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The Adoption of Technological and Organizational Innovations in a Traditional Public Hospital in Spain

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Content

THE CASE IN A NUTSHELL

This study analyzes the process of adoption of innovation with the peculiarities of the public health system. The innovation process itself is a very important issue that has been studied previously[1] and also applied to the health industry[2-8]. However, the aim of this research is to focus on the development of this innovation process when it happens in a public organization applied to the health sector. As we understand, there are two different processes of innovation that may apply in this work: the process of development of a technological intense innovation, and the process of development of a managerial or organizational intense innovation. Here we study in detail an example of each of those types and then we compare the similarities and differences in both processes. Specifically, this study analyzes the process of adoption of the Digital Radiology (DR) technology, which is a technologically intense innovation, and the process of adoption of the Main Ambulatory Surgery (MAS), which is a more organizational intense process.

The choice of these innovations has taken place considering the main objective of the PUBLIN project, which is to study policy learning and technical and administrative innovation in the public sector, and to get a better understanding of behavioral changes, learning processes and the implementation of new or improved technologies in public organizations. Both innovations take place at the service level, in the organization that provides the health service. However, both innovation processes implies also some policy learning. The adoption of the Digital Radiology has derived differences in behavioral attitudes due to the way in which the X-ray is developed (technological change), how it is transported to the physician, how it can be stored, or the way in which doctors analyze the resulting X-ray changes, besides other economic and health reasons as will be shown. The importance of this innovative process stems from the fact that the Service of Radiology is one of the most active areas of the hospital, acting more than 150,000 services during each of the years analyzed, and supposing more than 20% of all services provided in the hospital of reference (see tables 1a and 1b). With respect to the economics of the service, Radiology is not one of the most expensive areas per unit of service (see table 2 for details on the size of the expenditures at the hospital for different materials), although its management has an enormous effect in the rest of services in the hospital. The reason is that most of the Services or Areas in the hospital refer patients to the Service of Radiology in order to scan them and obtain the needed quality in the diagnosis. Thus, a high proportion of the X-rays provided by the Service of Radiology are solicited by external centers of specialists (28% in 2003), emergency (13% in 2003) and traumatology (11% in 2003), but also others as surgery, urology, cardiology, dermatology, gynecology, or internal medicine suppose a significant proportion of the services provided by Radiology (see tables 3a and 3b). The old technology associated to the Service of Radiology is the Analogical Radiology (AR). The change to the Digital Radiology derives not only variations in the costs of the raw material of the hospital, but also in the time needed to provide the service, and produces an important improvement in several other aspects of the service, as facilitating the communication among specialists and quality of the service, or the storage of the X-rays. However, it is important to note that using either the AR or the DR technology in the X-ray has no effect in the health status of the patient, in the sense that it does not suppose a different level of radiation. This characteristic facilitates the cost-benefit analysis of the new technology. In this study, we proceed to measure the economic gains (or losses) of the new technology, comparing the time series of the services accomplished by the Service of Radiology before and after the gradual adoption of the digital radiology. We also care in this study about the quality of the service. As a proxy of the quality we will use the evolution in time of how different areas of the hospital have demanded radiology services. If the relative weight of the service of radiology has increased for a number of areas of the hospital, it will be associated to an increase in the quality of this service. That is to say that if the relative weight of radiology has change with respect to other areas, some procedures that did not use radiology use it now.

The Main Ambulatory Surgery system appears as a reaction to the traditional surgery (TS) system, and supposes mainly the possibility of doing a surgical operation without having the

patient a night stay in the hospital. With the MAS, the patient can leave the hospital in the same day of the surgery, and stay at home obtaining outpatient care afterwards. As a consequence of this innovation, there is a substantial economic saving expected for the health system due to the higher cost of inpatient care compared to outpatient care. The main change has taken place at an organizational level, with the adoption of different procedures and ways of acting not only in the doctors, nurses and other staff in the hospital -they need to change procedures-, but also in patients -who receive a higher comfort being able to be at home much sooner, and therefore suffering a lower distortion or impact in their professional or family environment. Other effect is the improvement in the management and the lower utilization of resources as the physical space, that decreases the cost incurred by the TS system per unit of service, allowing a higher rate of services per unit of time (see table 4), and a richer utilization of resources. As a part of this study, we define the gains of the MAS system, specifying the consequences in the different Areas of the Hospital through the organizational changes derived by this innovation, paying attention to the quality of the service perceived by the patient. A measure to be used of the quality of the service perceived by the patient is the evolution of ambulatory practices controlling for the entrance and exit of the waiting list of those practices.

It is worth to take into account that each of both innovation processes, DR and MAS suppose both technological and managerial or organizational changes for the hospital. This case study analyzes the difference between both innovation processes, and how well they have dealt with the problem of being or suffering a bottleneck in the provision of health services in the hospital of reference.

1. THE CONTEXT

1.1 General Context

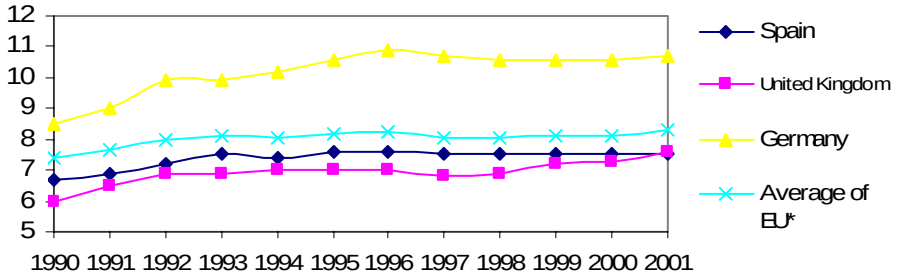
The Spanish Health System is mostly public. However, there exists an increasing industry of private insurance companies that offers health services to the enrollees. The public system has been reformed during the last decades, through a process of decentralization in which the central administration derived all the competences to the different regional administrations. This process started in the 1980s, in the Basque Country and Catalonia, and was followed by Andalusia and Valencia. By 1994, Navarre, the Canary Islands and the Galician Autonomous Communities had joined. Therefore, the health powers with full competence of the management and financing of health services had developed in seven regions. Finally, in 2002 the remaining Autonomous Communities (ten) developed completely the health powers.

One of the advantages of the process of decentralization is the possibility that each Region has in order to decide how to manage the different health services adapting them as much as possible to its population's characteristics and preferences. However, there exist several risks that a process of decentralization bears. One of them consists of the problem existing by losing economics of scale that might cause an increase in the risk of bankrupt in the public health system of each region in a context in which the health expenditures grow at a higher rate than the GDP. However, the most important problem originated by the decentralization as is perceived by the population is related with the Principle of Equity: with a decentralized system, a rich region might sustain a better quality in the health system through greater expenditures per capita that would be financed with higher taxes or even with co-payments. On the one hand, a different level of quality among regions means that there is no equity in the health system, and that a higher quality is associated, for instance, to a higher level of income. On the other hand, a region needing to finance the same quality in the health system by increasing proportional taxes or through co-

payment decreases the available family income and therefore, does not satisfy the principle of equity.

In this general context, each region will define its budget constraint for the health system depending on the income and different characteristics of the population, as demographic or cultural aspects. The innovation through organizational and over all through technology adoption supposes with no question great benefits for the society with the development of new diagnosis methods or more powerful new treatments allowing the improvement the quality of life and extend the expectance of years of life. However, this innovation processes are also costly and need of an initial investment. Thus, in order to understand the importance of the process of adopting technology or other innovations, it is needed first to introduce the situation of the health expenditures and the Research and Development investments that take place in Spain. Figure 1 presents the health expenditures as a percentage of the GDP in Spain, United Kingdom, Germany, and the average of the countries belonging to the European Union of 15 members until 2001. As can be seen, Germany has been spending more than 10% of the GDP in health in the last years, while Spain only spends 7.5%. If we compare this percentage with the arithmetic average of this percentage in the countries belonging to the European Union, Spain still spends less than the average in Europe. It is important to note not only the absolute levels but also the trend that this time series have shown. Now we can appreciate that this trend has been different in Spain compared to other countries. Even the United Kingdom, with lower health expenditure as a percentage of GDP at the beginning of the period, has a positive trend, meaning that it is increasing those health expenditures, and ends up with a level higher than the percentage in Spain, that has maintained constant the same percentage of the GDP from 1997 to 2001. At the same time, table 5 presents the composition of the health expenditures on public versus private sectors. Spain presents a lower presence of the public sector in health that United Kingdom or Germany.

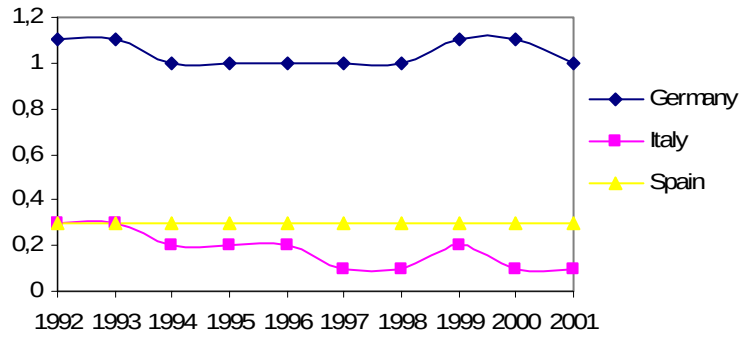
Figure 1: Health Expenditures in Spain, UK and Germany as a percentage of GDP



Own elaboration with data from the OECD Health Data, 2003[9].
*Arithmetic average of coefficients for countries belonging to the European Union.

Once we have presented the dimension of the health sector in Spain, it is useful to compare the efforts on the innovation processes that take place in Spain. In order to do so we present in figure 2 the behavior of the investments in Research and Development in Spain, Germany, and Italy. As can be seen, Spain not only has a lower presence of the public sector in health and a lower dimension of the health sector in the economy, but also has a low level of research and development investments in health, a third of that of Germany, although it is higher than these investments in other countries as Italy.

Figure 2: Public R&D investments in health as a percentage of total health expenditures



Source: Own elaboration with data from the OECD Health Data, 2003.

In order to complete the general context, and before describing specifically the particularities of each innovation process it is needed to understand how the innovation process is achieved in the hospital of reference, given that not all the hospitals in the public system in Spain have adopted the digital radiology, or use the ambulatory surgery as much as our hospital of reference. The innovation process is initiated with the discovery of a need in the infrastructure of the hospital, due to its lack or to a different way of doing the procedures. Usually, the hospital personnel are the first agents to realize the needs, especially doctors (professionals) and nurses that are in permanent contact with patients, and also know the use of raw material in each procedure or technique. They are supposed to communicate all the suggestions they might have to the management area of the hospital, because it is in this area where the entire budget is developed. Only a small proportion of the innovations stem from patients' suggestions, and they belong to very special cases from highly educated patients that read in foreign or specialized press the existence of a new procedure or the discovery of new problems associated to several procedures. When these suggestions from patients are not applicable (for instance, the application of laser technology to services where it is not feasible) it is the role of the physician to convince the patient of the advantages and disadvantage of each feasible treatment. This is valid for both technological intense and organizational intense innovations. However, there are other innovation processes that are started in a different way directly from the Area of Management and refer mainly to the different processes of ordering, using or managing resources. Also, some times the innovation processes stem from political compromises from the health authorities, which increase the funds dedicated to the innovations in order to hold social compromises. The importance of this type of source of innovative processes is that it may affect the funds dedicated to other innovations, or in other words, the political point of view may differ from the professional point of view on the priorities of innovations. An example of an innovation that is taking place nowadays in Madrid, coming with a promise of lowering the surgical waiting lists in public hospitals. Besides, the hospital in a continuous basis participates in different public programs in order to obtain funds that allow the introduction of new machinery, under the innovative pressure of doctors and the supervision of the management of the hospital; and also, once it obtains the fund, there is a cost evaluation part at each stage of the process.

Once the physicians select the innovative alternative to a given procedure, and present a proposal to the management section in the hospital, the first and main constraint or difficulty that the innovative process finds comes from the budget of the hospital. Some times, managers cannot offer the monetary resources needed to develop the innovation process, and it is stopped or

restricted. However, there are other difficulties to address: most innovations involving organizational changes (at least at some degree) suffer the effect of the learning process, which are visible once it involves modifications in the way of conducting activities for a large proportion of the hospital employees. Workers, specially low skilled, in public institutions in Spain as public hospitals, are generally paid under a fixed schedule, which is updated every year. Because they do not get any monetary incentive based on the results or quality of the hospital, at the first sight, they might consider innovation processes as a source of problems: new techniques demand time and effort to learn the process, innovations usually do not work at the first time, and therefore, at a first stage, they difficult the task of the workers. Other difficulties stem from the administrative way of developing tasks, in the sense that there are different steps that have to be done in a given protocol. The lack of flexibility in the administrative sections restricts the rapid adaptation to the innovation processes.

It is important to note that in the learning process there is a common characteristic that takes place in the different innovation processes at the hospitals: a positive attitude of most doctors and highly skilled personnel. The innovation process acts as a satisfying task for the same reason that is some times rejected by low skilled personnel. A change in the way of doing things is seen as positive when the personnel is able to see the long run gains, not only for them but also for the patients. Low skilled workers are used to accomplish the same tasks and under the same methods, and some times they take as negative any change. Differently, high skill workers feel those changes as a chance of developing their potential and find innovations as a way of improving their working life.

While I have described the sources of the innovation processes applied to hospitals, it is still pending the description of the aims that innovations seek. The ultimate beneficiaries of the innovation processes and their contributions are the patients. However, it is worth to note that most small innovations make doctor's task easier. As mentioned above, doctors and other health workers realize first about the need of innovations. Besides, they best know the actual machinery that is available and in which way it can be improved. Therefore it is intrinsic in the process of innovation that there is a benefit for the innovator.

When studying the process of adapting innovations, there is a fact that needs to be taken into account: the interactions of different innovative processes, which are designed to help to each other, but that at early stages while they are not fully operative, obscure the effects of each innovation separately. It has happened in this study, where the innovations in which we have focused have been affected for another organizational innovation related to politic compromises of lowering the time in the waiting list of surgical procedures: in order to get a better use of the machinery and installations of the hospital, and related to the innovations studied here, the hospitals and specifically the hospital we study here, has evolved increasing the use of different shifts of work, from using almost exclusively the morning shift, to use also the evening shift. Evidence of this process is shown in table 6, where we can appreciate that especially in year 2004 there has been a significant increment of the surgeries that are made in the evening shift. It is, however, too early to evaluate the consequences of this organizational innovation at this hospital, although it shows evidence of the interactions between the service and the policy level.

1.2 Local Context

Madrid is the most populated Spanish province, with more than 5 million. The available per capita gross income was 12.229 euros at the end of 2001, which was 18% higher than the national average. However, Madrid belongs to the last group of regions that obtained the decentralization and full competences of the health system in 2001. Being a rich region we expect

a high rate of innovations. However, the fact that it is one of the last regions in obtaining full competences in health difficult this process in the sense that it has to develop the innovation processes at the same rate than other regions without full competences.

Our analysis is focused in the Hospital of La Princesa, which is located in the urban area of Madrid and provides services to all patients in the public health system living in the neighborhoods of Barrio Salamanca and Chamartín in Madrid, and residents in the municipals terms of Coslada, San Fernando de Henares, Velilla de San Antonio and Mejorada del Campo. It was opened in 1955 and its management is traditional based (with almost no economic incentives to contain costs). It has more than 500 operative beds and all specialties are represented but Maternity and the Pediatric Service, being the seventh largest hospital out of 20 large hospitals in Madrid. There are more than 500 doctors and 900 nurses working at La Princesa. The population attended in La Princesa is more than 400,000. Approximately, 53% are females and the rest are males. The structure of population by age is as follows: around 15% of the population is under 15 years old, around 68% of the population is between 15 and 64 years old, and around 17% of the population is 65 years old or older. The average age of the population has grown in the last years. Lastly, another coefficient to be taken into account regarding the population is that around 50% of the women are in fertile age. A last feature of the hospital can be appreciated in table 7: the increasing average stay and the decreasing number of stays in the last years, with a very static but increasing number of programmed surgical rooms working.

Once the target population and the hospital of reference have been introduced it is worth to understand how the processes of the adoption of both innovations were developed. The Digital Radiology was adopted in the hospital of reference due to the suggestion of the doctor in charge of that area. He knew the existence of the digital radiology and studied the possibility of introducing this technique in the hospital. Then he had to elaborate a cost benefit study *ex ante* in order to present it to the Area of Management and the Head of the Hospital. The attitude he found was very positive. The cost of the technology was not only the monetary cost of the new machines, but also the informatics server and computers, and most importantly, the different in the way of working of several employees. The project was approved and it started in 1999. Since then, and in a gradual base, the analogical radiology has been substituted by the digital radiology almost completely. The main objective of this innovation is to improve the quality of the X-rays with the subsequent benefit for the patients. Through both, analogical and digital radiology, doctors can make diagnostic. However, it is worth to mention that as in other innovation processes, and the agent realizing the benefits of the innovation is the doctor in first place. This is so because with the use of the innovation, the digital radiology, doctors can make diagnostics in an easier or more comfortable way: they can firstly obtain the digital image through the intranet of the hospital in real time, and they can manipulate that image, using a digital zoom, and other tools to improve the contrast or light. It cannot be said that the diagnostic is now of higher quality, in the sense that it would assume a lower quality in the diagnostic of doctors using the analogical technology, and even now they use this technology at some proportion. However, the improvement in the innovation is that they can obtain the same diagnostic by reading the X-ray easier. In other words, the higher quality in the digital X-ray reduces the doubts that a doctor might have on a diagnostic. Also, if there are difficult cases, the digital radiology would ease the communication among specialists because every doctor in the intranet of the hospital has access to those files. While the positive attitude of the management of the hospital is taken as a force facilitating the adoption of the digital radiology, the biggest force that supposed an obstacle to this innovation was the negative attitude of some low skilled workers (not all of them). It has been already mentioned above that most low skilled workers in the public system are paid under a fixed schedule, and they do not perceive any monetary incentive depending on the quality of the service or the satisfaction in the patient. As a consequence, they might perceive as negative any change in the work routine, until they realize that it is better for them. As usual, the improvement in the quality of the service is accompanied by a more comfortable way of working for the personnel, because it eases or simplifies the procedure. There is an additional complaint by the

director of the Service of Radiology consisting of the misuse of some machinery regarding the radiology. Because low skilled workers are not compensated with the good use, sometimes they might not care of the machinery as much as they would if it was theirs (or if they had to be responsible for it). It is worth to note that this obstacle is not necessarily a general attitude in low skilled workers, what means that there are also a significant proportion of low skilled workers with a positive attitude to the innovation. However, with the adoption of the digital radiology, there were some workers that did not want to make the effort of the learning process. They corrected this attitude early in the process of adoption. The case of other high skilled workers as other doctors and nurses was very positive to the adoption of the digital radiology innovation, which supposed a positive force. There are, in any case, some particularities in the process of adoption of the digital radiology by other doctors: during the first periods, and during the learning process, the rate of X-rays was surprisingly greater than before and after the innovation. A possible explanation is that doctors for a while might have ordered X-rays of both types until they completely realize of the equivalence in the diagnostic and trying to compare both products, or while they checked the similarities of both X-rays. It is worth to mention that we only take care of the innovation consisting in the adoption of the digital radiology in the hospital of La Princesa, but there is no adoption of an external use. This means that we analyzed an innovation that is limited, while this limitation might be avoided through the adoption of a further organizational innovation: the outsourcing of making the diagnostics with the information of the digital X-rays through a wider intranet. The introduction of this innovation is also motivated to provide an increase in the number of X-rays produced since a low rate might suppose a bottleneck in the provision of other health services of the hospital.

The Main Ambulatory Surgery system (MAS) presented in this work is also limited to the application at the hospital of reference. Same as in the case of the digital radiology, more gains might be obtained were developed in a different scenario. The idea is the following: the MAS has already been developed in urban areas, near to hospitals, where a low investment in the common surgical package has been benefited from the current infrastructure. However, the current challenge of the MAS system is its implementation in rural areas, where the infrastructure is much worse and the communication has a lower quality, with more spread hospitals, and with the need of specialized health services centers, or primary care ambulatories. The gain of this innovation will be very important in the perception of those patients, even more than in urban areas. By focusing in the hospital of La Princesa, in Madrid, however, our analysis comprehends the consequences of the MAS adoption in an urban hospital. The scope of this case study covers the control of health expenditures derived from the organizational innovation. Some of the determinants of this savings consequence of the use of MAS instead of the traditional surgery with greater stays in the hospital are the difference between inpatient and outpatient services, visits to specialists, number of surgical operations made, or the proportion of patients attended. We also take into account with special interest the perceived patient and physician satisfaction. The first service that applied the ambulatory surgery system in the hospital of reference was the Service of Ophthalmology. That is the reason why we have focused in some parts of the analysis in that service, which is the most characteristic of the ambulatory practice. The adoption of the ambulatory surgery in the Service of Ophthalmology was facilitated by the positive attitude of most of the personnel in the service. The first type of procedure that applied the MAS was cataract, and gradually they were adopting this innovation to more procedures. Now, almost all surgical procedures in the Service of Ophthalmology use the MAS. The main objective of the adoption of MAS system is to provide a high quality health service such that the patients can minimize the time spent at the hospital. The improvement is two sided: on the one hand, it will be accompanied by a decreasing cost of the stay in the hospital by the patient. On the other hand, the surgical procedure under MAS minimizes the cost for the patients in terms of interaction with their private life, in other words, they suffer a lower distortion or impact in their professional or family environment. It is important to note that this positive effect might evolve sometimes in a negative perception by the patient, as the case of aged patients who live alone and that it is even worse for them to be at home than under inpatient care at the hospital while they recover

completely from the surgical procedure. The collateral aim that the MAS system seeks is to decrease the dimension and time for patients in surgical waiting lists through a higher ratio of utilization of the resources (beds and surgical rooms): since patients do not need to stay in the hospital, there is a decrease in the need of beds and more patients can enter every day to have a surgical procedure, which might have been seen as a bottleneck in the management of the hospital.

As mentioned above, the number of stays has decreased at the hospital and the average stay has increased in the last years (table 7). This is coherent with the adoption of the Main Ambulatory Surgery system innovation, because now there are patients that do not need to stay at the hospital, and therefore they do not enter in the statistics of stays. As a consequence, after the adoption of the MAS system, the characteristics of the patients staying at the hospital have slightly changed to patients with higher severity illnesses, more aged, and needing longer stays.

The first characteristic of this organizational innovation is the high cost of the technology, since the hospital had to buy new machinery with laser technology. Besides, most of the instruments that are used at each surgical procedure are of only one use, while with old technology (without the use of laser) some of the tools could be disinfected and used again. As the procedure has facilitated the procedure for doctors, their attitude has been very positive to the innovation. Now they can specialize better in the surgical procedure in the sense that they can attend to more patients everyday. The most important obstacle that the MAS system had to bear is to obtain the trust of the patients. At the beginning it was a difficult task to convince them that they could leave the hospital. However, once the procedure is known, all patients have a very positive attitude.

2. THE INNOVATION PROCESS

The search of new organizational patterns and management for hospitals consisting of decentralized units with high decision power has been pointed to be the solution for the problematic increase of the expenditures in the public health systems. In this pursued framework, it is needed to change the internal structure of the hospital, through the use of new techniques and processes, and allowing the development of a new organization based on a matrix structure instead of a functional one.

It is in this search where the technological innovations and new management styles — with a higher level of self-government or integration of health services — might help the Public Health System to be more flexible, and the hospitals to focus on the patient care and need, with a greater importance of professional and specialized points of view.

2.1 Technologically intense innovation

The technological innovation we take care of in this study is the substitution of the Analogical Radiology by the Digital Radiology. The main innovation consists of the digitalization of the X-ray, which becomes available to any physician or specialist connected to the hospital intranet. It is important to note that even if this innovation has a broader effect when the X-ray is available out of the hospital intranet, for instance, for an intranet of hospitals and

primary care ambulatories in the same region, we are only analyzing the effect of this innovation in the Hospital of La Princesa since this other mentioned extension still does not take place.[**]

The DR technology has been gradually adopted during the last years. Thus, until 1999 the only radiology system used was the AR. Since then, the hospital initiated a period in which the DR was introduced, being in the last two years when this process has evolved more rapidly. Now, six out of the seven Radiology rooms work with the new system. The innovation consists of the utilization of a laser printing system substituting the photochemical (acetate plate) previously used. The information contained in the X-ray is transmitted immediately to the hospital main computer, and optionally can also be printed in the acetate plate as under the AR technology but with lower dimensions, saving 75% of the raw material in these printings per X-ray. As a first consequence of the innovation, there is a lower expenditure in raw materials. Also, there is a difference in the way in which the image is printed at the acetate plate. Under the Analogical Radiology it is needed a dark room where the X-ray is developed using some liquids (the four different stages are developing, fixing, washing, and drying the image). This process usually takes about two minutes per X-ray, and sometimes it does not work (about 5% of the X-rays have to be repeated[*]) and the complete process has to start again, taking another X-ray to the patient, and therefore, being exposed twice to the radiation. All this process supposes a chemical contamination avoided under the DR, same as the development of the X-ray. However, from the point of view of the health service, it results a more important feature that the specialist that demanded the X-ray for the patient can observe from his computer the result with no waste of time, and the X-ray can easily be manipulated (enlarged or reduced, light contrasts, etc.) which is thought to increase the quality in the diagnosis.

Savings in Raw material

We have already mentioned several of the differences in the use of raw material between the different technologies. In this section we go to the detail and explain the savings of the digital radiology.

The Analogical Radiology and Digital technologies need a different set of raw materials. The analysis in this case study compares both technologies. It is important to note that because the innovation has taken place gradually, the monetary savings also are gradual. There are four main differences in the raw material used:

- The AR needs a processing room, which can be either with daylight or a dark room. Although they have some differences, both types of processing rooms suppose a very difficult to measure decline due to the chemical contamination. After the information collected during several interviews with the director of the Service of Radiology, we depreciate the cost of this decline in the condition of the processing room, which is reformed when needed, as all the rooms in the hospital. However, just the use of a processing room, which is not needed when applying the Digital Radiology, means the first important difference in the cost of the radiology per unit of service.

- Because of its technology and the process of development of the X-rays, the AR needs three different liquids during its transformation. First, it uses liquid for the development of the image captured in the X-ray, then it also needs a fixing liquid, and finally it uses a washing liquid. The use of the three liquids in the process of transformation of the image last around two minutes for each plate. After the development of the X-ray with the three liquids, the image goes through a drying process until it gets to the definitive format. All this stage is much simpler using the DR technology, because it does not need any of the liquids and all the development process is dry. Moreover, the process of development for the X-ray with the AR technology supposes the

[**] There exists an ongoing project studying the effect of a net of information among different hospitals and that if successful will be light in late 2005. However, there are institutional problems against the application of this innovation. The main obstacle is the law protecting personal data.

[*] This data has been obtained in a personal interview with the Director of the Area of Radiology.

contamination stemming from the remaining of the liquids used. Although the professionals know of this contamination, they have never quantified it, and traditionally it had been thrown out to the sewer system. Because there is no information on the effects of this contamination, we understand this point as another noise in the analysis which should be understood as a bias against the DR technology.

- The acetate plates. Both AR and DR use acetate plates. The main difference is that in the case of AR, the plate is absolutely necessary, since it means the way in which the X-ray can be observed. Differently, using the DR, the acetate plate may be used also to observe the X-ray, but it is also seen in the computer in real time through the intranet and using specific software. Still, there is a difference in the plates used between the two technologies. With the AR, the plates are of different sizes depending on the part of the body that is X-rayed while using DR, all the plates are of equal size. In order to print the image on the plate, it is needed a shot of light. In general, for the same size of acetate plate, this is cheaper in the case of the AR than for the DR. However, homogenizing the size of the plates as the DR technology decreases the cost of this printing stage.

- Computer system. This cost is exclusive of the DR technology. It supposes the maintenance of a central system with a server capable to store all the plates and make them accessible to all the computers logged on the intranet of the hospital.

It is important to mention that the machinery adapted to the AR can be readapted to the DR technology. It supposes a cost, and also a difference in the time needed for each patient, while buying directly the DR machinery is more expensive. This adaptation is called Computer Radiology (CR) and needs a special chassis. The maintenance cost is highest for the AR, the CR has still some significant maintenance, and the DR has almost zero maintenance cost. The Hospital of La Princesa has radiology rooms of the three types normally working.

Savings in space

The savings in monetary cost of raw materials is not the only important savings derived from the digital radiology. Other important savings come from the smaller space or room needed under each technology. Because we are studying a public hospital it is very difficult to measure the monetary cost of the room. That is the reason why we focus here on the opportunity cost of the space. Here we present the differences in the use of space for the two technologies:

- The process room or dark room needed in the AR technology (not needed under DR).
- The room needed to hold the computer server needed for the DR but not for the AR technology.
- The storage room. This room can be used under both technologies. However, while it is absolutely necessary using AR because it means the only way to recover the X-ray, it is not necessary using DR because the X-ray may be printed in another acetate plate at any time since it is saved in the computing system. Other difference regarding the storage room comes from the fact that the plates under the AR technology are of different sizes, which complicates the task of storage. Therefore, under the DR technology, smaller or less storage rooms are needed than under AR technology.

Quality changes

We now focus on other consequences, non economic, of the change in the technology of the radiology system. We are going to differentiate mainly two indicators of the quality: time and satisfaction.

a) Savings in time

The first indicator of the quality is the time needed for the service, and how it has been translated into the number of patients attended in the Service of Radiology per unit of time. In this stage of the analysis we take care of the details derived from the adoption of the new technology.

- The workers of the hospital have adapted very quickly to the new technology without a supplementary cost.
- The total time of the service, including the transportation of the plate has decreased. There are several explanations for this factor. The process of development in the dark room with the three liquids and the drying process using the AR system last around two minutes per plate, while under the DR technology the plate is obtained in real time. Also it is important to note that with the AR technology, around 5% of the X-rays were defective and had to be repeated (with double cost of raw material) or lost in the transportation until the plate got to the physician, with the consequence of a double radiation for the affected patient.

b) Satisfaction

The second dimension of the quality of the service refers to the satisfaction of the diagnosis with different technologies for the professionals. The hypothesis we manage is that although neither there might be significant differences in the diagnosis due to the innovation, nor it might be possible to empirically identify those differences for patients with the same pre-diagnosis, the Digital Radiology technology allows to obtain a better quality image of the radiography, and being available in the intranet of the hospital, it contributes to a better communication among specialists. From personal interviews we know that the externality of a better communication among specialists is not entirely used. However, another consequence of the increase in the quality of the service is the relative weight of the services that other areas of the hospital demand to the radiology service. The assumption is that increasing the quality of the service makes doctors to be more confident on the X-rays because they are more useful.

2.2 Organizationally intense innovation

It is believed that the first origin of the Main Ambulatory Surgery system took place in 1909 in the Glasgow Royal Hospital for Sick Children. The use of the MAS nowadays means that a patient can suffer a surgery and be at home the same day, while this is not possible without this organizational innovation. Within this process, it is critical the patient safety before, during, and after the surgery; and also the efficiency that allows to minimize the stay in the hospital and reduce the waiting lists.[10-11]

There are two different types of ambulatory surgeries. First, there are patients that leave the hospital the same day of the surgical procedure but that stayed at the hospital the night before. In those cases, the patient can leave the hospital after the effect of the anesthesia has gone, and once doctors have checked that there is nothing wrong. The technical name of this type of procedures is Main Ambulatory Surgery. The second type is the properly named Ambulatory Surgery, and consists of the surgery of a patient that does not spend a night at the hospital, neither before nor after the procedure. They enter the hospital and are directly addressed to the surgical room. During this study and in order to clarify the scope of it, we are going to deal with the broad name of Main Ambulatory Surgery (MAS) to both types of procedures, and therefore, we consider those procedures of patients that leave the hospital the same day of the surgical procedure, no matter if they spend the night before or not at the hospital.

The basis of the MAS is related to previous technological innovations; work in teams, and organizational changes. The expected result is the better perception of the health service by the patients, since a shorter stay in the hospital supposes a lower distortion of the family and professional life. As mentioned above, the specific characteristic of the Ambulatory Surgery on

which we base our study is that the patients who suffer this type of surgery can leave the hospital during the same day of the surgical procedure. At an early stage, some patients, especially aged, did not completely trust on the ambulatory surgery procedures and preferred to stay a night in the hospital. They were afraid of suffering any type of complications after the surgery while being at home. This fear was particularly important for aged patients who live alone. It was a cultural and informational problem that has already been solved by doctors. At this moment, patients feel as a positive sign that they can stay at home after the surgical procedure. Besides, ambulatory measures are taken, and there are a number of nurses that are specialized in visiting patients after the procedures at their home as outpatient care.

There are different areas of the hospital that take care of the ambulatory surgery. Table 8 shows how the Service of Ophthalmology is the one with a higher use of ambulatory surgery with more than 8000 of surgical ambulatory procedures from year 1997 to 2004, representing almost 40% or all ambulatory procedures. However, other types of surgeries together, as thoracic, general digestive, cardiovascular, neurosurgery, or maxillofacial surgeries suppose more than 6000 ambulant surgical procedures (nearly 30%). Thus, in order to make an applied analysis we are going to focus on the Service of Ophthalmology.

The high rate of the use of ambulant procedures in the Service of Ophthalmology is explained because it was the first service using ambulatory procedures in year 1994, although at a very low rate, and because today, Ophthalmology is the service that most heavily bases its procedures on ambulatory surgery. Thus, almost three out of four surgeries in these services belong to the MAS procedures. The evolution in time of this relative weight of the ambulatory procedures is due to the increasing number of cataract procedures to aged patients. The savings in time of this type of procedures is enormous: from staying three days at the hospital under inpatient care to only a few hours. As a consequence, same than in the study of the more technologically intense innovation, but at a much higher rate, it is not only the monetary cost of the inpatient care that is avoided, but more importantly, the opportunity cost of the beds that had to be devoted to the procedures that now are under ambulatory practice.

Same as we have developed in the case of the digital radiology innovation, it is possible to divide the gains in monetary savings, and quality gains.

Monetary savings

- The main factor on monetary savings due to the adoption of the ambulatory surgery system consists of the expenditures that were incurred in the stay of the patients that are now sent to stay at home. It is difficult to measure this economic savings. The reason is that the beds are still occupied, and the only difference is that other patients are using them instead of the patients having ambulatory surgery procedures. However, even if we are unable to identify this monetary saving, it is worth to note that it exists.

- The cost of the new technology with laser in the cataracts procedure is a negative saving. The reason is that it has been needed an initial investment in order to be able to apply the procedures under the MAS system. Besides, part of the material that could be used in several procedures, with the new system is of only one use, and therefore, the cost material per procedure has increased.

Quality changes

a) *Savings in time*

There is not only a monetary saving in decreasing the time that the patient stays at the hospital. There is also a time opportunity cost for the patient. Before the cataract procedure was

generally practiced under the MAS system, the time from the patient enters at the hospital until he can leave was around three days. Now, the time spent at the hospital for the same procedure after the adoption of the innovation is of only several hours.

b) *Waiting lists and quality of life*

It is important to note how the surgical waiting lists have evolved in time after the adoption of the MAS system. Table 10a presents the number of patients entering the surgical waiting lists by active service and year. Here we can appreciate that the services that actually have waiting lists observe an increase in the flow of patients demanding the surgical procedure. In the case of the Service of Ophthalmology, this waiting list increases each year from 1749 patients in 1997 to 3936 in 2003. It is necessary to combine this information with the net flow of patients (number of patients entering the waiting list minus number of patients exiting the waiting list) which is represented in table 10b, where we find that the net flow is decreasing in time, and the waiting time by active service which also decreases (table 10c).

The patients having a cataract procedure suffer a poor vision. After the procedure they recover the vision and can enjoy a better life. Therefore, the sooner they can have the surgery, the better for their quality of life. Thus, it is also important for this reason to study the evolution of the waiting lists, and the evolution of the characteristics of the patients having the procedure.

3. THE CONTENT: DESIGN AND RESULTS

This section is divided in two. First, it describes the design on the analysis and the results it obtains for each of the studied innovations. Then, it presents the conclusions and the comparison on what we have learned between the adoption of the more technologically intense innovation and the more organizationally intense innovation.

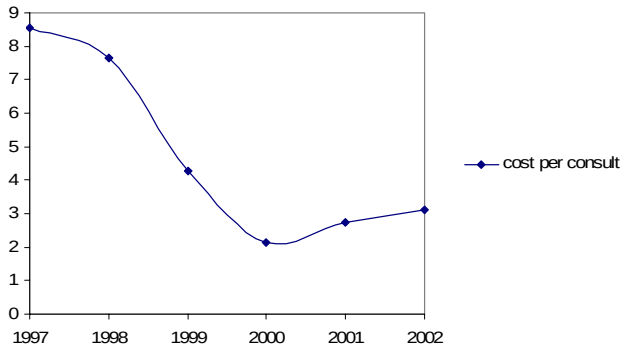
3.1 Technologically intense innovation

The aim of the analysis regarding the adoption of the DR technology is double. First, we seek a measure of the savings (not only economic or monetary savings) per unit of service. Second, we develop an analysis of the variation in the quality of the service, which will have a consequence in the different Areas of the Hospital.

With respect to the material savings, we have access to a classification of the expenditure in the hospital each year. However, it is a gross classification, and it does not get to the necessary level of detail in order to differentiate the cost of each X-ray room. Therefore, the measure we use is the evolution of the cost per service in the Area of Radiology, which is obtained as the ratio of the expenditures in Radiology on the number of services attended each year. Results are provided in table 9 and figure 3. While the number of X-rays increases from 53,729 in 1997 to 154,631 in 2002, the cost per unit of service decreases to less than a half. Therefore the expected result of an increase in the number of consults given the lower time needed to develop de X-ray with the DR adopted innovation and a decrease in the cost per unit of service holds. However, in this analysis we have found an unexpected result: during year 2000, there is a surprisingly high number of X-rays developed and the cost per unit of service is very low. We present a possible explanation after several interviews with the personnel at the hospital: during the first year in which the practice of the DR was generalized, doctors ordered duplicate X-rays using both technologies with the aim of compare both procedures. Also, there is a normal cost of adoption of the

technology that makes repeat the procedure until the doctors obtain the expected product. The lower cost per unit might stem from the AR material that was stored and needed to be used with the change of technology.

Figure 3: Evolution of the cost per service in Radiology

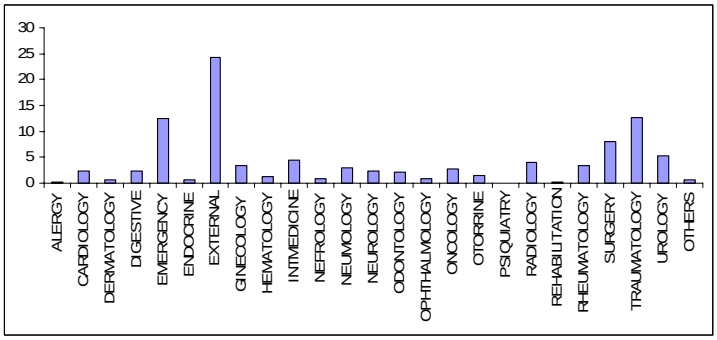


Source: own elaboration.

The savings in space stem from the fact that there is no need for a dark room in order to develop the X-ray, and also there are space savings in the store of the X-ray. It is too early to measure this gaining. However, we could use as a measure the small increase in the number of beds in the hospital, from 501 to 504 (table 7). However, after interviews we realize that there is no a direct causality relation between the innovation and the increase in number of beds.

With respect to the quality effect of the innovation, we differentiate two improvements: on the one hand, the savings in time that are already exposed above given the increasing number of consults in the same period of time. On the other hand, the satisfaction with an special focus on how much and in which way the different Areas have been benefited by this innovation, and if there is an increase in the use of the service. Figure 4 presents how the consults provided in Radiology are originated in many different areas of the hospital. The most important services in terms of use of radiology are the external health centers, traumatology, emergency, surgery, and urology.

Figure 4: Participation of the petitioner service for consults at Radiology in %



Source: own elaboration.

Table 11 presents the evolution of the relative importance of the service of radiology. In this table we can analyze which of the different service demand in relative terms more services from Radiology. Surprisingly we have obtained that only two services, Oncology and

Gynaecology, have increased significantly the relative weight of the service of radiology after the adoption of the Digital Radiology. The rest of the services do not increase this relative weight. A possible interpretation for this result is that before the adoption of the digital radiology, the number of consults in other services was lower because the radiology service supposed a bottleneck in the provision of the health service. Under this hypothesis, once the new technology is adopted, the bottleneck is removed and they can provide more consults even those without demanding X-rays.

As a result, the technologically intense innovation provides savings in the cost per unit of service and time savings with a higher number of consults that are provided with the digital radiology. The measure of quality shows that only a few services increase the relative weight of the radiology service what might mean that the bottleneck has been removed from the Service of Radiology.

3.2 Organizationally intense innovation

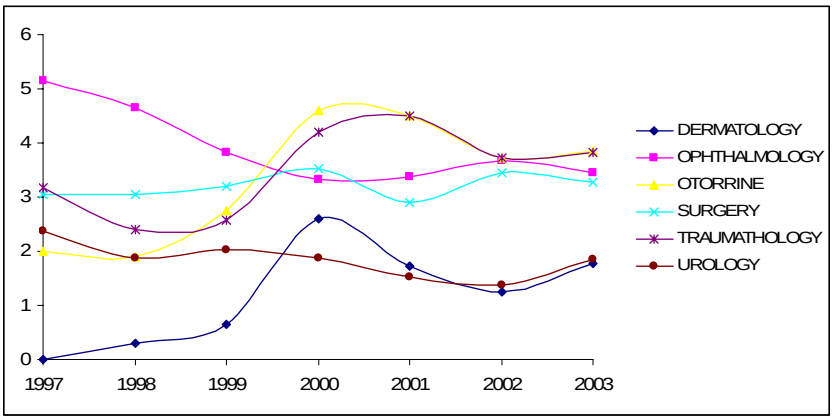
The aim of the analysis based on the adoption of the Main Ambulatory Surgery system consists of the study of monetary savings, and quality changes in the provision of the surgery due to the MAS system. The cost savings are associated with the lower cost of ambulatory care than inpatient stays in the hospital. There is a saving in the post surgery stay (the full cost of the days of stay in the hospital that were needed before), which is explained mostly by the labor cost of physicians and nurses. Other costs as medicines are not as important as labor cost because this type of patient does not require a very specific care. However, it can be argued that there will be an increase in the need of home care that might be needed. We have no information on the identified cost structure of the MAS procedures. A reason is that even if the patients having a MAS procedure do not stay in the hospital, the beds are occupied by other patients and the cost is incurred anyway. It is worth to take into account the opportunity cost of those beds that now are used by other patients that do not need to wait longer to receive inpatient service. The only measure for this is the variation in the diagnostic risk groups attended by the hospital which are oriented to a higher average relative weight of the DRGs which means that the average service provided by the hospital is more intensive in health. Therefore, the main benefit we can analyze from the adoption of the MAS system comes from the quality gains that have been presented in section 3 above.

The first quality gain is the time savings. The origin is that the patient does not need to have a night stay in the hospital and can obtain the post surgery care out of the hospital, either at home or at an ambulatory or health center. In table 7 we can observe how the average stay at the hospital has increase from 10.29 days in 1998 to 10.89 days in 2002 (with some variability). This result is expected given the adoption of the MAS system. The explanation is that as many patients that would stay in the hospital for only a few days were they treated as inpatient care, now and due to the innovation, they receive outpatient care and do not need to stay in the hospital. As a consequence, patients that were decreasing the average stay are not taken into account and thus, the average stay after the adoption of the MAS system is increased.

The second quality gain is defined through the evolution of the waiting time for surgical procedures. Table 10a shows how there has been an enormous increment in the number of patients entering the surgical waiting lists. Furthermore, the service of the hospital with the highest increase in relative terms is the Service of Ophthalmology, which is the one that mostly use the MAS system (from 1749 in 1997 to 20740 in 2003). With the information provided in table 10b we observe that the net flow of patients entering the waiting list is negative in years 1998, 1999 and 2002, meaning that there are more patients exiting the waiting lists and therefore with the procedure already done than those patients entering the waiting line. In contrast, during

year 1997 there are a very high and positive number of patients in the net flow, and in years 2000, 2001, and 2003 there is a moderate entrance of patients in the net flow. As a result we obtain that it is after year 1997 when the MAS system is applied on a regular base and over all in the Service of Ophthalmology. Figure 5 shows the evolution of the surgical waiting time for different services. Combining the information in the figure and the tables, we observe that the MAS system has decreased the waiting time in the Service of Ophthalmology, even if there has been an enormous increment of patients entering the waiting list. It has been able to do it through a high increase in the number of procedures per year. It is worth to note also the increasing proportion of procedures that are done in different shifts (table 6).

Figure 5: Evolution of surgical waiting time for different services



Source: own elaboration.

After year 2000, there is an increase in the usage of the surgical rooms in the evening. This coincides with a decrease in the waiting time of other services, but an increase in the waiting time of Ophthalmology. The interpretation is that when the surgical rooms start to be used in the evening, the procedures practiced are different than those of Ophthalmology and that explains the increase in the waiting time. By contrast, in year 2003 and especially 2004, there is a high increase in the proportion of procedures in the evening shift that belong to the Service of Ophthalmology. Although it is too early to obtain conclusions on that, it confirms the decreasing trend of the waiting time in Ophthalmology in last year. Therefore, the positive effect of the MAS system on the number of procedures is enhanced by other organizational innovation: the use of more than one shift of the surgery rooms.

As a result, before the adoption of the MAS system, the waiting time of different procedures in the hospital was high because the hospital was unable to practice more surgical procedures: the surgical rooms were used in one shift, and it was enough in the sense that the bottleneck was the number of beds. Patients could not have a surgery because they would need to stay in the hospital for at least several days with inpatient care. The MAS adoption has solved part of the problem. Now, an increasing proportion of patients can have the surgery with only outpatient care. However, as there is an increase in the offer of surgical procedures by the hospital, there has been an even greater increase of the demand of those services. As a consequence, the waiting lists have not been reduced as it would have, were remain constant the rest of the conditions. Also, with the application of the MAS system, the bottleneck has been removed from the number of beds, at least for a number of procedures. The new bottleneck in the provision of the surgical procedures is the number of surgical rooms, or the inefficient use of the existing surgical rooms, which can be improved with the use in different shifts, as is being considered and started to practice.

Another result has to do with the increase in the quality of life for patients having the procedure under the MAS system. This point has a relation with the increase in the demand of the procedures. As the number of procedures practiced increases, there are a high number of patients demanding that procedure. As a consequence, now, procedures as cataracts that use the MAS system are demanded by patients at an earlier stage of the illness and younger. Therefore, the MAS system has increased the quality of life of patients suffering the type of illnesses that this system can treat.

4. CONCLUSIONS AND DISCUSSION

This case study analyzes the adoption of two different innovations in the Hospital of La Princesa, a public institution in Madrid, Spain. The two innovations are the process of substituting the Analogical Radiology with the Digital Radiology, and the adoption of the Main Ambulatory system. Both innovations consists of both technological and organizational changes, although they differ in that the adoption of the Digital Radiology supposes mostly a technological change and the adoption of the MAS system is mostly an organizational innovation.

Both innovations pursue an aim related with the increase in the quality of life of the patients; at the same time that improving the provision of the health service. A natural analysis is the comparison on between the adoptions of both innovation processes. The origin of both innovations stems from the highly skilled personnel of the hospital. There are always several aims, and one should be related with the management of the hospital. In this analysis we have found the existence of several bottlenecks in the provision of health services. On the one hand, the Service of Radiology improves the service and is able to provide it much quicker with the Digital Radiology technology. As a consequence, the possible bottleneck in the provision of X-rays is reduced and some services benefit with an increase of the relative importance of the consults that use radiology services, as oncology and gynecology. On the other hand, before the adoption of the Main Ambulatory Surgery system, there was an important bottleneck in the number of beds in the hospital. The reason is that there were a number of procedures that needed the patients to stay at the hospital, and that now they only need outpatient care. The gain is observed in the beds that were occupied by those patients and that now are available for other procedures. The number of procedures practiced at the hospital has increased, and also the average stays. The characteristics of the average patient with inpatient care have also changed.

The adoption of both innovations correct, therefore, the problems caused by the mentioned bottleneck. However, with the adoption of the ambulatory surgery, we observe the bottleneck that had been removed has been substituted by another bottleneck that the management of the hospital needs to care about: when the beds are available, the procedures still cannot be practices due to the lack of surgery room, or to the use of the available surgery rooms. The data shows that with the use of different shifts per day in the surgery rooms, the waiting lists can be reduced, and also the waiting time for patients, which may affect the severity of the patients and their quality of life, before and after the surgical procedure.

Another consequence of both types of innovation processes is that the better is the quality of the service, the higher the number of patients willing to receive the health service. We have seen that the number of consults in the Service of Radiology has increased after the adoption of the Digital Radiology. This effect is more important when is referred to the organizational innovation. After the gradual increase in the use of ambulatory surgeries, the number of patients exiting from the waiting list has not compensated the great entrance in the waiting list for surgical procedures that use the ambulatory system especially those in the Service of Ophthalmology. The explanation for this phenomenon is provided in the health economics literature and is named Induced Demand: as the time needed for providing the procedure decreases, doctors know it, and increase the number of patients in the waiting list for that procedure. As a consequence, the

severity of the patients obtaining the surgical procedure decreases and the quality of life of patients increases. This would mean that doctors fix the level of severity at which they recommend the surgical procedure depending on the availability of surgical rooms and technology. Therefore, a higher quality in the supply of health services would induce the demand of those services.

The fact that there has been an increase in the number of consults, X-rays, and surgical procedures practiced at the hospital, after the adoption of both innovations, indicates that the innovation processes have held the expectations. However, the improvement in the provision of health services has not been enough in order to reduce sufficiently the average time in a surgical waiting list, given the increase in the demand of the procedures. As a consequence, we should conclude that more innovations are needed. The first one that is already being analyzed is the extension or generalization in the use of surgical rooms to two shifts a day and more services should generalize the use of ambulatory surgeries. It would have a cost for the hospital. However, as in the case of the Service of Radiology, the expected result is that the average unit cost of the services should decrease. We also have learned from the adoption of the two innovations in this case study that after the improvement in the provision of the health service, this bottleneck will be removed, but there will be another increase in the number of patients demanding services, in order to obtain the procedure at an earlier stage of the illness. The conclusion is that in order to improve the provision of health, it is not only needed technological innovations that remove the bottleneck in the provision of some consults, or the adoption of organizational innovations as the ambulatory surgery system for more services, but also others as the use of different shifts in order to give an efficient use of the resources at the hospital. A last recommendation at the extreme is the construction of several new hospitals in this area. The reason is that the improvement in the quality of the provision of services due to the innovations is neutralized by the demand induced by the supply.

5. STATEMENTS TESTED IN THE CASE STUDY

This section is motivated by a number of statements that have been evaluated during the development of this case study. They are oriented through two different perspectives: service innovation, and policy learning. The service level innovation corresponds to the experience observed at the innovating organization, while the policy learning statements apply to issues related to policy level, which is oriented here to the relationship between the innovating organization and the health agency of reference in Madrid. There are statements at service and policy level, related to different questions or stages in the process of adopting innovations:

- initiation,
- design and development,
- selection, diffusion, and utilization; and
- evaluation and learning

5.1 Statements on Initiation

A) Public sector innovation is problem driven…

At the service level:

The existence of a problem in the provision of the health service is taken as a driver of the innovations analyzed in this case study in the sense that if the professionals do not find a problem they pay attention to other issues in the provision of health services. However, it is

important to note what can be considered as a problem in the provision of the service: in fact, usually professionals wish to improve the quality in the provision and not only solve problems to guarantee that provision.

The primary rationale for the DR innovation was to increase the number of patients explored, and improve the quality in the service with some savings. In the case of the MAS, they were trying to low the cost of some procedures that did not need hospital stays and improve the quality of life for patients.

The innovations were developed *proactively* at the service level, and the recognition of the need was originated by the professional, although patients´ complaints are also important.

At the policy level:

The public policy learning innovation is problem driven since at the policy level, politicians are sensible to the needs of patients, and they need to hear their complaints. In this sense, the innovation process is a *reactive process*. First they observe the problems and their effects, and then at the policy level an innovation is projected. In the case of Madrid, the politicians observed a worrying problem in the long time at the surgical waiting lists. As a result they are focused on trying to solve this problem and that has also helped the development of the innovations contained in this case study.

B) Performance targets are a driver for innovation…

At the service level that is not completely true. The reason is that being a proactive process, professionals seek an improvement in the provision of the service, but once they start the adoption of the innovation, although they need some results on performance, this is not usually the driver for the innovation. Differently, performance targets do play a role as facilitators for innovations because they can strength the support professionals obtain from the Management level and so, the funds needed for the complete process of the innovation. The most appropriate drivers for the innovations studied here are the desire of professionals of improving the provision of the service (DR and MAS). This is not only a target itself, but is also accompanied by better and smoother conditions for professionals in the provision of the services.

At the policy level, performance targets works in fact as drivers for innovation. The reason is that politicians assume compromises with patients (who are also voters) in trying to solve their problems and improve the perception they have on the provision of health services. However, performance targets are not specifically a facilitator for policy innovations, although they can actually facilitate innovations at the service level. The most appropriate incentive and driver for innovation at the policy level is to improve the quality in the provision of the service perceived by patients.

C) This innovation is…

At the service level, both DR and MAS are “bottom-up” in the sense that professionals realize about the need and possibilities of the innovation, and then they seek funds at the policy level to be able to develop the innovation process. However, it is worth to note that at the policy level, being “bottom-up” innovations, they are facilitated by a “top-down” political compromise. At the service level, the location of the pressure for the introduction of an innovation has no impact on the diffusion and development, once the professional obtains the needed funds at the hospital level. Differently, the location of the pressure at the policy level has an impact on the diffusion and development of the same innovative procedure to other hospitals or institutions since once the consequences on quality and monetary issues are considered and evaluated, the diffusion of the innovation to other public institutions is the following step at the policy level.

With respect to the innovation processes analyzed in this case study, both are originated from professionals, but both needed at high degree the funds obtained from the top public institutions.

5.2 Statements on Design and Development

A) This innovation is developed through imitation of private sector practice

At the service level, this statement is false in the sense that both Digital Radiology and Main Ambulatory Surgery had already been developed in other institutions, but not necessarily only private. Both innovation processes arise from the Departments of Research and Development in other institutions, and in a broader way, from other countries. The central idea here is that the innovations are imitation from other places, no matter if they are private or public. In fact, some of both public and private health institutions in different countries use the innovations processes we take care of here in this case study. With respect to the policy level, the question is not applicable to this case study.

B) The choices and features of this innovation are influenced by underlying organizational politics, dominant values and belief systems.

At the service level, the only influence by organizational politics on the choice and features of the innovations analyzed here refers to the need or dependence that the service level has on the policy level. Thus, once the professional proposes the innovation process, the Area of Management of the hospital decides whether to approve the funds or not. Of course, the Area of Management is not fully independent but obtains the funds from the policy level, and that is the constraint that may affect the innovation procedure and its features. There is no conflict on the service level between agents at different organizational levels. Usually, the Area of Management desires to satisfy all the requests suggested by professionals. The conflict, however is present at the policy level, since at this level they need to decide where to invest the funds, and so, because of budget constraints, the policy level might affect the service level by choosing among different innovation processes to be develop taking into account their more important needs at the time of the decision.

C) The end user was involved in the innovation process

At the service level, the end user is the ultimate beneficiary of the innovation process. Thus, with respect to the Digital Radiology, more patients are finally attended, and with respect to the Main Ambulatory System, not only there are more patients receiving the surgical process, but also they are more satisfied because they reduce the time spent at the hospital. End users are not included in the innovation process more than as a subject using the services. They were not involved in improving the design features because in both cases (the more technologically intense DR and the more organizationally intense MAS) the innovations were well developed by other agents in other institutions. However, end users had a role in increasing the acceptance of the innovation, especially in the case of the MAS system, because at the beginning there were some difficulties trying to make understand patients that they did not need a night stay at the hospital. After the first cases, patients understood this fact and help the diffusion of this knowledge so that now all new patients with the MAS system are happy avoiding the night stay at the hospital unless it is needed.

This question does not apply directly to the policy level in this cases study, because the end user organization only imitated the innovation process. However, it is important to note that the needs perceived by end users or patients can suppose a pressure at the policy level because they are voters, and politicians need (at least try) to improve the provision in services or their

quality so that patients are satisfied enough. In the case of Madrid, in fact, there existed a problem with the waiting lists and it evolved to a political compromise that now needs to be hold.

5.3 Statements on Selection, Diffusion, and Utilization

A1) At the service level, the diffusion of the innovation required effective networking and competence building

In both innovation processes (DR and MAS) it is important the networking at the service level because professionals can anticipate problems existing at the development of the innovation in other institutions, and at the same time, they can know better the gains of the innovation. Although networks are important, it is worth noting that without the competence of professionals requesting and developing the innovations, the adoption would have been a failure. Their competence has been needed to understand the sequence in the adoption of the innovations, which in both cases has been gradual.

A2) At the policy level, the selection and deployment of the innovation required an environment that encouraged effective alternative thinking

An effective networking is always useful at the policy level because it allows to now whether the choices of innovation processes are similar in other institutions. However, at the policy level, the selection and deployment of the innovation definitively required alternative thinking in the sense that there were always other alternatives where to use the funds, and the Area of Management, working together with professionals, once agreed on the need to adopt the innovation, looked for a way of financing the process. This is also related to the professional competence at service and policy level.

B1) At the service level, the diffusion of these innovations did not require coordination between different governmental institutions or departments

The only coordination needed was between different departments in the hospital, as the Service of Radiology (in the case of the DR) and the Service of Ophthalmology (in the case of the MAS) with the Area of Management of the hospital. This intra-governmental coordination can depend on critical or crisis situations because it may change the actual needs in terms of results of a institution.

B2) At the policy level, again there is no coordination needed between different governmental institutions.

5.4 Statements on Evaluation and Learning

Given the innovations that have been analyzed in this case study, the only level that applies to this statement is the service level, at the public organization (the hospital). However, some of the policy learning and other innovations induced also affect to the policy level.

Evaluation played a critical role in the innovation process

At the service level, this statement is true for both Digital Radiology and Main Ambulatory Surgery system innovations. This case study has been analyzed from an evaluation perspective, which was present in the interviews with the professionals that adopted the innovations. Were the results of the innovations not as positive, they would have been stopped by the Area of Management at the hospital level. Differently, research institutions did not play a critical role since the innovations had already been developed from a technical point of view.

With respect to the interaction with other institutions or firms, it did play a role, because the professionals were already the persons in charge of buying raw materials, and they had a professional relationship with the providers. In this way, especially in the case of the Digital Radiology, the Director of the Area of Radiology obtained very good deals in buying the new machinery. However, this interaction was important basically in the economic perspective but not in a critical position. In other words, the innovation processes analyzed in this case study did not depend on the interactions with other institutions.

- At the service level, the innovations *did meet the expectations* of the stakeholders. In the case of the MAS, this can be seen at different stages of the process: first, the perception of patients started to be good very soon thanks to the information given. Later in the process, the increasing number of surgical procedures in Ophthalmology allowed to decrease the waiting time. Same conclusion can be reached with respect to the Digital Radiology given the positive attitude of most professionals from the beginning and the increase in the number of services provided.

- The MAS innovation in fact had an important unintended consequence: the MAS innovation aim was to solve the problem of the bottleneck in the number of surgeries that were provided given the number of beds at the hospital. Thanks to the MAS system, the problem of the number of beds is not that important, but the bottleneck has moved to the number of surgical rooms.

- The MAS innovation and the existence of the new bottleneck have induced to other innovation at the service level, which is a more efficient use of the surgical rooms with more shifts.

- There is evidence of policy learning from the studied processes since the use of the innovations are more and more efficient. In the case of the more technologically intense innovation (DR) professionals have quickly adapted to the new system. Some ongoing projects at the policy level are studying the application of a parallel innovation that affects not only at the hospital level, but at a higher level: the analysis of the X-rays from different hospitals at the same center given the possibility of obtaining the images in an electronic format. In the case of the more organizationally intense innovation (MAS), the evidence of the policy learning is the new innovation that was initiated at the policy level: the use of different shifts for the surgical rooms.

- Lessons from earlier innovation processes at the service level consisted of the identification of the agents presenting more difficulties in the acceptance of the adoption of the innovation, as the difference between most skilled workers and some unskilled workers, not worried by the development of the provision in the service.

5.5 Other questions

A) On the role of the entrepreneurs in the innovation process

- In the case of the Digital Radiology, there is a single entrepreneur: the Director of the Area of Radiology. In the case of the Main Ambulatory Surgery system, all the Service of Ophthalmology started and promoted the adoption of the innovation but there was no a single entrepreneur with a central role.

- The entrepreneurs were assigned to the task. In the case of the DR, the single entrepreneur did conduct the process of adoption, and in the case of the MAS it was the whole Service of Ophthalmology, as the statistics of the proportion of ambulatory surgeries at different services show.

- The entrepreneurs did have the control of the project, once the Area of Management approved the funds needed. At the policy level it is important to note that the Head of the Hospital's attitude always supposed a facilitating force in the innovation processes. His incentives and efforts were also aligned with those of the professionals in charge of the adoption of the innovations. Thus, this person in charge of the hospital did look for the necessary funds.

- The key quality of the entrepreneurs is mixed: in the case of the Digital Radiology innovation, which is clearly conducted by a specific entrepreneur, he is very high skilled and technically very competent. That is the reason why he realized that the innovation process might be developed. Then he needed to be close and have a good relationship with the Head of the Hospital (the policy maker in this matter). Finally, he showed he is strong in managing the Service of Radiology which is the reason of the success in the adoption of the DR. Thus, the two main characteristics were the management and the technical competence. In the case of the MAS innovation process, it is more difficult to answer since the responsible was a full team of professionals, but with a really high technical competence.

- The incentives behind the innovation processes are multiple. On first place, the ultimate beneficiaries are patients, because some of the problems in the provision of health services are alleviated, as the waiting time for surgical procedures. Also, the quality of the services is higher after the adoption of the innovations, both the Digital Radiology and the Main Ambulatory Surgery system, and patients perceive the increase in the quality with the lower time of stays at the hospital or receiving the surgical procedure at a earlier stage of the illness (in the case of the cataracts). However, it is worth to note that within the process of innovation, there exists always some improvement in the activity or procedure so that professionals provide the services in a more comfortable manner. In the case of the MAS, this can be seen through the ease and cleanness in the procedure (for instance, the cataract surgical procedure with laser technology opposed to the manual procedure done before). With respect to the DR, the Digital technology does not fail, and X-rays need not to be repeated (while a small but significant proportion of analogical procedures that are lost), and it is more comfortable to study the image from the computer with the appropriate software. Another incentive is to increase the number of services provided to improve the access of more patients.

B) On the interaction between policy and service level

- The policy learning was result of the "local" innovations at the service level in some degree. This is so because after the initiation of the innovative process started

basically by professionals, once new problems are detected, there was some policy learning and reactions to improve the quality of the services provided.

- Given the nature of the case study, there are no local variations analyzed, although they naturally may exist at the hospital level with for example different use of shifts in the case of the MAS.

- The innovations reflect power struggles at the local level given the dependence of the funds obtained from the top level to the bottom level and that may possible the adoption of innovations. The funds are usually the main constraint for the innovation processes.

- Given the nature of the case study focused at one hospital, it is not possible to know whether there was dissemination of the lesson learned or not. However, the use of different shifts is something determined at the policy level at several hospitals, and the innovation process studied here (MAS) helps to understand the need of its application.

- Although there were not specific evaluation criteria, in fact the entrepreneurs in charge of the innovation processes did evaluate the results obtained, and obtained a higher satisfaction in patients or a greater number of services provided. Nevertheless, it is important to note that once the new machinery is bought, the innovation process can hardly ever be stopped.

- The management of the hospital is the agent having the ultimate decision on the investments in the adoption of innovations. However, as mentioned before, there is a high grade of agreement between the professional entrepreneur and the management of the hospital (also composed by professionals). Thus, there are usually no problems but those stemming from the budget constraint.

- Because the alignment in the interest of the entrepreneurs and the management of the hospital, obtaining the funds is restricted by the budget constraint at the policy level. However, in the case of the innovations analyzed here, they were also aligned with political compromises and therefore they did not find additional problems in their selection.

5.6 Policy recommendations

Several lessons can be learned from this case study as mentioned in the conclusion section (4.2). First, the two innovation processes analyzed obtain very similar results in terms of quality of the service provided and an increase in the number of patients treated, although they suppose innovations of different nature: the Digital Radiology innovation is basically a technologically intense innovation, and the Main Ambulatory Surgery system is basically an organizationally intense innovation. Both innovations are analyzed at the service level because we consider a specific hospital as the unit of reference in the study. However, consequences and policy learning of both innovation processes can be observed at the policy level, with the implication of other institutions.

Some of the policy recommendations that professionals at the hospital point out are referred precisely to the relationship between different institutions. They complain about the rare contact among different institutions, and would like to see more efforts at the policy level in facilitating those contacts. If they had so, there would be a higher rate of diffusion of different

innovations, and they would know better the difficulties found in parallel innovative processes at other institutions. Also, working as a network would provide economics of scale in the result of Research and Development.

Other policy recommendation suggested by professionals at the hospital refers to a certain degree of privatization of some activities so that professionals are more involved with the level of expenditures that are generated in pharmaceuticals and other products. One of the possible extensions is the adoption of the Digital Radiology as a service provided out of the hospital, as the ongoing project that is now being considered (see footnote **).

Professionals realize that sometimes they are not looking for efficiency in the use of public resources. The natural attitude at the physician level is to provide as much care as needed, always looking for the welfare of the patients. This is a desirable attitude. However, when they do not feel responsible for the cost of the treatment, physicians might over provide some services and therefore result a higher level of costs with an inefficient use of the resources. Thus, some incentives (maybe economic) attached to the task of the professionals might help in increasing the efficiency in the provision of health services.

A conclusion obtained at this case study is that as physicians find a better quality in the provision of the health services, they provide a better service and try to make the surgical procedures at an earlier stage of the illness. Again, this is a desirable attitude and can be considered as good practice. However, it is important to note at the policy level that there exists some degree of induced demand by physicians, which is evidenced by the fact that the level of severity suffered by patients at the surgical procedures is lower after the innovation (MAS). Therefore, after an innovative process take place, at least a part of the expected monetary savings is consumed by the new demand of services, and the welfare of the patients is increased. We should not get confused by that result: the lack of monetary savings in the case of the MAS innovation is translated into a higher scope of the service (in terms of an increase in the number of procedures) and a higher quality of the service (since it is provided at an earlier stage).

Once we learned from the innovation process that the new bottleneck is now the number and use of surgical rooms, it is needed to provide different shifts, with a higher rate of collaboration between different institutions (public hospitals). Furthermore, it is expected that even with a more efficient use of surgical rooms, the behavior of physicians will be the same as before and will try to improve the quality of the service attending patients at earlier and earlier stages of the illness so that the result will be more on a higher welfare than in the economics. The program that the policy level is pending to solve is until what extent it can use public resources on some innovation processes that will increase the welfare of patients but will not satisfy an infinite demand. In other words, the policy level needs to evaluate the increase in welfare subject to the investment needed by each proposed innovation process.

6. References

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7. Tables

Table 1a: Number of consults attended by Active service and year

Active Service \ Attended consults	1997	1998	1999	2000	2001	2002	2003	TOTAL
ALERGY	5607	8249	10243	12265	13189	14025	14623	78201
AMBULATORYMED		520	1153	1519	1712	2040	2081	9025
CARDIOLOGY	16834	16408	22079	48000	48285	48340	46564	246510
CLINICANALISYS			46527	73225	70894	64899	82995	338540
DERMATOLOGY	10877	11237	19669	42778	43739	42048	44174	214522
DIGESTIVE	10972	11112	12974	27793	29787	28993	29280	150911
ENDOCRINE	4766	4834	7154	17852	17909	16802	16630	85947
ENDOSCOPY	2463	2762	2455	4798	4933	6151	6448	30010
GINECOLOGY	2571	2505	12710	59181	27648	4026	2479	111120
HEMATOLOGY	5004	14145	16338	19329	21686	21811	20561	118874
INTMEDICINE	11338	14457	17370	16814	17979	18475	20357	116790
NEFROLOGY	3187	3390	3577	3587	4142	4442	5507	27832
NEUMOLOGY	6515	7257	10757	24786	25430	26267	26414	127426
NEUROLOGY	7554	7488	9232	15785	17641	17468	18530	93698
OPHTHALMOLOGY	16875	16448	24126	60426	66670	67172	62954	314671
ONCOLOGY	2782	2761	3021	3374	3149	3290	3162	21539
OTORRINE	4445	4780	11297	37553	38282	36377	33985	166719
PSIQUIATRY	2360	3076	3055	3973	4130	4264	4412	25270
RADIOLOGY	53729	54019	102692	200557	160320	154631	152239	878187
REHABILITATION	3056	3952	5194	10006	9836	10459	9912	52415
RHEUMATOLOGY	19025	18871	19943	21550	22696	22791	24506	149382
SURGERY	24587	26840	30540	45650	47732	49179	49941	274469
TRAUMATOLOGY	17964	19225	27180	62096	60282	59731	58758	305236
UROLOGY	6619	7171	9605	22433	23036	21145	23704	113713
TOTAL	239130	261507	428891	835330	781107	744826	760216	4051007

Table 1b: Relative importance of consults attended by Active service and year

Active Service \ Attended consults	1997	1998	1999	2000	2001	2002	2003	TOTAL
ALERGY	2,3447	3,1544	2,3883	1,4683	1,6885	1,8830	1,9235	1,9304
AMBULATORYMED	0,0000	0,1988	0,2688	0,1818	0,2192	0,2739	0,2737	0,2228
CARDIOLOGY	7,0397	6,2744	5,1479	5,7462	6,1816	6,4901	6,1251	6,0852
CLINICANALISYS	0,0000	0,0000	10,8482	8,7660	9,0761	8,7133	10,9173	8,3569
DERMATOLOGY	4,5486	4,2970	4,5860	5,1211	5,5996	5,6453	5,8107	5,2955
DIGESTIVE	4,5883	4,2492	3,0250	3,3272	3,8134	3,8926	3,8515	3,7253
ENDOCRINE	1,9931	1,8485	1,6680	2,1371	2,2928	2,2558	2,1875	2,1216
ENDOSCOPY	1,0300	1,0562	0,5724	0,5744	0,6315	0,8258	0,8482	0,7408
GINECOLOGY	1,0751	0,9579	2,9635	7,0847	3,5396	0,5405	0,3261	2,7430
HEMATOLOGY	2,0926	5,4090	3,8094	2,3139	2,7763	2,9283	2,7046	2,9344
INTMEDICINE	4,7414	5,5283	4,0500	2,0129	2,3017	2,4804	2,6778	2,8830
NEFROLOGY	1,3327	1,2963	0,8340	0,4294	0,5303	0,5964	0,7244	0,6870
NEUMOLOGY	2,7245	2,7751	2,5081	2,9672	3,2556	3,5266	3,4745	3,1455
NEUROLOGY	3,1590	2,8634	2,1525	1,8897	2,2585	2,3452	2,4375	2,3130
OPHTHALMOLOGY	7,0568	6,2897	5,6252	7,2338	8,5353	9,0185	8,2811	7,7677
ONCOLOGY	1,1634	1,0558	0,7044	0,4039	0,4031	0,4417	0,4159	0,5317
OTORRINE	1,8588	1,8279	2,6340	4,4956	4,9010	4,8840	4,4704	4,1155
PSIQUIATRY	0,9869	1,1763	0,7123	0,4756	0,5287	0,5725	0,5804	0,6238
RADIOLOGY	22,4685	20,6568	23,9436	24,0093	20,5247	20,7607	20,0258	21,6782
REHABILITATION	1,2780	1,5112	1,2110	1,1978	1,2592	1,4042	1,3038	1,2939
RHEUMATOLOGY	7,9559	7,2163	4,6499	2,5798	2,9056	3,0599	3,2236	3,6875
SURGERY	10,2819	10,2636	7,1207	5,4649	6,1108	6,6028	6,5693	6,7753
TRAUMATOLOGY	7,5122	7,3516	6,3373	7,4337	7,7175	8,0195	7,7291	7,5348
UROLOGY	2,7680	2,7422	2,2395	2,6855	2,9491	2,8389	3,1181	2,8070
TOTAL	100	100	100	100	100	100	100	100

Table 2. Consumption of different types of materials in the hospital in euros

	1996	1997	1998	1999	2000	2001	2002
Office material	160706,075	166593,698	174261,002	202411,645	215042,245	216925,89	196262,62
Informatics	202794,983	164502,903	149604,438	181067,343	163828,159	192149,62	220755,71
Health instruments and tools	148721,178	169663,343	145081,678	147410,485	67899,9074	167070,13	143088,72
Other instruments and tools	81310,4167	189633,893	52106,2229	38657,2909	136832,474	56818,76	61301,42
Clothes	208495,18	178380,747	199980,449	176297,297	243995,565	230031,69	177036,99
Food	551961,277	580466,145	174261,002	570712,506	405896,193	263606,04	1054,79
Implants	2524611,96	3224942,3	3410727,41	3101760,17	3865593,55	4015541,15	4241620,26
Laboratory material	574766,97	556928,155	477468,753	481831,206	531269,428	595399,56	585068,94
Reactive analysis	2602076,89	2725023,08	2734460,49	2839834,42	3060727,43	3312939,51	3432101,93
Radiology	398465,899	460036,169	414159,737	439573,281	430008,384	438619,82	482834,46
Radiactive material	112337,607	112674,961	125959,762	70670,2667	50752,4972	15883,1	14911,59
Esterilization	71917,2647	9093,62567	19264,866	20912,4806	25256,548	17189,32	17245,12
Dialisis	398830,148	382544,595	404251,169	349282,061	399795,842	326764,35	221630,21
Other health material	3979455,89	4145088,2	3955683,84	4220341,98	4694822,58	4908230,09	4838748,31
Other nonhealth material and reparations	345677,407	442933,907	283253,477	327404,649	357604,294	436909,46	426206,21
Other materials	209274,29	211212,548	236136,556	231612,131	240914,073	244858,48	254643,47
Personel Expenditures	42274562,6	42813733,9	44601869,6	46634037,7	49752009,9	53308301	57207212,1

Table 3a: Origin of the petitions for consults realized at Radiology Service

Petitioner services for Radiology actions	1997	1998	1999	2000	2001	2002	2003	TOTAL
ALERGY	756	397	506	411	197	130	98	2495
CARDIOLOGY	1128	994	1754	4968	3997	3635	3794	20270
DERMATOLOGY	453	479	548	684	729	856	879	4628
DIGESTIVE	1890	1897	2223	4262	3441	3279	3952	20944
EMERGENCY	974	1043	14045	34483	19739	19400	20383	110067
ENDOCRINE	486	571	519	1110	1079	947	911	5623
EXTERNAL HEALTHCENTERS	6660	6779	14246	46170	51421	45974	42758	214008
GINECOLOGY	461	454	2176	11683	6404	5328	2868	29374
HEMATOLOGY	947	1036	1734	2132	1623	1820	1957	11249
INTMEDICINE	4003	3219	7980	9420	4647	4569	5243	39081
NEFROLOGY	1024	1127	1042	1374	1098	907	1179	7751
NEUMOLOGY	2108	2085	2732	4715	4143	4411	4973	25167
NEUROLOGY	2216	1742	2671	2933	3263	3697	4491	21013
ODONTOLOGY	2276	2538	2526	2461	2987	3080	2068	17936
OPHTHALMOLOGY	1059	713	791	1688	1001	820	538	6610
ONCOLOGY	3015	2986	3373	3850	3382	3772	4399	24777
OTORRINE	698	750	1222	2913	2479	2741	2509	13312
PSIQUIATRY	125	54	105	172	95	70	46	667
RADIOLOGY	3023	4325	4767	6242	6084	5514	5273	35228
REHABILITATION	188	169	244	696	844	377	146	2664
RHEUMATOLOGY	3983	4076	4308	4688	4295	4085	4398	29833
SURGERY	6686	6476	10991	15169	9973	10447	10864	70606
TRAUMATOLOGY	6680	7053	16662	26749	17481	19026	17957	111608
UROLOGY	2870	3031	3986	8908	9307	9331	9738	47171
OTHERS (ADMISION, CLINIC ANALYSIS, ICU)	20	25	1541	2676	611	415	817	6105
TOTAL	53729	54019	102692	200557	160320	154631	152239	878187

Table 3b: Relative importance in % of the origin of petitions for consults realized at Radiology Service

Petitioner services for Radiology actions	1997	1998	1999	2000	2001	2002	2003	TOTAL
ALERGY	1,41	0,73	0,49	0,20	0,12	0,08	0,06	0,28
CARDIOLOGY	2,10	1,84	1,71	2,48	2,49	2,35	2,49	2,31
DERMATOLOGY	0,84	0,89	0,53	0,34	0,45	0,55	0,58	0,53
DIGESTIVE	3,52	3,51	2,16	2,13	2,15	2,12	2,60	2,38
EMERGENCY	1,81	1,93	13,68	17,19	12,31	12,55	13,39	12,53
ENDOCRINE	0,90	1,06	0,51	0,55	0,67	0,61	0,60	0,64
EXTERNAL HEALTHCENTERS	12,40	12,55	13,87	23,02	32,07	29,73	28,09	24,37
GINECOLOGY	0,86	0,84	2,12	5,83	3,99	3,45	1,88	3,34
HEMATOLOGY	1,76	1,92	1,69	1,06	1,01	1,18	1,29	1,28
INTMEDICINE	7,45	5,96	7,77	4,70	2,90	2,95	3,44	4,45
NEFROLOGY	1,91	2,09	1,01	0,69	0,68	0,59	0,77	0,88
NEUMOLOGY	3,92	3,86	2,66	2,35	2,58	2,85	3,27	2,87
NEUROLOGY	4,12	3,22	2,60	1,46	2,04	2,39	2,95	2,39
ODONTOLOGY	4,24	4,70	2,46	1,23	1,86	1,99	1,36	2,04
OPHTHALMOLOGY	1,97	1,32	0,77	0,84	0,62	0,53	0,35	0,75
ONCOLOGY	5,61	5,53	3,28	1,92	2,11	2,44	2,89	2,82
OTORRINE	1,30	1,39	1,19	1,45	1,55	1,77	1,65	1,52
PSIQUIATRY	0,23	0,10	0,10	0,09	0,06	0,05	0,03	0,08
RADIOLOGY	5,63	8,01	4,64	3,11	3,79	3,57	3,46	4,01
REHABILITATION	0,35	0,31	0,24	0,35	0,53	0,24	0,10	0,30
RHEUMATOLOGY	7,41	7,55	4,20	2,34	2,68	2,64	2,89	3,40
SURGERY	12,44	11,99	10,70	7,56	6,22	6,76	7,14	8,04
TRAUMATOLOGY	12,43	13,06	16,23	13,34	10,90	12,30	11,80	12,71
UROLOGY	5,34	5,61	3,88	4,44	5,81	6,03	6,40	5,37
OTHERS (ADMISION, CLINIC ANALYSIS, ICU)	0,04	0,05	1,50	1,33	0,38	0,27	0,54	0,70
TOTAL	100,00	100,00	100,00	100,00	100,00	100,00	100,00	100,00

Table 4: Proportion of surgeries that are realized under Ambulatory procedures

	1998 Freq.	1998 %	1999 Freq.	1999 %	2000 Freq.	2000 %	2001 Freq.	2001 %	2002 Freq.	2002 %	2003 Freq.	2003 %	TOTAL Freq.	TOTAL %
Ambulatory	2963	28.31	3637	33.10	2870	27.69	3052	28.93	3981	33.75	4081	33.37	20584	0,31
Nonambulatory	7503	71.69	7352	66.90	7494	72.31	7499	71.07	7815	66.25	8147	66.63	45810	0,69

Table 5: Public health expenditures as a percentage of the total health expenditures.

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000
Austria	73,5	73,4	73,5	74,2	74,4	70,9	69,7	70	69,7	69,3	69,4
Belgium						70,5	72,6	71,5	72	72,2	72,1
Denmark	82,7	83,5	83,2	82,7	82,2	82,5	82,4	82,3	82	82,2	82,5
Finland	80,9	81,1	79,6	76,1	75,5	75,6	75,8	76,1	76,3	75,3	75,1
France	76,6	76,3	76,6	76,5	76	76,3	76,1	76,2	76	76	75,8
Germany	76,2		77,3	76,4	76,5	76,7	76,8	75,3	74,8	74,8	75
Greece	53,7	53,4	54,6	54,5	50,2	52	53	52,8	52,1	53,4	56,1
Irland	71,9	73	71,5	73,3	71,9	71,6	71,4	74,6	76,5	72,8	73,3
Italy	79,3	79,2	77,1	76,7	74,9	72,2	71,8	72,2	71,8	72	73,4
Luxemburg	93,1	93	92,8	92,9	91,7	92,4	92,8	92,5	92,4	87,9	87,8
Netherlands	67,1	69	72,8	73,6	72,9	71	66,2	67,8	64,4	63,3	63,4
Portugal	65,5	62,8	59,6	63	63,4	61,7	64,7	64,8	65,4	67,6	68,5
Spain	78,7	77,5	77,4	76,6	75,5	72,2	72,4	72,5	72,2	72,1	71,7
Sweden	89,9	88,2	87,2	87,4	87,1	86,7	86,9	85,8	85,8	85,7	85
United Kingdom	83,6	83,3	84,6	85,1	83,9	83,9	82,9	80,1	80,2	80,5	80,9

Source: OECD Health Data 2003.

Table 6: Use of different shifts in surgery

	1998 Freq.	1998 %	1999 Freq.	1999 %	2000 Freq.	2000 %	2001 Freq.	2001 %	2002 Freq.	2002 %	2003 Freq.	2003 %	2004* Freq.	2004* %
Morning	8736	83.48	9365	85.23	8626	83.23	8389	79.51	9118	77.30	9392	76.81	8831	65.07
Night	174	1.66	254	2.31	283	2.73	287	2.72	349	2.96	370	3.03	404	2.98
Evening	1555	14.86	1369	12.46	1455	14.04	1875	17.77	2329	19.74	2466	20.17	4337	31.96

*Data for year 2004 contains only data until November.

Table 7: Structure of the hospital and description of stays

	1998	1999	2000	2001	2002
WORKING BEDS	501	501	501	504	504
PROGRAMMED SURGICAL ROOMS WORKING	10,36	10,36	10,36	11	11
INPATIENT ENTRANCE	16112	15307	15657	15821	15631
AVERAGE STAY	10,29	10,85	10,99	10,5	10,89

Table 8: Active services using ambulatory surgery from year 1997 to 2004

Active Service	Number of MAS	Percentage of ambulatory surgeries	Total surgeries	Relative weight of MAS
CARDIOLOGY	2	0.01	10	20.00
DERMATOLOGY	592	2.78	1145	51.70
DIGESTIVE	22	0.10	77	28.57
GINECOLOGY	10	0.05	74	13.51
HEMATOLOGY	7	0.03	239	2.93
INTERNAL MEDICINE	2	0.01	4	50.00
NEFROLOGY	38	0.18	60	63.33
OPHTHALMOLOGY	8065	37.93	11105	72.62
OTORRINE	835	3.93	3667	22.77
SURGERY	6017	28.30	26815	22.44
TRAUMATOLOGY	3870	18.20	16026	24.15
TOTAL	21262	100		

Table 9: cost per unit of service in radiology

	1997	1998	1999	2000	2001	2002
Radiology	460036,169	414159,737	439573,281	430008,384	438619,82	482834,46
consults	53729	54019	102692	200557	160320	154631
cost per consult	8,56215766	7,66692714	4,28050171	2,14407068	2,73590207	3,12249458

Table 10a: Number of patients entering in waiting lists by Active Service and year

Active Service \ Year	1997	1998	1999	2000	2001	2002	2003	Total
CARDIOLOGY	358	210	6	1	4	1	2	582
DERMATOLOGY	0	28	62	255	363	169	199	1076
ENDOCRINE	1	0	0	0	0	0	0	1
GINECOLOGY	76	65	2	1	1	3	1	149
HEMATOLOGY	3	0	0	0	0	1	0	4
INTMEDICINE	0	0	0	0	0	1	0	1
NEFROLOGY	0	0	0	0	0	0	3	3
OPHTHALMOLOGY	1749	2362	2193	3030	3675	3795	3936	20740
OTORRINE	514	492	505	675	628	668	687	4169
SURGERY	2955	3331	3897	4225	4568	5401	5403	29780
TRAUMATHOLOGY	2239	1945	1895	1857	1914	1853	1887	13590
UROLOGY	1210	1200	1238	1235	1410	1227	1531	9051
Total Patients	9105	9633	9798	11279	12563	13119	13649	79146

Table 10b: Net flow of patients in waiting list by Active Service and year

Active Service \ Year	1997	1998	1999	2000	2001	2002	2003	Total
CARDIOLOGY	9	-9	0	0	0	0	0	0
DERMATOLOGY	0	5	-1	51	-35	-7	31	44
ENDOCRINE	0	0	0	0	0	0	0	0
GINECOLOGY	7	-7	0	0	0	1	-1	0
HEMATOLOGY	0	0	0	0	0	0	0	0
INTMEDICINE	0	0	0	0	0	0	0	0
NEFROLOGY	0	0	0	0	0	0	0	0
OPHTHALMOLOGY	822	-88	-170	198	272	-36	190	1188
OTORRINE	70	52	10	117	-55	2	-10	186
SURGERY	805	116	84	145	-71	639	-352	1366
TRAUMATHOLOGY	601	-248	117	206	-13	-197	120	586
UROLOGY	246	-125	116	-80	47	-48	120	276
Total Patients	2560	-304	156	637	145	354	98	3646

Table 10c: Waiting time by Active Service and year entering in the waiting list

Active Service \ Waiting time	1997	1998	1999	2000	2001	2002	2003
CARDIOLOGY	0,32	0,48	0,00	0,00	0,00	0,00	0,00
DERMATOLOGY	0,00	0,29	0,65	2,60	1,72	1,26	1,77
ENDOCRINE	0,00	0,00	0,00	0,00	0,00	0,00	0,00
GINECOLOGY	0,89	0,92	3,00	1,00	0,00	2,00	0,00
HEMATOLOGY	0,00	0,00	0,00	0,00	0,00	2,00	0,00
INTMEDICINE	0,00	0,00	0,00	0,00	0,00	1,00	0,00
NEFROLOGY	0,00	0,00	0,00	0,00	0,00	0,00	0,67
OPHTHALMOLOGY	5,15	4,66	3,82	3,32	3,37	3,67	3,46
OTORRINE	1,99	1,89	2,74	4,59	4,49	3,72	3,86
SURGERY	3,06	3,06	3,20	3,53	2,89	3,45	3,27
TRAUMATHOLOGY	3,17	2,40	2,57	4,21	4,50	3,73	3,82
UROLOGY	2,38	1,87	2,03	1,88	1,53	1,38	1,84

Table 11: Evolution of the relative importance of the Service of Radiology

	1999	2000	2001	2002	2003	Difference 1999-2003
ALERGY	4,940	3,351	1,494	0,927	0,670	-4,270
CARDIOLOGY	7,944	10,350	8,278	7,520	8,148	0,204
DERMATOLOGY	2,786	1,599	1,667	2,036	1,990	-0,796
DIGESTIVE	17,134	15,335	11,552	11,310	13,497	-3,637
ENDOCRINE	7,255	6,218	6,025	5,636	5,478	-1,777
GINECOLOGY	17,120	19,741	23,163	132,340	115,692	98,571
HEMATOLOGY	10,613	11,030	7,484	8,344	9,518	-1,095
INTMEDICINE	45,941	56,025	25,847	24,731	25,755	-20,186
NEFROLOGY	29,131	38,305	26,509	20,419	21,409	-7,721
NEUMOLOGY	25,397	19,023	16,292	16,793	18,827	-6,570
NEUROLOGY	28,932	18,581	18,497	21,164	24,236	-4,696
OPHTHALMOLOGY	3,279	2,793	1,501	1,221	0,855	-2,424
ONCOLOGY	111,652	114,108	107,399	114,650	139,121	27,469
OTORRINE	10,817	7,757	6,476	7,535	7,383	-3,434
PSIQUIATRY	3,437	4,329	2,300	1,642	1,043	-2,394
RADIOLOGY	4,642	3,112	3,795	3,566	3,464	-1,178
REHABILITATION	4,698	6,956	8,581	3,605	1,473	-3,225
RHEUMATOLOGY	21,602	21,754	18,924	17,924	17,947	-3,655
SURGERY	35,989	33,229	20,894	21,243	21,754	-14,235
TRAUMATOLOGY	61,302	43,077	28,999	31,853	30,561	-30,741
UROLOGY	41,499	39,709	40,402	44,129	41,082	-0,418

8. On the PUBLIN case studies

The following general presentation is based on the PUBLIN guideline report for case study researchers. See also the introduction to the case study summary report.

The overall aim of this PUBLIN study has been to gain insights into the processes of innovation and the associated policy learning in the public sector. These should contribute to the development of a theory (or theories) of innovation in the public sector, and contribute usefully to policy analysis. Within this study framework, the aims of Work Packages 4 and 5 (the case studies) have been *to understand the interplay between policy learning and innovation at the policy level, and innovation at the service level within the public sectors under study.*

More specifically, the objectives of each Work Package are:

1. To understand the innovation processes present within national public health systems/social service systems.

2. To understand the learning processes underlying policy development in publicly regulated health/social service sectors.

8.1 Innovation

Green, Howells and Miles (2001), in their investigation of service innovation in the European Union, provide a suitable definition of the term innovation which denotes a process where organisations are

> *"doing something new i.e. introducing a new practice or process, creating a new product (good or service), or adopting a new pattern of intra – or inter-organisational relationships (including the delivery of goods and services)".*

What is clear from Green, Howells and Miles' definition of innovation is that the emphasis is on novelty. *As they go on to say,*

> *"innovation is not merely synonymous with change. Ongoing change is a feature of most… organisations. For example the recruitment of new workers constitutes change but is an innovative step only where such workers are introduced in order to import new knowledge or carry out novel tasks".*

Change then, is endemic: organisations grow or decline in size, the communities served, the incumbents of specific positions, and so on. Innovation is also a common phenomenon, and is even more prominent as we enter the "knowledge-based economy".

An innovation can contain a combination of some or all of the following elements:

- New characteristics or design of service products and production processes *(Technological element)*

- New or altered ways of delivering services or interacting with clients or solving tasks *(Delivery element)*

- New or altered ways in organising or administrating activities within supplier organisations *(Organisational element)*

- New or improved ways of interacting with other organisations and knowledge bases *(System interaction element)*

- *New world views, rationalities and missions and strategies*. (Conceptual element)

8.2 Case study statements

In an effort to define a common methodological framework within which to study innovation in the public sector, several research orientation statements were put forward and related policy questions suggested.

These give a '*problem driven view'* of the issue under study. It should be strongly emphasised that this list was only intended to be indicative of what propositions might be tested and it was revised during the course of the PUBLIN study.

For instance, the following statements were added to the ones listed in the table below:

Entrepreneurs played a central role in the innovation process

- Was there a single identifiable entrepreneur or champion?

- Was the entrepreneurs assigned to the task?

- Had the entrepreneurs control of the project?

- What was the key quality of the entrepreneurs? (management, an establish figure, position, technical competence, access to policy makers, media etc)

- Incentives

There was no interaction between policy and service level (feedback)

- To what extent was the policy learning a result of local innovation?

- Are local variations accepted, promoted or suppressed?

- To what extent does the innovation reflect power struggles at the local and central level?

- Was there dissemination of the lessons learned, and was this facilitated by specific policy instruments?

- Where there evaluation criteria? (When?)

- Who where the stakeholders that defined the selection criteria? Did problems arise due to the composition of this group of stakeholders?

- How did the interaction and/or the interests of the stakeholders influence the selection of the indicators used?

Policy recommendations

Based on your experience from case studies, give concrete policy recommendations.

1. Preset also policy recommendations given by the respondents

2. Are the any examples of “good practice”?

The case study reports all try to comment upon these statements.

Moreover, all participants were also asked to use a comparable design for the case study itself and for the case study report.

Service Innovation		Policy Learning	
Statements	**Questions**	**Statements**	**Questions**
Initiation		**Initiation**	
Public sector innovation at the service level is problem driven	What was the primary rationale for the innovation under study? Were there supporting rationales? Was the innovation developed proactively or reactively? Where did (recognition of) the need for the innovation originate?	Public policy learning innovation is problem driven.	How can specific problem-orientated policy innovations be transformed into more general forms of policy learning? Is policy learning largely a reactive or proactive process?
Performance targets are a driver for innovation. Performance targets are a facilitator for innovation.	What are the most appropriate incentives and drivers for innovation in the public sector system under study? Be aware that it may be a driver and not a facilitator	Policies directed at performance measurement are a driver for policy innovation Policies directed at performance measurement are a facilitator of policy innovation	What are the most appropriate incentives and drivers for innovation in the public sector system under study? Be aware that it may be a driver and not a facilitator
This innovation is "top-down" (i.e. policy-led) as opposed to "bottom-up" (i.e. practice-led).	Does the location of the pressure for the introduction of an innovation impact its diffusion and development? Each country case should describe to what extent it is a top-down or a bottom-up innovation	This innovation is "top-down" (i.e. policy-led) as opposed to "bottom-up" (i.e. practice-led).	Does the location of the pressure for the introduction of an innovation impact its diffusion and development? Each country case should describe to what extent it is a top-down or a bottom-up innovation
Design and Development		**Design and Development**	
This innovation is developed through imitation of private sector practice.	Where did the innovation arise? Does it have models outside or inside the public sector?	This innovation is developed through imitation of private sector practice.	Where did the innovation arise? Does it have models outside or inside the public sector?
The choices and features of this innovation is influenced by underlying organisational politics, dominant values and belief systems	To what extent have the choices and features been driven by conflicts (specify: power, funding, belief systems … etc) between different stakeholders? How did the introduction of the innovation overcome the resistance to change at the service level?	The choices and features of this innovation is º influenced by underlying politics, dominant values and belief systems	To what extent have the choices and features been driven by conflicts (specify: power, funding, belief systems … etc) between different stakeholders? How did the introduction of innovations overcome the resistance to change at the policy level?
The end user was involved in the innovation process	What was the role of the end user? Were they involved in order to improve the design features or to increase	The end user organization was involved in the innovation process	What was the role of the end user organisation? Were they involved in order to improve

	acceptance of the innovation and/or for other reasons? If they were not involved, explain why.		the design features or to increase acceptance of the innovation and/or for other reasons? If they were not involved, explain why.
Selection, Diffusion and Utilisation		**Selection and Deployment**	
The diffusion of the innovation required effective 1. networking, 2. competence building and 3. alternative thinking		The selection and deployment of the innovation required an environment that encouraged effective 1. networking, 2. competence building and 3. alternative thinking	
The diffusion of this innovation required co-ordination between different governmental institutions and/or departments	How can inter-governmental roadblocks be by-passed? To what extent does intra-governmental co-ordination depend on direct political interaction? To what extent does intra-governmental co-ordination depend on stimulus from a crisis situation? Does fragmentation of government create a barrier?	The most challenging public policy innovation takes place at the intra-governmental (inter-functional) level.	How can inter-governmental roadblocks be by-passed? To what extent does intra-governmental co-ordination depend on direct political interaction? To what extent does intra-governmental co-ordination depend on stimulus from a crisis situation? Does fragmentation of government create a barrier?
Evaluation and Learning		**Evaluation and Learning**	
Evaluation played a critical role in the innovation process Research institutions played a critical role in the innovation process Interaction with other institutions/firms played a critical role in the innovation process	Did the innovation meet the expectation of the stakeholders at various stages of the innovation process? Did the innovation have unintended consequences (e.g shifting bottlenecks)? Did the innovation induce other innovations? Is there evidence of policy learning and any associated structure? Had lessons been drawn from earlier innovation processes?	Evaluation played a critical role in the innovation process Research institutions played a critical role in the innovation process Interaction with other institutions/firms played a critical role in the innovation process	Did the innovation meet the expectation of the stakeholders at various stages of the innovation process? Did the innovation have unintended consequences (e.g shifting bottlenecks)? Did the innovation induce other innovations? Is there evidence of policy learning and any associated structure? Had lessons been drawn from earlier innovation processes?