

# A research proposal on the relationship between investment in medical devices and hospital performance

José Figueiredo and Vasco Eiriz

**Abstract** — This paper aims to propose a research on the impact of medical devices on hospital performance. New medical devices, from typical magnetic resonance and ultrasound technology to more modern and rare technologies like transplant surgery or orthopedic devices, are very expensive and, in some cases, are in a test phase. These new medical devices allow hospitals to offer new or enhanced services. New medical devices provide more patients to hospitals, a higher level of usage rate and additional revenues. But sometimes, they will not bring superior performance due to its poor usage. This paper proposes to investigate the relationship between investment in medical devices and hospital performance in the Portuguese hospital sector using data collected from secondary and primary sources. Some of the expected difficulties in implementing this research are also discussed.

**Key Words** — Hospital, medical devices, performance, Portugal.

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## 1 INTRODUCTION

Technological innovation exists in many parts of a hospital. According to Djellal and Gallouj (2005), services provided by hospitals are basically medical and nursery treatment, nevertheless, hotel/catering and managerial services are included as part of the output of a hospital. In this case, one can identify many sources of technological innovation, from new pharmaceuticals to therapeutic diagnosis or even intangible soft innovation, like new therapeutic techniques.

Lovelock *et al.* (1999, p. 314) referred to the core service provided by a healthcare insurance as including a personal advisory team, a health information line and immediate access to private healthcare treatment. The extended service could include inpatient and outpatient treatment, use of private ambulances, home nursing and, among others, overseas medical care.

Given this wide range of healthcare services, therefore they may have different sources of innovation, whether in its core or in the supplementary part of the service. The focus of this research will be on hospitals, in

particular the ones with inpatient and outpatient treatment, regardless the type of ownership (state owned or private) and their main objective (profit or non-profit oriented). This study is being carried out in Portugal, where there are different types of hospital organisations, even though, a major part of hospitals belongs to the public national healthcare service.

This paper is organized as follows. Section 2 defines the type of technological innovation that it will be evaluated. Section 3 proposes a framework to evaluate performance, while section 4 discusses the proposed relationship between investment in medical devices and hospital performance. Finally, before concluding, section 5 will explore the main methodological choices.

## 2 TECHNOLOGICAL INNOVATION IN MEDICAL DEVICES

Jonsson *et al.* (2002, p. 218) have pointed out that health technology may be “broadly defined to include the drugs, devices, medical and surgical procedures used in health care, as well as measures for prevention and rehabilitation of disease, and the organisational and support systems in which health care is provided”.

This research will focus on medical devices (e. g., magnetic resonance, x-rays equipment, ventilators and chemotherapy equipment). There are two main reasons for this choice: i) medical devices represent an important part of hospitals' investments in new technologies; ii)

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the increasing importance of this type of technologies in healthcare services, especially for diagnosis purpose.

According to Siebert *et al.* (2002, p. 735), the European Directive 93/42/EEC defines a medical device as: “....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: a) diagnosis, prevention, monitoring, treatment or alleviation of disease; b) diagnosis, monitoring, treatment or alleviation of or compensation for an injury or handicap; c) investigation, replacement or modification of the anatomy or of a physiological process; d) 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 functions by such means”.

All medical devices available in European countries bear a CE marking, as Siebert *et al.* (2002, p. 735) referred to “as proof they meet the essential requirements for safety and performance laid down in the relevant directive”. But unlike new pharmaceuticals, medical devices will depend much more from the relationship with its users or its surrounding procedure.

The reimbursement process of costs of a new technology involves a complex evaluation in order to compare the clinical effectiveness or costs, compared with existing medical alternatives. The process of Health Technology Assessment (HTA) which is applied in the European Union (plus Switzerland), obliges manufacturers to support rational decisions, in order to stop the support of a product with well known technologies, cost effectiveness or clinical effectiveness irrelevant compared with existing products.

According to Siebert *et al.* (2002) the study design to prove the economic evidence is not a pacific issue in the medical devices industry. In pharmaceuticals it is common to use randomized controlled trials, which is almost impossible to carry out in some medical devices, because sometimes the number of patients to be targeted is so small, that it is statistically irrelevant. Black (1996) pointed out that randomized controlled trials and observation could be two complementary approaches.

The economic evidence based almost exclusively on costs is not a unique solution because sometimes the life-enhancing and

life saving perspective are very important too. In this case, it is important to develop the evaluation of the new medical device in a joint effort base, like the one developed by the medical devices industry with healthcare professionals and patients' associations.

Another important aspect to take into account is the international comparison of results. The results of the research could not be seen for a specific centre, neither for a specific country, but at a much more wide view (this is one of the major objectives of the HTA approach).

The National Institute for Clinical Excellence (NICE) was established to advise the National Healthcare Service (NHS) in England and Wales on the appropriate usage of health technology. Here, too, health technology can include pharmaceuticals, medical devices, diagnostic techniques, clinical procedures and health promotion.

The process of evaluation by NICE is referred to by Taylor (2002): “for each technology appraisal, NICE invites relevant manufacturers and sponsors, national professional groups, and national patient groups to submit evidence”. The author referred to some specific characteristics such as complications and, among others, results.

The focus of the HTA approach on doctors and manufacturers is criticized by Cookson and Maynard (2000) as creating barriers to optimal HTA. The authors categorized these barriers in two types: demand-side and supply-side barriers.

Demand-side barriers:

- ❑ doctors incentives to provide the best care for their own patients, regardless the costs and consequences for others;
- ❑ "expert" incentives to avoid accountability and to prevent the production and use of evidence from challenging decisions.

Supply-side barriers:

- ❑ provider incentives in order to supply selective evidence to market their products;
- ❑ researcher incentives to supply interesting rather than integrated and focused research.

Cookson and Maynard (2000, p. 644) also argued that doctors remain as “The Expert Judges of Need”, which sometimes will focus exclusively on clinical effectiveness, rather than to articulate equity goals and equity efficiency trade-offs.

At this point, this research will focus on existing technologies, in particular medical devices changing rapidly, as referred to by

Herzlinger (1999).

We will discuss in Section 5, the methodological steps of the research, but in the meantime we will propose a list of medical devices that will be evaluated in the hospital field, as presented in Table 1. The choices that we have done, regards: i) the most important equipments in diagnosis area; ii) equipments that are subject of incremental innovation are much more adequate to be studied; iii) the equipments selected are available in a bigger part of the hospital network.

TABLE 1  
MEDICAL DEVICES TO BE EVALUATED

Medical device	Date of
Mammography equipment	New equipment introduced after 2000
Ultra sound	
Resonance magnetic	
Computed axial Tomography	
Defibrillator	
Ventilator	
New devices for healing fractures	
Angiography equipment	
Radiography	
Nuclear medicine / PET	

Source: Authors.

### 3 PERFORMANCE

Services are mainly intangible and therefore service performance is basically intangible. Kennerley and Neely (2002) focused on performance as a major issue in business research and also a key point to

management. Nevertheless, according to these authors, the measures to evaluate performance are not evolving, which could be a drawback in an era of great changes. Profits and cost evolution are not yet fundamental measures of performance in healthcare. The mission, the objectives and the external competitive environment could be also a target of performance evaluation. Also, as referred to by Kennerley and Neely (2002, p. 1241), "the performance measurement system itself consists of three interrelated elements (individual measures, the set of measures and the enabling infrastructure)".

The focus of this paper is on hospitals and the need to find a common framework to evaluate the performance of different types of hospitals. Yap *et al.* (2005) developed a research in Canada (Ontario), concerning the evaluation of performance of different types of healthcare organizations, from acute and non-acute hospitals (one mental care hospital and one chronic care hospital) to teaching and community hospitals, large and small ones. Their methodology was based on the balanced scorecard developed by Kaplan and Norton (1992). The research aimed to indicate the performance of multiple hospitals or healthcare organisations in the dimensions of learning and growth, internal business processes, customer and financial performance.

Even tough, as referred to by Yap *et al.* (2005, p. 252), this evaluation system raises a critical question: "the critical question is, to what extent do the strategies of the payer or hospital system resemble the strategies of the healthcare organisation's individual hospital, which supports the use of a standardized scorecard for the hospital's specific management needs?"

From this research in Canada, we found a common base with the context of our research: i) funding restraints; ii) managers of hospital system are increasingly concerning about measuring and managing organisational performance in an attempt to remain focused on delivering high quality patient care, while maintaining expenditures within global budgets that are centrally established.

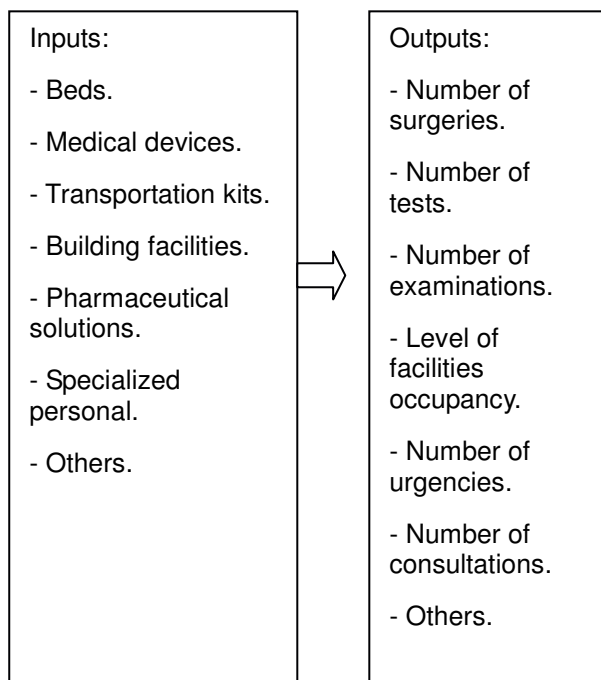
Some aspects could trigger poor performance from hospitals like over utilization of some services due to provider decisions, the mismanagement of sicker patients moving from a physician to another one, and repeating some tests or examinations (Davis, 2004).

Figure 1 presents several inputs and outputs of hospitals. This research intends to

evaluate the impact of medical devices inputs in the output of the hospital.

The evaluation of hospital performance that we intend to research is specifically focused on medical devices, which means that we will neglect some key aspects related to hospital performance, like the type of technical operators, their experience and specific knowledge. For instance, if a hospital has a Resonance Magnetic (RM) probably will have a higher number of examinations and a superior number of consultations, which at an ultimate step could mean that this hospital could have a higher rate of bed occupancy.

FIGURE 1  
INPUTS AND OUTPUTS OF THE HOSPITAL



Source: Authors

We will neglect also other aspects such as demographic evolution around the hospital area and the type of buying decision of equipments. Normally, the decision process of buying such type of equipment is centralized (at the Department of Health, in the case of the National Health Service), which could mean that the administration of the hospital, which knows better the needs of the organisation, could not be listened.

In the next section, we will develop in more detail the relationship to be tested.

#### 4 THE PROPOSED RELATIONSHIP

The research to be carried out will be developed in hospitals with characteristics presented in Table 2.

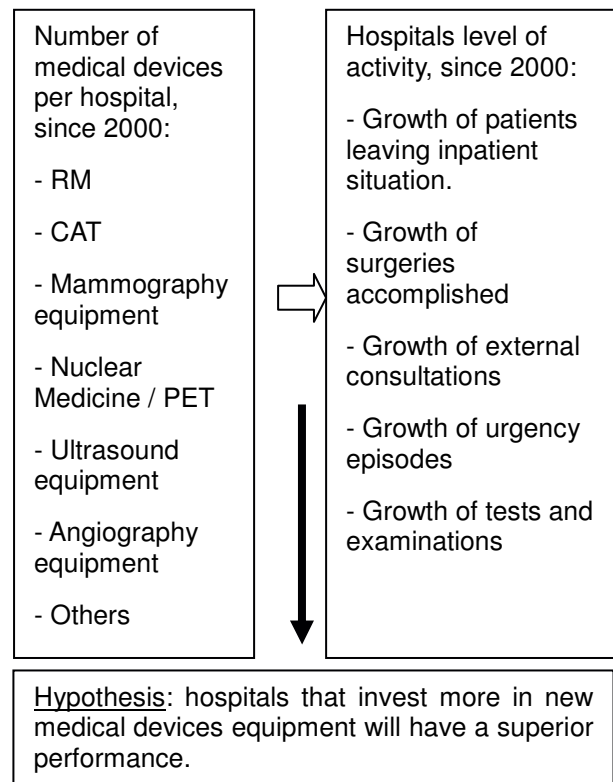
TABLE 2  
TYPE OF HOSPITALS TO BE RESEARCHED

Hospital variables	Characteristics
Ownership	Public (government owned); private for-profit; private non for-profit; public – private partnerships.
Inpatient and outpatient hospitals	All included
Specific illness hospitals	Excluded (mental illness hospital, chronic illness hospital and maternity hospitals)
Size of beds	All included
Teaching hospitals	All included
Geographical area	Portugal (including Madeira and Azores islands)

Source: Authors

After the selection of the hospitals to research, we will try to evaluate from primary and secondary sources, which ones invest more in new medical devices and the possible relationship with some specific variables of hospital performance, as proposed in Figure 2.

FIGURE 2  
RELATIONSHIP TO BE TESTED



**Hypothesis:** hospitals that invest more in new medical devices equipment will have a superior performance.

Source: Authors

The importance of diagnosis tools in

healthcare is increasing for several reasons: to decrease the level of doctor's doubts; to improve doctor's decision; and, among others, to serve as a defense for doctors.

On the other hand, for some hospitals the lack of some specific type of medical device could be a driver to lose many patients, and through this, to a decrease of its level of occupancy, number of examinations and consultations.

According to the Comissão para Avaliação dos Hospitais Sociedade Anónima (2006), it does not exist in Portugal a star ranking system to evaluate different hospitals, similar to the National Health System, from The United Kingdom. The British system is based on several items, such as: i) waiting time for a surgery; ii) percentage of cancelled surgeries; iii) waiting time in hospital urgency; and among others, iv) percentage of patients with a cancer waiting for a consultation for a period of more than 15 days.

The Comissão para Avaliação dos Hospitais Sociedade Anónima (2006), indicates that Unidade de Missão (which is a body dependent from the Department of Health) is the unique entity to have an efficiency index, even though with an excessive focus on economic issues, instead of a mix between clinical and economical items.

In order to test the feasibility of the proposed relationship, it will be necessary to have some precautions. These issues will be analysed in the next section.

## 5 METHODOLOGY

As referred by Comissão para Avaliação dos Hospitais Sociedade Anónima (2006), "we consider necessary to have an annual performance indicator of hospitals, which could reflect a clinical and an economic view". This means, that Portugal does not have an information system that collects, monitors and analyses all statistical information, to evaluate the performance of the National Healthcare System. This will oblige us to take a special precaution in the development of the research, otherwise we will miss some important data (for instance: different information available in different organisations, difficulty on the creation of the same concepts for different organizations and, among others, a lack of routine in providing and working real data).

As the universe of hospitals is so heterogeneous (belonging to the state government, with different types of management, private hospitals, with a profit as an objective and non-profit ones), we think the

best entity to answer to our questions is each Administration of each hospital.

In a universe of 135 Portuguese hospitals, it is difficult to manage a common mailing task and afterwards to face a possible low level of answer. Based on an official list from the Department of Health we will send a questionnaire to the board of the hospital. Some formal steps will be needed (e. g., formal letter explaining the objective of the research). We will take also some informal steps, like using e-mail, and phone and fax tools, in order to have a higher response rate.

Possibly, some data will be possible to get from secondary sources, but this will not invalidate the general questionnaire that we have in mind to do. Secondary data will serve to confirm, for instance, some concepts and terminology.

As it was mentioned before, this research proposal has some constraints and limitations. For example, if a hospital will buy new medical equipment in 2000, how long will it take to put the new equipment in a sufficient level of efficiency? This hospital will put the new medical equipment working possibly in 2000, but the necessary knowledge from the different operators of the equipment (doctors, nurses and other technicians) will take some months or more. This raises a new question: how long will we wait to try to relate the two data sources (the new medical equipment installation and the related higher level of service)?

## 6 CONCLUSION

Performance is definitely a major issue in private organizations and also in typical state government institutions, like hospitals. If a shareholder wants a superior return on investment, the government or the taxpayer wants better efficiency from public investments.

Healthcare treats human beings. Even though, healthcare is a major industry all over the world, and therefore it needs to have a special attention in the way the allocation of resources and its spending is done.

If we want to analyze all the hospitals and try to evaluate their performance, we will face a huge task, due to: i) different types of ownership; ii) the participation of different stakeholders in the hospital; iii) the complexity of dealing with human beings; and, among others, iv) the enormous number of variables that influences hospital performance (from demography variables to catering, type of services, etc.).

Medical devices are one of the major sources of spending in healthcare services, representing roughly 6% of total spending in healthcare in the European Union. But, medical devices

equipment is also one of the major sources of increased quality of life. These two assumptions have taken us to evaluate the investment in new medical devices and looking to the immediate answer of the market, instead of a common evaluation of return on investment.

Nevertheless, investments in new technology are always risky. Sometimes a hospital could buy new medical device equipment that will not bring additional outputs, because of a lack of knowledge in its use and, as a consequence, the offer of a poor service. Finally, some decisions to buy new medical devices in Portuguese hospitals are supported mainly by clinician directors, which could not be seen sometimes as an efficiency-oriented decision, but a pure clinical decision.

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