procedures and identify potential strategies for improvement in collaboration with the production management department of Hospital CUF Porto (HCP), a Portuguese private hospital managed by José de Mello Saúde (JMS).

### 1.2 Framework

José de Mello group is one of the largest Portuguese corporations, acting in three different sectors: infrastructures and mobility, the chemical industry and health. In fact, the first company of the group was called Companhia União Fabril (CUF) and is nowadays the largest chemistry company operating in Portugal, named Bondalti. The group controls Brisa, a Portuguese company responsible for the maintenance of highways and related infrastructures and José de Mello Saúde, the leading private provider of health care services in Portugal. In addition, the group also

holds half of ATM, a maintenance company, 14% of Efacec Power Solutions and José de Mello Residências e Serviços, which offers physical recovery and rehabilitation services.

Focusing on the health division, José de Mello Saúde was founded in 1945, when the Hospital CUF Infante Santo opened in Lisbon. As illustrated in figure 1.1, the group manages a network of eighteen health units throughout Portugal and a company which operates in the Health, Safety and Environment (HSE) area. Two of the health units, Braga and Vila Franca de Xira are public hospitals despite being managed through a public-private partnership model between the José de Mello Saúde group and the Portuguese Ministry of Health.

The JMS's practices are built on five strategic, interrelated pillars, namely, a Differentiated Clinic Process, an Impeccable Customer Experience, an Efficient and Consistent Operation, a Growth-Generating Agenda of Value and, finally, the Talent Management. Moreover, there are four shared values, Respect for the Dignity and Well-Being of the Person, Human Development, Competence and Innovation.

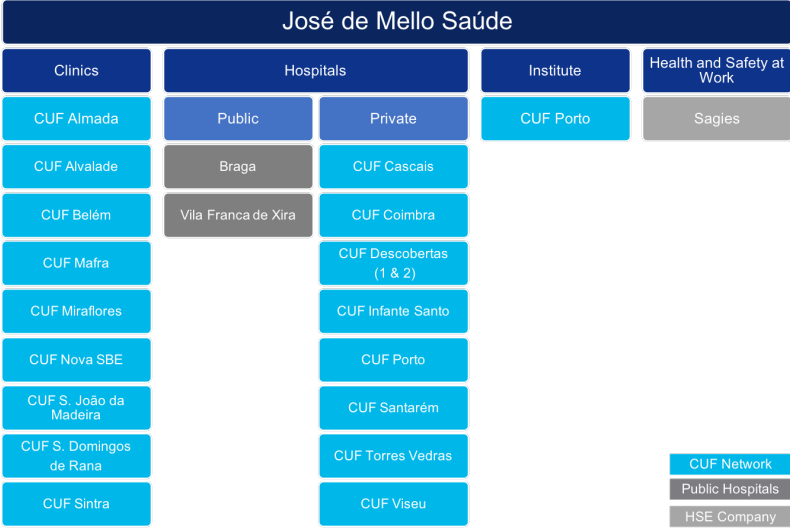


Figure 1.1: Structure of the JMS division.

Referring back to the project for assessing internal referrals, it was developed in Hospital CUF Porto, the main private hospital in the north of Portugal, built in 2010. The above-mentioned hospital, caters for thirty-five specialties and seven differentiated centers, the more noteworthy being the Maternity Unit, the Neonatal Intensive Care unit, the Emergency Medical Services and the Oncology unit.

### 1.3 The project

During the past five months, the project has been developed at the Production Management department, which plays an essential role in planning, improving and analyzing the hospital practices. It manages the allocation of people and resources while working together with people from a wide range of departments and specialties by means of an integrated approach.

As presented before, the private health care providers are largely dependent on customers' loyalty, so developing strategies for customer retention is crucial for the success of hospitals and clinics.

One way to ensure a higher customer lifetime is to invest in internal referrals between doctors and in quick scheduling, meaning that in case a second opinion and an appointment are needed, there is the urge to advise the patient to book another appointment and consult another specialist, thereby ensuring that the patient remains in the same unit rather than opting for the same services in other public or private health providers.

Despite the structured information system, the HCP currently lacks a method to measure and control internal referrals. Therefore, the opportunity to identify potential process improvements is being lost.

The project's goal is to overcome the subjectivity of the internal referrals by analyzing the process and defining suitable key performance indicators (KPI) in order to assess and control this process. In the end, by creating a user-friendly and appealing tool, the production management department will acquire immediate insights into the current situation of the hospital and be able to act, and develop concrete and adequate strategies. In such a dependent business such as the customer retention, controlling internal referrals is crucial for profit growth.

## **1.4 Methodology**

For achieving the final goal of this project, several steps are taken. Firstly, it is imperative to be aware of the current practices and the HCP referral procedure, in order to be integrated and fully aligned with its purpose while developing the project. This survey of processes was possible through several contacts with the Chief of the department, who clarified the dynamic within the hospital and all procedures related to appointments.

The following step consisted of analyzing the available database and extract all meaningful attributes for the internal referral process and its performance evaluation and control.

After analyzing the available data, the next step is arranging the attributes according to the expected ratios for the control and assessment of the internal referral process. Also relevant is the metrics definition and validation with the department since the expected instant insights will be used for their meetings and performance evaluations.

In the meantime, the data analysis takes place and the program that allows the metrics definition is developed, creating different methods based on initial assumptions.

The tool is then created, integrating all performance metrics. Again, validation is a key point. Accordingly, the dashboard features are verified and practical aspects are defined.

At last, the obtained results are analyzed so that potential improvement opportunities, at concrete specialties or even doctors, are detected and performance gaps are fixed.

## **1.5 Dissertation outline**

This dissertation begins with a literature review that considers customers in the healthcare area: their journey, loyalty and retention, in addition to the concept of Patient Relationship Management (PRM). Then, current health practices from the perspective of data analysis to known key performance indicators (KPIs) are addressed. In addition to these topics, there are also references to dashboards, their goals, and best practices in designing them. In the end, the internal reference concept is explained and the resulting challenges are indicated.

After studying the health sector, it is important to uncover all the process and define them through business analytics tools. This results in the As-Is analysis of the patient journey and the definition of the internal referral process. This section ends with the To-Be analysis by setting the improvement opportunities, overcoming the uncertainty and lack of metrics for internal referrals control.

The solution is presented in the following chapter. For this solution, a few assumptions are made and then the performance metrics are defined. Next, the data analysis procedures are shown and the dashboard development is explained.

Finally, a few conclusions are shared followed by limitations and future research.

## **Chapter 2**

# **Literature review**

This chapter provides an overview of the theme and of the work previously developed in the field. The first section highlights the customer journey in healthcare, addresses current gaps in the patient-provider relationship, the customer retention concept and the Patient Relationship Management (PRM). Then, section 2.2 describes the importance of data analytics and the prevailing inefficient use of data in the healthcare sector. In section 2.3, an overview of the current practices regarding Key Performance Indicators (KPI) in healthcare is made. Finally, the internal referral concept is defined in addition to its impact on private hospitals and related challenges.

### **2.1 Customers in healthcare**

In the United States, research has been done to look at possible barriers when it comes to seeking medical care and completing it. Five main barriers were identified. One was the negative assessment of doctors and healthcare providers, followed by the feeling that there is no need to consult a doctor due to the belief that the health condition will change. Finally, there were concerns with high costs, not having health insurance and even lack of time (Taber et al., 2015). Focusing on these barriers allows health service providers to take action to overcome them and capture and retain healthcare customers. For this reason, the full picture of healthcare customers will be studied to understand current flaws and consider a possible solution.

#### **2.1.1 Customer journey**

It is generally accepted that healthcare is facing considerable developments and that people now have different expectations from healthcare providers, more like "non-health goods and services", behaving in the same way, because in case their expectations are not met, they just go out and look for another provider (Jannenga, 2018).

Each person has their own "patient care journey," also defined in Jannenga's work as the "golden thread of healthcare" (2018). Whereas this journey is an important strategy for meeting the expectations, providing the best services not only in hospital facilities but also before and

after. The client's journey begins well before the first contact at the hospital or clinic premises, and providers must take this in consideration so as not to lose potential clients and retain them later.

Currently, patients have a wide range of hospital facilities available to choose from, so the first step is to choose the provider. People can get feedback from other doctors, family members, friends or even insurance companies. There is, however, a new tendency to evaluate options. Gaby Loria conducted a study on the use of online assessments when it comes to medical decisions and found that 72% of the American patients that were interviewed chose a doctor based on online assessments. In fact, the power of the online feedback through social media, online reviews and forums is even stronger, and almost 50% of those patients prioritize reviews over the doctors covered by their insurance (2018).

After choosing the doctor or the hospital facility, the next step is scheduling the appointments for consultation, treatment or exams. During these processes, contact with hospital facilities is decisive. A study conducted by an American non-governmental health-related agency (Altarum Institute) disclosed that 58% of patients surveyed have changed doctors due to poor treatment or service, leading to considerable losses for providers (2012). In this way, the relationship that is established with the patients should make them feel well and carefully treated in addition to being sure that the value they are paying for it is well worth it (Jannenga, 2018).

In the end, after a positive journey, they might share their experience, promoting a specific group, hospital or doctor. This is defined as the "internal marketing", and it is essential that not only these opportunities are not lost but are enhanced (Reys,2018). Kylie Mckee's work allows to conclude that by doing so, the reputation will be improved, the brand awareness will increase in addition to online visibility (2018).

### **2.1.1.1 Customer touch points**

Keller and Kotler defined touch point as "any occasion on which a customer encounters the brand and product— from actual experience to personal or mass communications to casual observation" and has a direct influence on loyalty. One example is calling customers by their names, which increases proximity and empowers customers' engagement (2012).

There are several touch points apart from the ordinary contact with a person. They go from websites and advertisements to phone calls or even simple transactions to pay for or to receive something. Concluding, it is every contact that a customer has with a company, regardless of whether the final outcome is a product or a service. Making efforts towards outstanding positive experiences is crucial since people have a "selective retention" that leads them to focus on a single service or product and turn a blind eye on competitive ones (Kotler and Keller,2012).

Within healthcare services, and depending on the provider, touch points can be complex and critical. The website or the available applications, the call center, all scheduling procedures, appointments and the interaction with the doctor or with any other staff members in addition to potential advertisements should be carefully analyzed and considered in order to maximize customer positive experiences. In fact, the key touch points have even been defined as the "moment of truth", since they are decisive moments of contact for keeping or losing a customer (Zeithaml,1988).

Therefore, initiatives should take into account all the touch points and continuously track them in order to make changes if necessary.

According to Stewart Gandolf, touch points can be classified according to the stage of the journey (2018). Starting with the discovery stage, this is the moment when someone recognizes that he or she has to seek healthcare services and start looking for alternatives on online reviews, the media or even online research. The media are the most relevant and controllable touch point at this stage, and several marketing strategies have been developed, ranging from radio to outdoor campaigns for new services or new hospitals like the new CUF Descobertas in Lisbon.

The second stage is the evaluation of the available options, by comparing them with one another (Gandolf,2018). It is the moment to make a choice based on hospital's website, public presentations, people's feedback and again on online reviews. The website is one of the most used touch points. Design, ease of finding the correct information and organization matter at the time of choosing between different providers.

Then, another "moment of truth" takes place. After analyzing the options, it is time to decide (Gandolf,2018). The first contact with the system is characterized by uncertainty, since people do not become loyal at first sight. This stage includes the scheduling moment and the attendance of the consultation, or in case of the emergency services, the personal contact with the hospital facilities. Again, the website is important thanks to online scheduling, but must be completed by the application available, the services desks and the phone contact. The user-friendly nature of the app, the kindness of the staff at the services desks and the helpfulness of the team that answers phone calls are key factors for customer engagement.

The third step, defined as the advocacy stage, is the connection patient-provider connection that is created (Gandolf,2018). At this point, the contact with the doctors, nurses and other professionals is decisive. This is the moment to form an opinion on the overall service and on all the people involved that have an influence on it and to share it with others I on the Internet, on social media or, more traditionally, via word- of-mouth.

Lastly, comes the bonding stage. This is the moment of customer retention, of dealing with the patients after the appointments, "between care episodes" (Eastwood,2018a). At this stage, the "moments of truth" created by a provider are just as important as the touch points that patients might have with competitive healthcare groups through marketing campaigns. Here, targeted messages play a major role, since a tailored approach strengthens proximity and the feeling of familiarity that leads to becoming loyal to a certain product or service.

### **2.1.2 Loyalty and customer retention**

From the moment patients enter a healthcare institution, it is important to keep them once a process is completed, i.e. "between care episodes" (Brian, 2018). Patient retention is 90% cheaper than attracting new ones and beyond the cost analysis, to foster loyalty and a sense of engagement is of the utmost importance (Whitehurst,2014). As a matter of fact, the "average number of visits per patient" is one of the factors that define healthcare providers earnings (McKee,2018).



As stated in the book *Marketing Management*, dealing with customer retention is one of the "core business processes" and involves managing a marketing network, the real competitive factor of today. It also works as an external marketing metric being the customers' autonomy the internal metric conceding specific evaluations of the current marketing practices (Kotler and Keller,2012).

This loyalty differs from one group of customers to another in the healthcare world, patients. It is represented by a funnel, as shown in figure 2.1, called the "Marketing Funnel" which accurately describes the evolution from an initial point to a loyalty scenario. Building customer bonds is the way to turn "open to trial" patients into retained ones, not only by investing in interactions with people and gathering feedback on their needs and expectations but also through improved services and customized approaches in addition to an effective structure that allows customers to know to whom they should turn to at specific moments of the customer journey (Kotler and Keller,2012).

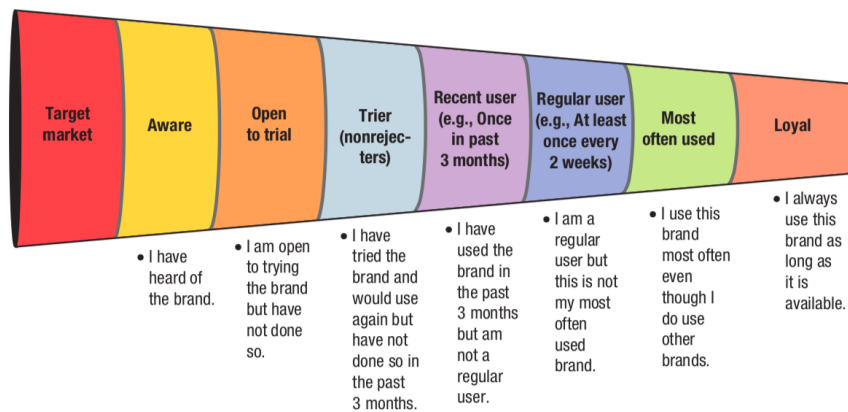


Figure 2.1: The "Marketing Funnel" (Kotler and Keller, 2012).

### 2.1.3 Patient Relationship Management (PRM)

Healthcare customers began to demand a different kind of services, a more individualized and targeted course of action based on a "patient-centered" approach and meeting patients' needs in a timely manner is a great challenge (Heath, 2018). As a result, the concept of Patient Relationship Management (PRM) have emerged and highlights the coordinated and integrated approach of patients' medical care (Eastwood, 2018a).

Inevitably related to the well-known concept of Customer Relationship Management (CRM), PRM goes beyond it, and is, according to Eastwood, "more than just CRM for healthcare" (2018a). What differentiates these two approaches is the analysis of the relationship from a broader perspective. Unlike CRM, that is restricted to customers' contact with the products or services and the people involved in them, PRM sees the whole picture, i.e., before getting in touch with providers and after, the main goal being to "meet patients where they are" (Eastwood, 2018a).

On the other hand, it is possible to follow common CRM strategies and use them as guidelines. For instance, Keller and Kotler mention a "framework for one-to-one marketing", outlined by Peppers and Rogers and consisting of four steps. Firstly, it is important to create a strong

customer database that takes account of data from every touch point. Secondly, comes customer segmentation and their value for the provider, such as profits and referrals as well as costs. The next step is investing in interaction and in getting to know customers to build a relationship having in mind targeted initiatives. The process ends with personalized actions at every touch point. In the healthcare sector, it is relatively easier to follow these steps given the nature and volume of the data collected (Kotler and Keller, 2012).

In addition, PRM seeks to integrate all parts of medical processes, including patients, suppliers and insurance companies. This creates better opportunities for improvement and more power of choice for the patient when it comes to making decisions about medical procedures and offers them better conditions to do so (Eastwood, 2018b). Moreover, it encourages patients to adopt a more autonomous attitude towards their own medical processes, which increases their engagement, loyalty, and, ultimately, their positive criticism. All this results in a more valuable brand and better reach (Eastwood, 2018c).

The benefits of IT efforts to PRM strategies are economic stability thanks to improved services and to a more efficient communication resulting in higher probabilities of patient retention (Reys, 2018). The fact that it is possible to follow the patient closely over the entire process is also an important aspect of improving the overall quality of healthcare services provided. Lastly, PRM allows a concrete performance analysis like the internal referrals process and the effect on earnings (Whitehurst, 2014).

Steve Whitehurst goes further by suggesting a specific team for managing communications with patients in order to overcome identified gaps. Besides, patient management might be carried out through a strategy of targeted messages according to the treatment and healthcare needs of each patient (2014).

## **2.2 Data analytics in healthcare**

In such a competitive sector, performance is decisive. According to Davenport and Harris, business performance and analytic approaches are correlated (2007).

However, there is a gap between the current practices in other sectors regarding data analytics and the health sector. In fact, Wang et al. believe that healthcare information systems are hindering value creation due to misemployed efforts towards data structures (2018). Furthermore, data is not being collected considering an integrated approach, instead, it is characterized by a large, miscellaneous and complex compound, which prevents analytics from getting a single and inclusive picture of the system (Acito and Khatri, 2014).

Nevertheless, healthcare is still considered to be a potential and valuable employment of data analytics efforts (Ward et al., 2014). According to May (2009), healthcare will change completely due to analytics. Eight years after, Mehdi et al. (2017) shared the same idea, claiming that although Marketing is a step ahead in using data to extract meaningful information, healthcare will surpass this on account of the significant data and the undisclosed knowledge.

Conboy et al. (2018) define business analytics as the strategies that boost data analysis resulting in better performance, disclosure of improvement opportunities and ultimately in profit growth. Beyond these benefits, there are other positive effects, namely IT infrastructure, operational and organizational benefits. Considering the efforts made towards relevant output, it is possible to get information about the clinical processes at once in addition to ameliorating the internal communications and support between all parties involved while giving concrete insights to chiefs and directors about the status for a more robust decision-making process (Mohammadzadeh et al., 2017; Wang et al., 2018).

### **2.3 Key Performance Indicators (KPI) in healthcare**

Since customer retention is critical for private healthcare providers, meeting the high patients' expectations by offering a quality and efficient service is determinant. Consequently, the definition of KPI is crucial to measure the quality and performance of services, so that the decision-making process for improvement strategies is more accurate and complete (Amor and Ghannouchi, 2017). In addition, a comparison of the the KPI values before and after the implementation of certain policies allows to assess the effect of these policies in practice. (Baslyman et al., 2017).

The KPI are classified into qualitative and quantitative indicators (Amor and Ghannouchi, 2017). Also, within the healthcare community it is generally accepted that they are divided into four different categories, namely (i) maintenance and occupancy of the hospital facilities, (ii) performance of the hospital, (iii) cost-effectiveness of the related activities and finally (iv) management, indicators that evaluate the "effectiveness of the managerial scheme" (Shohet and Nobili, 2016). Alternatively, there is a wider classification, made by the Health Information and Quality Authority (HIQA), from which the indicators may result of the combination of more than one category, depending on the type of care divided in Preventive, Acute or Chronic and the target of the measuring approach classified in Structure, Process or Outcome (HIQA, 2013). This classification system is included in Appendix A.

Some examples of implemented KPI in healthcare facilities are: "The duration of all activities by patient", "Number of doctors by date", "The duration of consultation by patient" and "The waiting time before consultation in box" (Amor and Ghannouchi, 2017). The complete list is included in Appendix B.

### **2.4 Dashboards**

Due to the continuous increase in the amount of data and their importance in decision-making, the need to systematize and present data in an effective and clear manner has grown. Therefore, creating a tool such as a dashboard that includes all data in a simple, clear and effective way is of great importance. Research has shown that dashboards employment improved communication having a positive impact on healthcare processes (Dowding et al., 2015).

In fact, a *"performance dashboard is a layered information delivery system that presents on a single screen the most important information about strategic objectives attainment enabling managers to measure, monitor, and manage performance more effectively"* (Ghazisaeidi et al., 2015). The main goal of a dashboard is to collect information from external sources and "improve the user's ability to extract information from data" (Karami et al., 2017).

For dashboards to be an accurate reflect of the business performance, there are key aspects to consider when developing these tool: data sources, performance metrics, presentation and integration with other systems (Ghazisaeidi et al., 2015). In such a complex environment, having a performance-oriented database greatly facilitates the more difficult work of managing the data in order to have the concrete attributes for performance evaluation (Marchand et al., 2017). Usually, these data sources are extracted from Enterprise Resource Planning (ERP) softwares that integrate all business data. Then, the performance metrics to present at the dashboard. This step of choosing the metrics to display is as important as the chosen features since the baseline is to be able to extract immediate information about the processes (Eckerson, 2011).

Furthermore, the presentation of the dashboard, used features and how data is displayed is the third factor to consider. The idea is to design dashboards to "assist our visual system to more efficiently process detail that might otherwise require significant cognitive effort" (Franklin et al., 2017). This is achieved by creating a "minimalist design" with simple visuals, a restrained colour set not to divert users and homogeneous visuals with meaningful values, according to the chosen features (Karami et al., 2017). Actually, dashboard features are classified into visual and functional (Ghazisaeidi et al., 2015).

Visual features concern how the information is presented to the user and whether is efficient or not. A balance between complexity and usefulness is needed not to overload the user with meaningless data. Choosing visuals according to the information and its utility is fundamental. To compare and disclose relationships, charts should be used over tables. In contrast, to gather concrete values and compare them with the overall result, tables fit better. In addition, pie charts or related graphics should be used for a reduced number of categories represented in percentages and bar charts for numerical values.

Functional features of the dashboards deal with managing and interacting with the visuals. For example, the drill-down feature that allows to analyze hierarchies and the sub levels, or highlighting specific field which sorts other visuals accordingly or the available tool tips for additional information are functional features. Regardless of the features chosen, it is important to pay attention to the above-mentioned balance and to the trade-off between simplicity and content (Ghazisaeidi et al., 2015).

When developing a dashboard, for meeting the final goal of showing "the most important information for achieving organizational goals", only the crucial information should be presented, using simple visuals that support users in decision-making processes. Selecting the essential metrics, with visual and functional features that fit users needs while being interactive and user friendly is challenging. The aspects mentioned in this section should be considered when creating a dashboard (Vilarinho et al., 2017).

## 2.5 The internal referral concept

Private healthcare providers are focused on improving and optimizing their resources and processes. Therefore, specialty referrals have started to be considered among specialists as a potential target to improve and increase efficiency (Guevara et al., 2011).

### 2.5.1 Definition

The referral process is defined as the act of recommending a patient to consult another specialty or a specific doctor. This process is characterized by a cooperative strategy that delivers an integrated and fulfilled service (Anderson et al., 2010). The main goal is to provide patients with the best available care. For this, the entire treatment consists of related phases until the final diagnosis, ensuring that apart from the good service, it is delivered within an acceptable time period (Guevara et al., 2011). Actually, the Ministry of Health has defined clinical referrals as a process that is *"medical act of transmitting a set of clinical information from a patient, namely the medical history, performed by the attending physician and directed to the hospital doctor of a particular specialty, through which a first clinically justified and supported consultation is requested as necessary, in the results of complementary diagnostic tests and in accordance with the defined reference rules"* (MS, 2013).

Specialists make internal referrals in specific scenarios. First, when there is uncertainty about the diagnosis and there is a need to get a second opinion before proceeding with a treatment. Another reason is the complexity of the process. Some diseases involve different specialties and cross-communication is needed (Barr and Ginsburg, 2006; Cooley, 2004). This process may start in the emergency service or after a specialty appointment, therefore measuring its performance gives healthcare providers the necessary insights about the performance of the hospital or clinic and compares them to competitors (Guevara et al., 2011).

### 2.5.2 Challenges

Handling internal referrals requests is a complex task. As a matter of fact, barriers to this process have been studied in the medical community (Gandhi et al., 2000).

#### 2.5.2.1 Responsiveness

According to Sherer, insufficient information is one of the main problems mentioned by doctors when it comes to support and to guide patients on their health journey (2019). With regards to appointments, sometimes it takes a while to set a new visit to a specific doctor after being counseled to do so. In the interests of efficiency, the sooner patients have access to a second appointment, the less likely it is that they quit or even seek another healthcare provider, which is a scenario of an inefficient internal referral. This is what is known as responsiveness, and WHO actually defined "responsiveness to healthcare consumers' expectations" as a relevant KPI to assess the quality of healthcare services (Grace et al., 2018). An updated information system may overcome some

problems like outdated information on physicians' availability and next vacancies. The latter, for instance, is considered as a cause for failure in children's medical services in locations with poor access to healthcare (Zuckerman et al., 2013).

### **2.5.2.2 Communication**

One of the central problems in the patient-provider relationship is communication. Within this individualized support, communication has become a concern and Cornell et al. at the Connecticut Children's Medical Center refers that heterogeneity of communication, together with reference variability, results in "inadequate and ineffective use of scarce clinical resources" (2015). In addition, the waiting time until the second visit is sometimes longer than 4 weeks, being a barrier to the efficiency of internal referrals. In order to improve and intervene in this process, the "lessons learned" are shown in C as a reference for other healthcare providers who can invest in improving internal referrals between the Primary Care Provider (PCP) and a specific specialist (Cornell et al., 2015).

Communication can also be disabled by lack of information. Unless doctors are aware of other specialists or abilities, this process will hardly take place. This specific circumstance calls for a different and little-known concept: social networks in healthcare. Bae et al. recognize that Social Network Analysis (SNA) has a strong influence on healthcare dynamics and on relationships between health professionals (2015). In a process as dependent on communication as this one, SNA is critical to powerful internal referrals due to the potential for the exchange of ideas and knowledge through regular contact between workers and give-and-take initiatives. A functional network results in trust, which is the first input for a physician to make an internal referral to another colleague and for professional fulfillment. The latter is important in a private environment since doctors may work for other private institutions and therefore make referrals to those instead of doing it internally. In this case, it is believed that feedback on possible referrals and on the specialists' worth tends to be considered more reliable when given by another colleague Bowers et al. (1994). It has also been proven that a stronger network leads to a cost reduction and that referral events increase when the physician holds a "more central" position (Bae et al., 2015).

Calling for a more efficient and integrated connection, hospitals should invest in better management of the scheduling moments and appointments while keeping them simple. Patients may cancel or miss appointments and through a coordinated connection, less undesirable scenarios will happen.

Another relevant aspect of communication is the contact with the doctor. According to J. Hibbard and J. Greene, a more inclusive process leads to more satisfied patients (2013). Physicians should try to promote a more active attitude on the part of their patients. A survey that interviewed more than 300 healthcare professionals in the US revealed that 59% agreed that the best approach is stricter medical monitoring and better follow-up as well as having more time to be with patients. A second factor was the decision-making process and the role of patients, and more than half believed that sharing decisions with their patients increased their sense of engagement (Hibbard and Greene, 2013)).

### **2.5.2.3 Brand equity**

Brand equity and the power of branding in healthcare services is also a relevant element. This concept has been widely studied in services other than healthcare and is defined as the additional value that enriches a product or service which entitles a stronger confidence in it, increasing the odds of seeking for a certain service or product (Berry, 2000).

Applied to healthcare and to the specialty referral process, the greater the power of the physician's brand equity, the more powerful this process will be, winning patients' absolute trust and leading them to schedule the recommended consultation sooner than they would if they were advised by a physician with a lower brand equity. Kumar et al. studied the effect of brand equity on Specialty Medical Practices (SMP) and realized that it is characterized by cyclical events on account of increasing brand equity that result in higher numbers of internal referrals events (2015). They also realized that by advising a patient to consult another specialist for a better diagnosis, physicians will automatically increase their brand equity. In the SMP network, it has been proven that it is empowered by "face-to-face" approaches, encouraging mutual trust between patients and physicians (Kumar et al., 2015).

This shows how relevant brand equity is in nurturing results for more efficient internal referrals and as the "primary catalyst" of referrals in a healthcare institution (Kumar et al., 2015).

### **2.5.2.4 Risk tolerance**

Strout et al. (2018) reviewed several studies on the effect of uncertainty and risk tolerance in healthcare in the referral process. Their conclusion was that referral events increase with the reduction of risk tolerance. For example, one of the studies conducted by Forrest et al. concluded that a physician with a lower uncertainty tolerance and a lower risk tolerance is likely not to transmit it to patients and be more inclined to refer them to a colleague. On the contrary, professionals who are more averse to demonstrating uncertainty to other colleagues are less disposed to referring patients to another specialist (2006).

### **2.5.2.5 Socio-economic background**

Escha et al. (2017) analyzed the practices of the Dutch people in relation to the health system and found that there is a propensity for avoiding internal referrals due to economic reasons. In this study, they focused on analyzing personal attributes and the level of noncompliance within the internal referral process and concluded that adults were more likely not to adhere to recommended referrals and that people from disadvantaged areas were more prompt not to comply.

## Chapter 3

# Process analysis

The main goal of this chapter is to characterize the current process by describing the client on boarding process, all customer touch points and the internal referral process at the Hospital CUF Porto. The second section discloses the To-Be process and the final objective of this project. In the end, the assumptions made during the project realization are described.

### 3.1 As-Is analysis

#### 3.1.1 Client on boarding process

Currently, a customer journey at Hospital CUF Porto may start in two different ways. As shown in figure 3.1, patients may go to the emergency department or schedule an appointment. In the emergency services, patients are seen and then referred to the specialty where necessary. Depending on the specialty and on availability of the doctors, this referral can end up being a consultation like any other scheduled appointments. Once they have been examined, these patients can effectively schedule appointments or examinations and start the continuous customer journey.

The other starting point — seeking a specific service and scheduling an appointment — is considered to be the most common approach. For the purpose of this project, only the appointments for consultations will be considered, since, at present, the goal is to analyze internal referrals between doctors and specialties. It all starts with a scheduling moment when someone decides to seek a certain healthcare service.

The next step is to contact the hospital and ask for a consultation for a specific specialty or doctor. As mentioned in the previous chapter, people usually have access and look for information before scheduling an appointment (Loria, 2018). Either by recommendation of a friend or relative, after checking online reviews or because it is a well-known doctor, patients may ask to be seen by a specific doctor and accept to be subject to his or her availability. If it takes too long, they will either go ahead with it and wait for the appointment date or seek another provider who can see them earlier. In case the patient does not have a specific doctor in mind, he or she may ask for the one that is available sooner, based on the opinion of the staff who answers the phone (in case the contact is made by phone) or simply choose one of the doctors who work in that hospital.



If the process is continued, the patient will go to the hospital on the day scheduled for the appointment and follow the defined procedures of checking-in, waiting in the waiting room and then being examined by the specialist. Then comes the payment step after which a reschedule procedure can take place. Rescheduling may be for the same specialty with the same doctor or alternatively for a specific colleague from another specialty.

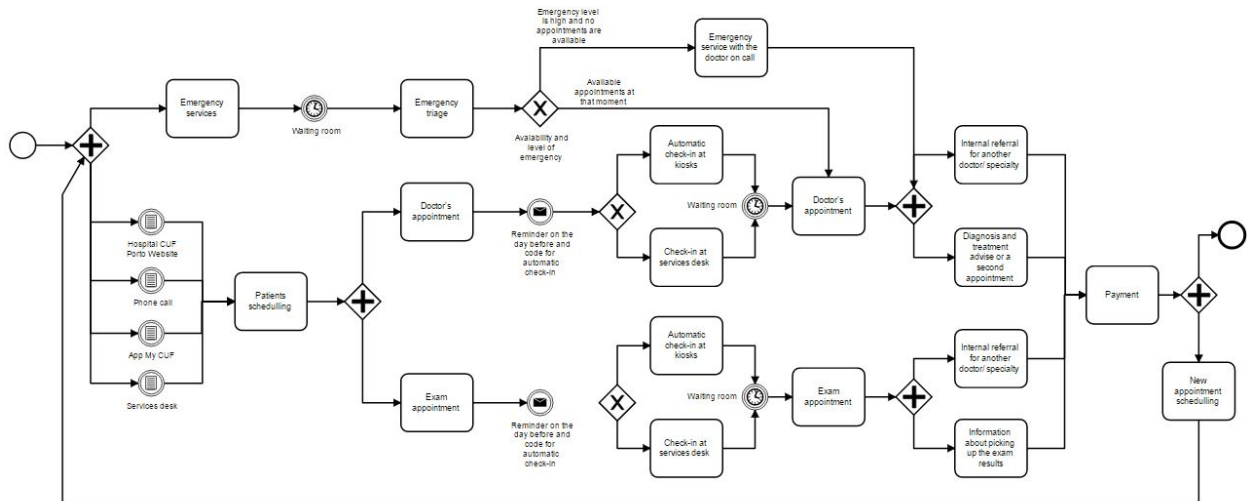


Figure 3.1: Business Process Model and notation (BPMN) of the Hospital CUF Porto.

Along with this journey at the hospital, there are several customer touch points. Even before the contact with the hospital facilities, a client gets in contact with CUF by consulting their website, phone call, friends recommendations, online reviews or advertisements (media and outdoors). During the scheduling moment, customers may use the app, website, call center or the service desk. After having scheduled an appointment for a consultation or an exam, customers receive a notification, reminding about the appointment giving details like the location within the hospital facilities and the code for automatic check-in at the available kiosks. Worth mentioning that in case a patient arrives late, the check-in has to be done at the service desk and in this case, the service desk is again, another customer touch point. The appointment is one of the moments of truth since the contact with the doctors, nurses or healthcare technicians are decisive for the future of the customer within the hospital facilities. Finally, the payment and the potential reschedule moment at the service desk. Apart from the contact during the appointment, it is evident that the service desk is a relevant customer touch-point.

### 3.1.2 Internal referral process

The internal referral process in this hospital consists of advising a patient to seek advice from another doctor. Evaluating this process is to measure the number of consultations that resulted from internal referral events, involving all specialties and physicians, in order to analyze the relationships established between the doctors, who refer patients to each other.

Usually, this referral process takes place when a doctor is unsure about the diagnosis or does not have sufficient resources to give the appropriate assistance and advises the patient to consult another colleague for a more complete examination. Another case is when a patient schedules an appointment bearing in mind a particular problem only to find out that it has to do with a different specialist area. In addition, some areas have doctors who are specialized in certain parts of the human body, so a doctor may refer his or her patients to the one dedicated to that specific part.

Furthermore, there are two types of internal referrals. A doctor might refer a doctor of the same specialty, a referral within the same specialty (RDE) or to a different one, a referral between specialties (REE). This is relevant since some specialties are highly related to others. The case when a patient set a new appointment with the same doctor is considered a subsequent appointment.

A key factor for referrals is the availability of a doctor, because the longer it takes to get a commitment, the greater the likelihood of losing it and rescheduling it with another provider, reducing the efficiency of the referrals made. Another important factor is the time it takes the patient to schedule the new appointment after the referral time, which would preferably be at the time of payment of the consultation where an internal referral may have occurred. All of the above factors are assessed through perceptions. For example, people easily realize that Physical Medicine and Rehabilitation are highly dependent on Orthopedics or Trauma, without having an analysis done, with concrete and measurable values.

### **3.2 To-Be analysis**

Presently, there is not a strategy or specific procedures to accurately calculate metrics and study both hospital performance and internal referrals. The goal is to develop and define appropriate metrics and a tool to visualise these metrics and their evolution over time.

By creating this tool, it is possible to benchmark services and doctors against their peers within the hospital. As a result, this tool will enable the management control team at CUF to obtain further information on internal referrals, and discover patterns such as typical relationships between medical specialties and trends in doctors behaviour concerning referrals.

With the knowledge gained, it will be possible to intervene and take the necessary measures towards performance improvements. In addition, since the number of internal referrals per specialty and doctor will be disclosed, the Production Management department will have useful information for advising chief of services and doctors towards the overall process improvement. As mentioned in section 1.3, internal referrals in the private sector of health providers are crucial for customer retention and profits growth.

### **3.3 Assumptions**

Like any research project, in order to make this analysis possible, the following assumptions were made.

For classifying internal referral events, a time frame of 20 days between a previous appointment and scheduling the following was accepted to be reasonable. Therefore, if the time difference between an appointment and the moment of scheduling another a referral event is equal to or less than 20 days, a potential referral event is considered to have taken place. People can meet this deadline of 20 days when it comes to scheduling a new appointment as a result of a relative or a friend advising them to do so instead of a referral made by a hospital doctor. However, there is no specific information to allow for the distinction between these two possible reasons for a patient to reschedule, and therefore some of the possible referrals considered as such may have resulted from referral outside the hospital or even a decision of the patient to schedule a new appointment unrelated with the previous consultation held at Hospital CUF less than 20 days before.

Moreover, if these two moments occur on the same day, beyond from a referral event, it is believed that the scheduling method was in person at the hospital's service desk.

Lastly, despite the fact that consultations in the emergency room are considered as moments during which potential referrals may occur, it was considered that there is no referral event when a patient attends a consultation and the following financial results result of a visit to the emergency department.

## Chapter 4

# Project outcomes

After analyzing the As-Is and To-Be scenarios, it is possible to define the following steps for the final solution, the dashboard creation. This section starts with the performance metrics definition that will be used by the Production Management department to control and assess the internal referral process performance. Next, the data analysis clarifies the available database and the related attributes. The initial data treatment and the programming procedures in order to get the final database are defined in the following section. In the end, with a suitable database, it is possible to create the dashboard and an explanation of the features is given.

### 4.1 Performance metrics definition

Considering the literature review and the examples given about the implemented KPI in health-care facilities, different performance metrics were delineated not only to assess the overall hospital performance but also for assessing and controlling the performance of the internal referral process. Moreover, it is expected to find potential relationships and patterns about patients' behavior, specialties, and doctors' methods, in order to develop strategies to improve the services that the hospital offers. Another goal is to structure a comparison system for future reports.

The metrics are classified into different dimensions of the hospital performance, related to appointments, the scheduling method, patients, overall service and the internal referral processes. All metrics are represented in table 4.1.

- **Appointments**

The main goal of metrics related to appointments is to give insights about the total number of appointments of the considered specialties provided by the hospital and compare to the same value of homologous time periods and check if significant variations have taken place. It is possible to classify appointments into first time appointments or not first appointments. A first time appointment is defined as the first consultation with a specific doctor within a specific specialty. In addition, in the light of internal referrals it is possible to analyze their origin. Actually, first appointments may result from RDE or REE events or in case

Table 4.1: Standard and referrals metrics.

	<b>Performance metrics</b>
Appointments	Number of appointments First time appointments Subsequent consultation (SC)
Scheduling method	Appointments scheduled at the service desk Appointments scheduled using other scheduling methods
Patients	Number of patients Patients' average age Time between previous appointment and new scheduling
Service	Waiting time for an appointment
Internal referrals	Potential internal referrals within the same specialty (RDE) Potential internal referrals between specialties (REE) Total referrals

the time frame between the previous appointment and the new scheduling moment is higher than 20 days, result from other causes, not related to internal referrals. On the other hand, appointments that are not first time events, may result from internal referrals (RDE and REE) or not. In addition they can be classified as subsequent consultations and in this case the appointments are not considered as being the result of potential internal referrals. This classification is illustrated in figure 4.1.

**Number of appointments:**

$$\begin{aligned}
 \text{Number of appointments} &= \sum \text{First time appointments (Flag = S)} \\
 &+ \sum \text{First time appointments (Flag = N)}
 \end{aligned}
 \tag{4.1}$$

**Subsequent consultations (SC):**

$$SC(\%) = \frac{\sum \text{Appointments (same patient, same doctor)}}{\text{Number of appointments}}
 \tag{4.2}$$

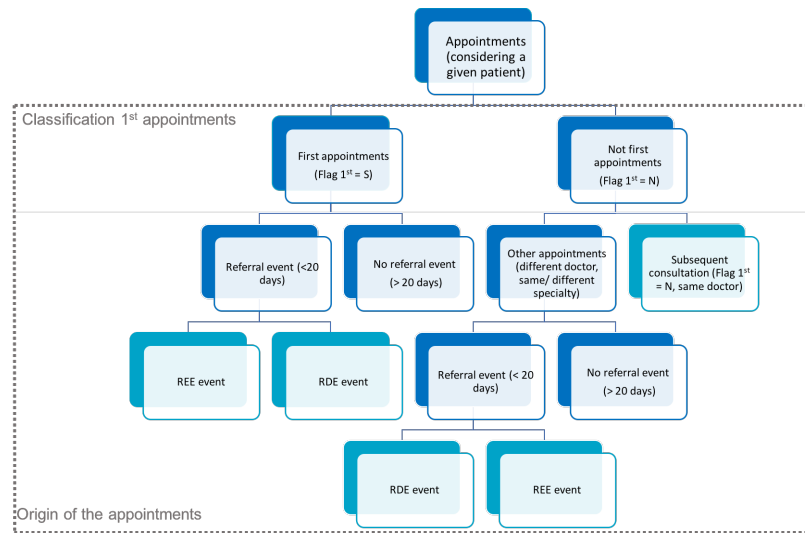


Figure 4.1: Distribution of the appointments and their origin.

- **Scheduling method**

Metrics that assess the employment level of the available methods for scheduling appointments at the hospital is useful to analyze the patients' preferences and improve strategies to enhance less used methods and maintain the others.

- **Patients**

Calculating the number of the patients and the average age allows to gather information for customer segmentation and develop targeted initiatives for the age ranges, according to their demand and characteristics. In addition, considering the time between an appointment and scheduling a new one is important for analyzing people's behavior. The longer it takes from the referral moment to schedule another appointment the less are the chances of scheduling it, resulting in lower levels of internal referrals events. For instance, in case the time difference between these two moments is long, with these values it is possible to advise staff to recommend patients to schedule new appointments during the payment moment.

**Patients' average age:**

$$Patients' average age = \frac{\sum Patients' age}{Number of patients} \quad (4.3)$$

**Time between previous appointments and new scheduling:**

$$Time between previous appointment and new scheduling = \text{Scheduling date} - \text{Previous appointment date} \quad (4.4)$$

- **Service**

One of the metrics for assessing the hospital responsiveness is the average waiting time (in days) for an appointment. In fact, the longer it takes to get a consultation with a certain doctor, the more likely the patient is to look for another provider.

**Waiting time for an appointment:**

$$\text{Waiting Time for an appointment} = \text{Appointment date} - \text{Scheduling date} \quad (4.5)$$

- **Internal referrals**

As stated in section 2.5, assessing internal referrals have become a target. With lower number of potential referrals events the total number of appointments is expected to decrease.

The number of internal referrals for a different specialty (REE) gives information about the relationship between specialties since higher numbers of REE result in stronger relationships between the involved specialties.

Finally, collecting information on the number of referrals received and carried out between specialists and physicians allows comparing these two metrics with the total number of appointments and verifying if there are measures necessary to increase the number of internal referrals and consequently the number of appointments of a given doctor or specialty, within a specific time frame.

**Potential internal referrals within the same specialty (RDE):**

$$\text{Potential RDE} = \sum \text{Appointments (same patient, scheduled } \leq 20 \text{ days after the previous appointment, same specialty, different doctor)} \quad (4.6)$$

**Potential internal referrals between specialties (REE):**

$$\text{Potential REE} = \sum \text{Appointments (same patient, scheduled } \leq 20 \text{ days after the previous appointment, different specialty)} \quad (4.7)$$

**Total referrals (REE and RDE):**

$$\text{Total referrals} = \sum \text{Potential RDE} + \sum \text{Potential REE} \quad (4.8)$$

All these metrics were defined in the sense of evaluating and controlling the internal reference process and registered in a new database with the purpose of being included in the created dashboard, as will be shown in the following sections.

## 4.2 Data analysis

For this project, 170637 records extracted from the financial records was used, considering appointments during the first semester of 2018. Each entry is made up of the data on the patient, the doctor, specialty and finally the appointment. In the light of the modelling language (Borges et al., 2015), all classes, attributes and methods are represented in figure 4.2.

Beginning with the patient class, it encompasses the personal identification code and the date of birth. With these two attributes, it is possible to define the patient's age group. About the doctor, this is a class with two attributes, the identification code and the doctor's name. Regarding specialty, this is a class that incorporates the service code and its description, since a certain service may be scheduled or results from an entry in the emergency department.

The last class is the engagement event. Each appointment includes the day of the scheduling moment, the appointment day, the service that was provided, and a flag in case the patient schedules an appointment for a certain specialty and doctor for the first time.

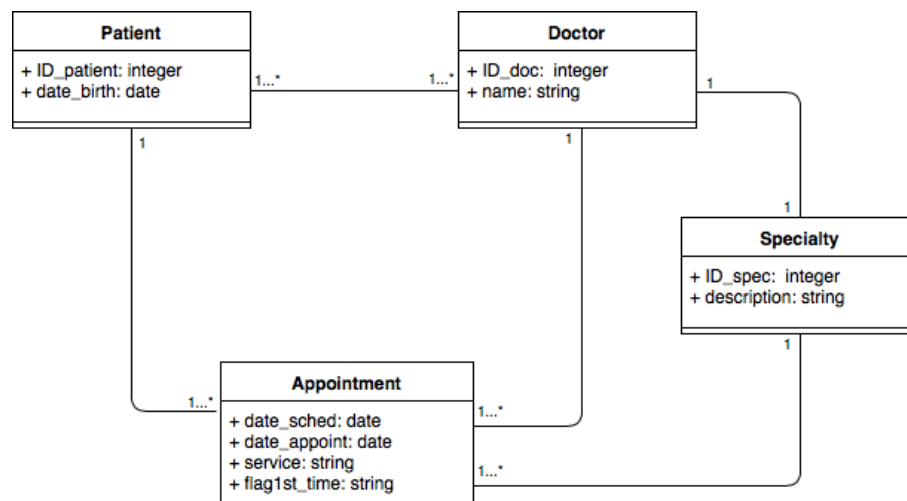


Figure 4.2: The Unified Modelling Language (UML) diagram of the available database of the patients' records.

For the calculation of the metrics, the tools used were Microsoft Office Excel and its programming language named Visual Basic for Applications (VBA).

Considering the previous assumptions, several methods were created. First, it was necessary to create methods for modifying the data format since the given one was a string with a different notation. This was done for the date of birth, the appointment and the scheduling dates. After formatting the dates fields, it was possible to define the Patients' age, a new attribute named "Age" and the period of time between the scheduling moment and the appointment day, specified as "TimeSchedAppoint".

The second step was to analyze all data and define loops for defining an array with the position of the first record of each patient and then the criteria for internal referrals scenarios was included.



Starting with the defined time frame for assessing potential internal referrals events, the first criteria was the maximum 20 days between the previous appointment and the moment of scheduling the following. This time frame is assigned to the attribute "TimePrevAppointSchedNext". Then, the analysis of the specialties and doctors allows to differentiate subsequent consultation (SC) from referrals to the same specialty (RDE) or to another one (REE). These values characterize one of the new attributes, the "Referral type". Noteworthy that in case a patient attends the emergency department the previous appointment is not considered as a potential referral event. Besides the referral type, the doctor who made the internal referral and the related specialty are expressed in two distinct attributes, accordingly "RelDoc" and "RelSpec".

Regarding the scheduling method it was considered that if the time frame between between the previous appointment and the moment of scheduling the following is zero it was probably scheduled on the day of the referral event, at the service desk of the hospital. Otherwise, it results of another scheduling method among the available methods, the website, the app or by phone call. These values define an additional attribute, "Method".

These conditions result in new attributes that support the input for the final goal, the dashboard. These attributes, shown in table 4.2, were the following: patients' age, waiting time for an appointment, related specialty, related doctor, referral type and the time between previous appointment and scheduling the next one. The related specialty and doctor give information about the circumstances of the referral event, who made the referral and the specialty of that doctor.

Table 4.2: Additional attributes for the input database of the dashboard.

<b>Attribute</b>	<b>Description</b>
Age	Patients' age (years)
Method	Scheduling method (Service desk or others)
Referral type	Nature of the referral (RDE or REE)
RelDoc	Doctor who made the referral
RelSpec	Specialty in which the referral was made
TimeSchedAppoint	Time period between scheduling day and the appointment day (days)
TimePrevAppointSchedNext	Time period between the potential referral event (previous appointment) and scheduling the next one (days)

In the end, a more complete data table was created since the performance metrics cannot be obtained straight from the database. The classes and methods of this new database are illustrated in figure 4.3. The main differences between the original database, represented in 4.2 and the final version are the class "Referral" that includes the referral type, the doctor who made the referral and his or her specialty.

By considering the patient and an appointment it is possible to define the number of appointments per patient ("nr\_appointm\_patient") addition to the appointments that resulted from referral events ("nr\_referral\_appointm"). On the same way, by focusing in the doctor and the appointment

it is possible to obtain the number of appointments per doctor ("nr\_appointm\_doc") and the waiting time for an appointment per doctor ("timetoappoint\_doc"). Also, by considering referrals it is possible get the number of referrals received ("nr\_referral\_doc") and made ("rel\_doc"). In respect to specialties, the same approach of the doctor is possible and results in the number of appointments and referrals made/ received per specialty and the waiting time for an appointment in each specialty.

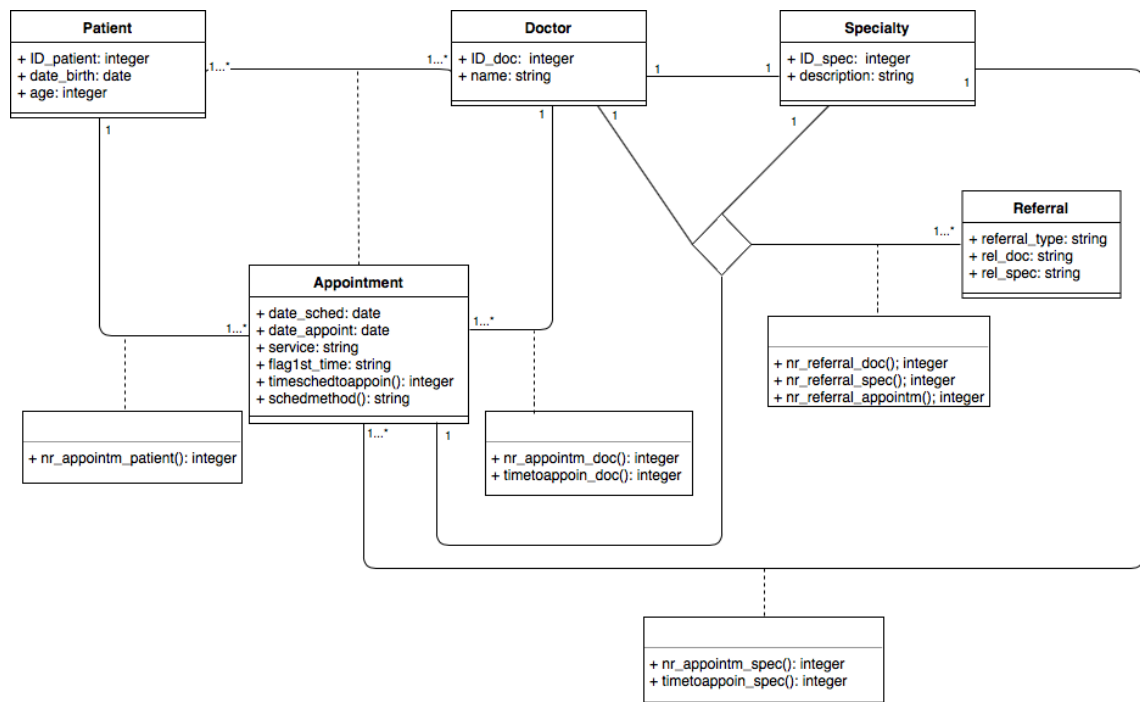


Figure 4.3: The Unified Modelling Language (UML) diagram of the developed database of the patients' records.

This process of analyzing the original database, creating the related UML, defining the criteria for the analysis, writing the VBA code to obtain the final database, characterized above with the new UML is represented in figure 4.4.

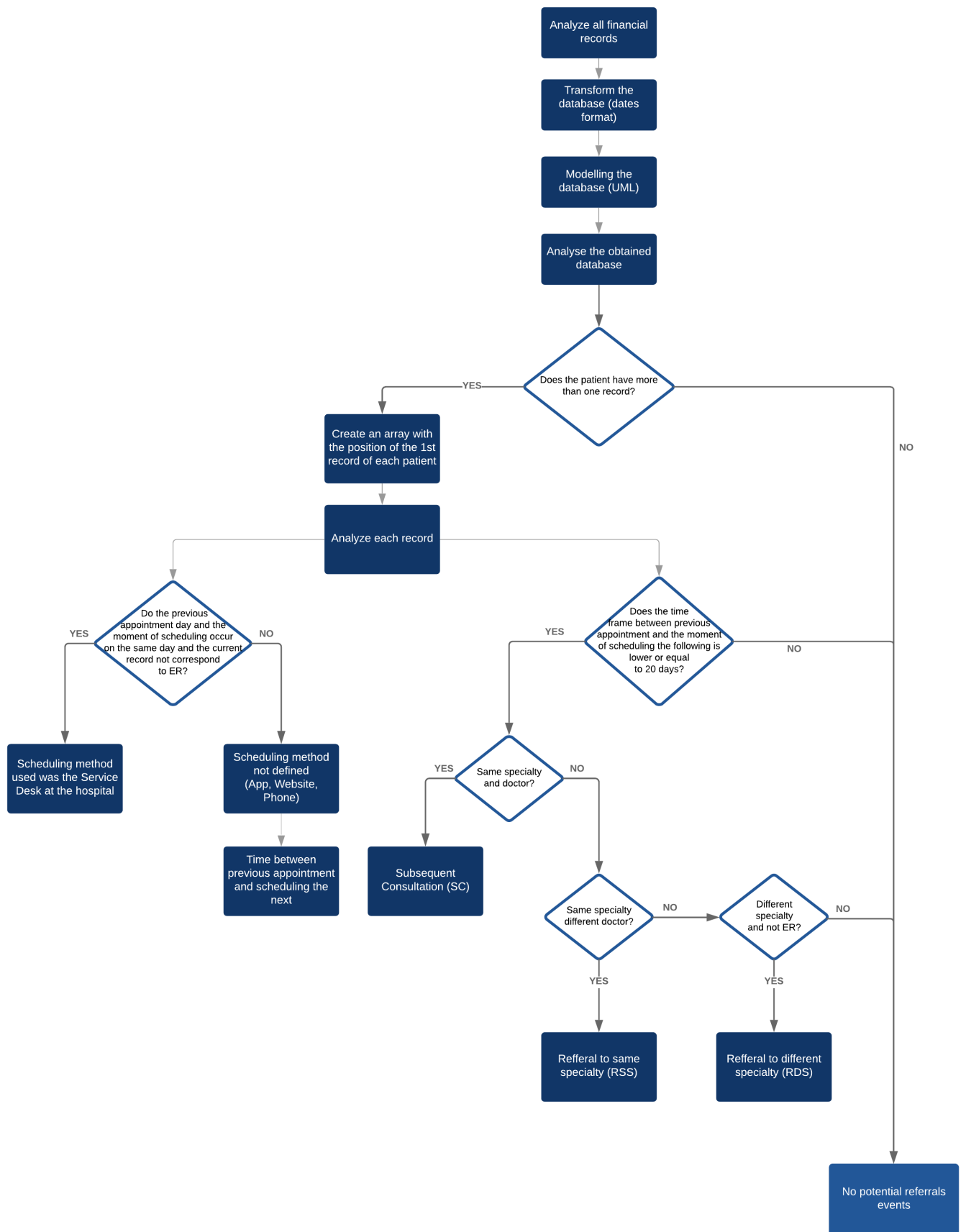


Figure 4.4: Flowchart of the analysis of the database and conditions used in the VBA code.

## 4.3 Dashboard

Creating a platform where all performance metrics are disposed and easily conferred during performance evaluation meetings is the goal. Nowadays, two of the most used dashboards are Tableau and Microsoft Power BI. Once the University of Porto has the license of the latter, the software chosen for the creation of the dashboard was Microsoft Power BI.

One of the crucial points when implementing new solutions in companies or service providers is taking into account their opinion, requirements and expected outcomes during the development stage. Hence, the designed dashboard was created always considering the opinion and needs of the production department and the head of the department feedback. In addition, it was designed in Portuguese due to internal procedures, inherent to the hospital.

### 4.3.1 Power BI features

Microsoft Power BI is a business analytical tool that provides a complete vision giving direct insights about businesses performance. It is available in a free version and there is also a pro version, only for Windows. The main difference between these two is the possibility of sharing and controlling access to the reports.

This tool offers three main features: datasets that allow to integrate different data files, dashboards characterized as interactive tabs based or not in distinct data that enable direct comparisons, and reports that display strategic and important information. In addition, there is a navigation pane that enables to change views between the above-mentioned features, a question and answer box to analyze the available data in a user-friendly way in order to find the expected answer.

Power BI stands out among similar tools due to its ease of use since the platform is identical to Microsoft Excel, used worldwide and to create a visualization the user just need to select a visual or drag the fields to the report/dashboard. Moreover, useful and extensive learning materials are provided by Microsoft so everyone is able to learn how to work with Power BI without specific workshops or training programs.

In terms of compatibility, due to the fact that is a tool designed by Microsoft, it is suitable to use with data sources such as Microsoft Excel, Azure, and the SQL Server. From the perspective as an outcome, the projects can be published on the web and it is appropriate for Windows, Android and iOS.

Considering the classification of the features presented in section 2.4, Power BI offers a wide variety of visual and functional features. Starting with the visual, there is an extensive visualizations pane, with 29 different options in addition to customized visuals. There are stacked bar/column charts, clustered, line and areas charts for comparisons over time and the combination of them like the stacked line chart. Furthermore, there are ribbon charts that allow to directly identify the highest values and trends, waterfalls chart used for comparing initial values and their evolution and the traditional doughnuts and pie charts. The charts that are more attractive are the funnel charts useful for analyzing bottlenecks, the treemaps that change categories size depending on the values, the gauge and KPI charts for progress analysis and the map charts, that combines data with

locations. There are cards for displaying single values, matrixes, and tables. All of these visuals can be customized for the axes, scales, colors, shapes, captions, labels, titles, and backgrounds using the format option.

In respect to functional features, the drill down option, slicers, and filters for controlling the displayed data, the interactivity between tabs and visuals such as the simplicity of clicking on a part of the charts and highlighting that attribute in other visuals and moving the cursor over points or bars and get more detailed information, are examples of the functional features since it is about interacting with the visuals.

### **4.3.2 Developed dashboard**

The designed dashboard contemplates four different tabs: Hospital, Specialty, Doctors and Internal referrals. Besides, for confidentiality reasons, two dashboards were created, one version with all original data including doctors' names, only accessible for the hospital staff and an encrypted version available online, with controlled access, using the following link: <https://app.powerbi.com/groups/me/reports/13d6abeb-21dd-4881-8252-a90868402e72?ctid=b7821bc8-67cc-447b-b579-82f7854174fc>.

All tabs are described starting with the purpose of the analysis, an explanation of the contents of the tab followed by an example of a possible analysis.

#### **4.3.2.1 Hospital performance overview**

The main goal of this tab is to provide the Production Management department a general assessment of the hospital. This tab is represented in 4.6.

First, the user can define a time frame for the analysis using the slider for gathering information about specific time periods. In addition, there are three more filters, defined as slicers, for the user to select one or multiple specialties, doctors or patients by their ID. This way, the user is able to visualize the related information of certain specialties, doctors or patients.

Second, five cards are displayed, giving insights about the number of appointments, patients, patients' average age, the average waiting time for an appointment and the average period of time between an appointment (potential referral moment) and the new scheduling moment. As stated in the previous section, when the user select concrete fields in the slicers, the information of the cards is updated according to the employed filters.

Furthermore, there are two treemaps, one for the first appointment analysis, with two available fields that follow a Yes/ No classification. Likewise, the scheduling method (Service desk or Others) is represented using the same type of chart. Also, a doughnut chart illustrates the distribution of the number of appointments by the origin of the appointments, resultant from a referral between specialties (REE), resultant from a referral within the same specialty (RDE) or in case a patient schedules a new appointment with the same doctor, a subsequent consultation (SC). This distribution is considered due to its interest for the analysis of internal procedures. Lastly, there is

a stacked column chart to display the evolution of the number of patients over the first semester of 2018.

Worth mentioning that the referred graphs also work as filters which means that by selecting one of the sides of the treemap or a column in the stacked chart or a part of the doughnut chart, all other visuals are filtered and the correspondent values are highlighted.

As an example, by dragging the slider including data of the first quarter, selecting Cardiology and doctor 21 in the corresponding filters, the total number of appointments is 292, addressed to 260 patients with an average age of 67,92 years. On average, a patient waits 18,77 days from the scheduling moment until the appointment day and schedules a new appointment 17,34 days after the previous appointment. From all appointments, 41% were classified as first appointments and 25% were scheduled at the hospital service desk. Regarding the distribution of the appointments into subsequent appointments or that resulted from internal referrals, 7,5% resulted from referrals within Cardiology, 17,5% were subsequent appointments and the majority, with 75%, resulted from referrals from other specialties, as the following figures shows. In the end, the month with the highest number of appointments was January. By changing the filters it is possible to seek for other results with different filters or even the full picture when no filters are selected.

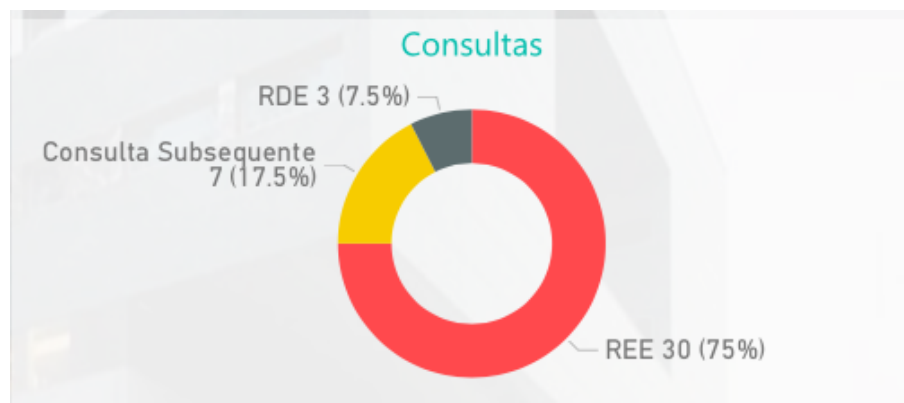


Figure 4.5: Distribution of the appointments, according to their origin, within Cardiology and considering doctor 21.

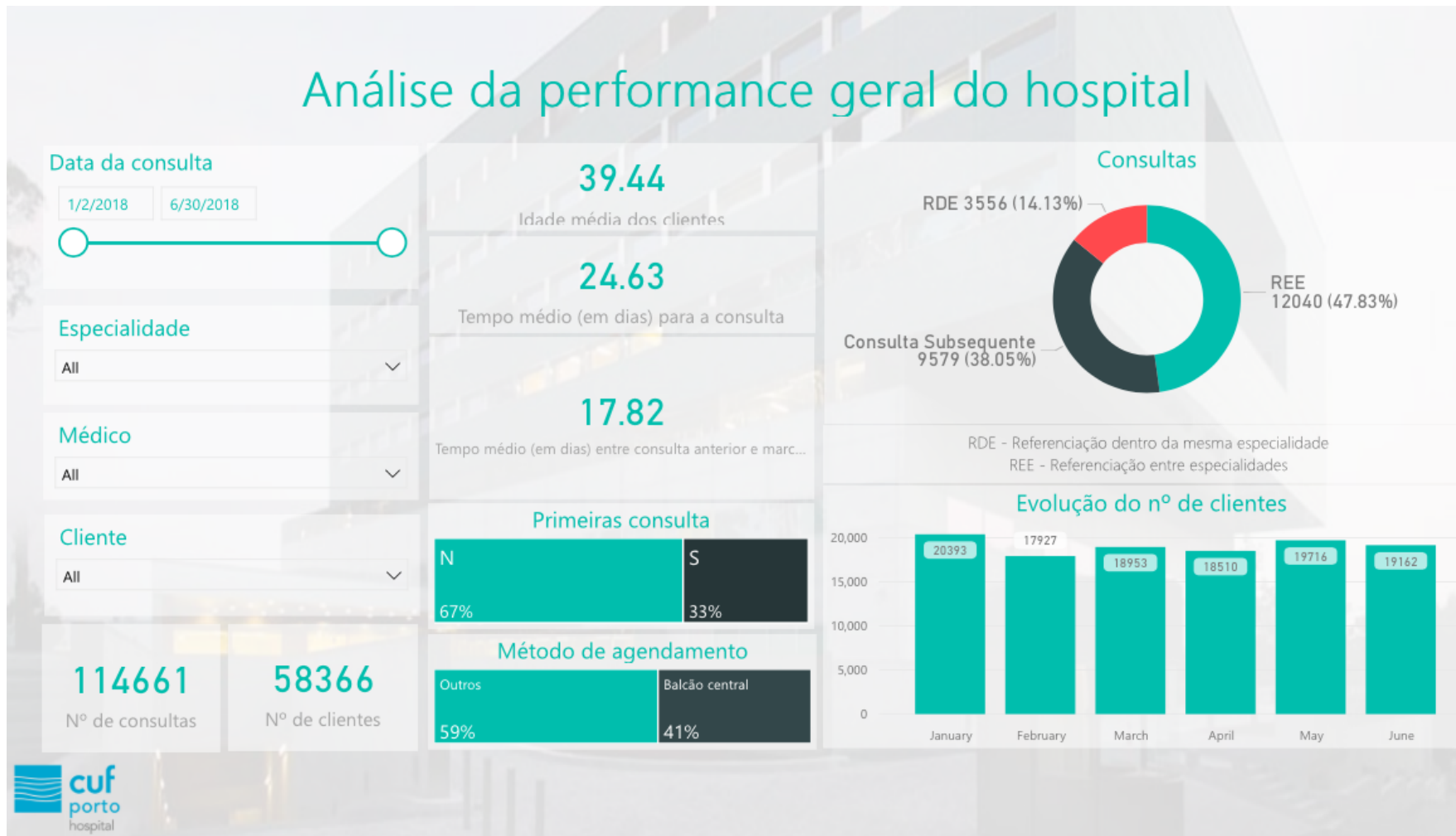


Figure 4.6: First tab of the developed dashboard - Hospital overview performance.

#### 4.3.2.2 Benchmarking between specialties

Comparing different specialties with regards to the number of appointments, average waiting time for an appointment and the average time that patients take from an appointment to schedule a new one, is useful since specialties with a vast number of appointments and longer waiting times should be analyzed in order to find a solution to increase the supply service level delivered by hiring new doctors of the critical specialties or by suggesting their doctors to increase their linkage to CUF by offering new conditions.

As created for the hospital tab, there are three main filters: time frame, specialties, and doctors. Again, you can choose more than one field from the last two filters. The slicer specialty is highlighted since this tab was designed towards a benchmark approach between specialties. Although, the filter doctor is available in order to allow to select one or more doctors of a given specialty. This is useful for investigating cases when specific doctors behave as outliers among the others of the same specialty.

Also, two cards with the number of appointments and the number of patients are available at the bottom left corner of this tab. These cards are used as reference values when analyzing other visuals.

In this tab, it is possible to get an overview of the specialties with more or fewer appointments and then select specific specialties for direct comparisons. Funnel charts are useful to get clear information in this case about the number of appointments of specialties as represented in figure 4.7. Therefore, besides the funnel chart for the number of appointments, more two funnel charts are used for the average waiting time and average time difference between an appointment day and a new scheduling event. It is worth mentioning that these visuals also work as filters and the user just need to select one of the bars of the funnel to highlight that specialty in other visuals in addition to obtaining the corresponding values of the cards.



Figure 4.7: Number of appointments of the specialties top 15.

By considering the visual of the number of appointments the user has the capability to know



the five specialties with more appointments and using the specialty slicer is able to get the related values of the average waiting time and the time to schedule a new appointment and compare them.

For example, if the user selects the following specialties: Dermatology, Family Practice , Internal Medicine, Obstetrics Gynecology, Oncology, Ophthalmology, Orthopaedics, Otolaryngology, Pediatrics, Psychiatry, Surgery-General, and Urology, it is possible to get all information regarding number of appointments, being Orthopaedics the specialty with more appointments, precisely 17166 and Oncology with 3225 appointments, being the specialty, from the selection, with less appointments. Concerning the waiting time, Pediatrics present their patients longer waiting times, an average of 42,48 days. In addition, the patients who are cared for in Family Practice services are those who take longer to make a new schedule, 27,59 days on average. With a substantial number of appointments, Pediatrics waiting time can be a concern and strategies to overcome the obtained results might be studied. In fact, this is one of various analysis that can be held using this tab. All these specialties involved 92127 appointments and 49334 patients during the first semester of 2018. This analysis is reflected in figure 4.8.

# Consultas e tempo de espera - Benchmarking entre especialidades

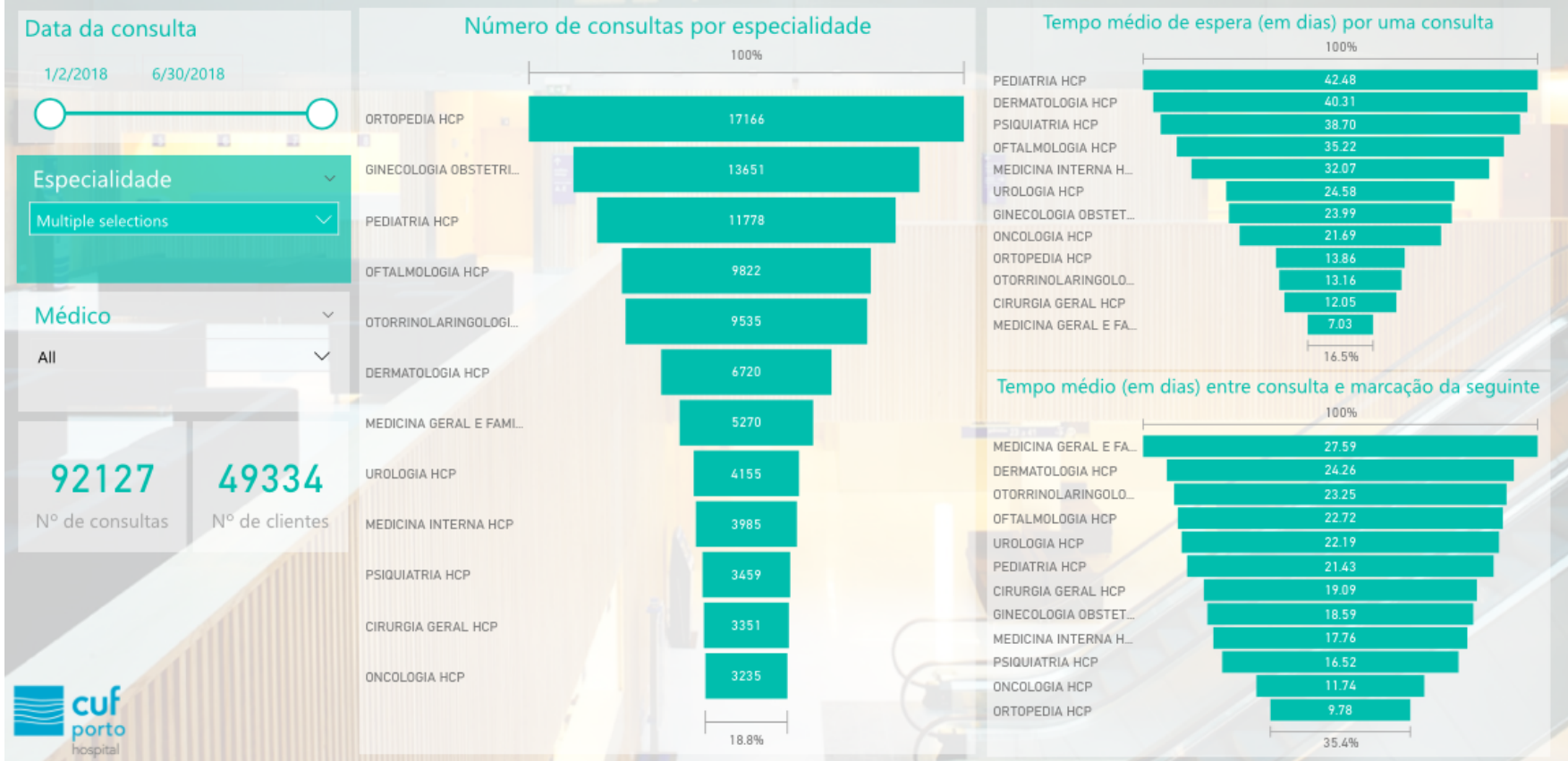


Figure 4.8: Second tab of the developed dashboard - Benchmarking between specialties.

### 4.3.2.3 Benchmarking between doctors

Analyzing the number of appointments and respective average waiting time for each doctor is crucial, especially when doctors have different linkages to the hospital and as a result distinct availability for appointments. Moreover, doctors also face different levels of demand on the part of patients, depending for instance, on brand equity as stated in section 2.5.2.3. Therefore, comparing doctors from different specialties and doctors within the same specialties is important to manage doctors' availability, their linkages to the hospital and the number of doctors. Ultimately, this analysis leads to improved customer services by meeting patients expectations when looking for a concrete doctor or specialty.

Following a homogeneous approach as section 2.4 recommends, this tab contains exactly the same visuals and settings, examining data of the doctors instead. As a matter of fact, there are the same three main filters: time frame, doctor and specialty. Now, the highlighted slicer is the doctor. The central data, like the previous tab, is displayed in three funnel charts. Likewise, functionalities such as select a section of the visuals and filter other visuals can be applied.

There are two possible approaches when interpreting doctors' tab. First, the user can select one and get information concerning that doctor or select several doctors to compare their number of appointments, the average waiting time and time to a new schedule with that doctor after a potential referral event. The second approach is to compare doctors within a specific specialty in order to expose doctors with better performance and outliers within the same specialty. Sometimes, considering multiple specialties may be valuable too. The elected approach depends on the target of the analysis.

In order to illustrate one of the approaches, an analysis focusing in Cardiology is made. Considering the first semester of 2018, eleven doctors are displayed. From the 2096 appointments distributed among 49334 patients, doctor 21 was the one with more appointments, 451 to be exact. With a difference of 398 appointments, doctor 330 conducted 53 appointments. In respect to the average waiting time, as figure 4.9 exhibits, the second doctor with the highest value for this metric is doctor 21, with an average value of 37,82 days.

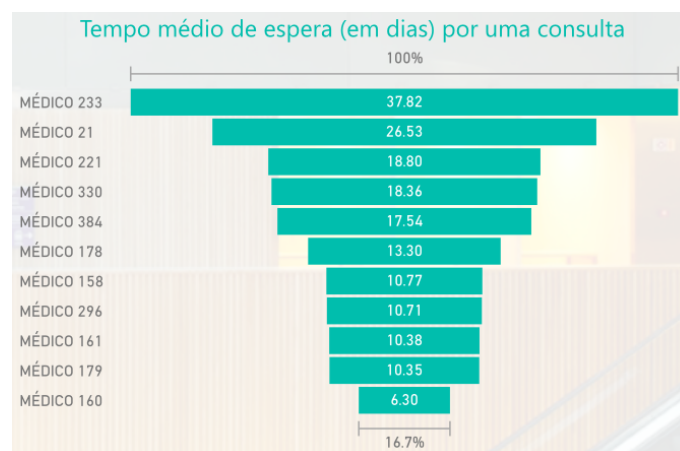


Figure 4.9: Average waiting time for an appointment in Cardiology, per doctor.

On the other hand, doctor 160 stands out since holds the second place of the number of appointments whilst being the doctor with the least average waiting time, 6,30 days. Probably, this doctor has a stronger linkage to the hospital. This tab is illustrated in figure 4.10.

This is the type of analysis that the tab provides. Being the doctor with more appointments, strategies for reducing the waiting time of this distinguished doctor can be taken. Eventually, patients who face longer waiting times might end seeking healthcare services at other private or even public providers. Accordingly, this is an important analysis for customer retention. Finally, on average, patients take longer to schedule a new appointment with doctor 179, after a referral event.

# Consultas e tempo de espera - Benchmarking entre médicos

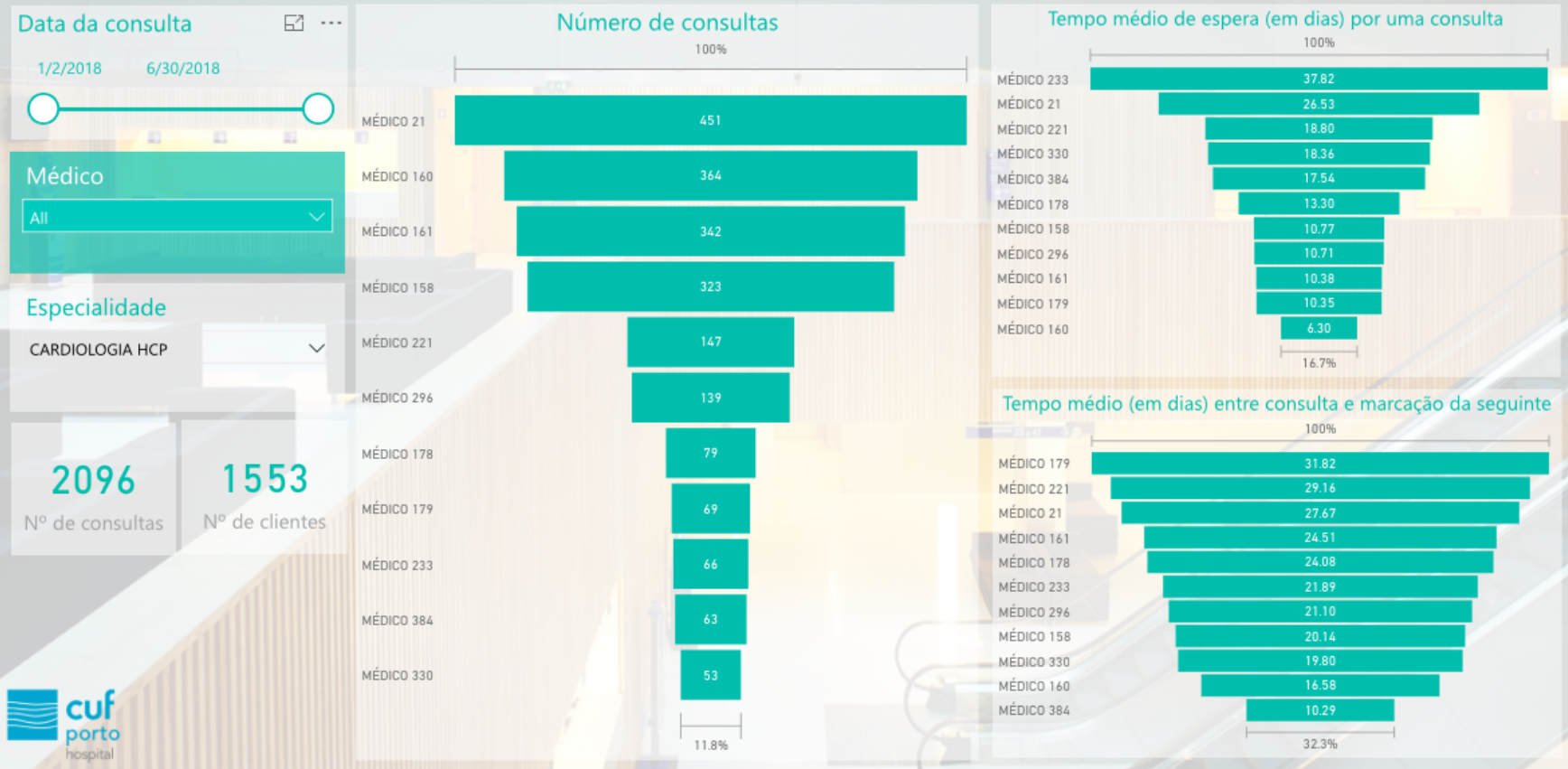


Figure 4.10: Third tab of the developed dashboard - Benchmarking between doctors.

#### 4.3.2.4 Internal referrals

The last tab affects the internal referral process. Some specialties are connected to each other. Uncovering these dependencies among specialties is relevant for more efficient services (Qashri et al., 2017). Furthermore, there are doctors of certain specialties like Physical Medicine Rehabilitation that highly depend on referrals from Orthopaedics. As stated before, doctors have different linkages levels to the hospital or are simply not used to refer others or even do not know which doctor to refer to in certain situations. There are several reasons that lead to a reduced number of referrals and consequently loss of potential appointments of certain specialties.

Due to its complexity, the structure of the tab is unquestionably different, there is a common filter though, the time frame. Describing all other visual aids in this tab, two cards show the number of appointments that resulted from referral events and the number of patients. Internal referrals are characterized by a doctor from a concrete specialty that refers to a doctor within the same specialty (RDE) or to another specialty (REE). Therefore, the user has two plausible approaches to interact with the tab. It is possible to analyze the process from the perspective of the origin of the referral or from the perspective of the target of that referral. To enable the analysis through these perspectives, there are two treemaps that incorporate data on physicians and specialties and the number of referrals involved. On the top of both treemaps, there are two filters for each that allow the user to pick the specialty or/and the doctor that made/receive the referrals that will be valued. These filters are represented in figure 4.11.

Noteworthy that the treemaps only display the referrals between specialties (REE) due to the nature of the filters that when the user select a specialty as the origin, the same specialty is not included in the target specialty. The analysis of the internal referrals within specialties (RDE) it is enabled in the "Hospital" tab in the doughnut chart, represented in section 4.3.2.1.

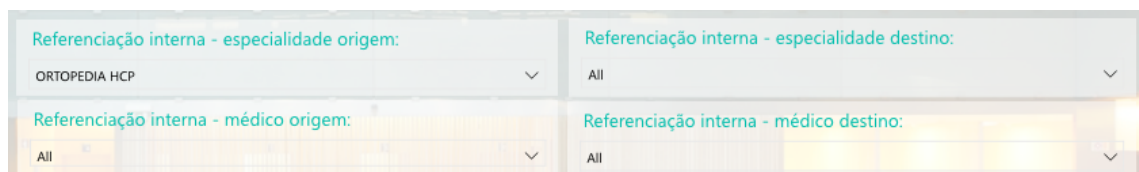


Figure 4.11: Filters for the internal referrals analysis.

As an example, Orthopaedics is selected as the specialty that makes the internal referrals and Physical Medicine and Rehabilitation is defined as the target specialty. This is exemplified in figure 4.13. From the cards, it is possible to know that 119 internal referrals were made to Physical Medicine and Rehabilitation from orthopedists, involving 109 clients. The instant analysis that stands out is that the orthopedist named doctor 11 is the one who most referred the other specialty, 21 times, during the first semester. On the same way, the most referred doctor from Physical Medicine and Rehabilitation was doctor 156, referred 95 times. When interacting with the dashboard it is possible to highlight information by clicking on the parts of the treemaps as figure 4.12 shows. For instance, doctor 11 referred 14 times the doctor 156 and the remaining 7 referrals were made to doctor 239.

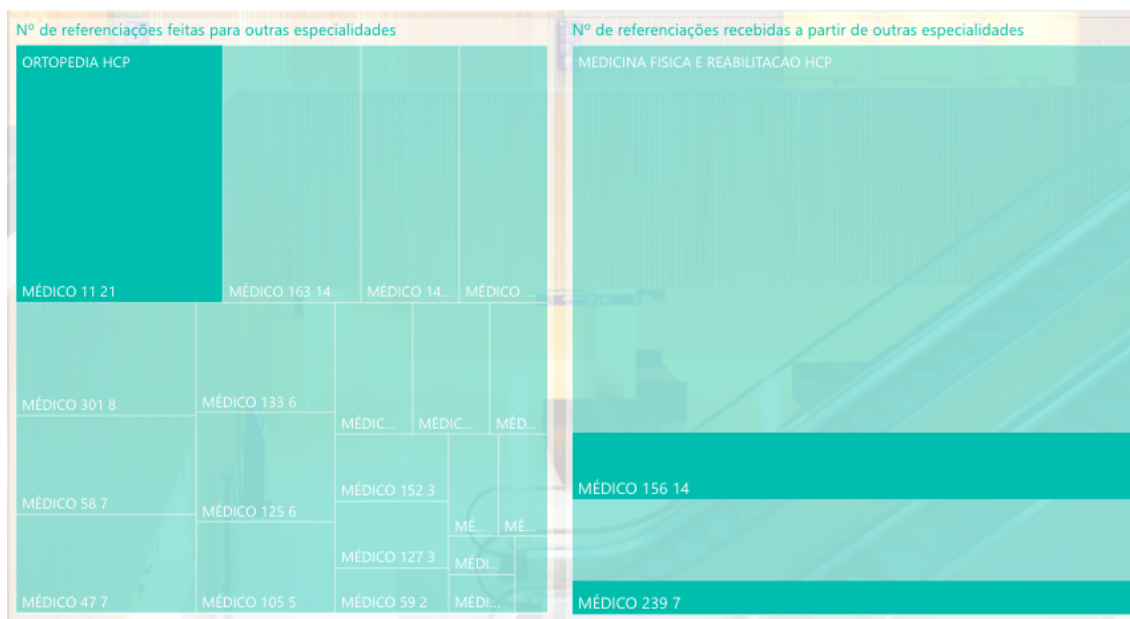


Figure 4.12: Referrals made from a concrete doctor to a given specialty and its doctors.

Another example is illustrated in figure 4.14, selecting Internal Medicine as the specialty that makes referrals and all specialties that had been referred during that time frame. From the perspective of the Internal Medicine, this specialty referred other specialties 366 times, advising 295 patients to make new schedules in other specialties and that doctor 4 is the one who made more referrals. It is also possible to visualize that Orthopaedics was the most referred specialty and that doctor 47 was the orthopedist that was referred more times. Followed by Urology and Otolaryngology.

The idea of these treemaps is to get the full picture of the established relationships between specialties and also among doctors. Then if required, it is possible to narrow down the analysis focusing on given specialties or concrete doctors using the filters or clicking on the parts of the treemaps.

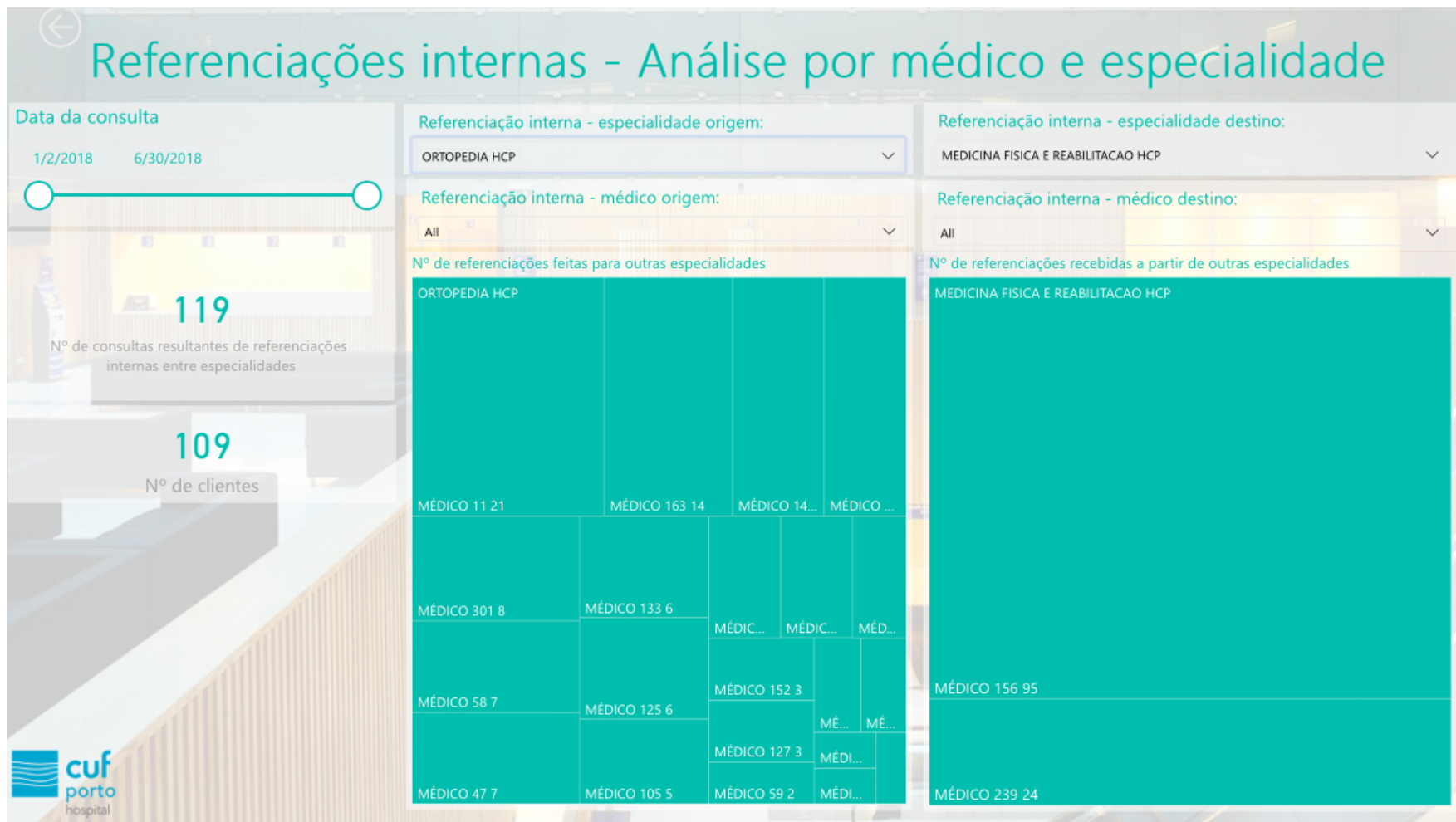


Figure 4.13: Fourth tab of the developed dashboard - Internal referrals from Orthopaedics to Physical Medicine Rehabilitation.



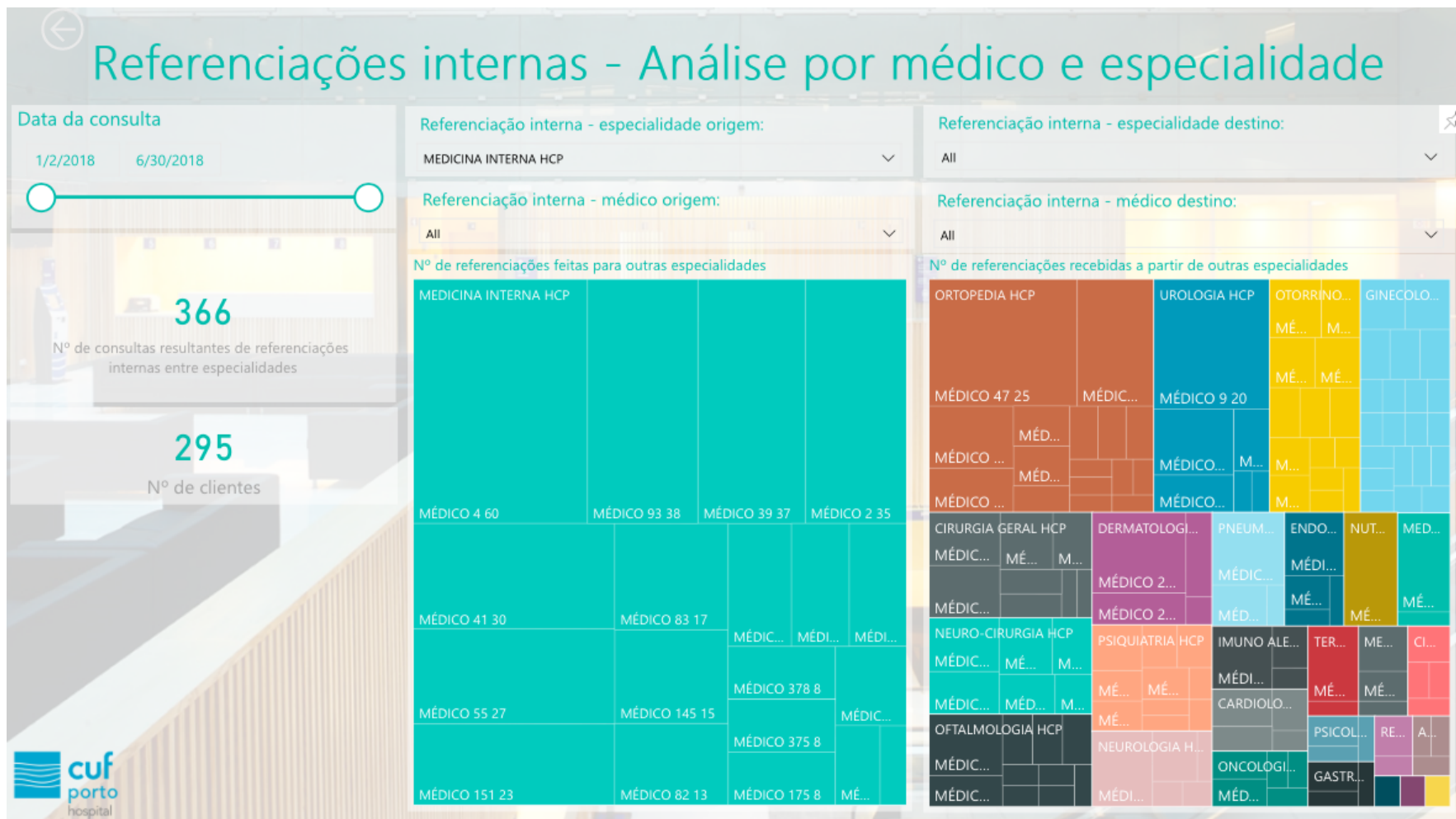


Figure 4.14: Fourth tab of the developed dashboard - Internal referrals from Internal Medicine to other specialties.

## Chapter 5

# Final statements

### 5.1 Conclusions

For private healthcare providers customer retention is vital and internal referrals are a key process when it comes to retain patients and increase their loyalty to a certain hospital. By considering PRM initiatives and closely follow patients during their customer journey it is possible to meet their expectations and supply the best available services, empowering retention. Data analytics play a major role in this task. In fact, to control and to assess internal processes performance from the number of appointments to the number of internal referrals made or received, is to give room for improvement strategies.

As a result, the first step was to study the available research about customers in the healthcare sector. In the light of healthcare services, topics such as the typical journey and all touch points, the recognized gaps of the patient-provider relationship in addition to loyalty and customer retention were analyzed. Moreover, PRM was defined and compared to well-known concept of CRM, uncovering the importance of PRM initiatives for services. Due to the extensive role of data in this project, the current scenario of data analytics in healthcare and all related benefits were also part of the research. The KPI in healthcare were a keypoint and be aware of already implemented KPI is useful so two examples within the literature available are provided. Finally, the internal reference concept is defined according to the definitions accepted in the literature. Next, challenges inherent in the process are considered in order to take them into account during project development.

Without a defined approach towards internal referrals it is not possible to gather information about this process and analyze each doctor and specialty performance. Until now, the Hospital CUF Porto did not have a tool to evaluate internal reference events between doctors and consequently no opportunity to act directly at a certain level since no values are defined for measuring this process performance. Therefore, this project results from the attempt to overcome uncertainty about this process and create an useful tool to assess and control this process, periodically for example. In addition, this tool can support practices and decisions of the Production Management department while increase awareness about the process.

The outcome of this project is a dashboard, created in Power BI characterized by outstanding

features such as the available interactivity and flexibility of the analysis. For this, four levels were considered: "The hospital, "Specialty level", the "Doctor level" and the "Patient level". For this analysis to succeed it was necessary to create a new database with more attributes than the originals one, using VBA programming techniques. Each of these levels include different metrics extracted from the the new database and by filtering it is possible to highlight the relevant attributes and values. Six tabs were created in order to contemplate all necessary information.

The analysis includes an assessment of the hospital performance regarding internal referrals and appointments. The main results are the overview of the hospital that revealed that during the first semester of 2018, there were 114 661 appointments, 58 366 patients with an average age of 39,44 years old and 15 596 potential internal referrals, 3556 within the same specialty (RDE) and 12 040 between specialties (REE). About the specialty level, Orthopaedics clearly stands out among other specialties at the number of appointments and the metrics regarding received internal referrals from other specialties. Patients face longer waiting times when scheduling Child Adolescent Psychiatry appointments, 46,38 days on average. In the end, one of the most influential relationships between specialties was established between Orthopaedics and Physical Medicine and Rehabilitation, with 119 potential referral events from the first to the latter. About the doctors, doctor 271 has the highest average waiting time for an appointment, 152,69 days and doctor 141 had more appointments, exactly 1880. Doctor 156 was the most referred others colleagues, namely by doctor 113.

Besides the previous results it was also possible to realize that there is a considerable potential of data analytics in healthcare and the developed tool. As disclosed in the following chapter, there are several limitations and future work can be done for better and more accurate results through cyclic assessments, by changing people's mindset and definitely integrate the tool across all services and doctors of the hospital.

## **5.2 Limitations and future work**

To analyze internal referrals is a real challenge. Starting with such factors as decisive as information systems and the data architecture, which are crucial and may not lead themselves to simple and straightforward interpretations, it is certainly the main barrier to a definition of internal referrals metrics. Some specific attributes could be easily collected. One example is the origin of the appointments, knowing whether or not they resulted from a referral event.

Although a more detailed analysis is still possible, the accuracy is reduced when compared to the case of a suitable and oriented database for the internal referral process. Without those specific attributes about referrals, the analysis is based on assumptions such as setting an acceptable period of time between the previous appointment and the scheduling moment after the referral event. For example, the scheduling method is not an attribute of the extracted database and as a result, it is not possible to analyze the use of the available tools, it can only be considered that if a patient schedules the next appointment on the day of another appointment, it is probably a scheduling scenario at the hospital's help desk and if that is not the case another method was used. Another

example is the fact that the database was extracted from the financial records of the hospital, meaning that assessing the internal referrals effectiveness is impossible since in case a patient schedules an appointment after an internal referral event and that person misses or cancel it, there is no record in the database that this scenario took place. In addition, the approach of setting restrictions about the specialties dependencies only in case a patient goes to the emergency service, led to possible nonsense relationships between specialties. Further, it is not possible to make a parallelism between the results obtained for the first semester of 2018 and other periods of time since the available database only includes this time interval.

Since some of the services provided are not performed by doctors but by other health professionals such as nurses, 18 different filters were applied to the database in order to consider only acts performed by physicians. Also, services like dentistry, emergency services and day care hospital were also excluded. In case there are human errors when registering patients' appointments, these filters can be the cause of more errors.

Furthermore, this process has a subjective component: people's behavior. Doctors may have different practices when it comes to referring patients to other physicians in the same hospital. For instance, a doctor may be more or less linked to a given hospital and this may influence his or her willingness to refer a patient to another colleague working for the same healthcare provider. In section 2.5.2.4, uncertainty and risk tolerance were mentioned as potential factors with repercussions in doctors' attitudes towards this process.

After analyzing the results and the performance of the internal referral process it is possible to define suggestions as for potential future work.

Starting with each level, in order to enhance the overall performance, specific strategies for customer retention related to the approach during touch points like the appointment itself, the payment and the scheduling moments should be created for a better experience during the customer journey. Moreover, with additional data, the analysis could reach the doctor level, enabling that the doctor's profile, main attributes and the referrals of performance be perused.

Regarding the database, part of the work of treatment of data would not be necessary if the database was more oriented towards internal referrals assessment. As mentioned in section 4.2, the original data had been extracted from the financial records database instead of being more oriented for this type of analysis, which hinders the performance evaluation about missed or canceled appointments. Another potential improvement strategies for further analysis are to include more data about patients like their home address and health insurance in addition to doctors' linkage to CUF and their age. Additionally, the dates format had to be changed since in the very beginning they were set as strings, demanding methods that could be avoided if the date were set in the right format, saving time. Finally, the assessment of the method used for scheduling could be more accurately assessed if it was an attribute of the database. In this project, it results from a more general consideration instead of evaluating the impact of the available methods.

To conduct the internal referral process, periodic performance review across services to find potential improvement opportunities is crucial. Through an integrated and well-structured approach aligned with PRM initiatives, the process can be made systematic with established mea-

asures and periodic monitoring, by holding monthly or semi-annual meetings. Ultimately, these strategies in addition to the dashboard analysis can be implemented across all units of the group José de Mello towards a standardization of the related processes.

Essentially, future work can be done to improve internal referrals by investing, focusing, and analyzing the resulting data that enable action to be taken to improve the overall performance of this process, side by side with all staff involved, fostering greater accountability for internal references and their vital role in a private hospital.

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## Appendix A

# KPI classification system

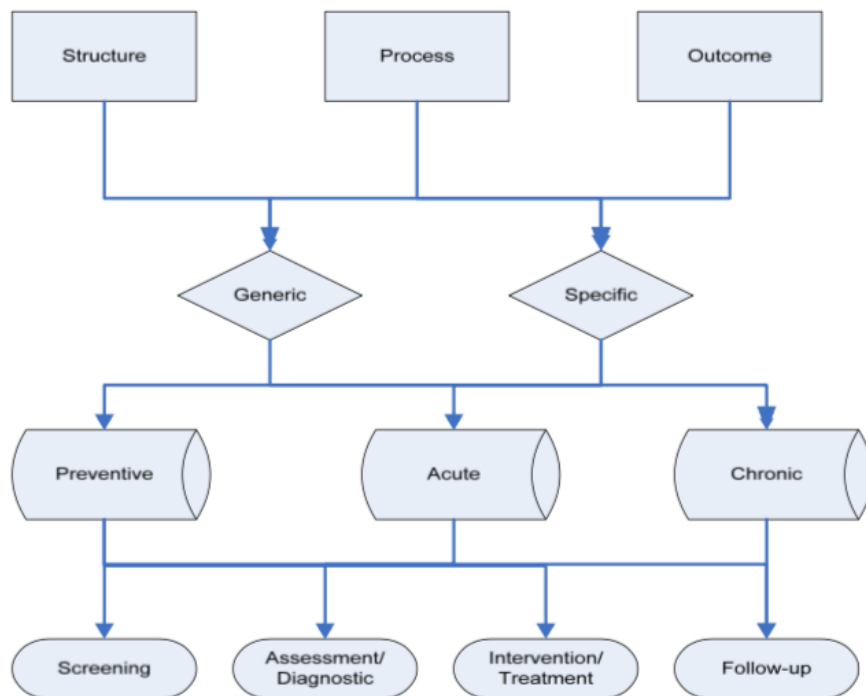


Figure A.1: System for choosing a KPI and different classifications (HIQA, 2013).





## Appendix B

### Example of KPI in the healthcare sector

Name of Quantitative KPI
Quanti_KPI1 Number of patients in registration
Quanti_KPI2 Number of patients in sorting
Quanti_KPI3 Number of patients in consultation box
Quanti_KPI4 Number of patients in delayed emergency
Quanti_KPI5 Number of patients in the supervision room
Quanti_KPI6 Number of patients in the crash room
Quanti_KPI7 The duration of registration by patient
Quanti_KPI8 The duration of sorting by patient
Quanti_KPI9 The duration of consultation by patient
Quanti_KPI10 The duration in supervision room by patient
Quanti_KPI11 The duration of delayed emergency by patient
Quanti_KPI12 The duration in crash room by patient
Quanti_KPI13 The duration of all activities by patient
Quanti_KPI14 The min duration of each activity
Quanti_KPI15 The max duration of each activity
Quanti_KPI16 The average duration of each activity
Quanti_KPI17 The waiting time before registration and payment
Quanti_KPI18 The waiting time before sorting
Quanti_KPI19 The waiting time before consultation in box
Quanti_KPI20 The waiting time before consultation in the supervision room
Quanti_KPI21 The waiting time before consultation in crash room
Quanti_KPI22 The waiting time before consultation in delayed emergency
Quanti_KPI23 The waiting time per patient in all activities
Quanti_KPI24 The min waiting time for all patients in all activities
Quanti_KPI25 The max waiting time for all patients in all activities
Quanti_KPI26 The average waiting time for all patients in all activities
Quanti_KPI27 The total time spent in the Emergency Department by the patient in all activities
Quanti_KPI28 The max of total time spent in the ED by all patients in all activities
Quanti_KPI29 The min of total time spent in the ED by all patients in all activities
Quanti_KPI30 The average of total time spent in the ED by all patients in all activities
Quanti_KPI31 Number of doctors by date
Quanti_KPI32 Number of nurses by date

Figure B.1: List of quantitative KPI (Amor and Ghannouchi, 2017).

Name of Qualitative KPI
Quali_KPI1 interest and attention brought by paramedical staff
Quali_KPI2 interest and attention brought by medical staff
Quali_KPI3 paramedical staff availability
Quali_KPI4 medical staff availability
Quali_KPI5 medical equipment availability
Quali_KPI6 hospital staff is well dressed
Quali_KPI7 the quality of care for patients by paramedical staff
Quali_KPI8 the quality of care for patients by medical staff
Quali_KPI9 the clarity of information
Quali_KPI10 installation in the waiting room before delayed emergency
Quali_KPI11 installation in the waiting room before registration
Quali_KPI12 installation in the waiting room before consultation in box room
Quali_KPI13 installation in the sorting room
Quali_KPI14 installation in the supervision room
Quali_KPI15 installation in the crash room
Quali_KPI16 the overall waiting time before treatment by paramedical personnel
Quali_KPI17 the overall waiting time before treatment by medical staff
Quali_KPI18 the regularity of doctor visits in the supervision room
Quali_KPI19 the regularity of doctor visits in the crash room

Figure B.2: List of qualitative KPI (Amor and Ghannouchi, 2017).







## Appendix C

# Reference to implement strategies to improve referrals process

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<b>Choice of the condition matters</b>	Though initially an arbitrary decision based on input from community PCPs, the choice of condition for which the Referral Guideline is developed is critical. In practice, not all guidelines are felt to be useful by the PCP. To preemptively prioritize conditions best suited for Referral Guidelines, a scoring tool was developed to measure: PCP and subspecialist interest in a guideline for the condition, the overall prevalence and complexity of the condition, and the proportion of patients with the condition that PCPs typically refer.
<b>Build partnerships and foster collaboration</b>	It is rare that the initial draft, authored by the subspecialist, does not undergo minor or major changes as a result of review by members of our PCP review committee. Receiving this input early on, before guidelines are made widely available, provides an opportunity to identify and address discrepancies in opinion. Further, it is likely that establishing a role for the PCP in development contributes to continued support of the initiative. Buy-in from PCPs may be promoted both directly, among those PCPs who are involved in the review of a guideline, and indirectly, as awareness of the involvement of their colleagues increases PCP receptivity even among those not contributing to the review process.
<b>Promote active dissemination in place of passive</b>	Referral Guidelines are consistently and reliably available to PCPs. Further, their availability is regularly promoted to PCPs through a number of channels. However, without the ability to systematically track provider use of the guidelines, overall adoption rates are elusive. A novel triage process was piloted that directed referring providers to the relevant Referral Guideline in response to referrals that did not meet the criteria outlined in the guideline. This process ensured that PCPs obtained the guideline at or near the point of care.

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Figure C.1: Lessons learned from the implementation of referral guidelines (Cornell et al., 2015).