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Innovative Integration of Information Systems for Managing a National Access to Surgery

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1. Introduction

Leverage technology in improving access to surgery

National Health Systems are facing very difficult times. In most OECD countries, there are evident trends such as the shortage of human resources (HR), HR are becoming too expensive to handle, new therapies that are very expensive and patients that are becoming older and with increasing co-morbidities, and complementary exams that are also very expensive (Gauld & Derret, 2000). It is difficult do cope with the patients demand, to do so managing tools are required. The Portuguese National Health System (NHS) services aims at serving all citizens. The primary-care services cover the entire country and are responsible for referring to hospitals. The larger demand and the limitations of supplying health services lead to the existence of waiting lists (WL). In the case of surgery it leads to waiting lists for surgery (WLS). The spread of healthcare units and of patient demand across the country leads to inefficiency (Porter and Teisberg, 2007). In this regard, the need for information systems (IS) to address the exchange of information between different health institutions is critical (Lapão, 2007).

Today, most of the inefficiency problems relate to the lack of coordination between systems due to the use of different architectures and standards (Lenz and Kuhn, 2002). The National Health Systems Administration (ACSS) is both responsible for addressing the "National Health Information Systems Infrastructure" and developing the "Surgery Access National Program". ACSS started to implement the SIGIC (Integrated System of Management of the Waiting List for Surgery) program in 2005, following a less integrated equivalent program named PECLEC that had started years before. By "access to healthcare" is meant the possibility that individuals have to get proper healthcare treatment according to their needs in order to have real healthcare gains (EOHSP, 2009). In Portugal, access to healthcare services is a constitutional right. Proper care treatment is understood as a combination of factors: the opportunity (on-time treatment), the gains in health (effectiveness), the adequate costs (efficiency), and the value perceived by the patient. The need for regulation elapses from the fact that healthcare services are a scarce and valuable resource. SNS needs to deal with limited resources to serve our 10 million inhabitants: the numbers of primary care

health centers in the public healthcare system in Portugal. The numbers of hospital beds in the public healthcare system (regarding North, Centre, Lisbon, Alentejo and Algarve Regions) is limited to 18.553 (MS). The numbers of National Reference System for Continued Integrated Care (RNCCI) beds (North, Centre, Lisbon, Alentejo and Algarve Regions) are limited to 2851 in total. All of these resources (primary care referencing, hospital and tertiary beds availability, surgery scheduling) need proper and timely management (Lapão & Dussault, 2011).

Therefore it became clear that an information system was a necessity. An IS that would integrate the available information about the demand and supply, and at the same time would present an estimate of the patients and the waiting time on the WLS, accessible to professionals and patients. In 2004, SIGIC was defined legally to be a structure of the Ministry of Health to manage and improve the "access to surgery". SIGIC was established to assure the treatment by services in the following terms (PRLD, 2007):

- High standards of technical quality for the healthcare services (quality);
- Maximum allowed waiting time by medical priority and pathology (standards);
- Universal schedule rules safeguarding medical priority and waiting time (equity);
- Guarantees of alternative choice if waiting time is 75% of the maximum waiting time established (process);
- Transparency and guarantee of information quality (transparency).

This chapter contributes to the understanding of the role of information systems integration in supporting the development of a nation-wide access to surgery system. The information system allows for significant improvements in the management with clear impact for patients.

This chapter will start covering the definition of the problem of the management of a nation-wide waiting list system, followed by the definition of an information strategy, and the development of the system to accomplish that aim. At the end the results of the first 5 years of this program will be presented and discussed.

2. The problem of managing nation-wide waiting list for surgery

2.1 The patient path and waiting lists for surgery

Waiting lists (WL) are the register of patients who have been clinically assessed as needing elective surgery in a hospital. It could include patients both with and without a scheduled date of admission to hospital (GoSA, 2006). Since there is an instable equilibrium between demand and services supply, WL is an important and useful management instrument to help prioritize the use of resources in the health system. More important is the rationale behind determination of the waiting time of the patients expecting (queuing for) elective surgery, with the identified problems of clinical urgency and universal access. Furthermore, although the waiting experience was described as stressful and anxiety provoking, for a significant numbers of patients the experience of waiting was not uniformly negative (Carr et al., 2009).

In many western societies the universal access to health services is a constitutional right (EOHSP, 2009). This is an increasingly difficult challenge. Health managers have to use WL

management tools aiming at providing the support for proper hospital production planning (Valente & Testi, 2009; van Ackere & Smith, 1999). The adequate use of WL could provide a balanced (and fair) prioritization of patient needs and at the same time provide some pressure over the health system to improve its organization and processes towards a better response, to better reply to the patient demand (Sibbald et al., 2009). To better understand the role of processes and information flow it is important to be aware of the patient path in the system. Figure 1. shows the path of the patient and the time waiting from booking to surgery.

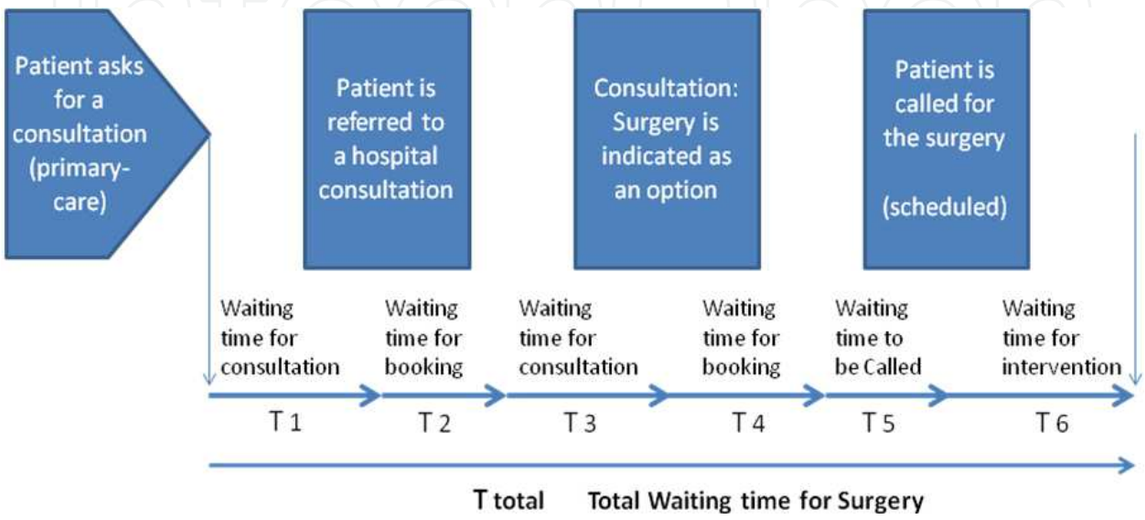

Fig. 1. The patient path in the system.

We have split the total flow in six stages with the corresponding time (Ti). The first stage starts when the patient initiates the consultation booking process in the eAgenda system (available in the Internet), where he/she can pick-up one available spot within the next days. T_1 is the time the patient will wait until the consultation in the health centre. The second stage starts when the family physician considers that the patient probably requires a surgery and decides to refer the patient for a hospital consultation. T_2 is the time the patients need to wait before the hospital consultation is effectively booked. When the booking is completed, patient will have to wait until the hospital consultation (T_3). The third stage starts with the indication for surgery by the hospital surgeon, after which the patient will have to wait until the surgery is booked (T_4). After that patient will have to wait to be called for the procedure (T_5), then the surgery is scheduled. After the surgery is been scheduled the patient will have to wait until the actual day of the procedure (T_6).

The total waiting time for surgery T_{total} is the linear summation of the six partial times: $T_{total} = T_1 + T_2 + T_3 + T_4 + T_5 + T_6$. The management problem here emerges from the fact that we do not have enough information about any of these waiting times. Recently, the introduction of eAgenda, Alert (used for supporting the referring process) and other systems created the opportunity for getting closer to the situation, nevertheless the databases are not prepared to be used for management analysis. These information systems were built for the unique purposed of exchanging information rather than allowing for tactical and strategic analysis.

2.2 Wanting list theory

A "waiting list" is the collection of random arrivals of patients (demanding for a surgery) and the necessity of allocating the right resources to avoid waste and inefficiencies (intervention capacity not used) (GoSA, 2003). This organizational capacity must be managed in order to properly satisfy the needs of patients without exceeding the recommended or acceptable waiting time (taking much time than clinical recommended or acceptable). We should use the total waiting time (T_{total}) as one suitable indicator of performance. This indicator is clearer than the total number of inscribed patients because it really tells the impact on patient's life, while the number of patients in the WLS is just a number expressing the demand. It does not specify how well the systems respond to the demand.

A long waiting time (T_{total}), if longer than recommended for the pathology, could be the result of an excess of demand and a lack of resources to properly respond. In the case of a weak response the Health authorities are require to intervene to tackle the problem. Nevertheless, to manage an intervention is necessary to develop mechanisms for controlling both the demand and the supply. On the one side, the demand depends from non controllable factors such as population health status, available resources and the clinical practice. On the other side, controlling the supply by hospital services could mean to improve capacity, by either using more resources or by increasing efficiency. If necessary, hospital managers could also increase capacity temporarily to tackle a punctual problem of excess of the demand.

As a theory, Iversen (1993) proposes the need to consider that the no-cooperative character of resource allocation in a national health service could contribute to excessive waiting lists. The theory of hospital waiting lists is derived from this concept. The existence of waiting lists implies the loss of efficiency: the hospital's resources are drawn away from medical work. Although there is scope for Pareto improvements, the structure of budget allocation obeys other criteria and may prevent these improvements from being achieved. The health organization may need to be re-organized. Therefore, the conceptualization of a nation-wide system for managing the access to surgery will need rethinking (and the Surgical Departments should also review their processes).

Health services could use waiting lists in general for different purposes, being one of the most relevant the waiting list for (elective) surgery (WLS). An elective surgery is a surgery that, once established as an indication, can await over 24h before being performed, note that it does it cover medical treatments other than specific stabilizing drugs in preparation for surgery. Opposed to this definition is emergency surgery or treatment, which needs performing within less than 24h. WLS should encompass specific instruments to help hospital's managers' process the patients enrolled, their established surgical indication and its priority time frame.

With increasing life expectancy and of co-morbidities, the demand for new hospital specialist consultations is huge. This demand could arrive to the hospital through two different pathways: either by referral from primary health care or by direct entrance in the emergency. However, in the case of elective surgery, the patients usually enter from primary care referral. The demand for hospital specialty consultations increases from primary-care referral, leading to an increase in hospital consultations, some of them leading

to the WLS, others to other types of treatment. The later produce an increase in the waiting time for booking and consultation (T2 and T3). If the number of surgeries performed does not cope with the increasing demand, it leads to a further increment in the number of patients registered in the WLS. Before the introduction of mechanisms for managing waiting lists, often cases would go to media because a patient had died before proper treatment had been delivered, or because other patient had stayed in the list for months, much longer than guidelines recommended. These situations are unacceptable by public opinion and pressure built-up for governments to introduce sophisticated mechanisms to support a fair approach to improve access to surgery. These mechanisms are also important to assure transparency in processes regarding selection and scheduling patients to surgery. Furthermore, by allowing for complete registration of the process, this new system will render accountable those responsible in cases of longer than expected waiting time.

One of the purposes of the system is to integrate data from all patient surgeries registrations, independently of other requirements like the need for staying in the hospital as inpatients, type of anesthesia to be used, or where the surgery will be performed (in a NHS hospital or on a private or social institution). In order to improve workflow the patients have to sign the express his/her consent before registration in the WLS. Signed consent is also needed for legal purposes. Hence, a system for managing the access to surgery is supposed to regulate all the programmed surgery production and incorporate the whole set of stages in patient management.

2.3 The negative health effects of a long permanence in the waiting list for surgery

The existence of a significant number of patients waiting for treatment that exceed the clinical acceptable times has ominous consequences not only for the individuals (increasing suffering, reduce treatment success, more complex treatments) but also for the society (more expensive use of resources, higher absenteeism, etc), which forced the government to take political measures such as the creation of an upgraded program.

In the recent past, the access to healthcare was carried through in a non-regulated manner and the integration of the different levels of treatment was inexistent. The citizen did not have the opportunity to be aware of the process. The system evolved, with the expansion of new regulation units guided towards efficiency of the system centered in the patient. Health-care referencing nets were defined and consolidated and the participation of the patient was strengthened during the development of the processes (Jeston and Nelis, 2006). It is put together as a comprehensive system that integrates the diverse levels of healthcare.

The regulation should be centered on patient gains in health. As the Portuguese National Health service is driven by the "Primary-care", closer to patients, from which MCDT (Exams, Complementary Means of Diagnosis and Treatment) are prescribed and hospital-care is referenced. SIGIC personnel works the data from surgical services, medical services, and other MCDT in order to manage the "surgery access" (with SIGA: the Integrated System of Management of the Access) and related it with Continued care and, Patient needs.

2.4 Problems managing waiting lists

Prioritization of waiting lists for elective surgery represent a major issue in public systems in view of the fact that patients often suffer from consequences of long waiting times (Valente

et al., 2009). The most significant problem whilst managing waiting lists is to access all the important information to accelerate the decision process (take faster decisions) (Dexter et al., 2000). But, when there are plentiful resources available often the easy solution to "through money" into the problem. This was the case for the first years of addressing the waiting list for surgery. In Portugal, since 1995 four interventions have been developed to tackle WLS. First, PERLE (Waiting Lists Solution Specific Program) run from 1995 to 1998. Second, in 1999, it was launch the PPA (Access Promotion Program) with small improvements. Third, in 2001, a more sophisticated PECLEC (Surgery Waiting Lists Reduction Special Program), with specific reduction goals was initiated. These first three experiments programs would lead to the fourth intervention with SIGIC (that will be analyzed in the following pages).

3. Evidence from what others have done

Siciliani & Hurst (2004) found that waiting times may be reduced by acting on the supply of or on the demand for surgery (or both). Van Ackere & Smith (1999) proposed a macro model for developing a National waiting lists management system. They mentioned that waiting lists for surgery have been endemic to the UK National Health Service since its inception in 1948. The use of waiting lists reveals a management concern to serve the patients. The lists emerge as a result of interaction between supply factors (the provision of resources and the efficiency of their use) and demand factors (arising from a complex conjunction of the perceptions and preferences of patients and physicians). The adoption of a macro model takes an economic perspective and assumes that the waiting time for surgery, as perceived by patients, physicians and managers, is a central influence on the quantity of elective surgery demanded and supplied. From their study, van Ackere & Smith (1999) further alert, by exploring a number of future scenarios, for the fact that the NHS will eventually cease to be a universal service if resources fail to keep pace with increasing demand.

VanBerkel & Blake (2007) performed a comprehensive simulation for waiting time reduction and capacity planning applied in general surgery, using operational research techniques. They have studied the consequences of redistributing beds between sites, and achieving standard patient lengths of stay, while comparing them to current and additional resource options. This simulation exercise proved that there were multiple independent and combined options for stabilizing and decreasing the waiting for elective procedures.

Valente et al. (2009) developed a model to prioritize access to elective surgery on the basis of clinical urgency and waiting time. They mentioned that administrative and standardized data on waiting lists are generally lacking in Italy, even since 2002 an implicit Urgency-Related Groups (URGs) associated with Maximum Time Before Treatment (MTBT) was defined. The Surgical Waiting List Info System (SWALIS) project was created in 2001, with the aim of experimenting solutions for managing elective surgery waiting lists. First, only ten surgical units in the largest hospital of the Liguria Region were involved in the design of a pre-admission process model embedded in web-based software. This SWALIS system allowed pre-admissions based on several steps: 1) urgency assessment into URGs; 2) correspondent assignment of a pre-set MTBT; 3) real time prioritization of every referral on the list, according to urgency and waiting time. Next, they selected a single surgery unit to perform a prospective study, from March 2004 to March 2007 (1809 ordinary and 597 day cases). The study lead to the change in the SWALIS model: waiting lists were monitored and analyzed, measuring a significant impact of the model by a set of performance indexes

(average waiting time, length of the waiting list). The SWALIS pre-admission model was used for all registrations in the test period, fully covering the case mix of the patients referred to surgery. The software produced real time data and advanced parameters, providing patients and users useful tools to manage waiting lists and to schedule hospital admissions with ease and efficiency. Positive changes were observed, meaning that more patients were treated within their MTBT. The SWALIS model managed to provide useful data to monitor waiting lists and it also allowed a standardized prioritization of patients, an enhancing transparency, more efficiency and equity.

Kim, S.C. & Horowitz, I. (2002) took advantage of an advance-scheduling property for elective surgeries by exploring whether the use of a daily quota system with a 1-week or 2-week scheduling window would improve the performance of a typical intensive care unit (ICU) that serves patients coming from a number of different sources within the hospital. They have shown that formally linking the scheduling of elective surgeries (as one controllable upstream process) through a quota system, to the downstream ICU admission process, can have beneficial effects throughout the hospital. This shows that management tools like combining a quota system with scheduling improves efficiency.

Cromwell et al. (2002) assessed six web-based waiting time information services, with a cross-sectional survey of government websites in countries with publicly funded hospitals, to identify how they aimed to meet the information needs of patients and general practitioners, and to evaluate how well waiting time information was presented. The services presented information to help both GPs and patients deciding where to look for a surgery by comparing hospitals statistics. The websites overall advice was poor: the websites did not state whether the statistics predicted expected waiting times, and only one stated that the statistics were only intended as a guide. Statistics were based on different types of data, and derived at different levels of aggregation, raising questions of accuracy. Most sites explained waiting list terms, but provided inadequate advice on the uncertainty associated with making statistical inferences. Cromwell et al. (2002) further suggests that users should access web-based waiting time information services cautiously because of a lack of guidance on how to appropriately interpret the presented information.

Several National Health administrations have addressed the use of information systems to deal with the integration of data but success is still very limited. Most OECD countries use information systems only to monitor the system, whereas health services are obliged to submit regular reports to authorities (OECD, 2003; GoSA, 2006; Kuhn et al, 2007). There is a sense that we are still learning and searching for better solutions to improve the management of access to surgery.

4. Methods: SIGIC and SIGA framework

4.1 SIGIC framework

The need for regulation at the Portuguese National Health System elapses from the fact that healthcare services are a scarce and valuable resource. In this context, SIGIC (Waiting List for Surgery's Integrated Management System) was created to manage the "access to surgery", intending to assure the treatment by services in terms of quality, standards, equity, process and transparency.

SIGIC was established (in April 2004) as an integrated system to manage patients waiting for elective surgery (MS, 2004). The main purpose was to overcome specific fragilities of the NHS and to make it more universal by allowing a global management of the system. By considering both the demand and supply together it would be possible to improve management and to optimize the resources. Covering a substantial part of the supply surgery resources of the NHS it would be possible to allow for a better response to prioritization. This effort was developed by a team who looked at other similar international systems for benchmarking (it included Spain, Denmark, United Kingdom, Canada, Australia and New Zeeland). This research concluded that more than 50% of the OECD countries were focusing their attention on "waiting time for elective surgery". The SIGIG task-force initiated its activities with a comprehensive comparison of international examples. This benchmark exercise was critical to guarantee the best solution would be used to deal with the problem of waiting list for surgery, besides the difficulty of reaching information and of difference and non-homogeneity of concepts used by different systems (Banta & Wija, 2000). There are countries where the struggle for waiting list for surgery is considered a priority in health policy. Comparing Portugal with Spain and United Kingdom there is a clear disadvantage for Portugal both in terms of waiting list and waiting time (TDC, 2007).

The main idea is to centralize the management of the surgical resources offering/enabling the flexibility and the usage of the available resources (specialists, beds, Surgery rooms) leveraging both the public and private hospitals. On the side of demand, it is possible to establish priorities linked with pathologies and their prognosis, creating rules (guidelines) to support the waiting list of surgery management, allowing both the access to public and to private hospitals, if the public ones did not timely respond (MS, 2005).

This sort of strategy is based on the following assumptions (with impact on the IS strategy to be developed):

- WLS centralized management to allow the optimization of the available resources;
- Clearly defining institutional aims, regarding maximum waiting time (global and with pathology) and assuring the access to surgery within those maximum waiting time;
- Promoting alternative methods for performing ambulatory surgeries;
- Developing incentives and payment models related with surgery production;
- Promoting a diversification of therapeutic options for patients: from private to social institutions enabling the fulfillment of the clinical goals;
- Increasing the hospital commitment for releasing the waiting list for surgery certificate (WLS), accepting to solve the patient clinical situation within the time frame corresponding to 75% of the WLS maximum time;
- Standardizing the WLS management processes to assure both transparency and fairness; and promoting the participation from patients (recognizing both rights and duties) and formalizing with signature the acceptance in being registered on the WLS;
- Strong promotion of WLS related information to patients, hospital physicians and managers, and to society in general, based on the actual clinical information and transparency.

To mitigate the implementations and deployment risk (Haugen & Woodside, 2010) it was decided to start the system as pilot covering only a limited region in the south of Portugal

(Algarve e Alentejo). First all the available WLS in that region were collected and analyzed and the system was implemented right away. During that time the data from the hospitals of the remaining of the country started being collected as well. This process of collecting data from the system enables the definition of the SIGIC model (MS, 2005).

SIGIC goals are to reduce waiting time for surgery (improve the service), to apply identical standards to all patients (equity in access), to profit from good use of resources (Increase the efficiency) and, to create a national structure of homogeneous information based in a system of data collection (a database) that elapses from the production process (knowledge and transparency). The chosen strategy was the "survey of information systems and technology in Demand / Supply / Resources", the "institutionalization and monitoring of procedural standards for management of the Waiting List for Surgery (WLS)", to provide "evaluation by results" and, to regard the "Correction of deviations to the standard".

4.2 SIGA framework

To fulfill SIGIC's objectives (defined by law) it was created a management model and an information system (IS) to support it. SIGA is the integrated system of management of the access (includes the information model, regulation model, financial model, incentives and penalties). There are four main issues to be accomplished by SIGA: create knowledge, establish the equilibrium between demand and supply, guarantee the equity in access, improve the quality/efficiency, and tackle sustainability. Therefore, the SIGA mission is to serve adequately the citizen's needs of surgical treatment. Presently 66 public hospitals (all with sustainable surgery activity) and 54 private hospitals (with convention with SIGIC) had joined the SIGIC network (now with 3,012 certified users). The SIGA is based on a centralized architecture and has adopted the following principles:

Means to achieve the goals: After setting the goals and defining the targets, the necessary instruments were built in order to pursue them. The main targets identified were: increasing supply of "surgeries", improving the management of WLS (i.e. creating the conditions to improve the use of operating rooms and surgical teams), supply and demand regulation, process improvement, assess the quality of services provided, guarantee of the access for all citizens and, improving the quality of information.

Processes Effort: Right from the beginning of the effort, a strong drive to properly define the right workflow processes was established, by involving all actors within the system. The result was the definition of: "The circuit of the patient in WLS and in hospital transfers" (Figure 2).

The "hospital of origin" of the patient (HO, the hospital where the patient had the first consultation) classifies the patients according to their priority and tries to schedule a surgery for them on time. But, the shortest defined time limit is 15 days for the HO's surgery department to reply to all cases: The HO must then clarify and declare any lack of capacity for coping with the high priority patients in the list. Therefore, it was further defined a time limit of one month for the HO to perform the surgery. Otherwise, if HO cannot schedule the surgery, the patient must be transferred to another hospital within the network (and accepted by the patient): Then, within 1 to 6.75 months, depending on the priority level assigned, the patient should be sent to another hospital.

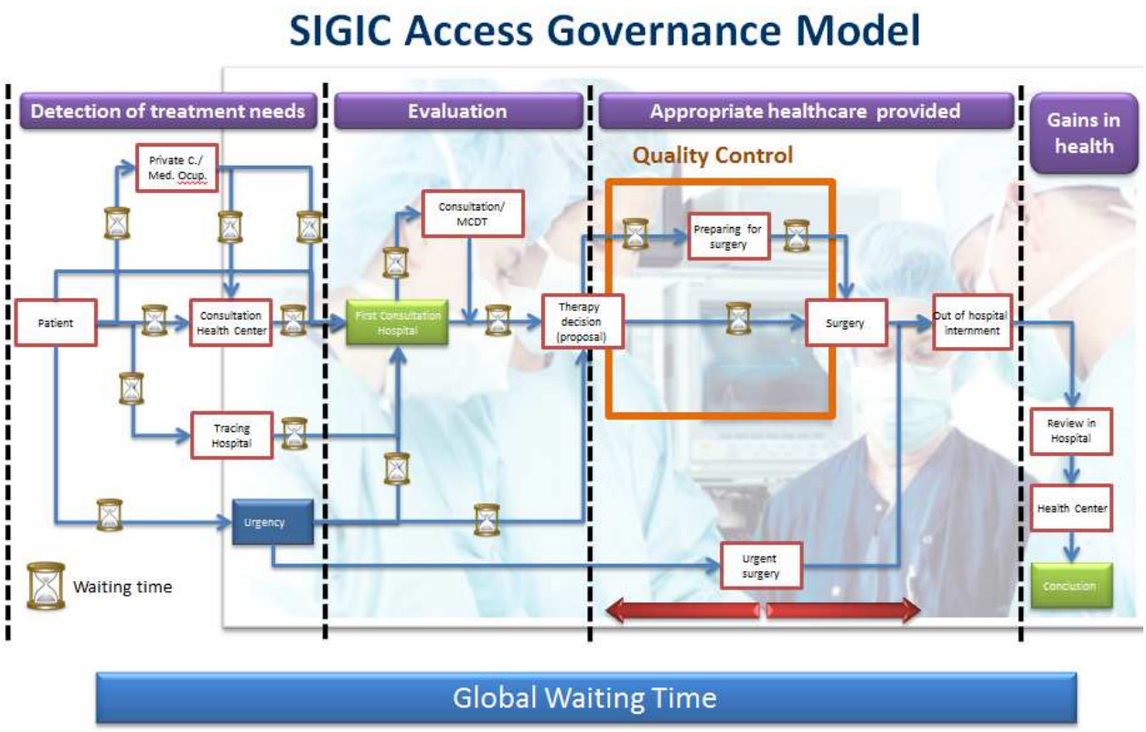

Fig. 2. SIGIC Access Governance model.

This destination hospital could be a private hospital on the condition of having a convention agreement with SNS/SIGIC. The maximum waiting time allowed was defined as 9 months (always adjusted to pathology). The circuit of each patient is always monitored in order to guarantee that the maximum waiting time is never reached. Once such system is created one should always consider that an increase on apparent demand would be expected. The use of an information system made possible to include all the patients and register them providing a the real perspective of the WL, the patients not previously known, because they were registered in different systems, were tracked and added as well.

In summary, the SIGIC aims at optimizing the demand-supply imbalance by allocating higher priority surgeries to available surgery spots in order to minimize the waiting time for surgery and to address priority surgeries within the clinical expected time.

5. Information systems strategy: From SIGIC to SIGLIC

Once implemented the SIGIC, it was necessary to create an information system for supporting the whole system, allowing for organizing all the data related with surgeries and at the same time to following-up the different stages. It also was necessary to make information available to all partners. It was subsequently decided to develop an information system enabling the storing and the exchanging of all relevant data. This system, designated as SIGLIC (Patient Waiting List Support Information System), is thought to play an important role in coordinating the referring and management processes, with automatism for all standard steps and allowing for transparency and easiness (MS, 2005). SIGLIC is an information system to support SIGA in improving the access to surgery (MS, 2005). The

relevance of SIGLIC is that it allows for the complete integration of all SIGIC data and from all set of hospitals. Furthermore, this integration assures the synchronism of data and the interaction of all involved parts.

5.1 Developing an information system strategy

From the perspective of information systems strategy, one could perceive strategy translated as a set of action plus regular improving meetings (Kuperman, 2000). In this sense, the SICLIC is a management decision-making and scheduling information system that was created to support the access to surgery and its clinical and management implications. It was designed to be improved in every cycle of analysis. To develop an information systems strategy a set of main initiatives were identified to be addressed: the design of a clinical and administrative data repository, discovery of inpatient process support, electronic medical records, a web-based portal strategy, selection of referral applications, management of knowledge resources, patient information and participation, confidentiality, and clinical decision support systems.

The SIGLIC is supposed to integrate the data from all hospitals with surgery services, where it picks the data to find optimal solutions for each patient. It should allow for real time exchange of information to drive SIGIC's decision-making processes. SIGIC's goals are to reduce waiting time for surgery, to apply identical standards to all patients, to profit from good use of resources and, to create a national structure of homogeneous information based in a system of data collection. It is important to clearly define who produces and signees for the information, the minimal data set and all the information to be recorded should be included in the workflow (Grilo et al, 2009).

The SIGLIC systems require access to the other hospital and primary care information systems. However this is not a straightforward assignment. The maturity of hospital information systems is still low (Lapão, 2007) and integration barriers is a well-known global problem (Kuhn et al., 2007). The debate over the introduction of Information Systems in healthcare in Portugal at the beginning of the XXI century follows the growing concern that the costs of healthcare are increasing too fast and have already surpassed the acceptable level to society. The pressure for government budget contention from EU is the strongest factor. It all began in the 1990s with major shifts happening from administrative health information systems (HIS) to systems that started to be used by physicians, nurses, and other healthcare providers as part of the delivering process (MS, 1999). But there are also medical reasons to look for the development of an integrated HIS. Western countries, more sensitive to this issue, are witnessing a movement towards the integration of information systems in Hospitals (or preferably integrating the entire healthcare network). In the United States this has been mainly driven by HIPAA, an information privacy and security standard promoted by the US Government, although management reasons are the most relevant due to the opportunity to reduce costs out of inefficiencies (Glaser & Salzberg, 2011). Even in well-advanced countries like The Netherlands (Hasselbring et al., 2000), and the U.K. (McKee & Healy, 2002), there was a perceived lack in actual integration of information systems working as the best practice examples to be followed. There are two fundamental objectives to tackle health information system. First, only recently the management Boards became aware of the hospital management ineffectiveness because they did not have the opportunity to look for proper indicators before (Smaltz et al., 2005; Lapão, 2007; Lapão et

al, 2009). The motivation for investing in these systems is now clearly economic and strategic. Physicians and nurses have been encouraged to help the hospital to manage the allocation of resources by a proper cost-benefit analysis of problems. Second, it is also important to acknowledge that Health information systems (HIS) are still quite a complex structure (Winter et al., 2001) that comprehends vast information technologies, several application systems and information management.

A strategic roadmap for SIGLIC Strategy aimed at two objectives: A detailed analysis of the initial WLS situation and the definition of a HIS strategy roadmap, representing an organizational change of hospital surgery-related services that should put the patient and their needs in the centre of the process as well the conditions of healthcare professionals (following the defined business strategy) (MS, 2005). The process started with the SIGIC's mission and objectives definition, both as short and medium term goals. Hence, the board defined that "*The SIGIC's mission is to provide a centralized access to surgery management service, enabling the flexibility and the usage of the available resources (specialists, beds, surgery room) leveraging both the public and private hospitals to globally reduce the waiting list for surgery*"(MS, 2005). Secondly, it is necessary to complete a full-scale characterisation of the surgery-related hospitals information systems that helps to understand the dimension of the task required to reach the goal. Thirdly, regarding the objectives defined for the implementation it is required to address the SIGLIC's strategic alternatives for the integration of the information system considering the SIGIC's specifics. The alternatives were: a) Implement a holistic Solution bought from a HIS supplier; b) Adopt a phased implementation after proper prioritisation; c) Focused only on the most urgent systems; d) Develop internally a system solution that covers all sub-systems requirements.

A very important aspect is how deeply involved in the process the solution provider is and how its leadership is developed throughout the whole process (Smaltz et al., 2005). The providers should be regarded as partners, meaning that the provider should be involved in the process right from the beginning and be co-responsible for the outputs. Mostly because the HIS implementation is part of a crusade to promote the utilisation of the HL7 or web-based protocol as the standard to be used. To overcome the problems imposed by the existing HIS parts, the SIGIC Board decided that the HIS strategic plan has to be defined to fit the mission statement. All the relevant stakeholders must be involved. Therefore a stakeholder-oriented approach was preferred to cope with the complexity of the problem. Considering the Regional Health Authorities (that could speak in the name of the hospitals) objectives, three task forces teams were defined to address those objectives: Clinical decision-making information system; Management information system; and Networking and Data warehouse. To manage each of these groups was defined a co-ordinator from the SIGIC team. Each workgroup defined the policies within their area of responsibility, prioritised projects and allocated budgets. To address the strategic planning, that would support the HIS, the Winter at al. (2001) methodology was adapted, comprising "the health unit strategic goals assessment", "the identification of the current state of the HIS" and "an analysis on how far the current information system fits the goals". The methodology for a strategic HIS plan encompasses the following five steps:

a. Strategic goals of SIGIC (MS, 2005);
b. Description of the hospitals surgery-related IS current state;
c. Analysis and assessment of the current state of the HIS (MS, 2005);

d. Description of the planned state of the SIGLIC (MS, 2005);
e. Roadmap definition: Path from the current to the planned state: This plan assigned resources and concrete deadlines (although flexible) for partial results, as well as assigning priorities to individual tasks and the dependencies between tasks. Representatives of the different stakeholders were involved in the definition of the future state process.

5.2 System selection and implementation leadership strategy

The IS integration is usually a very difficult task due to the complexity and the number of different systems involved. An integration process can be technically accomplished through two different ways by means of a direct link or by means of message exchange (Lenz & Kuhn, 2002). Since the HIS is composed by many different suppliers, following a "best-of-breed" approach, it was advisable to opt for the second one. An additional assumption was defined: the message exchange system will have to be web-based. The freedom to exchange some of the applications in the near future was among the criteria considered. A good communication infrastructure is essential so that it ensures in all cases messages to be correctly delivered to the addressees in the proper sequence and that standard message protocols are used: the solution proposed implied the utilisation of Virtual Private Network within the Ministry of Health private network.

There are several advantages in adopting a phased implementation strategy (Spil et al., 1999). Moreover phasing the implementation would allow for a better financial resources management, as time delay would diminish considerably the financial risk. Phasing is also the best way to address learning, because one can learn with early projects and adopt new measures in the following ones thus augmenting the probability of fitting with the users' requirements and therefore diminishing the risk of failure. The development of subsystems or changes in existing systems was carefully planned within a finite period of time but allowing some flexibility due to financial restrictions. Decisions on budget and personnel allocations must be made, and priorities in relation to other, competing projects must be set. One must also understand the introduction of IS imposes changes on an organisation process. SIGIC program implies that surgeons (anaesthetists, nurses and other technicians) will work after the normal daily schedule. This additional work will be like another service provided by the hospital. The volume of activity of SIGIC in a hospital can be paramount, eventually creating the need to hire, or reallocate, a manager just focusing on SIGIC activities.

Organisations usually follow several stages in their growth toward a situation in which information systems are fully integrated. Nolan (1979) growth model was used to address maturity of hospital IS understanding. Galliers & Sutherland (1991) observed that most organisations overtake maturity stages one by one, and that the transformation into the formalisation and maturity stages especially requires explicit leadership by managers. At most hospitals, the next Nolan stage implied the rethinking and redesign of the whole organisational structure that support SIGIC.

5.3 The process of selection of a HIS solution

The selection process was developed through a set of test prototypes to reduce both risks and the strategic gap. To support the selection decision-making process an operational methodology was used. Like SMARTER (Graeber, 2001) or the TRIDENT (Tavares, 1984)

both allow for a balanced approach. In the TRIDENT Methodology the problem is addressed with a five-phase process balanced by three parameters (quality, cost and implementation time):

Phase 1 – Needs Assessment and Planning;
Phase 2 – Gathering Information;
Phase 3 – Vendor Demonstrations;
Phase 4 – Negotiation;
Phase 5 – Pilot Projects implementation.

The process analysis considered the technology supplier's that responded to the call. One pilot projects was selected to be implemented in Alentejo and Algarve region.

When defining a HIS, one must also consider its time evolution. Whatever the Information System considered it will need, sooner or later, an up-grade or maintenance. Recent trends enhance the importance of processes, workflow management and web-based applications as best practice (Lenz & Kuhn, 2002). With these conditions satisfied, the hospitals in the pilot test could then proceed towards the HIS. The initial analysis and diagnosis of the IS concluded that: a) The hospitals' IS are very complex system, with several different sub-systems and different actors; b) Most application were not linked and coherently integrated together. There were in fact only few point-to-point connections between applications from the same supplier; c) Enormous difficulty accessing timely precise information; d) Some problems regarding specific applications due to lack of knowledge and a troubled dependency from technology suppliers; e) Difficulties in correctly training the healthcare professionals. Theses conclusions and department objectives were considered at a workshop that defined the roadmap.

The idea is to give to surgeons an information system that allows them to make decisions and therefore adds value. So he/she can become somewhat positively dependent on the use of the system. With valid data the mangers might gain as far as possible a clear perspective over the surgeon's behaviour as he/she writes orders to allocate resources. This sort of resources-use control is desirable as it allows a highly autonomous group of professionals to allocate resources according to a specific best practice available with the system. Although one must recognise that this is a dramatic change in the relationship between managers and health professionals that need proper leadership. The option for the "integrator" had in mind the efficiency and clinical gains in the communications between applications, i.e. the benefits for patient service itself. The future implementation of an electronic patient record system also needs the support of the integrator, in order to combine all the data that is needed to sustain the increasing demand for quality, alert and clinical knowledge systems and, if possible, clinical decision-support systems. It is usually unsuccessful to implement a electronic clinical system without guarantying integration beforehand.

The methodology followed a Roadmap framework, which allowed associating both SIGIC and hospitals' HIS strategy. The added value to SIGIC is clearly shown by the appropriated budget allocation for the investment needed to build the information system that will help healthcare professionals to serve the patients better. There was also a clear advantage in parallel process development because each task force could either develop them individually without depending on the others or address difficulties independently. The roadmap had the objective of mapping the short-medium term strategy into actions (Kuperman, 2000). It was also given special attention to the users and to the decision making

processes by the setting up of a workshop, which was based on the definition of management indicators that would cope with the SIGIC strategy.

6. Improving the access to surgery with SIGLIC information system

SIGLIC is the information system defined to support real time exchange of information of all the SIGIC decision-making processes. The knowledge is integrated with a unified and coherent set of information. This information is based on the data model required to perform the management of waiting list for surgery. By integrating the production processes, while generating cost and value, it will culminate in the perception of the gains in health and the value perceived by the patient.

The Information model includes the following items: information on patients and events to allow "Process management", "clinical information" for "Disease Management" and "financial data" to allow the "Contract management" between the health units, from which data is gathered to improve access management (quality treatment, i.e. gains in health, and value perceived for the patient). The information should be recorded by hospitals (with the responsibility for the information contents) in accordance with a set of standards and then integrated into the central database of SIGIC. It was also clearly defined who would produce and sign the information, the minimal data set (standardized information), and all the information to be recorded is to be included in the workflow.

The quality of the integrated information from the hospitals is guaranteed by a set of tools that validate its consistency, and rejects non-compliant data. The information is recorded in hospitals throughout the process of managing the patient on WLS and integrated daily in the central database (Figure 3).

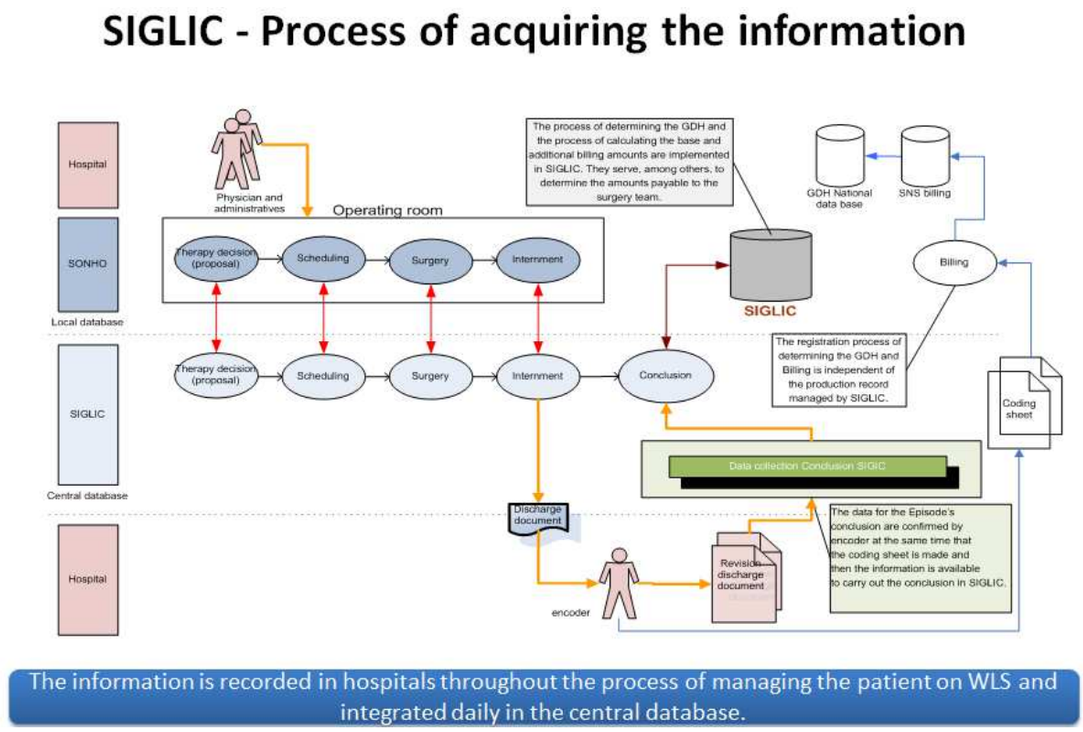

Fig. 3. Flow of information between hospitals and the central database.

The information exchanges between hospitals and central database are executed (two-way) daily. They must be subject to central data sync with the hospitals and to a reporting system for errors that identifies gaps in the transaction. Thus the central IS does not create parallel processes but generates an integrated knowledge of hospital activity with only 24 hours of delay. In SIGIC, all the information campaigns, the training sessions for professionals and the provision of quality information are key measures to promote the participation of all stakeholders in this process of improvement.

7. Results: Improving the access to surgery from 2000 to 2010

7.1 The SIGIC evolution

The SIGIC system was defined in 2003 and started operating in June the first 2004 as a pilot project in the region of Algarve and Alentejo. The regions that followed were Lisbon, the Tagus Valley and North on the first of June 2005. The last region to join was Centre on first October 2005.The Centre region's entrance in the SIGIC system (with SIGLIC) was somewhat delayed because of technical integration problems on a set of hospitals information systems whose software versions were not compatible with the SIGIC (Palmeira, 2010). In 2007, three years after being on service, the number of patients waiting for a surgery was of 234.463 (TDC, 2007). Comparing this number with the first semester of 2009 (169.461 (and from 175.761 in December 2008), an additional reduction in the number of patients waiting for surgery was obtained. The median of waiting time (TE) at the WLS was 3,4 months in June 2009 (a reduction from 3,7 months in December 08), in spite of the increase in number of patients entering the WLS (+7,1%), first semester of 2008.

The Accounting Tribunal report criticizes SIGIC for not showing management indicators regarding productivity and the hospital units capacity, which would enable a higher management efficiency regarding surgery production and the number of surgeries produced per specialty (TDC, 2007). Recently, the program e-SIGIC was developed. This innovation enables each patient to Access to the WLS and check about His/her position in the list, and therefore knowing the waiting time for surgery. This Web-based program started to operate on December 2009, which allowed for the improvement of communication with patients and easing their access to relevant information using internet.

7.2 Evolution of the performance indicators on WLS

The SIGIC program results are very positive (Figure 4, 5, 6 and 7) and show clearly the importance of developing an information systems that allows improved resources allocation. Figure 4. shows the number of people in waiting list for surgery has decreased 33.7%, which is an evidence that the system is actually working. The impact could also be translated in reduction time: the waiting time for surgery decreased from 8.6 to 3.4 months, meaning a 60.5% reduction simply being allowed through better system organization and management (Figure 5.). At the same time, this improvement has allowed an increase on patient's entrance (meaning an improvement in accessibility to surgery) from 426,949 to 560,695 episodes (+31.3%) (Figure 6.). This was possible because of an increase on scheduled surgery from 345,321 to 475,293 episodes (+37.6%) has been provided (Figure 7.). Another significant impact has been on hospital transfer (a usual bureaucratic process) which has increased from 3,003 to 38,976 episodes (+1200%). This last result shows the real impact of an integrated IS over bureaucracy. Should be noted, that some of the decrease in number of

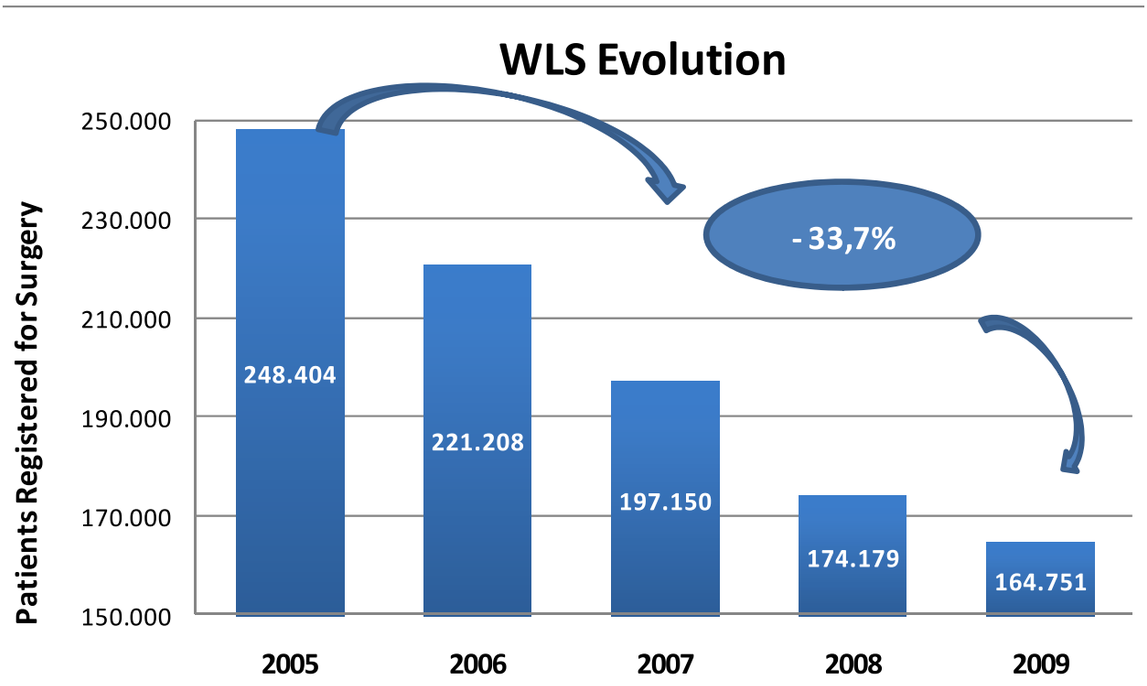

Fig. 4. Waiting list for surgery time evolution.

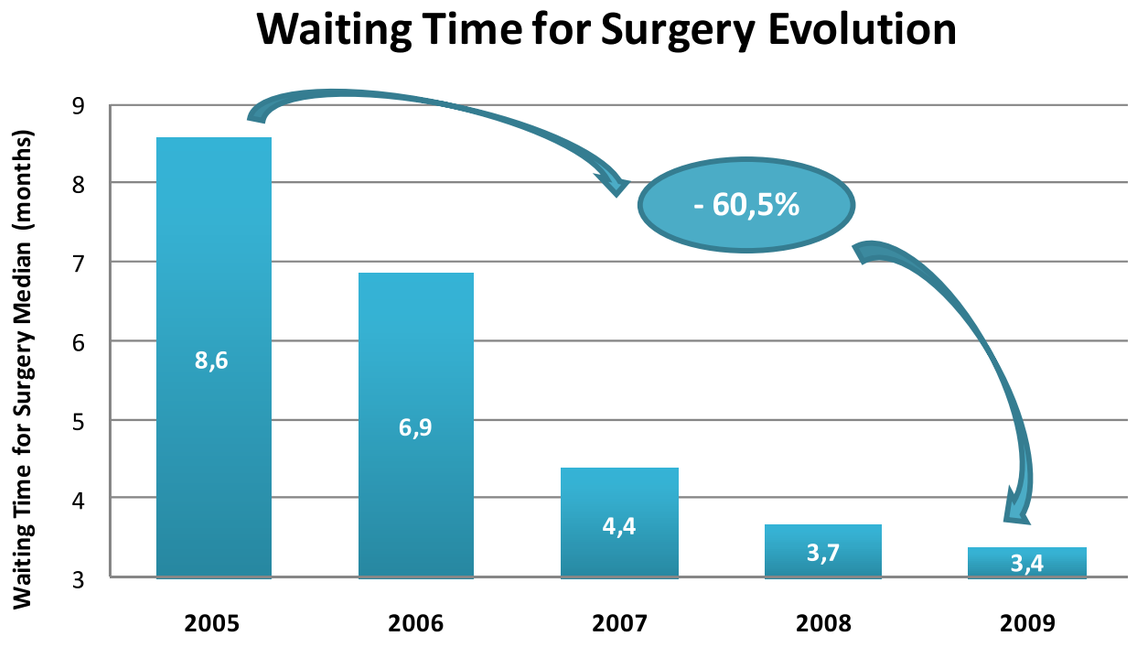

Fig. 5. Waiting time to surgery reduction.

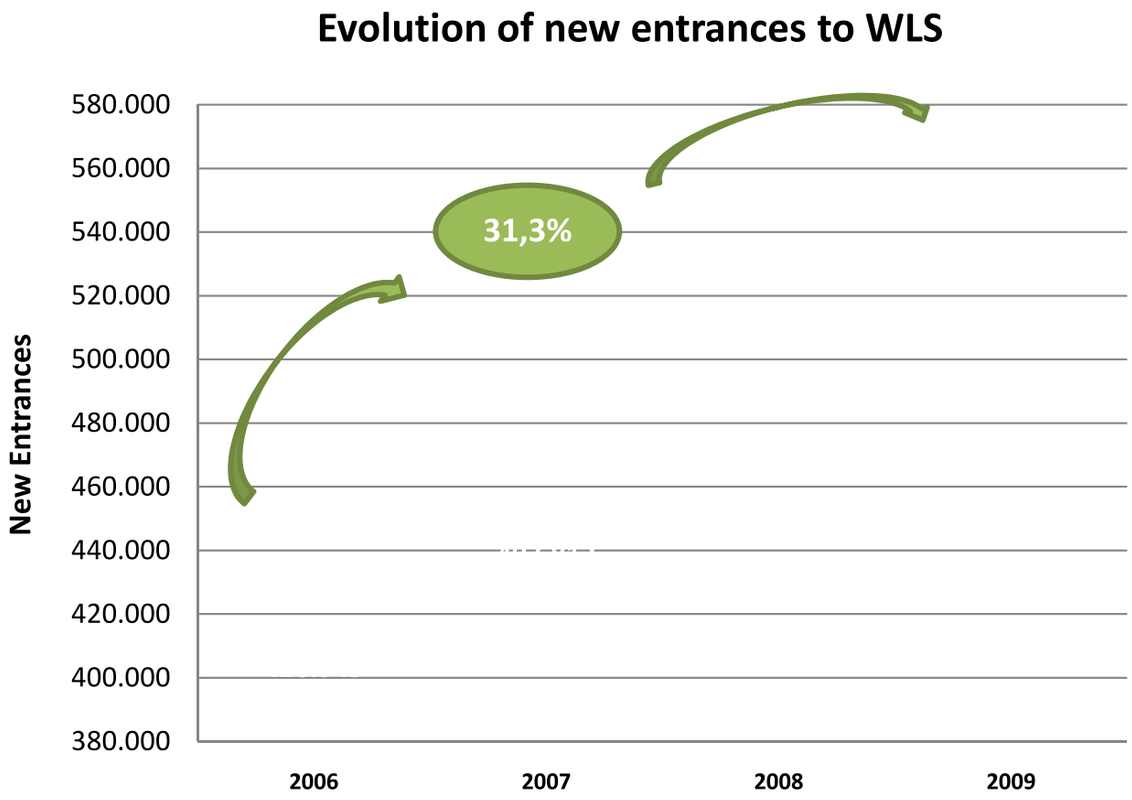

Fig. 6. The evolution of new patient entrances to the waiting surgery list.

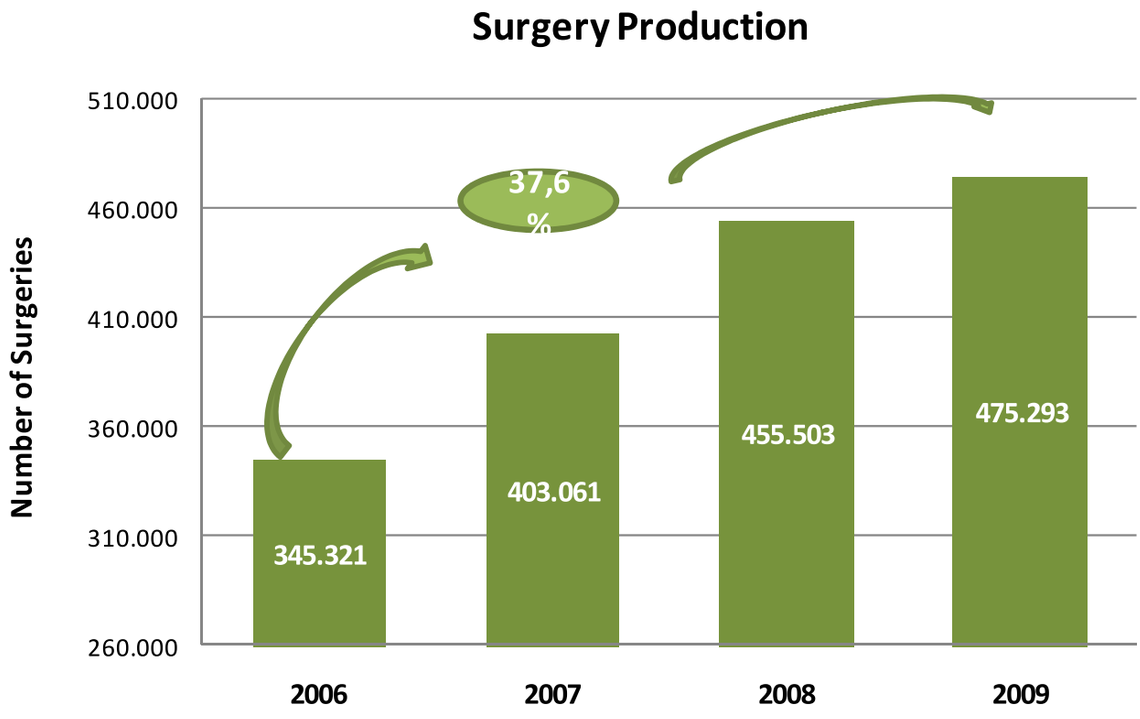

Fig. 7. The evolution of the number of surgeries performed.

patients waiting was due to systematic purge to the list, identifying those already operated, already deceased, enrolled in more than one list, no longer indicated for surgery or non traceable. This effect was felt mostly during the early years and does not overpower the system´s actual measured increase in efficiency.

8. Debate: The positives and the negatives

From the case presented one should conclude that SIGLIC, the IS that supports SIGIC, has been essential to ensure the delivery of benefits to the patient and healthcare providers in improving the access to surgery. The results are quite impressive, deriving from a professional application of IS design and implementation principles that allowed the overcoming of communication barriers and the lack of operating rooms management practices.

The SIGLIC system enabled the SIGIC program to cover the whole country and furthermore, allowed many hospitals to increase the participation of surgeons and a more efficient usage of operating rooms. This is only part of a wider effort to implement a comprehensive strategy to consistently allow information collection and sharing within Portuguese healthcare sector to improve resources' usage management. Future work would include both the analysis of the use of the IS itself and of the actual health gains provided with the surgeries.

From Siciliani & Hurst (2004) we know that, on the supply side, evidence suggests that both capacity and financial incentives towards productivity can play an important role (as SIGIC can also prove). And on the demand side, the SIGIC also induced the raising of clinical thresholds with significant reduction of waiting times but with an increment in the tension between clinicians and policy makers.

9. Conclusion

This chapter describes the design and first results of the use of an information system (SIGLIC) supporting the integrated management program (SIGA) to improve the access to surgery in Portugal. SIGIC, the Ministry of Health's agency responsible for access to surgery management, started re-thinking the system in 2005 by re-defining key processes and workflows.

Although the focus was on improving the access equality, the Portuguese Accounting Tribunal has released recently (second semester 2009) that, according to its criteria, these equity principles were not met, once there are still patients referred to the private and social sectors, which are not part of the WSL and do not hold the same warranties and rights (TOC, 2009).

The designed information system SIGLIC integrates all hospitals with surgery with every other hospital, where it picks data to allow the search for optimal solutions for each patient. In the context of SIGIC (Waiting List for Surgery's Integrated Management System) "access" means to assure the treatment by services in terms of quality, standards, equity, process and transparency.

SIGIC's goals are to reduce waiting time for surgery, to apply identical standards to all patients, to benefit from good use of resources and, to create a national structure of

homogeneous information based in a system of data collection. The methodology followed was to: a) "survey of information systems and technology in Demand/Supply/Resources"; b) "institutionalization and monitoring of procedural standards for management of the Waiting List for Surgery (WLS)", c) provide "evaluation by results" and, d) "Correction of deviations to the standard". To fulfill SIGIC's objectives a management model (SIGA) and SIGLIC were created as to support it. By now 57 public hospitals and 96 private clinics and hospitals (with convention in SIGIC) have joined the SIGIC network.

The Information model includes the following items: information on patients and events to allow "Process management", "clinical information" for "Disease Management" and "financial data" to allow management between the health units, from which data is gathered, to improve access management. The information is recorded by hospitals in accordance with a set of standards and integrated into the central database of SIGIC.

The quality of integrated information from the hospitals is guaranteed by a set of tools to validate its consistency, rejecting non-compliant data. The information is recorded in hospitals throughout the process of managing the patients on WLS and integrated daily in the central database. The results since 2005 show the importance of an integrated information system to overcome the bureaucracy: There was a 36% improvement in number of scheduled surgical episodes and 60% reduction in days on waiting time.

At the present moment SIGIC has almost all its core and support applications. If all these applications were working properly they would be guarantying the efficiency of the Hospital's productive process further.

Future research includes understanding regional differences and benchmark better practices in prioritizing and managing the WLS. Regarding the SIGLIC, there is still space for improvements: the development of alert systems and of mechanisms to enhance the participation of the patients in the process.

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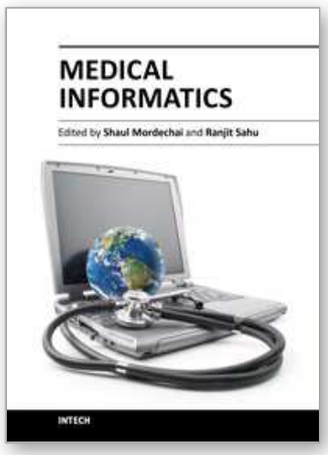

Medical Informatics

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Information technology has been revolutionizing the everyday life of the common man, while medical science has been making rapid strides in understanding disease mechanisms, developing diagnostic techniques and effecting successful treatment regimen, even for those cases which would have been classified as a poor prognosis a decade earlier. The confluence of information technology and biomedicine has brought into its ambit additional dimensions of computerized databases for patient conditions, revolutionizing the way health care and patient information is recorded, processed, interpreted and utilized for improving the quality of life. This book consists of seven chapters dealing with the three primary issues of medical information acquisition from a patient's and health care professional's perspective, translational approaches from a researcher's point of view, and finally the application potential as required by the clinicians/physician. The book covers modern issues in Information Technology, Bioinformatics Methods and Clinical Applications. The chapters describe the basic process of acquisition of information in a health system, recent technological developments in biomedicine and the realistic evaluation of medical informatics.

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