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## Equity in access to MRI equipment: the Portuguese case

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# Equity in access to MRI equipment: the Portuguese case

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## Abstract

Magnetic resonance imaging (MRI) is a method of image diagnose proven to be of undeniable importance when it comes to neuro and cardio related diseases. In fact, these diseases (such as: ischemic heart disease, stroke and acute myocardial infection) have high incidence in Portugal. For these reasons, the allocation of this medical technology should not be considered with light thoughts. In fact, making decision of resource allocation in health care can be a very complex and contested matter. The impacts of new technology allocation, such MRI, can be assessed in a variety of ways. However, a fundamental component should always be present: the use of evidence-based decision-making methods. One of these methods is Technology Assessment (TA). This paper aims to characterize the equity on access of the Portuguese population in general, to a specific medical device such as MRI, under the TA point of view. It is hoped to promote a bridge of scientific knowledge between the gap on research and policy-making through TA that can emerge as a tool to aid decision-makers in the organization of health systems. There are gaps in providing healthcare, due to geographical imbalances, with some areas unable to provide certain specialized services, as hospitals in the countryside do not provide all medical specialties. Portugal has also a large independent private sector that provides

diagnostic and therapeutic services to NHS users under contracts called conventions. These medical contracts cover ambulatory health facilities for laboratory tests and examinations such as diagnostic tests and Radiology. However, there is no convention from the NHS when concerning the MRI exam. Therefore, this reality can be considered a limitation in the access of the general population to this kind of clinical exam. TA can play an useful and important role in helping the decision-makers to explore potential gains that might be achieved by introducing a more rational decision making into health care management, namely into the Radiology area, regarding the allocation of MRI equipment.

**Keyword:** Health Technology Assessment, Medical Device, Magnetic Resonance Imaging, Portugal, Equity, Decision-making

**JEL codes:** I18, M15, O33

## Resumo

A ressonância magnética (RM) é um método de imagem diagnóstica de inegável importância quando se trata de doenças relacionadas com a área de neuro e cardiologia. Actualmente estas doenças (tais como: doença isquémica do coração, acidente vascular cerebral e infecção aguda do miocárdio) têm alta incidência em Portugal. Por estas razões, a alocação desta tecnologia não deve ser considerado com pensamentos leves. Na realidade, a tomada de decisão acerca da alocação de recursos na área da saúde pode ser um assunto muito complexo e contestado. O impacto da alocação de novas tecnologias, como a ressonância magnética, pode ser avaliado de diversas formas. Contudo, um componente fundamental deve estar sempre presente: o uso de métodos de tomada de decisões baseadas em evidências. Um desses métodos é a Avaliação de Tecnologia (AT). O presente trabalho tem como objectivo caracterizar a equidade no acesso da população portuguesa em geral, a um dispositivo médico específico, como a ressonância magnética, sob o ponto de vista de AT. Espera-se que este trabalho possa promover uma ponte de conhecimento científico entre a lacuna existente na pesquisa científica e formulação de políticas através de AT que podem emergir como uma ferramenta para auxiliar os tomadores de decisão na organização dos sistemas de saúde. Existem lacunas na prestação de cuidados de saúde, devido a desequilíbrios geográficos, com algumas áreas a não fornecerem determinados serviços especializados, nomeadamente hospitais no interior do país incapazes de fornecer todas as especialidades médicas. Portugal possui um grande sector privado independente que fornece serviços de diagnóstico e terapêuticas aos beneficiários do Sistema Nacional de Saúde (SNS), através de contratos designados por convenções. Estes contratos cobrem as unidades de saúde ambulatoriais para exames laboratoriais e exames como os de diagnóstico e radiológicos. No entanto, não existe nenhuma convenção entre o SNS que contemple o exame de RM. Deste modo, esta realidade pode ser considerada uma limitação no acesso da população em geral para este tipo de exame clínico. A AT pode desempenhar um papel útil e importante para ajudar os tomadores de decisão na exploração de ganhos potenciais que podem ser alcançados através da introdução de uma tomada de decisão mais racional na gestão de cuidados de saúde, nomeadamente na área da Radiologia, em relação à alocação de equipamentos de RM.

**Palavras-chave:** Avaliação de Tecnologia em Saúde, Equipamentos Médicos, Ressonância Magnética, Portugal, Equidade, Tomada de decisão

## Introduction

Due to continue constraints in health departments, all the decision-making processes should be based on the best evidence research available. Medical devices are one critical area, since they can involve great amounts of money in their acquisition. MRI is a clear example of an extremely expensive technology with huge potential in diagnostic and therapeutic area.

Considering the importance of MRI in the diagnosis and evaluation of stroke, and the high rate of occurrence of this pathology in the Portuguese population, this medical device assumes a higher importance, at a national level.

The allocation of medical technologies should not be considered with light thoughts. In fact, making decision of resource allocation in health care can be a very complex and contested matter.

The impacts of new technologies allocation, such MRI, can be assessed in a variety of ways. However, a fundamental component should always be present: the use of evidence-based decision-making methods. One of these methods is Technology Assessment (TA).

TA is a form of policy research that examines short and long- term consequences (for example, societal, economic, ethical, legal) of the application of technology (Arnstein (1977) and Coates (1971,1977) cited in Banta (2009). According to the TAMI report (Europäische Akademie 2004) and to Bütschi, Decker and colleagues (Bütschi et al. 2004), TA is considered a scientific and communication process, which aims to contribute to the formation of public and their political opinion on social aspects of science and technology, and for this reason it is necessary to go further than mere economic studies.

When applied to health area, TA can be designated “Health Technology Assessment” (HTA) defined as the systematic evaluation of properties, effects or other impacts of health care interventions. Its main purpose is to inform decision making in health care, including decisions made at the individual or patient level, the level of the health care provider or institution, or the regional, national and international levels. It may address the direct and intended impacts or consequences of interventions, as well as their indirect and unintended ones. HTA is conducted by interdisciplinary groups using explicit analytical frameworks and drawing from a variety of methods (HTAi and INAHTA).

Health technologies are actually, one of the six building blocks identified by the World Health Organization (WHO) as essential for all health systems, along with other factor such as: financing, health workforce, information, service delivery and leadership/governance (see Figure 1). If one (or more) of these six components is missing or inadequate, health systems cannot function at the level necessary to improve the health of individuals and populations in a sustainable way. Furthermore, health technologies have key implications for universal health coverage, for the way in which health care is provided based on individual and population needs, on sound governance and community participation, and on public health policies (WHO 2010).



**Figure 1 - Six building blocks of health systems**  
 (Source: World Health Organization, 2010)

It is important to realize that “people”, either as individuals or as a population, should always be in the center of every health system and for that matter should always be the main focus when a decision as to be made. These decision will affect people, in a more direct or indirect way.

Since 1996, Portugal has experienced a rapid diffusion on MRI equipments, presenting governments with unprecedented challenges to provide high quality and innovative care to meet Portuguese needs most effectively. But did the government was able to manage the basic principles of equity, access and choice when it comes to the use of this medical device?

The access to appropriate medical devices is a fundamental factor in improving the health of populations. So, in order to accomplish it, all stakeholders should be aware of the importance of decisions related to the development, design, choice, safety, effectiveness and appropriated use, as well as allocation of medical devices, and act accordingly.

It is intended that the allocation of health resources is made in a fair way, just so that every person can access them, equitably. For the purpose of this paper, in terms of access, it is considered equity at a territorial level, meaning a balanced geographic distribution of health resources.

There is a lack of understanding and a lack of evidence on the practical application of HTA, from both a process (decision-making) and as an outcome (health outcomes, acre delivery, cost, equity...) perspective. In Portugal, HTA scope still is mainly focus on pharmaceuticals and less frequently on medical technologies, such as devices.

This paper aims to promote a bridge of scientific knowledge between the gap on research and policy-making through TA that can emerge as a tool to aid decision-makers in the organization of health systems. To accomplish this, it is intended to develop a work, focusing only MRI equipments.

In the end, the goal is to promote health policies targeting health gains and reduce health inequalities in health sector, ensuring that decisions and investments are planned and undertaken together, based on TA basis, since a critical element in improving health system performance with limited resources is, the ability to make policy choices to allocate resources, in areas where they can be most effective, improving health and equity, providing the most benefit to all Portuguese population.

This paper is organized in six chapters. The first provides an introduction to the theme, giving an overview of the studied issues and presents the purpose and aim of the working-paper. In the second chapter, a brief overview of the Portuguese National Health System (NHS) is made, focusing its characterization. A brief overview on the number of MRI devices in Portugal and in Europe is also made. In the third chapter, the contribution that Technology Assessment can bring in the focused issue is presented. The methodological approach is summarized in chapter four, followed by the results and its discussion (fifth chapter). Conclusions and some recommendations are made in the last chapter (chapter six).

## 1. The Portuguese National Health System

The aim of this is to in light about the organization of the Portuguese NHS concerning medical devices. A framework is drawn, starting with the Ministry of Health (MH) and the RHAs. An overview of the Portuguese constitution is made concerning health protection and the equity to access to medical care. Radiology is the health department referred and MRI the medical device in focus in the working paper. Keeping this in mind, summarized information concerning some indicator on the number of exams performed and number of units in Portugal is presented.

The MH is the government department with the mission to define and lead the national health policy, ensuring implementation and sustainable use of resources and assessment of results. The MH fulfills its responsibilities through integrated services in direct state administration, of bodies embedded in indirect State administration, advisory bodies, other structures and entities incorporated in the state enterprise sector.

The RHAs, are an example of organisms peripherals, indirect, whose mission is to provide the population of its geographical area of intervention the access to health care, adequating the available resources in order to meet the population needs and enforce policies and health programs in your area of intervention. There are seven RHAs:

- a) The North Regional Health Authority I. P.;
- b) The Center Regional Health, I. P.;
- c) The Lisbon and Tejo Valley (LTV) Regional Health Administration, I. P.;
- d) The Alentejo Regional Health Administration, I. P.;
- e) The Algarve Regional Health Administration, I. P.;
- f) SESARAM – Health Service of Madeira Autonomous Region
- g) SASARAA - Health Service of Azores Autonomous Region

In Article 19, of the -Decree n° 124/2011 of December, 29<sup>th</sup>, each territorial areas of each HRAs, include the following assignments, among others: to ensure regional planning of human and material resources, including the implementation of the necessary investment projects, institutions and services for health care providers and overseeing their allocation and also licensing private providers units of health care (Diário da República 2011).

In Portugal the NHS covers all residents in the country. It is universal, comprehensive and almost free at the point of use. In 1976, a new constitution was adopted, and its Article 64.º dictates that all citizens have a right to health protection and the duty to defend it and to

promote it. This right shall be affected through the creation of a national universal health care, universal and tendency free. To ensure the right to health protection, the State has a primary duty to ensure access of all citizens, regardless of their economic circumstances, care of preventive medicine, curative and rehabilitation as well as a rational and efficient coverage of all medical and hospital the country (in accordance with the Portuguese Constitution, Article 64) (Diário da República 2005).

In resume, the Portuguese constitution contemplates the right to health protection to every citizen, thought a national health service, general and universal. It is tended to be free. It ensures heal care access for all citizens, as it ensures a rational and efficient coverage nationwide in terms of human resources and health facilities. The State has the duty to regulate and control the production and distribution of diagnosis and treatment means (here medical equipment is included).

In Portugal almost half of the population lives in urban areas. The population is ageing. Recent projections shows that the Portuguese populations will most probably stabilize or even decrease between 2008 and 2060 due to the combination of an increase number of deaths and decrease in the number of live births, as seen previously.

Medical devices are regulated by law – Decree n° 145 / 2009, which determines that the National Authority of Medicines and Health Products (INFARMED) is the entity responsible for the surveillance of all medical devices (Diário da Republica 2009). This Law-Decree establishes rules about R&D, manufacturing, sales, entry, surveillance and advertising and it is adopted from the EU Directive n° 2007 / 47 / CE.

The core of Radiology is indeed medical devices, since it is a medical specialty were images are used to diagnose and treat several diseases. These images are obtained by applying different types of radiation, such as: x-ray, ultrasound and radio-frequency.

Since 1988 the MH has authorized the procurement and installation of expensive medical technologies in the public and private sectors. In 1995, new legislation lifted the restrictions on Computerized Tomography and MRI scanners. There are currently no effective methods for regulating the distribution of health equipment in the private sector. Most expensive medical equipment (67%) is located in the private sector, which is more flexible and innovative and therefore outstrips the public sector in the acquisition of high-technology equipment. Hospitals contract with private clinics for the use of equipment, providing a strong incentive for this provision pattern to continue (Barros, Machado, and Simões 2011).

Progress in medical technologies continues to transform health care delivery and to improve life expectancy and quality of life, but it is also one of the main drivers of rising health expenditure across OECD countries. The availability of MRI units has increased rapidly in most OECD countries over the past two decades (OECD 2012).

In 1998, an equipment chart was developed in Portugal with information referring to 1995/96. It established national and regional ratios for the major medical technologies for diagnostic imaging (including MRI equipment). Since then, new equipments have been introduced and the growth in diagnostic imaging examinations has been increasing. The number of MRI units per million people in Portugal, more than doubled between 2003 and 2008, from nearly 4 to almost 9. This was close to the average of the EU 15 countries for which 2008 results were reported. In

2010 (latest year available), Portugal had 9.2 MRI per million people. Less than the OECD average (12.5 per million people). However, there is no evidence of any health impact of these increases and there for no technology assessment study (OECD 2012).

MRI exams represent 2.7% of total exams performed by Hospitals, since, as seen before, there is no convention<sup>1</sup> (contractual agreements) for this exam.

It seems that in Portugal, the justification for most medical practices, including medical devices allocation, rests on the experience and expertise of clinicians, rather than on objective evidence. As the system improves its knowledge on what technology works better and where, decision-makers can use this knowledge to improve health inequalities in an ageing population. The efficacy, effectiveness and above all, equity in Portuguese Health Service also improve with this knowledge.

With the continuous growth of expenditure in healthcare, the emergence of new technologies and changes in the epidemiological profile of the population, new mechanisms of coordination between the sectors involved in the production, development and use of technology and service sectors, together with regulators, policy and management of the health system should be taken into consideration.

Taking into account that Portugal has in fact an aging population, in the NHS, decision-makers must take into consideration some details such as:

- From the technologies available in the market, which ones can meet the needs of the population (in general)?
- Will the technologies - identified as necessary for the general population - generate the expected benefits?
- What are the health gains for the population, with the implementation of the technology?
- Is there enough resources (financial, economic, human...) available and will they be sufficient to provide and maintain the technology (equipment, software, protocols, etc.) to all who eventually is needing?
- Do social and ethical issues have been taken into account, when technological resources are being allocated? (Population needs, geographical localization for the new equipment, existing nearby equipment for example)

To answer to these questions, decision-makers need to support their answers in HTA studies, since these studies provide a set of TA information, which can be reliable and synthesized on the effects and costs of health technology.

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<sup>1</sup> *Convention* is an adhesion contract signed between the Ministry of Health, through the Directorate General of Health (DGS) or Regional Health Administrations (ARS) and private persons, single or collective persons that have as their object the provision of care health, in conjunction with the National Health Service, integrating the national network of health care delivery. (ACSS - <http://www.acss.min-saude.pt/DownloadsePublica%C3%A7%C3%B5es/TabelaseImpressos/Convencionados/tabid/143/language/pt-PT/Default.aspx>)



## 2. The contribute from Health Technology Assessment

This chapter provides an overview on how the TA can contribute for the development of based-evidences decision-making, focusing the equity access of the general population to o given medical technology. It discusses the importance of TA when dealing with decisions made by some stakeholders, which will affect others.

One of the objectives of HTA is to provide robust and objective information for decision making in health care at different levels (Siebert et al. 2002). It can play a valuable role in health care decision-making, when it concerns the allocation of MRI equipment. But the process must be transparent, timely, relevant and usable.

Decision-makers must do their assessment based on robust methods, supplemented by other important criteria. HTA will enhance potential decision-makers ability to implement decisions and capture the benefits of an equity distribution of MRI equipment throughout Portugal. The term evidence-based medicine reflects to the use of current best evidence from scientific and medical research and the application of clinical experience and observation, in making decisions about the care of individual patients but also about the resources allocation.

That is why TA decisions should not neglect how a device improves the life of a patient. Decisions that are based solely on costs will ultimately fail patients who depend on access to lifesaving and life-enhancing innovative technologies. For that reason, it should be clear that the purpose of HTA is not to create another technical barrier to trade or simply to delay the entry of new technologies onto the market (Siebert et al. 2002).

A full societal perspective should be considered when undertaking HTA, to ensure efficient resource allocation at the level of the society.

In a more recent report concerning Portugal health system, by the European Observatory on Health Systems and Policies and Nova School of Business and Economics, it is stat that Portugal does not have a tradition of HTA, with the exception of pharmaceutical products (Barros, Machado, and Simões 2011). As seen, the role of HTA in Portugal is currently limited to pharmaceutical products. There are some emerging needs to apply HTA to medical devices.

Attempting to contradict this tendency and has a way to initiate a process of TA institutionalization in Portugal, in 2010 a national TA network was founded (Technology Assessment Study Group – GrEAT <sup>2</sup>). At the moment,—it has four TA working areas: Health, Transports and mobility, Foresight and Indicators.

The objective of a HTA network in Portugal is to support cooperation between national authorities or bodies, in order to avoid duplication of resources and information. A National HTA institution would, among other things:

- help to reduce unnecessary duplication of HTA activities;
- develop and promote good practices in TA methods and process;
- facilitate local adaptation of HTA information, and
- act as a contact point to provide a gateway to the HTA community in Europe.

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<sup>2</sup> For more detailed information visit: <http://avaliacaotecnologia.wordpress.com/>

An HTA principal aim is to provide a range of stakeholders with accessible, usable and evidence-based information to guide decision about the use and diffusion of technology and efficient allocation of resources. This is why TA (also when applied to health area) has been called “the bridge between evidence and policy-making” and it provides information for health-care decision-makers at macro, meso and micro-levels (Battista and Hodge 1999).

HTA contributes in many ways to the knowledge-base for improving the quality of health care, especially to support development and updating of a wide spectrum of standards, guidelines and health care policies, since it can be used to inform and advise technology-related policy – makers.

### **3. Methodology**

The aim of this chapter is to present the methodological approached in order to persue the aim of the working-paper. The baseline information that supports this research is divided in two groups:

- The Portuguese population – as potential users of the MRI technology, and
- The MRI installed capacity in Portugal

#### **Characterization of the Portuguese Population**

In order to get the needed information to characterize the Portuguese Population (as potential users of the MRI technology), National Statistical Institute (INE) database was the source chosen in order to study some indicators, collected from the largest national source of information on population, family and housing that is Census to the Portuguese population. The last Census was made in 2011 (INE, 2012).

#### **MRI installed capacity**

For this purpose, a MRI park at national level will be considered, a survey on the number of equipments in Portugal, both within the public and non-public sectors. Their features and geographical location will also be studied. In a second phase, a two level analysis will be made: capability analysis - ratio on the number of MRI per million inhabitants, by RHAs and competition analysis (market concentration by MRI and group of providers will be evaluated).

Different manufacturers and distributors, represented in the Portuguese market were contacted in order to gather information concerning the number of MRI equipment and its geographical distribution, as well as some Radiology Department (Hospitals and private practices) and National Authority of Medicines and Health Products (INFARMED), via mail or phone, asking for an update of the total of equipment’s represented by each firm. It was asked for: number of equipment installed, their geographical localization, equipment’s characteristics: field intensity and model, instalation year an if they belong to public or non-public sector.

Not every firm replied to the mail or phone contact. So, in order to overcome the lack of data, a desk research was made combining internet data from public and non-public Radiology Departments. Previously data collection (Maia 2011, Maia 2012) were also taken into account.

## **Identification of the Population**

The population in this study consist in all Radiology Department (in public or private sector) that posses at least one MRI equipments in the facility.

## **4. Results and Discussion**

The results obtained are presented in two parts: part one refers to desk research on some Portuguese population indicators (mainly related to demographic aspects, such as population density, age distribution and index of aging among others) as part two focus on the characterization of the MRI Portuguese technological park.

### **Portugal through some indicators**

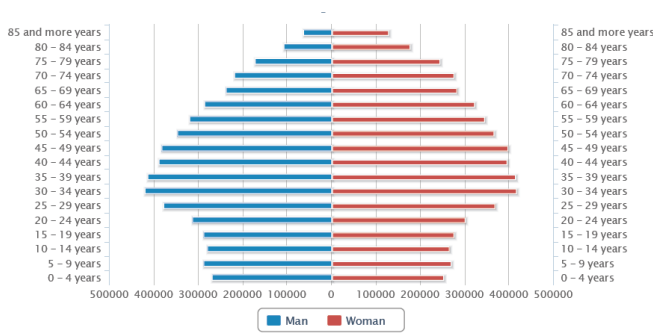
In terms of age structures, the changes in demographic structure are well reflected in the composition of the age's pyramids in 2010 and projections for 2060.

The age structure of the population in 2010 accentuated the imbalances already evidenced the past decade. The base of the pyramid decreases, which corresponds to the younger population and widens the top with the growth of the elderly population, has we can see in Figure 2. In the last decade, Portugal has lost population in every five-year age groups between 0- 29 years. From age 30 the situation is reversed and there is a growth of 9% of the population for the group of 30-69 years and 26% for ages above 69 years.

The age group from 30 to 69 years accounted for 51% of the resident population in 2001 and now represents about 50% in 2010. Also in the group of older ages has been strengthening of its importance in the total population. The population aged 70 and over accounted for 11% in 2001 and now represents about 12% in 2010 (INE 2012).

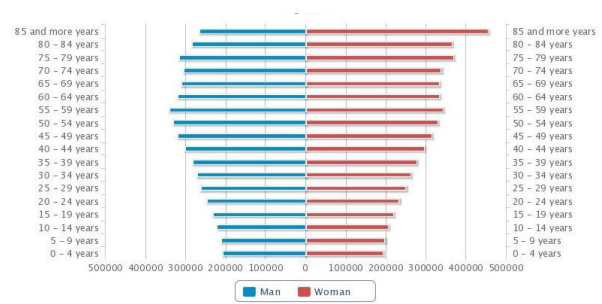
In projections for 2060, we can see that from the analysis of Figure 3, a successive narrowing is expected of all ages inferiors at the age of 59 years. Starting this age, the remaining ranges also suffer a marked change with a successive increase of the same. The age group of 85 years or more will now represent the majority of the population.

The average age of the resident population has increased in the last decade, about 3 years and it was fixed in 41.8 years. The women average age (43.2 years) is higher than men (40.3 years).



**Figure 2 - Resident Population projections (No.) in Portugal, 2010**

(source: INE 2013)



**Figure 3 - Resident Population projections (No.) in Portugal, 2060**

(source: INE 2013)

The aging population is at the current time, one of the most worrying demographic phenomena in modern societies. The population aging is worsening and the phenomena has been occurring widely throughout the country and no longer is just a localized phenomenon in the interior area of the country.

In 2011 the index of aging has deteriorated to 128 (102 to 2001), which means that for each 100 young people exist 128 older people. The Autonomous Regions have the lowest rates of aging of the country respectively in 73 in Azores and 91 in Madeira. The regions of Alentejo and Centre are, on the contrary, the more aged with indexes of 178 and 163.

## MRI Characterization

As a result of the gathering of baseline information, six firms were identified as companies competing in MRI technology marketplace: Philips, Siemens, General-Electric (GE), Toshiba, Hitachi and Esaote.

A contact via mail or phone was made to each company commercial department, asking for an update of the total of equipment's represented by each firm. It was asked for:

- Number of equipment installed;
- Their geographical localization;
- Equipment's characteristics: field intensity and model
- Instalation year
- Public or non-public sector.

Not every firm replied to the mail. Thus, in order to overcome the lack of data, a desk research was made combining internet data from private and public hospitals and clinic webpage's MRI equipment's licensed companies by the Directorate- General of Health (DGH) and webpage's from the MRI equipment manufacturers (Firms).

In 2010, there were 105 MRI equipment in Portugal, distributed within the public (n= 29) and the private (n= 76) sector (Maia 2011) (WHO 2011a). At the light of this new research, a table was drowned in order to summarize all information. Regardless of the equipment model, a total

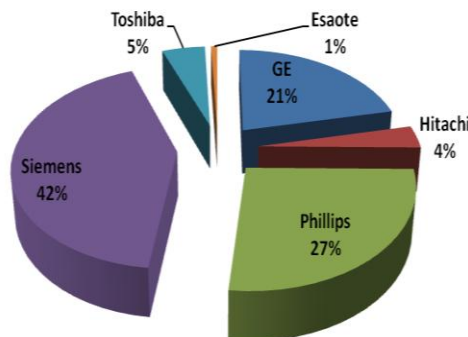
of 139 MRI devices in Portugal were identified, distributed mostly on the non-public sector (see Table 1). Further research such be done in this area.

Firm	Sector					
	Public		Non-Public		Total	
	No.	%	No.	%	No.	%
<b>GE</b>	n/a	n/a	n/a	n/a	30	22
<b>Hitachi</b>	1	4	4	5	5	4
<b>Phillips</b>	11	42	26	31	37	27
<b>Siemens</b>	13	50	46	55	59	42
<b>Toshiba</b>	1	4	6	7	7	5
<b>Esaote</b>	0	0	1	1	1	1
<b>TOTAL</b>	26	100	83	100	139	100

Table 1 - MRI equipment distribution in Portugal, by firm and sector

n/a: not available

As we can see in Graphic 1, in the representation of the market weight, Siemens comes first with almost half the market share (42%) , followed by Philips (27%) and GE (21%). The other firms do not have expression on market weight.



Graphic 1 - MRI equipment distribution in Portugal, by firm

Because GE data is missing, we can only evaluate the MRI equipment distributions in terms of institutional distribution, for the remaining firms. 76% of the equipment installed is in the private sector, against only 24% in the public sector. Comparing data from 2010 to 2013, we realized that there was an increase of 34 MRI equipments, in the country.

In terms of geographic distribution, taking into consideration Statistics Portugal data from the CENSUS 2011 publication and the recent research made updating research (Maia 2012), table

2 summarizes information regarding the localization of MRI units by NUTS II<sup>3</sup>, regardless of the firm of the MRI equipment.

Geographic Area	Resident Population (2011)	No. MRI Equipment		
		Public	Private	Total
Portugal	10562178	29	99	128*
Continent	10047621	24	91	115
North	689682	8	34	42
Viana do Castelo	244836	1	3	4
Braga	848185	1	8	9
Porto	1817172	6	20	26
Vila Real	206661	0	2	2
Bragança	136252	0	1	1
Center	2327755	7	20	27
Aveiro	714200	0	4	4
Viscu	377653	1	3	4
Guarda	160939	0	1	1
Coimbra	430104	5	4	9
Leiria	470930	1	3	2
Castelo Branco	196264	0	1	1
Santarém	453638	0	4	4
LVT	2821876	10	34	44
Grande Lisboa	2250533	9	28	37
Península de Setúbal	851258	1	6	7
Alentejo	757302	0	1	1
Portalegre	118506	0	0	0
Évora	166726	0	1	1
Beja	152758	0	0	0
Algarve	451006	1	7	8
Faro	451006	1	7	8
Azores	246772	1	1	2
Madeira	267785	2	2	4

**Table 2- Distribution of MRI equipment in Portugal, by NUTs II and District**

\*Also a total of 139 MRI units are identified, only 128 are correctly localized geographically

For a more visual representation, the same data is represented on Figure 4.

<sup>3</sup> NUTs are administrative first level division which is the district when referring to the mainland, and island, in the case of the Azores and Madeira.

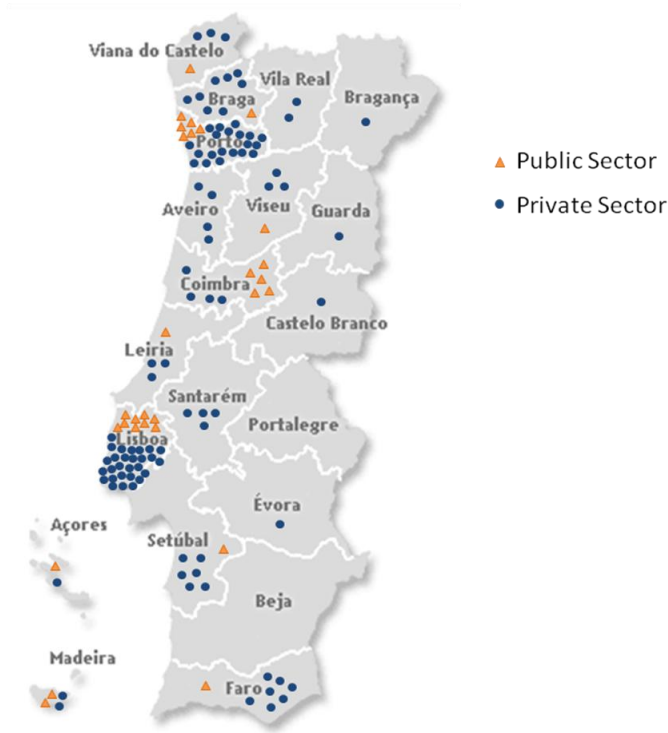
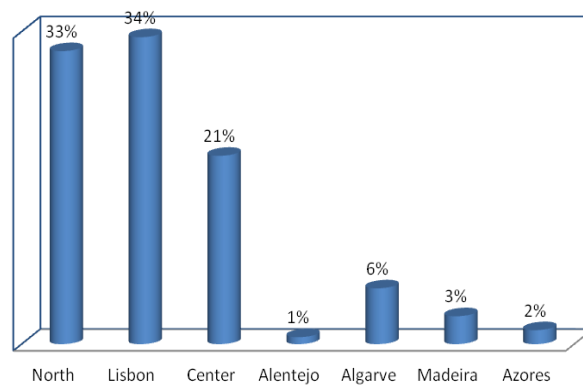


Figure 4 - Distribution of MRI equipment in Portugal, by District

Geographically, this equipment's are localized mainly in the cost of Portugal. When analyzing the distribution by the seven RHA (Graphic 2), it is possible to identify that there are some discrepancies between Algarve and Alentejo, and also between the North and LVT, taking into consideration de number of MRI units per RHA.



Graphic 2- MRI equipment distribution in Portugal, by RHA

But when the analysis is made taking into consideration the average of MRI unit per inhabitants (Table 3) Algarve is leader, followed by LVT and Madeira.

		Ratio (MRI/Inhab.)	Total (%)	Public (%)	Non-Public (%)
<b>HRA</b>	<b>Algarve</b>	56376	6.3	3.5	7.1
	<b>LVT</b>	65625	34.4	34.5	34.3
	<b>Madeira</b>	66946	3.1	6.9	2.0
	<b>Total</b>	82517	100.0	100.0	100.0
	<b>Center</b>	86213	21.1	24.14	20.2
	<b>North</b>	87850	32.8	27.6	34.3
	<b>Azores</b>	123386	1.6	3.5	1.0
	<b>Alentejo</b>	757302	0.8	0.0	1.0

Table 3- MRI equipment distribution in Portugal, by ratio and sector

Alentejo who appears in 4th place, when it comes to total of resident population, is now the region who offers less availability of MRI units per inhabitants, since it only as 1 MRI equipment for. The most populated region is The North region, the most populated one, is on 5th place in MRI offer to its inhabitant.

In terms of MRI equipment investment, the non-public sector is leader, since it leads the market with 77.3% (99 MRI units) against 22.7% (29 MRI units) from the public sector.

Taking the data from MRI distribution in public and non-public sector, in each of the 7 RHA, it is possible to realize that both sectors invest almost on the same geographical areas, since LVT, North and Center regions are the ones with more MRI units and Alentejo and Azores, with the fewest (see Table 4).

In terms of proportion, it appears that the more equitable distribution between MRI equipment installed in the public vs. non-public is in Madeira and Azores, since there are an equal number of MRI units installed. But for the rest of the regions, it is clearly evident that great discrepancy exists in terms of MRI unit localized in the private versus the non-private sector.

Public Sector		Non-Public Sector	
LVT	10	34	North
North	8	34	Lisbon
Center	7	20	Center
Madeira	2	7	Algarve
Algarve	1	2	Madeira
Azores	1	1	Alentejo
Alentejo	0	1	Azores

Table 4 - MRI units per sector and RHA

A bigger discrepancy is identified in the LVT area, followed by the North area, were the difference in terms of equipment number is to evident.



There are a total of 44 equipments in the LVT area. 77.3% (34) are in the non-public sector and 22.7% (10) are in the public sector. Very similar distribution is detected in the North area: 81% (34) equipments are in the non-public sector and only 19% (8) are in the public sector. The Alentejo region is the only one that presents single equipment in the non-public sector.

## 5. Conclusions and Recommendations

Portugal is an aging society. Recent projections for 2060 show a successive narrowing for all ages, inferior to 60 years, and a growing of the top of the pyramid. Portuguese NHS does not fulfill the aim of national contribution.

MRI is a medical device with high diagnosis potential. It is very useful and much needed in aging population in health care delivery.

Portuguese national data concerning MRI equipment are scarce and not updated. Official data are limited and out of date. Until now, no research is known that focus on this issue.

This working-paper made possible the MRI technological park characterization at a national level, with the identification of 139 units. Geographically only 128 were localized.

In terms of manufactures, Siemens is the leading company, holding 42% of the MRI market followed by Philips (27%) and GE (21%). The other 3 identified manufactures don't have market expression.

It is too evident that the core of MRI equipment is well established in the non-public sector. That means, only approximately a quarter of MRI units are in the public sector.

Geographically, and along the coast line, it is possible to identify niches of MRI equipment, with higher concentrations in Lisbon and Porto districts. As we move to the country interior, MRI equipments tend to be scarce and in some regions, inexistent.

Having these results in perspective, some questions inevitable must be made, such as: why are these regions the one's with the most average of MRI units per inhabitant, taking into account that they are in 5<sup>th</sup> (Algarve), 2<sup>nd</sup> (LVT) and 6<sup>th</sup> (Madeira) place when resident population are taken into account. Is the answers related to the fact that all these three regions invest more in tourism? The answer should be the aim of some research....

Indeed, these numbers should be taken into consideration when it comes to equity in access to MRI equipment by the Portuguese population.

If we analyze carefully the ratio of MRI equipment per million population through Portugal, we can concluded that this ratio can also be used as an indicator of geographic misdistribution from district to district, has the previous data present. Since this ratio (MRI equipment per million inhabitants) does not include the geographic dimension of access it should not be used has as indicator of relative access.

In conclusion, there are gaps in providing healthcare, due to geographical imbalances, with some areas unable to provide certain specialized services, as hospitals in the countryside do not

provide all medical specialties. Portugal has also a large independent private sector that provides diagnostic and therapeutic services to NHS users under contracts called conventions. These medical contracts cover ambulatory health facilities for laboratory tests and examinations such as diagnostic tests and Radiology. However, there is no convention from the NHS when concerning the MRI exam. Therefore, this reality can be considered a limitation in the access of the general population to this kind of clinical exam.

HTA can be understood, according to the International Network of Agencies for HTA, as a multidisciplinary field of analysis and decision, which studies the implications of clinical, social, ethical and economic development, dissemination and use of health technologies, without neglecting its political analysis. Therefore, it can play an useful and important role in helping the decision-makers to explore potential gains that might be achieved by introducing a more rational decision making into health care management, namely into the Radiology area, regarding the allocation of MRI equipment.

HTA should emerge as a tool to aid decision-makers in the organization and finance of health systems, acting as a bridge between research and policy-making., with its studies and reports. The stakeholders should make evidence-based decisions, i.e., decisions that use the best current evidences from not only medical research but scientific also. HTA can help them with that.

TA, applied to health, provides evidence-based input to the policy-making processes concerning the use of technology in health services and thereby seeks to promote evidence informed policy-making.

It is the potential to function as a mediating mechanism between policy and research domains by providing a problem oriented systematic overview of research.

The sustainability of Portugal health system is coming under numerous strains, as the pressure of health care budgets and increasing diseases burden are rising, resulting from health inequalities and ageing population.

The contrast emergence of new technologies and the proliferation of the existing ones, either in public or non-public sector, are not subject of efficient decisions when concerning allocation.

Decision-makers should feel the pressure of balanced resources allocations and promote national use of it, when making discussions concerning this issue. They need to evaluate the effectiveness and efficiency of MRI equipment, with variable costs and limited resources available during the decision-making process for the acquisition and allocation of such technology.

A support network between different agencies, to avoid duplications of resources and information should be created. HTA can helps in this matter.

In the end, the big questions are: How can (H)TA contribute as an input to decision-making (regarding equity in access to MRI equipment)? By creating a link, a bridge, between policy and research domain; How? By taking a specific policy question as a starting point and transform it into several HTA questions which can be answered trough systematic reviews and analysis of research results. HTA can indeed create bridges between policy and research field.

The institutionalization of HTA, namely in Portugal, will allow a national policy with broad guidelines oriented to the implementation, evaluation, incorporation and management of technologies in the health system, in an equity way.

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## Appendix

### Definitions

Regarding the scope of this study, there are some main concepts that should be addressed and clarified. Taking this concern into consideration, there are some terms defined as follow:

**Health Technology:** Any intervention that may be used to promote health, to prevent, diagnose or treat disease or for rehabilitation or long-term care. This includes the pharmaceuticals, devices, procedures and organizational systems used in health care.<sup>4</sup>

**Health Technology Assessment (HTA):** the systematic evaluation of properties, effects, and/or impacts of health care technology. It may address the direct, intended consequences of technologies as well as their indirect, unintended consequences. Its main purpose is to inform technology-related policymaking in health care. HTA is conducted by interdisciplinary groups using explicit analytical frameworks drawing from a variety of methods.<sup>1</sup>

**Magnetic Resonance Imaging:** is a non-invasive medical imaging technique that produces exploratory images, used in radiology to visualize internal structures of the body in detail, based

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<sup>4</sup> (INAHTA 2013)

on the principle discovered by Bloch and Purcell in 1946<sup>5</sup>. This medical technology as a powerful magnet that produces a magnetic field with a particular frequency that makes the hydrogen nucleon (proton) resonates. Depending on the frequency of the magnetic field applied, systematically alters the alignment of this magnetization. MRI can create more detailed images of the human body than are possible with X-rays. It differs from other imaging techniques, since it allows obtaining axial, coronal and sagittal images. It has also a high sensitivity to fluids movements, including blood and cerebrospinal fluid. This can be critical for an accurate medical examination. MRI does not use x- ray radiation to obtain images, since they are based on the tissue own physical and biochemical properties, and therefore there is some easiness in observing tissue surrounded by bone structures.

**Medical device:** any instrument, apparatus, appliance, material or other article, whether used alone or in combination, including the software necessary for its proper application intended by the manufacturer to be used for human beings for the purpose of:

- diagnosis, prevention, monitoring, treatment or alleviation of disease,
- diagnosis, monitoring, treatment, alleviation of or compensation for an injury or handicap,
- investigation, replacement or modification of the anatomy or of a physiological process,
- control of conception,

and which does not achieve its principal intended action in or on the human body by pharmacological, immunological or metabolic means, but which may be assisted in its function by such means.<sup>6</sup>

**Medical equipment:** Medical devices requiring calibration, maintenance, repair, user training, and decommissioning – activities usually managed by clinical engineers. Medical equipment is used for the specific purposes of diagnosis and treatment of disease or rehabilitation following disease or injury; it can be used either alone or in combination with any accessory, consumable, or other piece of medical equipment. Medical equipment excludes implantable, disposable or single-use medical devices.<sup>7</sup>

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<sup>5</sup> (Manuila et al. 2003)

<sup>6</sup> Council Directive 93/42/EEC of 14 June 1993 concerning medical devices (The Council of the European Communities 1993)

<sup>7</sup>(WHO 2011b)