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Application of information and communication technologies for health systems in Belgium, Denmark, Spain, the United Kingdom and Sweden

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Executive summary

The Economic Commission for Latin America and the Caribbean (ECLAC) is currently developing the "Alliance for the Information Society, phase 2 (@LIS2) - Inclusive political dialogue and exchange of experiences" Programme.[1] The main purpose of this programme is to encourage political and regulatory dialogue between Latin America and Europe in order to facilitate the formulation of regional, subregional and national strategies designed to develop the information society in Latin America, drawing inspiration from experience in Europe.

Within this context, eHealth experience in some European countries detailed in this document showcases achievements and advances, as well as difficulties and relevant aspects to be addressed in the implementation of actions aiming to expand and improve access to people's health. From a cooperative and productive interchange perspective, these experiences are expected to contribute to the formulation of strategies and projects designed to implement information and communication technologies in LAC healthcare.

This document describes and analyzes implementation of eHealth in several European countries, as well as strengths and weaknesses, using this experience in order to support the management and execution of this kind of projects in other scenarios. Five EU member States evidencing different degrees of advancement in their national eHealth projects have been selected for this purpose: Belgium, Denmark, Spain, the United Kingdom and Sweden.

[1] This program is being implemented with financial support provided by the European Commission.

In addition to these five cases, a brief study has been made of several international collaboration projects for the implementation of cross-border spaces for eHealth that most of these countries are currently participating in.

A. Scenario

1. General overview of these countries

General population characteristics of the countries studied are listed as follows:

- Belgium is a densely populated country with a marked population ageing trend following several decades of a steadily declining birth rate, which has stopped in recent years. The country is divided into three linguistic communities, each of which speaks a different language and is highly self-sufficient because of administration system decentralization. This leads to substantial complexity when it comes to competency distribution, including healthcare, as well as major differences between the three communities.
- Denmark's population density is slightly higher than the European Union average. The birth rate has been falling slightly over the last fifteen years. The country is divided into five regions and almost one hundred municipalities, following simplification of these administrative limits executed in the mid-2000s in order to specifically improve healthcare system management.
- Spain's population density is below the European Union average. Following several decades of population ageing due to a steadily falling birth rate, a massive influx of immigrants has helped to stop this process. The country is divided into 17 autonomous communities, which have progressively adopted several central government competencies, including healthcare service management.
- The United Kingdom is one of the largest and most densely populated states in the European Union. The country has also evidenced a steadily falling birth rate in recent years. The UK is a unitary state made up of four countries (England, Scotland, Wales and Northern Ireland), each of which has its own national administration entities and its own healthcare system independent of the other countries, although United Kingdom citizens have the right to healthcare in any of the four existing services. This study focuses on National Health Service (NHS) [REF: http://www.nhs.uk/NHSEngland/thenhs/about/Pages/overview.aspx] England, England's healthcare service.
- Sweden is one of the least densely populated and most geographically dispersed countries in the European Union. The country's birth rate has been steadily increasing since a steep decline fifteen years ago. The country is divided into twenty-one counties and three hundred municipalities, although other historical limits lacking any current administrative value are frequently used.

2. General healthcare system characteristics

Healthcare systems in these five countries offer universal coverage to citizens and are financed by public funds, most of which stem from tax collection. The only exception is Belgium, which is mainly financed by the country's social security system. 2008 healthcare expenditure came to approximately the EU-15 group average (9.5% of GDP), with Belgium approximately three-quarters of a point higher and the United Kingdom approximately three-quarters of a point lower. Private sector participation is still minoritary, but slightly more important in Belgium and in Spain.

All of these systems are decentralized when it comes to health competency distribution. Regional administrations are in charge of managing healthcare services and social services are provided by local administration in some countries such as Denmark and Sweden. Central governments are in charge of legislation and coordination at a national level.

Depending on the country, healthcare systems offer patients different degrees of freedom when it comes to choosing physicians and hospital centers. These also empower the role of the primary care physician as the point of first contact for the patient with the system to a greater or lesser degree in order to authorise sending the patient to specialized care services if necessary (the gatekeeping process). The most open system is the Swedish system, which offers the patient total freedom of choice and dispenses with gatekeeping. The most restrictive system is the Spanish system, which offers freedom of choice within the public system, but this is limited by geographical criteria.

Healthcare staff also varies from one country to another and may be made up of public employees, private employees or independent professionals. As for volume, healthcare systems in Belgium and the United Kingdom are well-staffed, but Denmark and Sweden are considered to be poorly staffed in some lines of work, such as nursing in Denmark because of working conditions or physicians in Sweden, due to the population's geographical dispersion.

Some government healthcare objectives are common, such as financial sustainability and expenditure restraints by adopting new planning and payment procedures associated to productivity and improving pharmaceutical management. Another shared objective is the shortening of waiting lists in keeping with citizen expectations. As for eHealth, only the United Kingdom has expressly included implementation of the same among lines of government action lines from the very start. The same happened in Sweden following the new government administration in 2006, although the country's eHealth strategy is pretty much in line with that espoused by the former government.

B. *e*-Health implementation

1. Belgium

The first eHealth projects in Belgium were executed in the private sector, with a view to simplifying and enhancing the efficiency of administrative processes. Subsequently, demographic charges predicted in Europe and the progressive ageing of the population led to the consideration of ICTs as a means of also improving the quality of medical care.

Due to current healthcare facility distribution with regions in charge of healthcare service provision, the Belgian strategy was to promote shared clinical information, guaranteeing patient mobility and medical care continuity. The use of standards allowing interoperability of the different systems with access viewing of laboratory test results and diagnostic imaging, medication plans, clinical reports, discharge reports, vaccinations and other tests became indispensable.

The following elements were developed for this purpose: the Kmher technological standard for sharing information; the Sumehr catalogue, which is used to store a patient's summarized clinical record; the Carenet national networks for invoicing management and BeHealth for access to clinical information. This access must also feature the right safety measures to guarantee information confidentiality.

The Belgian healthcare system is currently developing basic systems such as patient identification, the electronic prescription (the first project failed and a second is being developed in collaboration with another two countries, but post-pilot expansion is still pending), medical order

management, and requests for interconsultation and mobile access to information, among others. The federal government is focusing its efforts on coordination and compatibility of different regional projects, determining the legal frameworks required and promoting the incorporation of eHealth into educational and staff programmes for healthcare professionals. The Belgian agency in charge of promoting eHealth in the country's national territory is the eHealth-platform, which was created in 2008. However, use of the platform's services is optional for regions, since these are competent entities in terms of medical care.

2. Denmark

Following execution of several eHealth projects focusing on local and regional sharing of clinical data in an electronic format, Danish institutions created the MedCom organization in 1994, which focused on promoting eHealth implementation at a national level. Ever since its creation, this group has executed several pluriannual programmes, which were also called MedCom.

The fundamental objective of the first MedComs was to share existing clinical information and distribute the same throughout different points of the medical care network. In keeping with the same, the Electronic Document Interchange (EDI) was developed. EDI is a set of communication standards for exchanging clinical data in an electronic format between primary care and hospital care professionals, local authorities and pharmacy offices, creating laboratory test and results management systems, electronic prescriptions and digital medical imaging, as well as some telemedicine pilot projects.

In the mid-2000s, and once the existing information had been shared, MedComs focused on the direct generation of data in a common format, which would further facilitate sharing of the same in the healthcare system. EDI was further developed in order to adapt to new technological tools, followed by the creation of a summarized clinical patient record and a portal for safe access to information on the Internet. Denmark also started to participate in international projects, especially Baltic eHealth.

Some outstanding features of MedComs are short-term planning and the evaluation of results pooled after these finished, which were used to plan a new project programme. An important part of MedComs is the consolidation and expansion of systems whose pilot programme has been successfully completed in former programmes. In fact, some MedComs have mostly consisted of consolidation and expansion. These programmes have always met a very high percentage of their objectives in terms of scope, deadlines and costs.

3. Spain

Healthcare competency distribution in Spain has caused each of the autonomous communities to develop its own totally independent electronic health record (EHR), with some of these communities developing a strategic eHealth plan. With the exception of national projects (on-line healthcare) and European projects (epSOS) promoted by the Ministry of Health and Social Policy, there is no real collaboration experience between communities, although know-how and good practices are commonly shared. The Ministry of Industry, Tourism and Trade has included implementation of eHealth in its strategy to promote the Information Society (Avanza Plan) and the ministry therefore collaborates with and cofinances actions by the Ministry of Health and Social Policy and actions by autonomous communities.

There is a wide array of management formulas. Several communities have chosen to develop a single project whose scope includes all necessary actions, while others have preferred to divide their EHR into several more specific projects. Specialized external suppliers are often hired to develop software applications, although there have been some experiences of independent

development, although these initiatives require continuous funding provided by the communities themselves, which is often uncertain.

One initial difficulty is the difference between the two different levels: primary and specialized healthcare. This often means the existence of at least two clinical histories (one for each level), generally with no way of sharing information between primary care centers and specialised care centers, while mechanisms for facilitating information sharing within the same regional healthcare service and enabling healthcare professionals to access a patient's complete clinical record from any point of the medical care network remaining practically non-existent. There are two possible solutions in order to meet this need: establishing integration and communication procedures between different systems in order to allow sharing data between the same, or developing a single system encompassing all specific systems and sharing information in a centralized manner. Most communities have opted for the first solution.

The main information systems currently being developed are listed as follows: patient identification, laboratory test result and request management, diagnosis via digital medical imaging, electronic prescriptions, appointment management, a clinical post and telemedicine. The development status of each of these systems varies depending on the community, since this depends on the priorities established in the healthcare service.

In contrast with the case in Denmark, one of the most frequent problems is the slow post-pilot consolidation and system expansion process, which leads to a long co-existence period between existing solutions and solutions stemming from eHealth projects.

At a national level, the Ministry of Health and Social Policy directs the SNS Digital Clinical Record project (HCDSNS) that was promoted in 2007 in order to share clinical information between different communities by means of the Ministry's central node. The system is based on the Summarized Clinical Record or Health Record, conceived as the minimum set of indispensable information for professionals attending patients for the first time, although the sharing of several kinds of reports is also considered.

This project presents several critical aspects, such as the identification of patients and professionals; the system's semantic and technological standardization; the balance between information availability and confidentiality; or compatibility of the communities' own projects.

4. The United Kingdom

Implementation of eHealth in the United Kingdom is part of the overall healthcare system reform considered in the New Labour government programme following the election of Tony Blair as Prime Minister. This reform was planned based on the prior execution of exhaustive studies regarding the healthcare system in general and specifically addressing eHealth. These reports identified ICTs as key elements for transforming the healthcare service and laid the groundwork for the NHS National Programme for IT (NPfIT).

The NPfIT established some concrete objectives, such as access to laboratory tests and images; electronic prescriptions; access to patients' integrated electronic health record; appointment management; telemedicine in the teleconsultation modality; creation of standard infrastructure and services for the entire system (known as the Spine); and the establishment of coordination mechanisms for developing the projects required.

The first work schedule featured a four-phase plan to be executed between 2002 and 2010, together with several intermediate milestones. Service provision was to be resolved by hiring specialised private companies for development of the main systems in conformity with standards determined at a national level. Strategic Healthcare Authorities were to be in charge of project

management, dividing UK territory into five geographic zones and assigning a provider to each of the same.

Since the very beginning, the NPfIT has faced several hardships, constantly making late deliveries, implementing systems of questionable quality and incurring in considerable cost overrun. In an attempt to correct these wrongs, changes have been made with regard to both external providers and internal management formulas. A national organization was founded in 2005, NHS Connecting for Health, for project management but these competencies were returned to the Strategic Healthcare Authorities two years later, coinciding with the elimination of five geographic zones from the division. At the same time, there have been problems related to information confidentiality and the consequences of the same have been used and empowered by pressure groups that oppose the implementation of eHealth.

Consequently, healthcare institutions have been accused of being unable to properly manage project risks or transfer the benefits and added value of eHealth to professionals and patients, fostering a generalized sense of rejection. The latest final cost estimates come to 20 billion pounds, eight times the amount originally estimated in 2000. In addition, the project conclusion date is estimated to be 2015, five years later than the initial objective and the professionals involved believe it will be hard to finish the project by this date. Project continuity, reform or cancellation currently depends on a decision by the new coalition government between Conservatives and Liberals.

5. Sweden

Sweden has always shown major interest in information transmission technologies and especially in telemedicine. ICT progress led to extended use of the same for global treatment of clinical information in the late 20th Century, enabling parallel development of information systems for professionals (clinical reports, laboratory test requests and laboratory result consultation, electronic prescriptions, etc.) and telemedicine systems (teleophthalmology, teledentistry, teledermatology, telepsychiatry, tele-homecare, etc.).

Efforts subsequently focused on creating the SJUNET network for sharing clinical information and developing a national healthcare professional directory, providing each of the same with a smart card with a digital certificate for authentication and access to SJUNET.

The national organization Carelink was founded in the early 2000s for coordinating all eHealth activities whose level of implementation was high in most primary care centers and in a large number of hospitals throughout the country. The main difficulties experienced to date were also evaluated and were found to be mostly due to unfavourable starting conditions, such as the absence of legal frameworks, organizational defects, leadership problems and interoperability limits between systems. Some of the results obtained were considered satisfactory, but were not conveniently disseminated, understood or evaluated.

The new working plan featured the following objectives: development of an eHealth record shared at a national level, expansion of the electronic prescription and participation in international cooperation projects. The Swedish central government included the implementation of eHealth in its national strategy for promoting the Information Society and actively collaborated in the Baltic eHealth project.

A new Swedish government was elected in 2006 and healthcare system reform was one of the most important lines on its new agenda, which established eHealth as the main instrument for reforming and improving healthcare services. The starting point for this new planning featured a high degree of eHealth record implementation and widespread use of the electronic prescription,

with information systems lacking integration facilities and presenting difficulties for coordination and decision making at a national scale.

The new strategy featured six main action lines: the legal framework; information standards; technical infrastructure; efficient and interoperable systems; access to information shared between organizations; and citizen access. These lines led to promotion of the national summarized clinical patient record and the electronic prescription, maintenance and development of existing infrastructure and services, and international collaboration.

6. International collaboration

In virtue of the eHealth objectives specified in the eHealth-i2010 initiative, the European Union promotes execution of the following projects:

- CALL for InterOPErability: Creating a European coordination network for eHealth interoperability implementation (CALLIOPE), which aims to create fora and platforms for dialogue and international collaboration, with a view to unified eHealth services and creation of a cross-border interoperability network within the European Union, as well as the dissemination of experiences, results and good practices.
- European Patient – Smart Open Services (epSOS), based on access to the Summarised Clinical Patient Record, enabling professionals to quickly consult essential information regarding a patient requiring medical care outside of his or her country of origin, and access to the electronic prescription, allowing a patient to receive the medication prescribed in his or her country of origin while outside the country and also medication prescribed outside of his or her country of origin after returning to the same. This possibility has existed between Denmark and Sweden for several years.

The following must be resolved in order for the epSOS system to work properly: identification needs of patients and professionals, data exchange standards, information security, maintaining an index with countries that have information about a specific patient, regulation differences between the different member states, etc. Denmark, Spain, the United Kingdom and Sweden participate in epSOS, among others, and Sweden is project coordinator.

On the other hand, several Baltic countries are currently executing the Baltic eHealth project, which aims to promote implementation of eHealth in rural zones of Denmark, Sweden, Norway, Estonia and Lithuania by creating a transnational network known as the Baltic Health Network. This network was created following the interconnection of national and regional networks already existing in these countries. The network enables cross-border service provision, fundamentally telemedicine, with is of major interest due to the population's geographical dispersion. This guarantees healthcare access throughout the entire territory and helps to counteract depopulation of rural areas.

C. Analysis and conclusions

1. Scenario

Three of the five countries studied have designed a nationwide eHealth strategy, while Belgium and Spain have a different strategy in each region. The most widespread solution architecture model consists of the development and integration of several specific information systems in order to share information contained in each of the same. However, the United Kingdom and some autonomous communities of Spain have chosen to develop single systems. This decision

determines project execution conditions: integral architecture implies the parallel development of several specific systems, while the single system assumes macroproject execution. In the United Kingdom, the latter model came at the same time as the division of England into several geographical areas in order to ensure that each of the same features a different private supplier for project execution.

A wide range of planning models was used. Denmark works with a short-term milestone calendar, following cycles that never last any longer than two or three years. Sweden uses a similar medium-term method, with four- to five-year cycles, while initial planning in the United Kingdom considered a milestone calendar with a nine-year outlook. This outlook has been extended to 13 years following several project execution delays. Continuity of this plan currently depends on the decision made by the new British government. In Spain, each region features its own planning which is independent of the other regions. This is also the case in Belgium, which also lacks a formally established milestone calendar.

There is also a wide array of coordination methods. Project management in Denmark and Sweden is centralized into a national organization specifically created for this purpose. The United Kingdom assigned project management to different regional healthcare administrations, subsequently adopting the Danish and Swedish model, but then finally returning to the initial model. As was the case with the project calendar, continuity of this model depends on the decision made by the new government. National coordination in Spain conforms to the HCDSNS project, which focuses on information shared between healthcare services and communities, and coordination of Spanish community participation in the European epSOS project. Belgium lacks national coordination structure of any kind, limiting the role of federal organizations to drawing up recommendations as to how standards should be adopted.

Lastly, all of the countries in the study participated in or have participated in international collaboration projects. The most active countries are Denmark and Sweden, which became involved in the epSOS and Baltic eHealth programmes in order to respectively promote interoperability in the European Union and in some Baltic countries. Spain and the United Kingdom also participated in the epSOS project, while Belgium collaborated with the other two countries between 2006 and 2008 in order to develop an electronic prescription system.

2. Results

Healthcare systems in the five countries studied evidenced several common characteristics: universal coverage, a public financing model, similar healthcare expenditure levels and decentralized healthcare system administration, although the degree of decentralization varies from country to country. Despite these baseline similarities, the level of eHealth development reached in these five countries varies. Summarizing these results into just one sentence, it could be stated that eHealth implementation is highly advanced in the Nordic countries Denmark and Sweden; is at an intermediate level in Spain and in the United Kingdom; but is somewhat more backlogged in Belgium.

The development of eHealth in Denmark and Sweden has typically met most of the scope, deadline and cost objectives established for projects. Primary and social care services have been especially successful, while eHealth record implementation in hospitals was somewhat less successful, even though substantial headway has been made. Sweden also evidences early and satisfactory implementation of telemedicine systems, which is assumed to be due to its population's geographical dispersion. Both countries currently feature enviable system integration and access to shared information.

Spain evidences different levels of implementation depending on system type: widespread in the case of electronic primary care health record; uneven for hospitals, although this was excellent

in terms of departmental solutions and digital medical imaging and high in the case of electronic prescriptions, only surpassed by the two Nordic countries included in the current study.

The United Kingdom eHealth project has featured outstanding political and budget support, but it seems that the results obtained were not up to initial expectations despite the success of several systems implemented. Several problems have come up while these projects were being managed, possibly due to the scope of the same, and these have led to several changes made in terms of work and coordination methods.

Although eHealth is less widespread in Belgium, the country has evidenced outstanding initiative when it comes to training human resources in this field of knowledge and implementing systems most often used by physicians in their daily work, such as medical order management and access to diagnosis test and hospital release reports.

The following factors contributing to eHealth development have been highlighted:

- The pursuit of added value for professionals in order to better meet the challenges of project execution and facilitate change management.
- Planning in order to gradually obtain tangible results, together with the execution of pilot programmes, subsequent system consolidation and expansion, as well as proper dissemination of results obtained. This planning should not depend on political calendars or new government administrations.
- National coordination, regional management and participation of all parties involved with an eHealth strategy encompassed in the general healthcare system strategy and in line with the national ICT strategy. Users must make use of and take the time to communicate their needs and improvement proposals. These should also specify common action procedures and standards for use by all services. Lastly, the different administrations must share good practices and experiences related to both success and failure.
- Telemedicine, as a way to facilitate patient access to healthcare systems and increase the tapping of resources.
- Citizen participation, ensuring clinical information confidentiality in the current geographical mobility framework and increasing use of ICTs.
- Patient, clinical information and healthcare professional safety by implementing specific procedures into eHealth systems and by formulating specific legislation.
- International collaboration, which is becoming more and more necessary as patient and healthcare professional mobility increases. This collaboration may lead to economic benefits and to the creation of a specialized corporate network.

3. Some key aspects for eHealth planning projects

The following key aspects have been highlighted when it comes to planning eHealth implementation:

- An eHealth strategy in line with the objectives of the general healthcare strategy objectives and with an innovative perspective, following prior analysis and improvement of the processes involved.
- The meeting of common baseline requirements: hardware, software and communications infrastructure; a single patient, professional and healthcare center identification system;

standardized medication and healthcare product catalogues; assignment of specialized ICT personnel and clinical personnel dedication; specification of the legal framework required.

- Establishment of an integral healthcare information system stemming from the application of ICTs for clinical information and clinical-administrative information in order to assist healthcare system administration. The clinical system is fundamental for the provision of medical care, but must be integrated with the clinical-administrative system that controls healthcare system organization and with the economic-financial management system that provides logistics required for clinical activity.
- Knowledge management based on the integral healthcare information system, whose data can be used for the purposes of epidemiology, research, teaching, planning, management and quality control.
- Analysis of the initial scenario, which always features several non-integrated and heterogeneous systems based on different technologies. Priorities must be established and work must be started on an information system designed to integrate these systems in order to share existing data.

Introduction

Healthcare authorities in the countries of Western Europe face pressure exerted by citizens, patients, professionals and other public and private institutions. Circumstances such as population ageing, improved living standards during the last years of the twentieth century and at the start of the twenty-first century, patients becoming more autonomous, healthcare professional expectations, the economic crisis and the ongoing upsurge of new healthcare, communication and information technologies invite investment in the implementation of these technologies, seeking to improve healthcare system equality, efficiency and quality. Other countries face additional pressure, such as unequal access, urban growth and an epidemiological transition with special features (Fernández and Oviedo, 2010), as is the case in Latin America and the Caribbean. Information and communication technologies (ICTs) are also considered to be a useful tool in order to face these risks. However, the economic crisis and budget cuts stemming from the same mean that a careful opportunity cost study for these investments is more necessary than ever, while the successful management of these projects is also more critical. Knowledge and consideration of prior experiences, the success and failures of others is therefore paramount in order to avoid making the same mistakes and to adopt good practices for healthcare ICT project strategy and management.

Some European countries and other countries such as Canada, Australia and the United States started a discussion[2] about their healthcare systems in the late nineties and considered the healthcare ICT strategy to be an indispensable instrument for sustainability of the same.

In contrast, this discussion led to plans for the implementation of ICTs in the healthcare systems of the United Kingdom, Canada, Australia and the Nordic countries. Enough time has gone by to evaluate how successful these strategies were and to analyse difficulties that came up during project execution, in order for these experiences to be taken into consideration when planning the future healthcare ICT strategy.

ICT development is highly uneven in Western Europe. *e*Health[3] has been better implemented in Nordic countries than throughout the rest of the continent. The United Kingdom and Spain evidence important advances, but other countries are more backlogged. In keeping with the same, this study focuses on the status of eHealth in Denmark and Sweden, as well as on countries that have successfully implemented *e*Health; the United Kingdom, whose *e*Health strategy was part of important changes made to the country's healthcare system; Spain, a country with highly decentralized healthcare planning and management, as well as important eHealth solution implementation success stories; and Belgium, which is more backlogged compared to the rest.

Among other circumstances, the eHealth strategy depends on each country's social and economic conditions, as well as population density (for example, countries with low population density or communication difficulties tend to promote telemedicine), income level, the healthcare system's model and organizational structure, the general ICT strategy and of course on how much priority public powers assign to the development of eHealth.

This paper reviews the geographical, demographic and governmental characteristics of Belgium, Denmark, Spain, the United Kingdom and Sweden, their healthcare systems, their eHealth strategies and results obtained to date. Achievements made and difficulties faced are analysed, detecting the strong and weak points of each country's eHealth strategy, concluding with the main factors to be considered when planning ICT implementation in healthcare systems. An exhaustive review of specialized literature and several reports published by the different countries and international agencies has been made for this purpose.

[2] President's Advisory Commission on Consumer Protection and Quality on the Health Care Industry (1998a). Advisory Council on Health Infostructure (1999). National Health Information Management Advisory Council (2001).

[3] According to Fernández and Oviedo (2010), the concept of *e*Health is used to encompass the many possible applications of ICTs in the field of healthcare systems.

I. Scenario

Five European Union member States evidencing different degrees of eHealth project development have been selected for this study: Belgium, Denmark, Spain, the United Kingdom and Sweden. In addition, the outstanding scope of the United Kingdom ICT project should be highlighted.

This section provides a general overview for each of these countries, as well as their healthcare systems, degree of coverage and financing model, services portfolio, organizational structure and competency distribution, legislation, human resources, objectives and measures.

A. Belgium

1. General overview

Belgium is located in the northwest region of the European continent. It borders with the Netherlands to the north, with Germany and Luxembourg to the east, and with France to the south and east. Belgium is one of the founding members of the European Economic Community, forerunner to the present European Union, and is home to the headquarters of this organization's main institutions. These include the European Commission, the European Union Council and part of the European Parliament, as well as other international organisations such as NATO.

Belgium has three official languages: Dutch, which is spoken by 60% of the population, mainly in the region of Flanders; French, spoken by nearly 40% of the population, especially in the region of Wallonia in the south and in the region of Brussels-Capital; and German, spoken by the remaining population living in the east of the country, amounting to less than one percent of the country's population. This linguistic diversity regularly sparks political and cultural conflicts, which are evidenced in Belgium's complex government system and also in its healthcare system. Belgium is presently a single federal state based on three levels established by law as of 14 July 1993:

- The federal government with headquarters in Brussels.
- The three main regions: Flanders, Wallonia and Brussels-Capital.
- The three aforementioned linguistic communities: the Flemish, French and German-speaking communities.

TABLE 1
BASIC DATA ABOUT BELGIUM

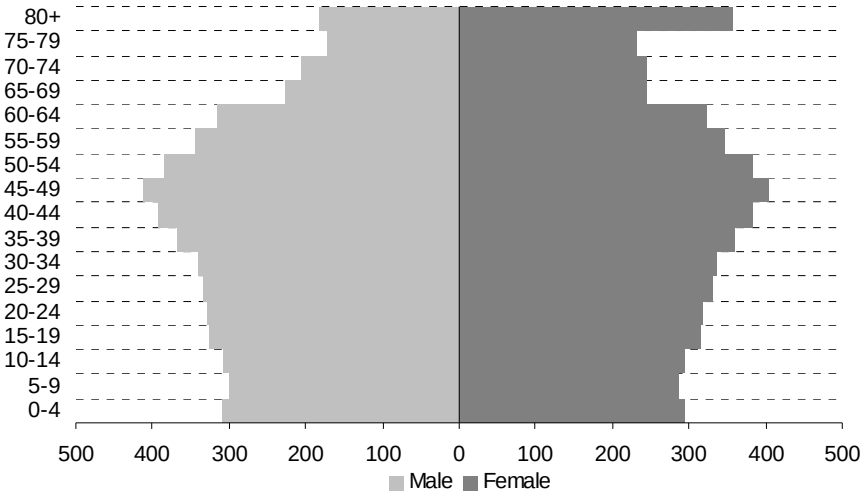
Population (inhabitants)	10 396 421
Surface area (km²)	30 528
Population density (inhabitants/km²)	340.6
Immigrant population (%)	8.5
Visitor arrivals (millions of visitors per year)	7.2
Nominal gross domestic product (US$ million)	471 765
Per capita income (US$/inhabitant)	45 378
Life expectancy (years)	79.5
Education index	0.974
Poverty index	12.2
Human development index	0.953

Source: Prepared by the authors on the basis of information from EUROSTAT (2010), The World Factbook (2008), Human Development Report (2009), Tourism Highlights (2009), and International Monetary Fund (2009).

Belgium features one of the highest population density rates in Europe. Areas with the highest population density are around the Brussels-Antwerp-Ghent-Leuven agglomerates, a region known as the Flemish Diamond, as well as other important urban centers (mainly Liege, Charleroi, Bruges, Namur, Mons, Kortrijk and Hasselt). The region of the Ardennes features the lowest population density in the country.

The population pyramid evidences a steadily falling birth rate up until the last five years, as well as a certain balance between men and women that moves apart at the top due to the female population's higher life expectancy.

FIGURE 1
BELGIAN POPULATION PYRAMID IN THOUSANDS – 2010



Source: United Nations, World Population Prospects: The 2008 Revision, New York, 2008.

2. The Belgian healthcare system

2.1 Degree of coverage and financing model

The Belgian healthcare system features universal coverage and is financed by means of contributions from employers, employees and independent workers (the social security model). This financing is complemented with part of the revenue stemming from the collection of value added tax, with the copayment of some services by citizens and with voluntary insurance premiums. When it comes to purchasing medication and healthcare products, patients are partially reimbursed for contributions made at the time these are purchased, with a difference between patients belonging to less-favoured collectives and those who do not.

Most Belgian hospitals are privately owned and feature two major sources of financing: assignment of a pre-established budget item, complemented by a rate charged for social services. There are also private insurance entities whose market share is currently growing but remains minoritary. According to data provided by the Organisation for Economic Co-operation and Development (OECD), private insurance companies provided complementary and supplementary coverage[4] for 77.4% of the population in 2005, although the corresponding costs only amounted to 5.6% of total healthcare expenditure.

Healthcare expenditure came to 10.2% of Belgium's GDP in 2008, ahead of the EU-15 group average (9.5%). Table 2 provides a breakdown of total expenditure by financing agent:

TABLE 2
HEALTHCARE EXPENDITURE IN BELGIUM– 2008

Taxes	11.40%	Rates	22.20%
Social Security	61.10%	Private insurance	4.70%
		Non-profit institutions	0.50%
		Corporations	0.10%
PUBLIC TOTAL	**72.50%**	**PRIVATE TOTAL**	**27.50%**

Source: Organisation for Economic Co-operation and Development (OECD).

[4] The OECD classifies services offered by private insurance into three categories: *complementary*, which aim to cover the cost of copayment patients are responsible for; *supplementary*, which provides additional coverage on top of the obligatory base; and *duplicative*, which provide medical care services already included in the obligatory basic coverage but offer shorter waiting times compared to the public system.

2.2 Services portfolio

The Belgian healthcare system offers patients primary and specialised clinical services, hospital care, pharmaceutical services, emergency care, odontological care, mental health, healthcare promotion and disease prevention, rehabilitation, home care, palliative care, alternative or complementary medicine and mother and child care.

Belgian citizens are completely free to choose a primary care physician, specialised physician and hospital center. However, the role of primary care is encouraged as the patient's first point of contact with the healthcare service throughout the care provision process. In keeping with the same, rates corresponding to copayment to be financed by patients are reduced in order to encourage choice of a primary care physician, who authorises patients to be referred to a different specialty if necessary.[5]

2.3 Organizational structure and competency distribution

Healthcare competencies and budget appropriation are distributed in two levels: regional and federal. Promotion and prevention corresponds to the regional level, with the exception of preventive measures applied at a national level. Healthcare policies and services therefore vary from one community to another. Figure 2 provides a healthcare competency distribution map featuring the entities involved.

Appendix I includes Belgium's main legislation in terms of healthcare organization and financing.

2.4 Human resources

Healthcare workers include both salaried workers and independent professionals, the latter being physicians, pharmacists and physical therapists. Their salaries are based on charging service rates in accordance with rates negotiated and agreed to at a national level. The number of professionals doubled and in some professions even tripled over the last decades of the twentieth century, partly due to the absence of control measures based on existing medical service demand, leading to the introduction of a *numerus clausus* system in 2004. Table 3 indicates the number of professionals in 2008, broken down by profession.

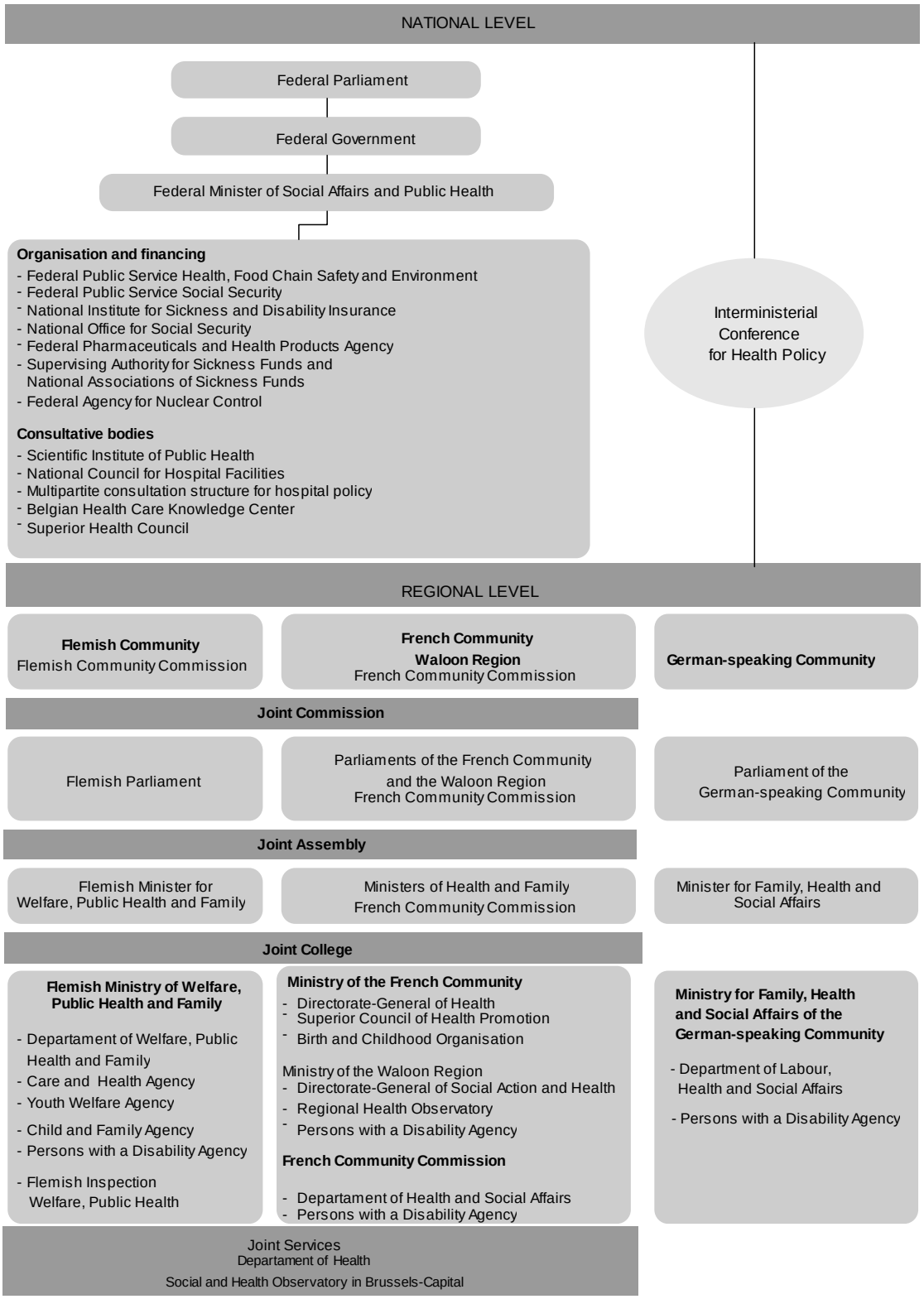
TABLE 1.
HEALTHCARE PROFESSIONALS IN BELGIUM– 2008

Profession	Number
Physicians	31 281
Odontologists	7 687
Pharmacists	12 811
Physical therapists	25 622
Nursing	64 756
Midwives	5 592
TOTAL	147 749

Source: European Observatory on Health Systems and Policies, Health Systems in Transition: Belgium (2010).

[5] Authorizing referral to specialised levels is known as gatekeeping and the physician in charge of the same, generally a primary care physician, is known as a gatekeeper.

FIGURE 2
HEALTHCARE COMPETENCY DISTRIBUTION IN BELGIUM



Source: European Observatory on Health Systems and Policies, Health Systems in Transition: Belgium (2010).

2.5 Objectives and measures

Government healthcare objectives over recent decades are listed as follows:

- Clearly determine competency distribution between the state and regions.
- Guarantee system sustainability and curb healthcare expenditure by adopting a prospective financial model based on the use of Diagnosis Related Groups (DRGs). Financing can therefore be planned based on justified hospital activity, following both quantitative and qualitative criteria such as the case-mix of each hospital and national average lengths of stay classified by DRG instead of exclusively quantitative criteria, such as the number of beds and daily activity rates.
- Facilitate citizen access to healthcare by developing a preferential reimbursement system, applying exemptions based on fiscal and social criteria and establishing a maximum invoicing system in order to curb expenses stemming from copayment by the patient.
- Improve pharmaceutical management by promoting the use of generic pharmaceutical specialties, developing a reference system for prices and reimbursements, simplifying reimbursement procedures and optimising the vade mecum maintenance process.

B. Denmark

1. General overview

Denmark is a state made up of three fully autonomous territories: Denmark, Greenland and the Faroe Islands. With the exception of the latter two dependent territories, the Danish state is located in the Nordic zone of the European continent and is made up of the Jutland peninsula and over 400 islands, 79 of which are inhabited. Denmark borders with Germany to the south and Sweden to the east. This position has historically granted Denmark strategic control of access to the Baltic Sea. In addition, the Oresund Bridge has joined the country to Sweden by highway and by rail since 1999.

The administrative organization in force at the time divided Danish territory into 13 counties and 271 municipalities between 1970 and 2006. In 2004, the central government proposed an administrative reform specifically designed to improve how the healthcare system works by reducing these constituencies. The reform was passed in 2005 and applied in 2006. Denmark has had five regions and 98 municipalities since 1 January 2007.

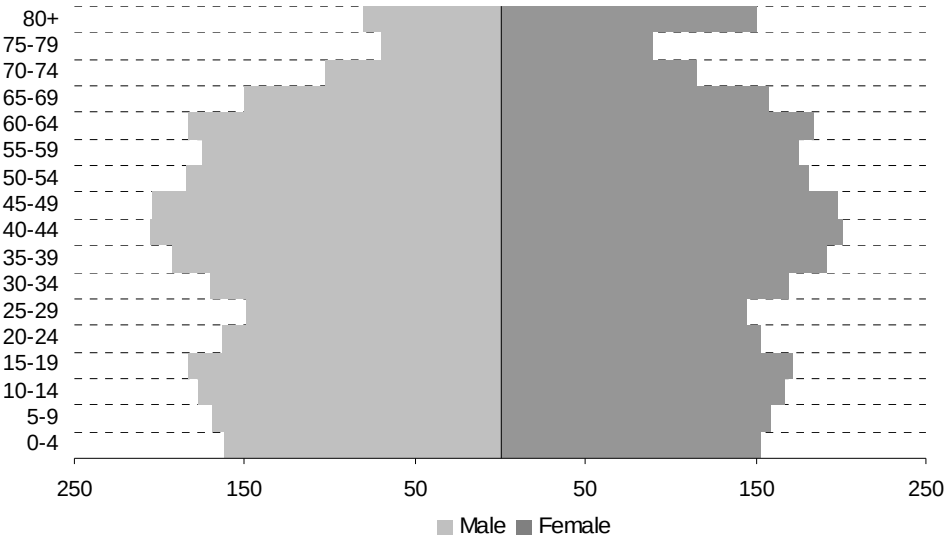
TABLE 4
BASIC DATA ABOUT DENMARK

Population (inhabitants)	5 534 738
Surface area (km²)	43 094
Population density (inhabitants/km²)	128.4
Immigrant population (%)	7.8
Nominal gross domestic product (US$ million)	313 825
Per capita income (US$/inhabitant)	56 701
Life expectancy (years)	78.2
Education index	0.993
Poverty index	7.7
Human development index	0.955

Source: Prepared by the authors on the basis of information from Statistics Denmark; The World Factbook 2008, Human Development Report (2009), Tourism Highlights (2009), and International Monetary Fund (2009).

Denmark's population density is slightly higher than the European Union average. Areas with the highest population density are mainly concentrated in the coastal region of the Baltic Sea and in the main cities belonging to the former thirteen counties.

FIGURE 3
DANISH POPULATION PYRAMID (IN THOUSANDS) – 2010



Source: United Nations, World Population Prospects: The 2008 Revision, New York, 2008.

The population pyramid has evidenced a slightly decreasing birth rate over the last 15 years, as well as a certain balance between men and women that moves apart at the top due to the female population's higher life expectancy.

2. The Danish healthcare system

2.1 Degree of coverage and financing model

The Danish healthcare system features universal coverage, as well as both public financing from taxes and private financing, which mainly stems from copayment and voluntary insurance payment. Most of the population has basic compulsory coverage and the private sector has a very small market share. As of 2005, only 15.5% of the population was covered by complementary and supplementary private insurance, which accounted for 1.7% of total healthcare expenditure.

Healthcare expenditure came to 9.7% of the country's GDP in 2008, slightly higher than the EU-15 group average (9.5%). Table 5 shows overall expenditure by financing agent in 2007:

TABLE 5
HEALTHCARE EXPENDITURE IN DENMARK – 2007

Taxes	84.50%	Rates	13.80%
		Private insurance	1.60%
		Non-profit institutions	0.10%
PUBLIC TOTAL	84.50%	PRIVATE TOTAL	15.50%

Source: Organisation for Economic Co-operation and Development (OECD).

2.2 Services portfolio

The Danish healthcare system provides the country's population with primary and specialised clinical services, hospital care, pharmaceutical services, odontological care, mental health, senior citizen care, health promotion and illness prevention, rehabilitation services, palliative care, alternative or complementary medicine, mother and child care and home care.

Danish citizens are completely free to choose what hospital center they wish to receive care at, but there are limits when it comes to choosing either a specialist physician or a primary care physician (who also acts as a gatekeeper). Both of these are proposed by the healthcare service at no cost for patients. However, patients may freely select another professional as long as they are willing to pay the corresponding rate. 98% of the population accepts professionals first proposed by the healthcare service and customer satisfaction is fairly high.

2.3 Organizational structure and competency distribution

Healthcare competencies and budget allocation are distributed at three levels:

- National: establishment of national healthcare policy objectives, legislation formulation, personnel regulation and control, coordination of cooperation between healthcare agents and institutions, and healthcare information management.
- Community: care provision and health promotion. Counties own and finance the vast majority of hospital centers. Private hospitals account for merely 1% of all hospital beds.
- Municipal: social service provision, such as senior citizen care, illness prevention and healthcare promotion, social psychiatry and care not related to acute pathologies.

Figure 4 features a healthcare competency distribution map showing the entities involved. With regard to budget, it is noteworthy to mention that the process includes direct negotiation with hospital center management teams with a view to prospective resource allotment based on DRG use.

Appendix I includes the main Danish legislation in terms of organization and healthcare financing.

2.4 Human resources

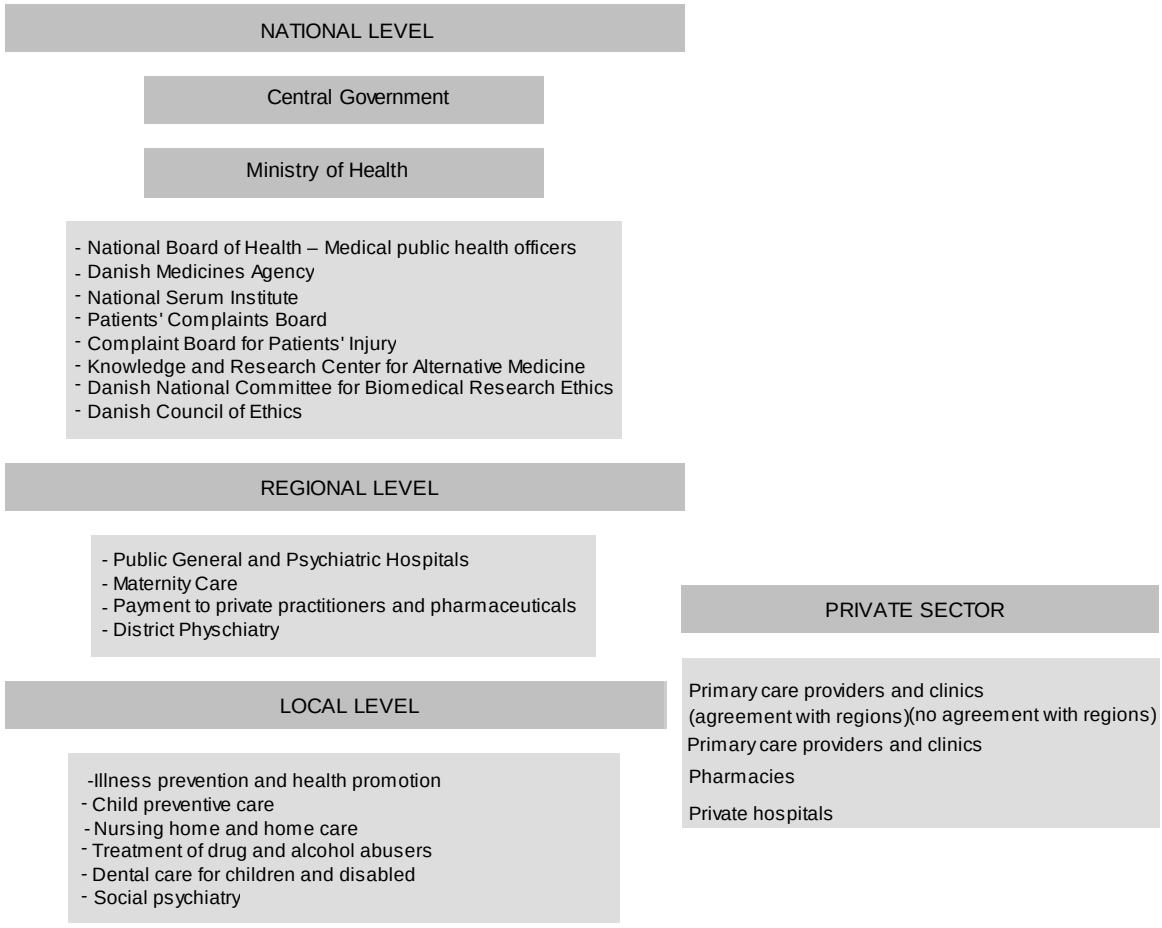
Danish healthcare professionals are independent professionals. Primary care services feature autonomous workers who work in close coordination with public employees from municipalities in order to integrate social services provided by the latter. Professionals are paid fixed wages, with the exception of physicians, whose wages are made up of a fixed monthly salary comprised of approximately 30% emoluments and service charges. Likewise, there are private specialists with a license granted by counties, whose wages integrally stem from service charges. The main problem for Danish healthcare institutions is a growing deficit of nursing professionals due to low salaries, heavy workload and working conditions associated to the position. Table 6 indicates the number of healthcare professionals as of 2003, classified by profession.

TABLE 6
HEALTHCARE PROFESSIONALS IN DENMARK – 2003

Profession	Number
Physicians	16 602
Odontologists	5 272
Pharmacists	3 574
Nursing	59 055
Midwives	1 463
Physical therapists	7 580
TOTAL	93 546

Source: European Observatory on Health Systems and Policies, Health Systems in Transition: Denmark (2007).

FIGURE 4
HEALTHCARE COMPETENCY DISTRIBUTION IN DENMARK



Source: Source: European Observatory on Health Systems and Policies, Health Systems in Transition: Denmark (2007).

2.5 Objectives and measures

Government healthcare objectives in recent years are listed as follows:

- Increased productivity and care quality. Care options such as day hospitalization and outpatient services are being promoted and this increase has led to less hospital beds in the system.
- Establishment of maximum response time guarantee mechanisms.
- Reduction of waiting lists corresponding to non-acute pathologies.
- Implementation of free choice for hospital treatment.
- Promotion of management contracts based on the definition and the degree of objectives met, based on care activity according to DRG.
- Development and measurement of quality control indicators.
- Structural primary care service reform in order to increase private sector participation.

C. Spain

1. General overview

Spain is a state located in the southwest region of the European continent and is largely made up of the Iberian Peninsula, the Balearic Islands, the Canary Islands and the autonomous cities of Ceuta and Melilla. The peninsular territory borders with France to the north, Morocco to the south and Portugal to the west. This position has historically granted Spain strategic control of access to the Mediterranean Sea.

Since Spain's return to democracy in the late 70s, the country's administrative organisation divides Spanish territory into 17 autonomous communities, two autonomous cities and 8,114 municipalities. A decentralisation model has been maintained ever since, assuming the progressive transfer of central government competencies to autonomous governments (as is the case with the healthcare system) and to local administrations.

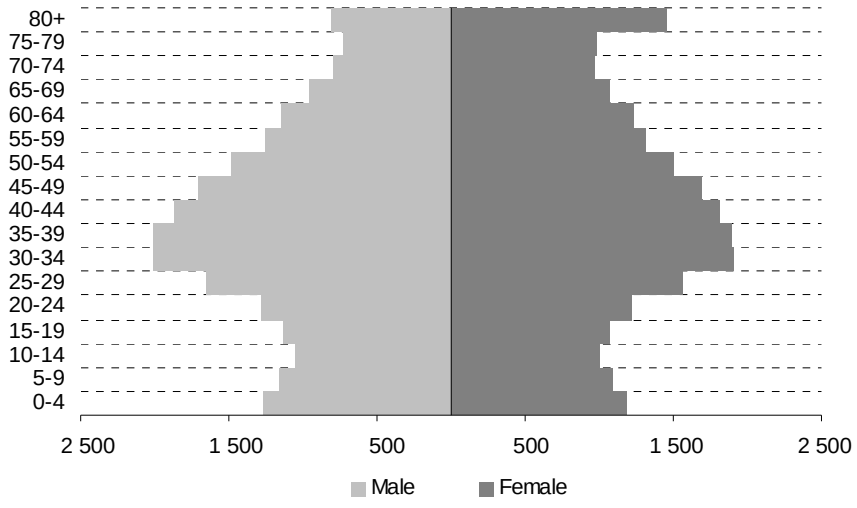
TABLE 7
BASIC DATA ABOUT SPAIN

Population (inhabitants)	45 989 016
Surface area (km²)	504 782
Population density (inhabitants/km²)	91.1
Immigrant population (%)	10.7
Visitor arrivals (millions of visitors per year)	61.6
Nominal gross domestic product (US$ million)	1 424 687
Per capita income (US$/inhabitant)	30 979
Life expectancy (years)	80.7
Education index	0.975
Poverty index	12.4
Human development index	0.955

Source: Prepared by the authors on the basis of official information of the National Statistical Office of Spain (2010), The World Factbook (2008), Human Development Report (2009), Tourism Highlights (2008), and International Monetary Fund (2009).

Spain's population density is below the European Union average. Areas with the highest population density are mainly concentrated in the capital city Madrid and in the coastal region, as well as in the country's main inland cities.

FIGURE 5
SPANISH POPULATION PYRAMID (IN THOUSANDS) – 2010



Source: United Nations, World Population Prospects: The 2008 Revision, New York, 2008.

The population pyramid evidences progressive population ageing, although the birth rate has been increasing slightly over the last 10 years. This is fundamentally due to a massive influx of immigrants, which currently account for more than 10% of the country's population. There is also a certain balance between men and women, which moves apart at the top due to the female population's longer life expectancy.

2. Spain's healthcare system

2.1 Degree of coverage and financing model

Spain's National Healthcare System (SNS) features universal coverage and is financed by means of public funds stemming from tax collection, complemented by copayment of medication and healthcare products by patients. Although there are also private insurance and healthcare centers, care is mostly provided through the public network and therefore the system is defined as an integral and public healthcare service. As of 2005, 10.3% of the population was covered by a duplicative private insurance policy, the cost of which amounted to 6.1% of overall healthcare expenditure.

Healthcare expenditure came to 9% of the country's GDP in 2008, below the EU-15 group average (9.5%). Table 8 shows overall expenditure by financing agent:

TABLE 8
HEALTHCARE EXPENDITURE IN SPAIN – 2008

Taxes	67.70%	Rates and copayment	20.70%
Social security	4.80%	Private insurance	5.60%
		Non-profit institutions	0.70%
		Corporations	0.50%
PUBLIC TOTAL	72.50%	**PRIVATE TOTAL**	27.50%

Source: Organisation for Economic Co-operation and Development (OECD).

Approximately 45% of the SNS budget corresponds to employee salaries, 21% to medication and healthcare products, 17.5% to intermediate consumption expenses and 11.3% to private sector purchases.

2.2 Services portfolio

The NHS services portfolio features:

- Patient assistance: primary care, specialised care (hospitals) and urgent care.
- Pharmaceutical, ortho/prosthetic, dietary/nutritional and transport services.
- Public healthcare services: epidemiological surveillance and information, health and illness prevention campaigns, environmental health promotion, nutritional safety, healthcare risk control and surveillance related international passenger and merchandise transport, as well as labour health protection.

The public medical care network features 10,202 local public medical centers, 2,916 healthcare centers and 300 hospitals. The SNS offers patients to choose freely and citizens are entitled to select a primary care physician (who also acts as gatekeeper) and even in some cases a specialist and hospital center, but this choice is highly limited by geographic criteria. There has been a substantial increase in hospital day care and specialized outpatient care in order to improve SNS efficiency. The autonomous communities have developed their own legal framework in order to guarantee maximum public healthcare service response times.

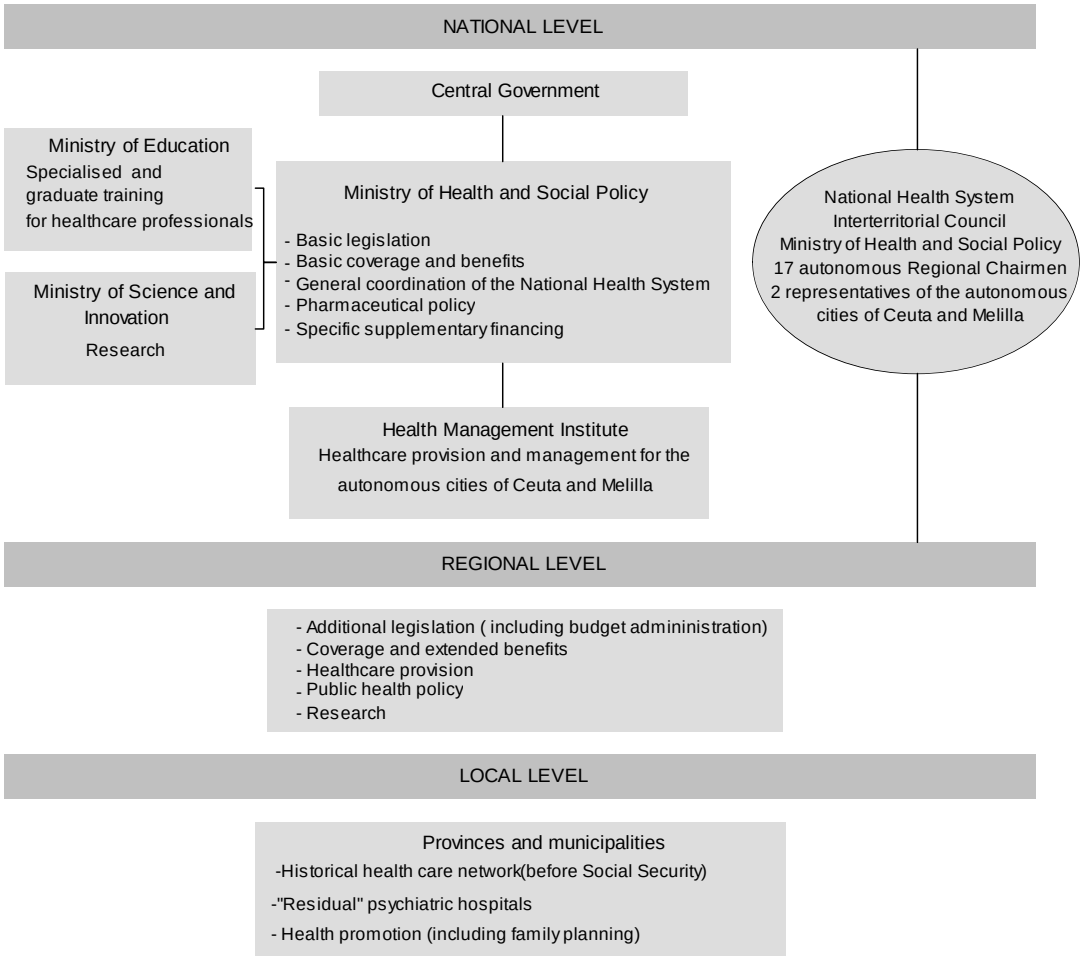
All medical care services are free of charge at the care center, with the exception of pharmacy offices, for which the patient is responsible for copaying 40% of the price of medication and products dispensed. This copayment can be reduced or eliminated depending on the social collective the patient belongs to or the nature of his or her treatment, as is the case with citizens over the age of 65, who are exempted from the same.

2.3 Organizational structure and competency distribution

Several structural reforms aiming to increase healthcare coverage, reform and unite the public medical care network, establish new models and management and financing, and provide a transition to a financial system based on social security and another based on taxes were executed between the 1980s and the 1990s. All of this led to system decentralisation by means of the progressive transfer of competencies to the autonomous communities, which are currently in charge of providing medical care and promoting health, starting in the 1980s and finishing in 2002. By means of the Ministry of Health and Social Policy, the central government formulates legislation and coordinates cooperation between the different institutions and SNS agents, pharmaceutical policy and others.

Figure 6 provides a healthcare competency distribution map detailing the entities involved.

FIGURE 6
HEALTHCARE COMPETENCY DISTRIBUTION IN SPAIN



Source: European Observatory on Health Systems and Policies, Health Systems in Transition: Spain, 2010.

Appendix I includes Spain's main legislation with regard to healthcare organisation and financing.

2.4 Human resources

SNS healthcare professionals are public employees. Their wages are basically made up of fixed monthly salary. Primary care professional salaries include a catchment bonus, which is to say a bonus calculated according to the number of patients registered and their demographic characteristics; and a geographical dispersion bonus that considers registered population density. Both primary and specialised care physicians are paid a salary bonus associated to their professional development. Finally, another salary bonus is productivity associated to the meeting of objectives, although the amount of this bonus is very small compared to the rest of the salary breakdown. Table 9 indicates the number of healthcare professionals in 2008, classified by profession.

TABLE 9
HEALTHCARE PROFESSIONALS IN SPAIN – 2008

Profession	Number
Physicians	130 962
Nursing	195 483
Pharmacists	42 310
Odontologists	24 696
TOTAL	**393 451**

Source: Informe anual del sistema nacional de salud 2008 and Ministry of Health and Social Policy (2010)

2.5 Objectives and measures

The SNS has reported good results in recent years, as reflected by different population health status indicators; coverage, access and equality parameters; medical care quality and safety; patient satisfaction levels and citizen appreciation of the system. These results are to be appraised taking into consideration that the same have been achieved while keeping the healthcare expenditure index relatively low compared to other European Union member States.

Government healthcare challenges for the coming years are listed as follows:

- Consistency of employee and supplier objectives with quality and system efficiency objectives.
- Transition from a model based on providing care for acute illnesses to a model based on managing chronic processes, including mental health.
- Establishment of a healthcare model centred on patients and based on the public provision of services by a group of professional public employees.
- Application of a cultural change establishing increased productivity and specialised infrastructure, reduced waiting lists for outpatient care and diagnostic tests in line with patient expectations as the main objectives.
- Increased integration between healthcare levels, enhancing primary care physicians' problem-solving capacities by reinforcing their role as those responsible for managing patients' clinical episodes.
- Adaptation to the ageing of SNS professional staff by promoting healthcare education and implementing a more flexible salary model that awards healthcare activity performance efficiency and quality.

D. The United Kingdom

1. General overview

The United Kingdom is a state located in the northwest zone of the European continent and is made up of the island of Great Britain, northeast Ireland and small surrounding islands. It borders with the Atlantic Ocean to the north and west, with the English Channel to the south, and with the Irish Sea and Republic of Ireland to the west. It was historically the first industrialised country in the world and the leading world power during the nineteenth century and early twentieth century, a position lost due to the aftermath of two world wars and decline of the British Empire, as well as progress made by the United States of America. However, the United Kingdom currently retains substantial economic, cultural, military and political influence. The UK is member of the European Union, G8, NATO and the Commonwealth of Nations and holds one of five permanent positions on the United Nations Security Council with voting rights. The UK is also a nuclear power.

Administratively, the United Kingdom is a unitary state made up of four countries: Scotland, Wales, England and Northern Ireland. All of these are governed by means of a parliamentary system whose government headquarters is located in London, the capital city, although the UK is substantially decentralised, articulated by means of three national administrations located in Edinburgh, Cardiff and Belfast, the respective capital cities of Scotland, Wales and Northern Ireland. In addition to the British Isles, fourteen overseas territories belong to the former British Empire and make up the Commonwealth, whose Head of State is the monarch of the United Kingdom.

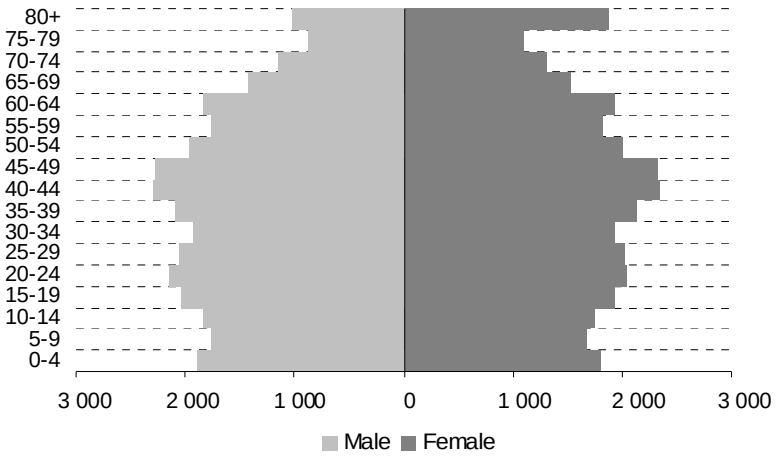
TABLE 10
BASIC DATA FOR THE UNITED KINGDOM

Population (inhabitants)	62 041 708
Surface area (km²)	244 820
Population density (inhabitants/km²)	253.4
Immigrant population (%)	9.7
Visitor arrivals (millions of visitors per year)	36.0
Nominal gross domestic product (US$ million)	2 222 629
Per capita income (US$/inhabitant)	35 825
Life expectancy (years)	79.3
Education index	0.957
Poverty index	14.6
Human development index	0.947

Source: Prepared by the authors on the basis of EUROSTAT (2010), The World Factbook (2008), Human Development Report (2009), Tourism Highlights (2009), and International Monetary Fund (2009).

The United Kingdom's population density is much higher than the European Union average. Areas with the highest population density are mainly concentrated in urban zones throughout the south of the island of Great Britain. 80% of the population lives in British territory.

FIGURE 7
THE UNITED KINGDOM POPULATION PYRAMID (IN THOUSANDS) – 2010



Source: United Nations, World Population Prospects: The 2008 Revision, New York, 2008.

The population pyramid evidences a steadily falling birth rate up until the last five years, as well as a certain balance between men and women that moves apart at the top due to the female population's longer life expectancy.

2. The United Kingdom's healthcare system

2.1 Degree of coverage and financing model

The National Health Service (NHS) is really a set of four independent healthcare systems corresponding to the four countries that make up the United Kingdom: NHS England (commonly known as NHS), NHS Scotland, NHS Wales and NHS Northern Ireland. All of these are publicly financed and provide universal coverage for all United Kingdom citizens. This study focuses on NHS England, hereinafter NHS.

The NHS is financed by means of revenue proceeding from tax collection and constitutes the largest Department of Health budget item. Employee salaries account for approximately 60% of the NHS budget, while medication and healthcare products make up another 20% and the remaining 20% corresponds to investment in infrastructure and services. The latter has increased over the last decade due to the modernisation programme undertaken by the central government.

Private sector participation is limited, with 11.1% of the population benefiting from duplicative private insurance coverage in 2005, with costs amounting to 1.2% of overall healthcare expenditure.

Healthcare expenditure amounted to 8.7% of the UK GDP in 2008, below the EU-15 group average (9.5%). Table 11 shows overall expenditure by financing agent:

TABLE 11
HEALTHCARE EXPENDITURE IN THE UNITED KINGDOM – 2008

Taxes	82.60%	Rates	11.10%
		Private insurance	1.20%
		Non-profit institutions	4.00%
		Others	1.10%
PUBLIC TOTAL	82.60%	PRIVATE TOTAL	17.40%

Source: Organisation for Economic Co-operation and Development (OECD).

2.2 Services portfolio

The NHS services portfolio features primary care, hospital care, care of chronic patients, ophthalmology and odontology. Patients are completely free to choose their specialist physician and hospital center, but have limited options when it comes to selecting a primary care physician, who must also be accepted by patients as a gatekeeper.

NHS services are free of charge for patients at the care center, with the exception of rates associated to ophthalmological tests, odontological care, prescribed medication and healthcare products, and some personal hygiene articles. Some social collectives are exempt from paying these rates. The private sector attends 8% of the population, which generally hires this type of insurance as a complement to NHS services. The NHS hired several subcontractors in the 2000s in an attempt to increase its capacity in the healthcare sector, but this measure led to widespread public rejection.

2.3 Organisational structure and competency distribution

Healthcare competencies are distributed throughout national, regional and local levels:

- The United Kingdom central government controls the NHS by means of the Department of Health, an entity that assumes the corresponding political responsibility and keeps Parliament informed regarding the functioning of the same.
- NHS administration is delegated to a set of 10 Strategic Health Authorities (SHAs), who control care provision in their geographic zones, especially primary care. These SHAs practically coincide with England's nine administrative regions, with the exception of the southeast region (the most populated region), which is divided into two.

Each SHA features different units for the provision of local services:

- Foundations for hospital administration and specialty centers that manage approximately 1,600 NHS hospitals. One foundation generally controls between two and eight hospitals.
- Primary Care Units, which are responsible for basic care and public healthcare. The number of primary care units dipped from 303 to 152 in 2006, in order to integrate services and cut costs. It is estimated that these units control 80% of the total NHS budget and feature nearly 30,000 physicians and 18,000 odontologists.
- Basic healthcare and social services units.
- Mental health units.
- Transport services.

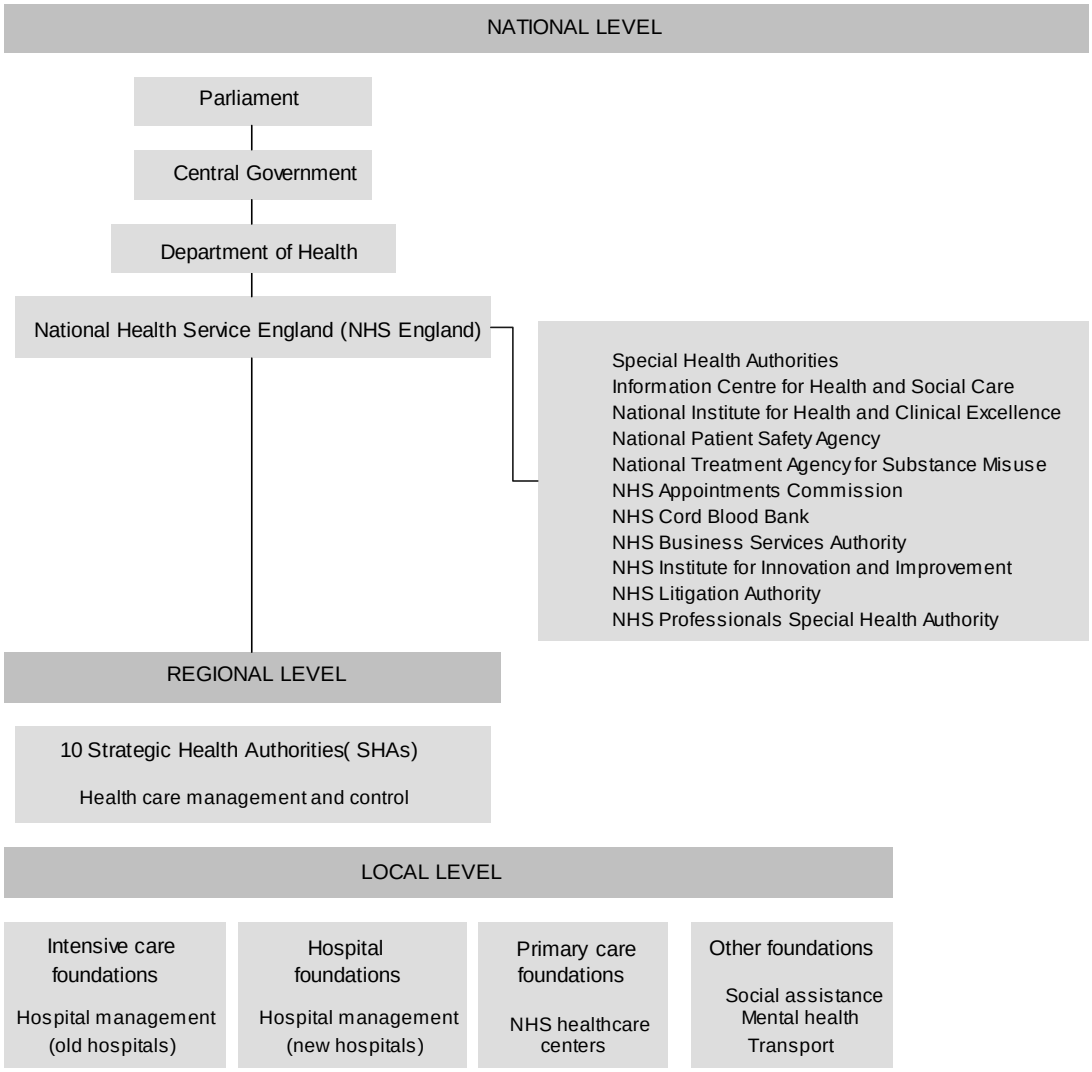
Figure 8 shows a healthcare competency distribution map for the aforementioned entities.

Appendix I includes the United Kingdom's main legislation and political measures with regard to healthcare organization and financing.

2.4 Human resources

NHS healthcare professionals have different working conditions: the large majority of hospital workers are public employees, while the primary care staff is mainly made up of independent professionals who are free to exercise private medical practice. In the event that primary attention needs to be reinforced, the NHS is entitled to assign its own employees in order to complement its staff of self-employed professionals.

FIGURE 8
HEALTHCARE COMPETENCY DISTRIBUTION IN THE UNITED KINGDOM



Source: Prepared by the authors on the basis of information from the National Health Service (NHS).

NHS staff has been increasing every year since 1997 when the Labour Party was voted in. The NHS employed a total 1.43 million workers in 2009 and is currently ranked as one of the five largest labour groups in the world, after the Chinese Army and India Rail, competing for third place with the US supermarket chain Wal-Mart and the US Department of Defense. Table 12 shows the number of UK healthcare professionals in 2009, classified by profession.

2.5 Objectives and measures

Important reforms have been undertaken over the last 30 years, started by conservative governments and continued by labour governments. Management processes were modernised in the eighties in order to facilitate increased involvement of clinics, and the so-called "internal market" was established, making SHAs entities that hire more services as opposed to managing the same, encouraging competition between healthcare units by introducing a substantial variable bonus depending on performance, which has been subject to criticism because it could have compromised care quality.

TABLE.12
HEALTHCARE PROFESSIONALS IN THE UNITED KINGDOM – 2009

Profession	Number
Physicians	140 897
Nursing	417 164
Qualified scientific and therapeutic personnel	149 596
Transport	17 922
Clinical support personnel	377 617
NHS infrastructure support	236 103
Practicum students	92 333
Others	364
TOTAL	**1 431 996**

Source: Prepared by the authors on the basis of data from The NHS Information Centre.

The labour party opposition reported what it considered to be privatisation of the NHS and started an ambitious modernisation plan after coming into power. However, measures that strengthened the model previously established by the conservatives were applied during the labour party's second term. Possible causes behind this change in direction are the need to curb increasing healthcare expenditure, the attempt to increase patients' freedom of choice and progressive ageing of the population.

The main reforms instituted by the labour party include service standardisation, tight budget control, reintroduction of the "internal market", closing surplus facilities and more thorough efforts made by management and direction teams. Other measures focused on modernising clinics' professional development plans, but these were rejected by different professional associations such as the British Medical Association.

One of the most ambitious initiatives undertaken by the labour government is the NHS National Programme for IT (NPfIT), developed in order to implement eHealth in the NHS. This project, which has been called the largest civil ICT project in the world, will be explained in greater detail in upcoming sections.

Lastly, it is noteworthy to mention that all of these reforms have only been implemented for NHS England, which has contributed to exacerbating differences between this system and the National Health Services of the other three countries that make up the United Kingdom.

E. Sweden

1. General overview

Sweden is a state located in the Nordic zone of the European continent and makes up part of the Scandinavian Peninsula. It borders with Norway to the north, with Finland to the east and with Denmark to the east. Sweden has been connected by highway and by rail to Denmark since 1999 by means of the Oresund Bridge.

Sweden has long been an exporter of iron, copper and lumber. Communications and transportation progress has led to large-scale exploitation of these natural resources and development of a powerful manufacturing industry. Nature conservation, environmental protection and energy efficiency are some of the population's main concerns. Together with the absence of fossil fuels such as oil and coal, these make the development of clean and renewable energy sources one of the national policy priorities. 39% of all energy consumed in Sweden came from

clean and renewable energy sources in 2005 and the government plans to bring this total up to 49% by 2020.

Sweden's current administrative organisation divides the country's territory into 21 counties and 290 municipalities. The parish is another unit below the local level, which was inherited from the ancient division established by the Church of Sweden. Other historical divisions which lack any administrative value but which are very important from a cultural perspective are also used, such as the 25 provinces or the country's three large regions. The central government is currently considering the possibility of undertaking an administrative reform similar to the Danish reform in order to reduce the 21 provinces to only 8, following the National Areas system applied by the European Union for statistical exploitation purposes. If this initiative is successful, the same could come into force by approximately 2015.

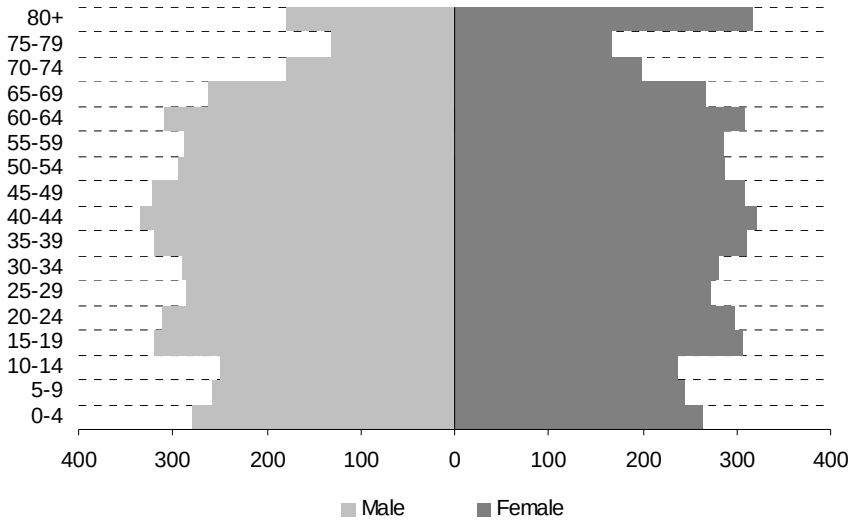
TABLE 13
BASIC DATA ABOUT SWEDEN

Population (inhabitants)	9 354 462
Surface area (km²)	449 964
Population density (inhabitants/km²)	20.8
Immigrant population (%)	12.3
Visitor arrivals (millions of visitors per year)	5.2
Nominal gross domestic product (US$ million)	443 718
Per capita income (US$/inhabitant)	47 434
Life expectancy (years)	80.8
Education index	0.974
Poverty index	6.0
Human development index	0.963

Source: Prepared by the authors on the basis of information of Statistics Sweden, The World Factbook (2008), Human Development Report (2009), Tourism Highlights (2009), and International Monetary Fund (2009).

Sweden's population density is one of the lowest in the European Union, with 84% of the country's inhabitants in urban areas and especially in the country's meridional zone.

FIGURE 9
SWEDISH POPULATION PYRAMID (IN THOUSANDS) – 2010



Source: United Nations, World Population Prospects: The 2008 Revision, New York, 2008.

The population pyramid evidences a steep birth rate decrease 15 years ago, followed by a steady increase. The balance between men and women clearly breaks up at the top, due to the female population's longer life expectancy.

2. The Swedish healthcare system

2.1 Degree of coverage and the financing model

The Swedish healthcare system provides universal coverage and is financed by public funds stemming from tax collection. Voluntary insurance premiums can be hired in order to provide supplementary coverage beyond the limits required by law, but use of the same is very uncommon (2.3% of the population in 2005, or 0.2% of total Swedish healthcare expenditure) and is generally limited to companies wishing to avoid expenditure caused by long employee absences.

Healthcare expenditure amounted to 9.4% of the country's GDP in 2008, slightly below the EU-15 group average (9.5%). Table 14 indicates total expenditure by financing agent:

TABLE 14
HEALTHCARE EXPENDITURE IN SWEDEN – 2008

Taxes	81.90%	Rates	15.60%
		Private insurance	0.20%
		Non-profit institutions	0.20%
		Corporations	2.10%
PUBLIC TOTAL	**81.90%**	**PRIVATE TOTAL**	**18.10%**

Source: Organisation for Economic Co-operation and Development (OECD).

Healthcare expenditure has increased relatively little over the last two decades (from 8.2% of Sweden's GDP in 1990 to 9.4% in 2008), due to expense containment established in the 1990s as a result of the economic recession. Although counties have an overall budget, many have delegated financial management to healthcare districts and approximately half of these eventually subcontracted integral management of medical centers, a formula forbidden by the "Stop" Law passed in 2000.

2.2 Services portfolio

The Swedish healthcare system offers citizens primary and specialised clinical care services, hospital care, pharmaceutical services, odontological care, mental health care, rehabilitation assistance, palliative care and care for the chronically ill, public healthcare promotion, alternative medicine treatment, mother and child care and care for specific collectives.

The Swedish healthcare system is based on providing basic healthcare through primary care centers; outpatient services for hospitals that care for more patients than healthcare centers; and private medical centers that have signed an agreement with the county. In addition, patients are completely free to choose a primary care physician, a specialist physician or a hospital center, and are not required to meet any gatekeeping criteria.

2.3 Organisational structure and competency distribution

Healthcare competencies and budget allocation are distributed throughout three levels:

– National: the Ministry of Health and Social Affairs is responsible of guaranteeing proper functioning of the healthcare system and is supported by several public institutions such as the National Healthcare and Welfare Committee, the main state consultancy and

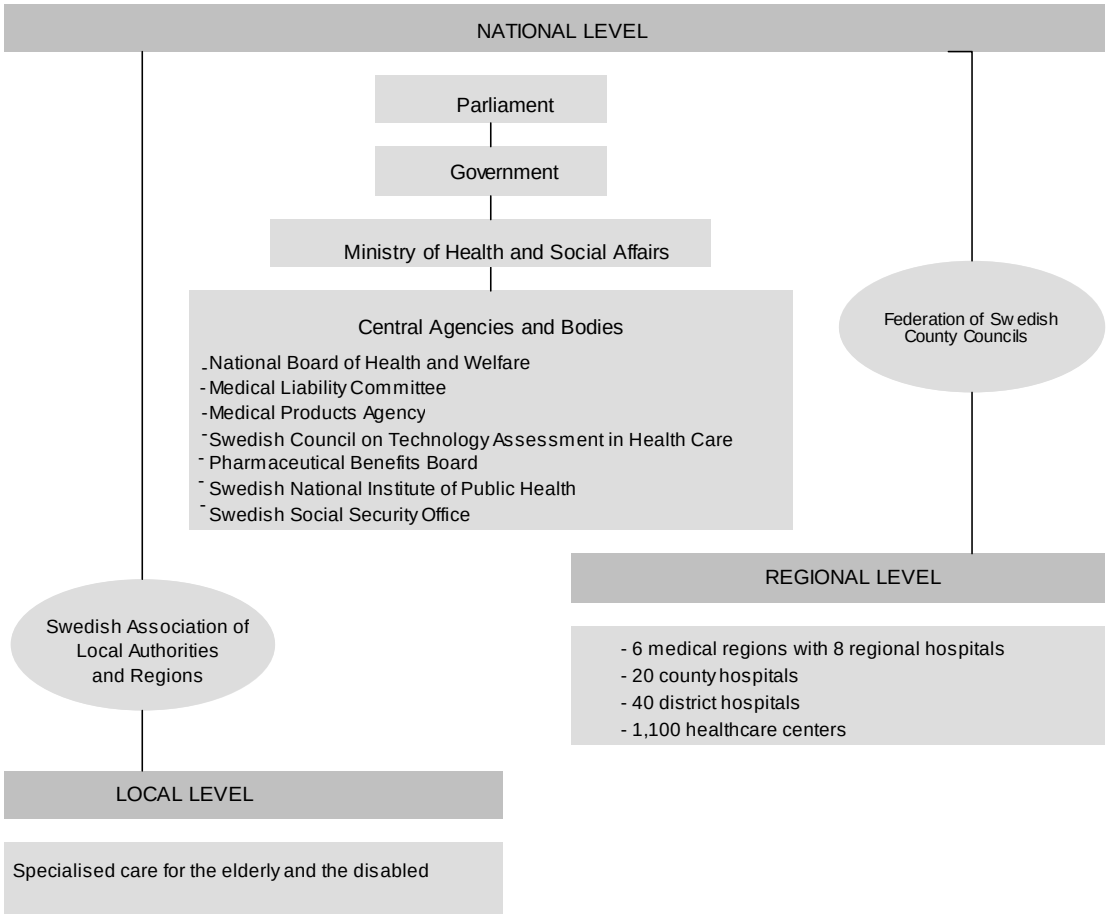
supervision agency, or the National Social Security Committee, which seeks to ensure service provision uniformity and quality.

– Community: provision of healthcare and health promotion. Counties are in turn divided into healthcare districts, each of which has a hospital and several primary care centers. Likewise, the 21 counties are grouped into 6 healthcare regions in order to facilitate intercommunity cooperation.

– Municipal: provision of social services, including child care, school health, senior citizen care or care for persons with a high degree of dependency, long-term care of psychiatric patients, home care and adult day care centers.

Figure 10 provides a healthcare competency distribution map featuring the entities involved.

FIGURE 10
HEALTHCARE COMPETENCY DISTRIBUTION IN SWEDEN



Source: European Observatory on Health Systems and Policies, Health Systems In Transition: Sweden (2005).

Appendix I includes Sweden's main legislation with regard to healthcare organisation and financing.

2.4 Human resources

Most Swedish healthcare professionals are public employees. Wages for physicians who work at public medical centers are made up of a fixed monthly salary and service rates charged. Wages for

some private professionals such as odontologists are calculated similarly and these are reimbursed by the National Social Security Committee. The number of healthcare professionals increased substantially in the 1970s and 1980s, but the number of physicians is still below the European Union average and geographical dispersion of the rural population must also be taken into account, which requires a percentage of these physicians to reside in areas with very few inhabitants. As for nursing personnel, the country has a relatively high number of professionals but there is a deficit of highly qualified nurses. Table 15 indicates the number of professionals in 2002, classified by profession.

TABLE 15
HEALTHCARE PROFESSIONALS IN SWEDEN – 2002

Profession	Number
Physicians	26 873
Nursing	90 758
Midwives	6 247
Odontologists	7 270
Dental hygienists	2 770
TOTAL	**133 918**

Source: European Observatory on Health Systems and Policies, Health Systems in Transition: Sweden (2005)

2.5 Objectives and measures

Sweden has introduced important structural reforms in recent years, especially in the 1990s. Results of the same have been the progressive transfer of competencies to local government and service providers, the establishment of new organisational and management systems, relatively successful expense containment (from 8.2% of the country's GDP in 1990 to 9.4% in 2008) and increased productivity for regional healthcare services.

II. *e*Health implementation

This section focuses on eHealth projects executed in the different healthcare systems presented in the last section, showcasing strategies, current execution status and results to date. In addition, several international collaboration projects are briefly described.

A. Belgium

The first Belgian eHealth projects started in the private sector in 1988 and were designed to simplify and increase the efficiency of administrative processes. ICTs were subsequently seen as a chance to improve healthcare service quality, considering the demographic changes foreseen in Europe, especially population ageing. The first ICT performances in the public healthcare sector thus started in 1997.

The main objectives of the Belgian strategy focused on the quality of information systems, process efficiency, interoperability, standard implementation, patient mobility and the safety of both patients and information regarding the same. The use of standards is especially important since each region is responsible for healthcare service provision and executing different ICT projects, leading to differences between regions. In turn, these differences are evidenced by the existence of several information systems and the Belgian eHealth model is therefore based on access to shared information.

The existing systems enable access to and consultation of the following clinical information:

- Laboratory test results.
- Test image diagnosis reports. This functionality does not include access to images, although most centers have digital medical imaging systems.
- Medication plans taken from invoicing data.
- InterConsultation reports.
- Hospital release reports.
- Previous on-line appointments.
- Vaccination records.
- Home care monitoring.

A first e-prescription project was unsuccessfully completed between 2002 and 2003, with the causes for failure attributed to market immaturity and the fact that not all parties participated in the project. A new project called *e*Prescript was executed between 2006 and 2008, made up of two complementary services: *e*Prescribe, for the prescription of treatment in accordance with a medication database designed to assist the prescription process; and *e*Transcript for dispensing prescriptions at pharmacy offices. This project was executed in collaboration with Ireland and Poland, within the framework of the European Union *e*TEN Programme.[6]

Other systems are currently in a development phase, highlighting the following:

- The HEPI-GO patient identification system.
- Interconsultation requests.
- Medical orders.
- Clinical test management.
- Mobile access to eHealth record.

Coordination between the different regions is based on the execution of several projects that solve needs common to all of these regions, enabling implementation of eHealth at a national level. The Ministry of Social Affairs, Public Health and the Environment, the Ministry of the Interior and the Federal Public Service for Health and the Federal Public Service of Information and Communication Technologies, among other entities collaborate in the management and coordination of these core projects. The following projects have been highlighted:

- Creation of a catalogue for the different existing eHealth record systems and the summarised electronic health record, Sumehr (Summary EHR).
- Implementation of a technological infrastructure foundation with the creation of two large national networks:
  - BeHealth, created in 2007, for safe access to different clinical information systems based on user professional profiles.
  - Carenet, created in 2004, for sharing invoicing data between financing agents and hospitals, pharmacies and other healthcare institutions.

[6] eTEN (e Trans-European Networks) is a programme promoted by the European Union in order to deploy trans-European e-services of public interest, allowing citizens to reap the maximum benefits of Information Society advantages. The development of eHealth is one of the eTEN action lines.

- Adoption of interoperability standards:
  - Technology: there is no generally accepted standard and mostly de facto standards are currently being used. The Belgian federal government has promoted the development of Kmehr (Kind Messages for the Electronic Healthcare Record) based on HL7 for access to the shared electronic health record.
  - Semantics: multiple encoding systems are used for storing information (CIE-9 for hospitals, CIE-10 for primary care, LOINC for laboratories, etc.). Kmehr extensions have been developed in some cases in order to provide compatibility with these semantic standards.
- Introduction of the electronic identity document, *e*-ID, and the electronic health insurance card, SIS.
- Formulation of a healthcare professionals registry.
- Creation of a legal framework for patient rights, data protection and certification of software related to the electronic health record.
- Application of an ICT education plan at several levels:
  - Teachers: all faculties of medicine in Belgium offer optional medical information technology courses. In addition, clinical information specialist certification started in 2000 and every hospital is now required to employ at least one clinical information specialist. Attempts have been made to include eHealth as required subject matter for educating primary care physicians, but this proposal has been rejected by the leading professional associations.
  - Professionals: specific training with regard to eHealth record system handling and general ICT training for administrative and support personnel.

The eHealth-platform was created in 2008 in order to encourage safe interchange of clinical information in Belgian national territory. The eHealth-platform features infrastructure and a series of its own services for this purpose, which enable access to several systems:

- Clinical: prescriptions and a medication database.
- Records: cancer, hip and knee prostheses, arthritis, previously expressed wishes.
- Administrative: services catalogue and hospital center rates, care accreditation, invoicing data, reimbursement processing, organ donation, etc.

Use of these services is optional in the case of regions, since these are competent healthcare entities. In keeping with the same, eHealth-platform principles include compatibility with the specific projects corresponding to different regions.

B. Denmark

The first eHealth projects in Denmark started in the late 80s, with several local actions designed to interchange clinical data in electronic form. One outstanding action connected 11 medical centers to 10 pharmacy offices. A short time later, the first three projects with a regional scope were executed in 1992, followed by the creation of a MedCom collaborative working group featuring the participation of healthcare institutions and several private organisations associated to the healthcare sector.

MedCom is funded by the Ministry of Health and Prevention, the Ministry of Social Welfare, the Danish National Board of Health, the Danish Pharmaceutical Association, as well as regional and municipal budgets. Ever since it was founded, this group has promoted and is managing several pluriannual programmes, also called MedCom, for the implementation of eHealth.

1. MedCom 1 (1994-1996)

The first MedCom was executed in order to develop and test Electronic Document Interchange (EDI), a set of communication standards for the interchange of clinical information in electronic form between hospital and primary care professionals at a national level. MedCom 1 was executed in three phases:

- 1994: definition of system specifications and the necessary information standards.
- 1995: development and testing of 29 information systems, with 25 pilot projects implemented in different regions throughout the country. The functional scope of the project focused on the most commonly used information: clinical analysis, microbiological and biochemical test results and requests, as well as digital radiological imaging; medication prescription; management of hospital appointments for patients referred from primary care; clinical reports and hospital release reports. These systems were commissioned independently without establishing communication of any kind between the different implementation points and up to 24 different providers participated in the same, 80% of which were Danish.
- 1996: interconnection and data interchange between different implementation points.

Results generally met initial estimates: 81% of the functional scope predicted was covered (92% for hospitals, 74% for primary care); execution time came to only two months, finishing in February 1997 with the implementation of EDI version 2.0, which introduced corrections and improvements defined based on pilot project development. The final cost was less than the initial budget of 15 million Danish kroners (a little over 2 million euros), with almost 800,000 kroners remaining.

2. MedCom 2 (1997-1999)

MedCom 2 objectives are listed as follows:

- Development of EDI standards for the interchange of clinical information between different hospital centers and local authorities. Local authorities are responsible for providing social assistance services.
- Communication improvement and expansion of communications between hospital care, primary and pharmaceutical professionals.
- Execution of Internet-based telemedicine, odontology and communications pilot projects.

Once again, results obtained were satisfactory. By the end of the project, daily network users included all hospitals, pharmacies and laboratories, as well as two-thirds of the primary care physicians and 16 local authorities. A few months before the end of 1999, 103 of the 173 scheduled implementations had been completed and 44% of all information was shared through the network compared to the target of 68%. At the end of the project, this scope had increased to 193 implementations and approximately half a million kroners were left of the initial budget set at almost 30 million kroners (a little over four million euros).

3. MedCom 3 (2000-2001)

Following the success of the first two EDI programmes, the central government and regional authorities agreed to assign the MedCom group on a permanent basis in order to "contribute to the development, testing, dissemination and quality assurance of electronic communication and information in the healthcare sector with a view to supporting good patient progression".

MedCom 3 was executed within this framework in order to consolidate and expand actions completed during the two previous MedComs, in addition to starting several international collaboration lines, especially with Sweden, whose eHealth strategy was quite similar to the Danish strategy.

4. MedCom 4 (2002-2005)

Projects corresponding to the four-year programme MedCom 4, the longest MedCom executed to date, are grouped into four general action lines:

- The Mini-IRSK Project: the first MedComs established close communication between hospitals, primary care centers and local social services, but the degree of communication between hospitals was still minimal. The objective of Mini-IRSK was to empower this communication by developing more efficient procedures for interchanging the most frequently required information: clinical reports and release reports, patient referral between hospitals, interconsultation and biochemical test results.
- The SUP Project: this project was promoted in order to establish a summarised clinical patient record standard in order to ensure that each hospital could share information in a standard format and thus facilitate Mini-IRSK development.
- Connection of all healthcare centers belonging to the Danish healthcare system to the Internet-based MedCom data network, allowing healthcare professionals to access information available through the Danish healthcare portal Sundhed.dk. The functionalities of this portal enable consultation of radiological and biochemical test results, the issuing of laboratory test requests by means of the WebReq system, the establishment of interhospital communications via videoconferencing, and the offering of teledermatology and telemedicine services, the latter in collaboration with local authorities.
- Information interchange between local and hospital authorities in the healthcare and home care services provision framework, with a total 92 implementations.

From a strictly technological point of view, new information interchange standards were developed based on XML messaging for the purpose of interhospital communication. Likewise, tools were created in order to convert EDI format to XML and vice versa, in order to guarantee compatibility with systems implemented as part of former MedComs.

5. MedCom 5 (2006-2007)

MedCom 5 was designed and planned considering reform of Denmark's administrative organisation and the introduction of new technologies based on the use of XML messaging and service-oriented architecture. However, the most important change affected the MedCom strategy itself. Strategy efforts up until that time had focused on sharing already existing information scattered throughout the entire national healthcare system, executing all standardisation and transformation processes required in order to guarantee data availability. Starting with MedCom 5, part of the work focused on generating new information about standards and formats used by MedCom.

Six main project lines were established for this purpose:

- SUP project development in order to expand its functionalities and create a patient e-record, a centralised database updated on an ongoing basis with information provided by information systems from all hospitals belonging to the national network, which enables consultation of clinical data for patients at the same by means of Internet access. In addition, use of the electronic patient record is to be extended to more professionals and even to patients themselves via Internet, with all of these communications protected by an encoding mechanism.
- Collaboration with local authorities: the DGOP project for rehabilitation programmes, with a pilot project in four regions and 13 municipalities; expansion of the care and home care information system; and the LÆ project for exchanging information regarding early retirement for health reasons.
- Development of the Sundhed.dk portal, incorporating a laboratory guidebook, expanding result consultation functionalities and giving the patient the opportunity to manage appointments and to be reminded of the same.
- Medication prescription management, implementing a standard vade mecum for all national territory (the FAME project) and standardising the prescription renewal process.
- Consolidation and expansion of several systems developed previously: Mini-IRSK, communication between laboratories and development of the WebReq request manager in order to incorporate new tests. The initial objective, using WebReq to manage 80% of all requests by late 2007 was achieved in October of that same year.
- Development of new specific systems: electrocardiogram standardisation, the SEI electronic report system for the National Board of Health, the SOR system for identifying centers and departments, and the EPNR system for identifying persons.

6. MedCom 6 (2008-2009)

For the sixth edition, the most important MedCom planning component was consolidation and expansion of its most relevant projects: the electronic patient record, with 80% of the population included in the system in late 2009; interconsultation management with the creation of a centralised database; incorporation of new tests and functionalities into the WebReq request manager; telemedicine systems; and collaboration with local authorities for home care systems, rehabilitation (DGOP) and LÆ.

New projects were also undertaken, featuring collaboration between healthcare services and local authorities with regard to illness prevention and child bearing; the FMK common identification card, in order to guarantee patient treatment plan data availability at any point of the healthcare network; and the *SIP* system for standardising primary care reports.

7. Medcom 7 (2010-2011)

Coinciding with MedCom's 15th anniversary, the main MedCom 7 projects currently underway are presented as follows:

- Laboratory information system expansion.
- Progress made for collaboration projects with the local authorities: home care, rehabilitation, LÆ, etc.
- Implementation of the FMK common medication card for primary care.

- Access to electronic patient records for the entire healthcare system and for the entire population.
- Incorporation of new telemedicine systems and expansion of currently existing systems.
- Participation in international projects promoted by the European Union, especially with regard to standardisation, telemedicine and well-being technology.

C. Spain

1. *e*Health strategy

As previously explained, Spain's SNS became highly decentralised after the process of transferring healthcare competencies to the autonomous communities was completed. Consequently, each of the communities is executing its own electronic health record (EHR) project and implementing information systems to meet its specific needs.

One of the fundamental features of the starting status for these ECR projects that is common to practically all regions is the distinction between healthcare levels. These projects generally have a primary care clinical record and another specialised care clinical record. This is due to healthcare system organisation, which distinguishes between two healthcare levels. The most commonplace type of organisation in the Spanish healthcare system is by means of primary care and specialised care managements, with the area management (common to the two levels) still uncommon.[7] Moreover, most EHR systems have no way of sharing information between primary care centers and specialised care centers, meaning that there are practically no mechanisms to facilitate sharing information within the regional healthcare service itself.

In order to overcome this problem and provide healthcare professionals with access to information available at each of these centers, one of the two following possibilities have been chosen for EHR projects being implemented by the different communities:

- Establish a communication and integration procedure between different information systems, enabling users to consult data required no matter where these users are stationed. This means dividing the EHR project into several specific projects.
- Develop a standard system to integrate and encompass all specific systems, while centrally storing all corresponding information. This option means that a single large-scale EHR project must be developed.

Most communities have chosen the first option and are executing a system integration phase for centralised access to shared information. Integration mechanisms used are based on adopting standards to regulate information interchange between systems. Health Level 7 (HL7) is used the most, although several versions of this standard currently coexist. On the other hand, there are also some single system experiences, with the choice between a macroproject and several specific projects marking the main difference between EHR projects being implemented by the different communities.

Other noteworthy differences are the formulation or lack of a strategic ICT plan to determine general action lines, as well as the use of own funds or external funds for project execution. Healthcare institutions have generally chosen to hire specialised external providers for software application development, although some of these institutions have developed their own

[7] Organisation into two healthcare levels stems from Spain's primary care reform that started in the second half of the 1980s. In order to empower the first healthcare level and prioritise funding of the same before hospitals, this level was provided with its own unique structure that was different from specialised care structure. This decision had unquestionable advantages at the time but must now be reconsidered in order to promote the integration of management as a means to improve healthcare process integration and continuity.

applications. However, these require healthcare institutions to employ human resources on an ongoing basis, which is often unreliable.

Planning of these projects generally includes execution of a pilot project in order to test how well the information systems developed work. However, the subsequent consolidation and expansion project is not always completed in a timely manner, which leads to a long period of coexistence between the already existing systems and the systems implemented during project execution.

2. Specific eHealth projects

Although each community is developing its own eHealth project independently, interchange of experiences and good practices between regions is commonplace. The main difference between these is unequal project progress and implementation, mainly due to different priority levels for each healthcare service strategy. The following projects have been highlighted:

- Patient identification systems. This is the first problem when it comes to developing corporate systems. Most communities have chosen to use health insurance cards for identification, but some have also decided to create a population database with a separate patient identification number. The health insurance card was implemented in Spain in the early 1990s and was designed to identify persons in the healthcare services, provide proper population databases for planning and managing the same, and to individually certify the right to healthcare services.
- Laboratory result and request management. Every clinical laboratory has its own department system, meaning that integration of information stored in the same is indispensable for developing the electronic health record. This integration features a double scope: diagnosis test requests and access to test results. Both aspects require considerable work beforehand in terms of standardising concepts, methods and classification. Many communities are working along these lines and implementation has been quite successful.
- Diagnosis by means of digital medical imaging. In parallel with laboratory result and request management, headway is being made in the implementation of RIS-PACS[8] diagnosis systems via digital support imaging. These systems require substantial infrastructure investment, from the installation of servers and large-capacity storage units to diagnosis stations with high resolution monitors, as well as a communications network to support massive data traffic generated by the same. All communities have commissioned projects of this type, in some cases highlighting the incorporation of additional tools such as voice recognition for report formulation or computer-assisted diagnosis.
- Electronic prescription. Due to increased EHR penetration in primary care and its repercussions on citizenry, since this encompasses the medication prescription cycle and dispensing of the same at pharmacy offices, electronic prescription systems are one of the most commonplace initiatives among these communities. Consolidated systems currently coexist with pilot experiences and their main advantage is increased patient safety. However, the validity of this instrument for controlling pharmaceutical expenditure is still being discussed.
- Computer-based prescription. This is included in electronic prescription systems for primary attention. Several projects are being executed in order to implement computer-based prescription systems incorporating several medication prescription assistance

[8] RIS: Radiology Information System and PACS: Picture Archiving and Communication System

functionalities for specialised attention, but development progress and implementation are still incipient.

- Appointment management. In order to improve patient care and meet current legislation obligations with regard to maximum response time, several communities have implemented or are currently developing systems for centralised outpatient resource agenda management. There are successful experiences with centralised telephone appointments in several autonomous communities, which have led to important improvements for primary care center management.
- Clinical station. Work is being done on the implementation of clinical station systems in order to provide healthcare professionals a working environment where they can access and introduce information at the same time. However, in many cases the scope of these systems is departmental, especially in the case of emergency services. As for primary care, all communities have a corporate station that provides services to all physicians.
- Telemedicine. One of the most innovative EHR areas is the development of telemedicine systems, which include functionalities such as teleradiology, vital sign monitoring, etc. These systems have been unequally implemented throughout national territory, with communities featuring the highest demographic dispersion evidencing the best efforts for implementation.
- Data protection. All healthcare services manage information security in order to safeguard the protection of patient confidentiality rights established in the Organic Law on the Protection of Personal Data and other legal provisions. The incorporation of authentication measures and electronic signatures have been highlighted as indispensable for developing functionalities such as citizen access to their own clinical information, which is currently in an experimental phase in the community of Catalonia.

The entire SNS has invested over 300 million euros on eHealth projects between 2006 and 2009 and an additional investment amounting to 200 million euros has been predicted over the next three years. These contributions not only come from autonomous community budgets, but also from collaboration agreements with the Ministry of Health and Social Policy and the Ministry of Industry, Tourism and Trade. The latter agreement is executed by means of Avanza Plans, and more concretely through On-line Health Programmes. Table 16 showcases some ICT usage data in the SNS throughout this period.

TABLE 16
ICT USE IN THE NATIONAL HEALTH SYSTEM

Electronic health record	**2007**	**2009** [b]
Healthcare centers with EHR	[a]	3 718 (98%)
Primary care physicians with EHR	[a]	28 163 (88%)
Hospitals with electronic patient management and a clinical station	[a]	226 (70%)
Online appointment management for primary care	**2007**	**2009**
Healthcare centers with online appointment management	2 282 (65%)	3 321 (87%)
Patients registered at healthcare centers with online appointment services	22 082 166 (55%)	37 116 767 (86%)
Previous appointments managed online	5 289 677 (1.5%)	12 464 018 (3.28%)
Computer-based prescription and e-prescription[c]	**2007**	**2009**
Healthcare centers with computer-based prescription	3 338 (95%)	3 718 (98%)
Healthcare centers with e-prescription system	420 (12%)	1 513 (40%)
Pharmacies with e-prescription system	3 489 (18%)	8 879 (42%)
Patients attended using e-prescription system	7 199 906 (18%)	11 999 298 (26%)
Dispensing executed using e-prescription system	24 788 288 (3%)	139 383 324 (18%)

Source: Red.es, "Las TIC en el SNS: el programa sanidad en línea" (2010).
[a] Data not available.
[b] Percentages calculated regarding the total corresponding to each parameter.
[c] Computer-based prescriptions use electronic health record systems in order to print a prescription on paper. The e-prescription system is an information system that relates the physician with the pharmacy office and the pharmacy office to the entity in charge of paying for the service rendered, which is the healthcare service.

3. The SNS Digital Clinical Record

In addition to execution of their own EHR projects, several communities are participating in the SNS Digital Clinical Record project (HCDSNS) promoted in 2007 by the Ministry of Health and Social Policy in order to share clinical information at a national level, using the central link of the Ministry as a communication element.

The project's initial scope is based on the assumption of a patient requiring care in an autonomous community other than his or her own community, facilitating essential clinical data to the corresponding health service professionals in order to guarantee care quality. However, there is another possible scenario entailing additional complexity: if a patient changes residence to another community it would mean the need to transfer already existing clinical information to the health service in his or her new community. Although this case is not considered in the current HCDSNS project, there are plans to include the same in subsequent system development and facilitating this upcoming inclusion has been considered in project design and development.

At the core of this system is the Summarised Clinical Record, a minimum set of data featuring indispensable information for a professional seeing the patient for the first time. Content and structure of this data set has been specified and agreed to by representatives from 31 associations and professional collectives. The system also allows access to several kinds of reports: primary care, emergencies, hospital discharge, external consultation with specialists, nursing care, as well as laboratory and diagnostic imaging test results.

The main hurdle for project success is the ability to reach a compromise between patient information availability and privacy protection. Healthcare professionals will therefore only be able to use the HCDSNS for strictly healthcare purposes and only access data their profile (physician or nurse) allows access to. Patients have full access to all existing information, as well as access and

consultation records. Patients are also entitled to hide concrete data if they wish to do so. If this is the case, the patient is notified beforehand as to the possible negative consequences of this action and the system shows healthcare professionals that there is hidden data in the record that may even be called up in the event of an emergency as long as access to this information is properly recorded.

Execution of a project of this scope means several basic needs must be addressed and met: patient identification; healthcare professional identification and authentication; semantic and technological standardisation of the system; citizen access mechanisms; incorporation of information protection measures; compatibility with EHR projects being implemented by the different communities with a view to unequal progress between the same; and planning for a future interoperability space in the European Union. Three working groups were created for this purpose:

- A standards and technical requirements group, made up of ICT professionals and responsible for determining technological standards to be implemented and reviewing system technical design.
- A semantic interoperability consulting group, responsible for guaranteeing the use of a standardised clinical terminology by all communities, which is to be the SNOMED CT standard. All of Spain's co-official languages are represented in this group.
- A group of 10 autonomous communities for system pilot projects, while the remaining communities will act as observers with a view to participation in post-pilot project stages.
- A pilot project was executed with two autonomous communities in 2009. The purpose of this project was to test HCDSNS in a controlled environment, draw several conclusions and suggest opportunities for improvement before incorporating the other communities starting in 2010.

D. The United Kingdom

1. eHealth strategy

As stated beforehand, one of the main action lines committed to by the Tony Blair administration following his election as Prime Minister was the NHS modernisation plan, whose main features included service standardisation, tight budget control, a model for paying healthcare professionals according to activities executed, a new professional development plan, closure of surplus facilities and tighter control by management and directing teams.

The year 1998 marked the publication of Information for Health, a report drawn up by members of the NHS and different administrations, representatives from several healthcare sector schools and professional associations. The Department of Health presented a health information corporate strategy proposal for the 1998-2005 period to Parliament in this report. The proposal was based on safe and confidential information principles, centred on patients and shared throughout the NHS thanks to full system integration. This integration was to surpass clinical limits because information for management was generated by operating systems.

The report highlighted poor ICT performance in the NHS up until that time, stating that most efforts put forth and investment made so far had focused on promoting massive data accumulation that was never used, leading healthcare professionals to see ICTs as a burden and not as a work tool. The main objectives of the NHS reform included the implementation of the electronic health record, conceived as a longitudinal record of all information related to health and care received by the patient throughout his or her entire lifetime. This record therefore combined data proceeding

from primary and hospital care, even taking into account the importance of the same for upcoming telemedicine services.

In keeping with the same, the NHS had to face several challenges, including the non-existence of coordination mechanisms for developing ICT strategies, as well as the management of corresponding projects and investment, especially at a local level. Another important challenge was to include ICT management, which had been delegated to technical professionals as part of the directing team competencies up until that time, although creation of specialised and continuously updated ICT services was required.

The year 2000 marked publication of the NHS Plan, which addressed the needs for reform from a global point of view but established several concrete eHealth objectives, including medical test result consultation; e-prescriptions; access to patients' integral electronic health record; electronic appointment management; and telemedicine in the teleconsultation modality. Likewise, special emphasis was placed on several baseline needs, such as the use of standards and healthcare professional training.

This strategy was developed in the Building the information core – Implementing the NHS Plan. The document was published in 2001 as an update to the NHS Plan and revised in April 2002 due to the publication of two reports. The first of these is known as the Wanless Report and recommended ICT management improvement by means of a nation-wide programme, adoption of stringent centrally managed standards and increased investment. The second was entitled Delivering the NHS Plan - Next steps in investment - Next steps in reform and promoted the concept of a new patient-centred NHS. The results of this review were published in Delivering 21st Century IT Support for the NHS – A National Strategic Programme, a document published in June 2002. The new ICT strategy featured new deadlines, with four action phases described in Table 17.

In addition to presenting this new planning layout, the document appraised five service provision modalities required for project execution, ranging from project development to complete outsourcing depending on the degree of private sector participation in the same. The recommended option, known as strategic outsourcing, consisted of hiring private companies to develop the main information systems in accordance with standards established at a national level. The NHS Information Authority was to be responsible for secondary element development and the Strategic Health Authorities were to be responsible for project management. All of these actions are part of the NHS National Programme for IT (NPfIT), created by the Department of Health in October 2002.

Despite the national scope of projects considered in NPfIT execution, a division was established in five geographic zones (Northwest, South, Northeast, South, East, West-Northwest and London), with a service provider hired independently for each of the same (Accenture, Fujitsu, Accenture once again, CSC and British Telecom), which in turn subcontracts part of the project to other providers. This model's objective was to encourage competitiveness and to diversify risks.

Two years later, the Department of Health created a new organisation, *NHS Connecting for Health* (NHS CFH), which took responsibility for NPfIT management, as well as for ICT competencies that had been previously handled by the NHS Information Authority. However, the management model was changed again in 2007, eliminating the division into five zones and returning project management to the Strategic Health Authorities, to which part of the NHS CFH deployed locally were transferred. NHS CFH kept provider contract management and relations as part of its competencies.

TABLE 17
PLANNING HOW TO IMPLEMENT THE NHS ELECTRONIC HEALTH RECORD (2002-2010)

Phase 0 Start: April 2002 Finish: March 2003	Infrastructure	Define open data and information interchange standards. Design and specify the electronic health record. Investment in microinformatics infrastructure.
Phase 1 Start: April 2003 Finish: December 2005	Applications	Electronic health record services and appointment management completely implemented. E-prescription services implemented up to 50%.
	Infrastructure	Broadband internet access and authentication functionalities for all clinical professionals. Communications encoding.
	Others	Investment plan for Strategic Health Authorities.
Phase 2 Start: January 2006 Finish: December 2007	Applications	Centralised clinical record database 100% implemented, facilitating access to existing information at each point of the healthcare network. 100% of all appointments managed electronically at a national level. E-prescription services completely implemented. Digital medical imaging service implemented in all hospitals. Telemedicine applied to dermatology, electrocardiogram execution and home monitoring. Patient portal accessible via the Internet, digital TV and wireless communications.
	Infrastructure	Safe system access for NHS professionals by using smart cards with authentication mechanisms (digital certificates, electronic signature, etc.).
Phase 3 Start: January 2008 Finish: December 2010	Applications	Telemonitoring incorporated in ambulances. Telehome monitoring 100% implemented. The Unified Health Record, integrating both healthcare and social care information.

Source: Department of Health "Delivering 21st Century IT Support for the NHS: A National Strategic Programme" (2002).

2. NHS National Programme for IT execution status

NPfIT application is based on implementation of the following information systems, some of which were conceived and started before the NPfIT itself:

- NHS Care Records Service (NCRS): integral electronic health record.
- Choose and Book: electronic management of hospital appointments, negotiated with patients.
- Electronic prescription: treatment prescription management and dispensing in pharmacy offices.
- Picture Archiving and Communications System (PACS): a system for capturing, recording, distributing and consulting medical images in digital format.
- Quality Management and Analysis System (QMAS): a measurement of activity indicators in order to assess the meeting of specific objectives for management contracts in the clinical services.
- NHSmail/Contact: a centralised e-mail and NHS directory service.

In turn, these systems are supported by another system that manages access to information and data interchange between systems and which therefore acts as the spinal column of NHS ICT infrastructure. It was therefore christened the National Data Spine, the Spine. This classification also reflects the system's division into several elements, which are described as follows:

- Personal Demographics Service (PDS): a population database that stores basic demographic information about patients, assigning these an NHS Number in order to guarantee proper identification.
- Summary Care Record (SCR): a summary of basic clinical information about patients, such as allergies and adverse reactions to treatment.
- Secondary Uses Service (SUS): a system for exploiting information for research purposes, quality control and planning by means of the anonymous use of patients' clinical data.

Lastly, all of these systems work based on a corporate communications network infrastructure, the New National Network (N3). Table 18 shows the features of each element in chronological order, as well as progress status in 2006 and 2009.

3. Project difficulties

The NHS has faced considerable difficulties since the start of these projects. Provider management has been especially complicated, since work execution delays led to the application of penalties, changing the provider after existing contracts expired and even dismissing some. This has led to substantial instability for working teams and eagerness to meet the agreed deadlines, which has clearly affected the quality of products to be delivered. Constant changes made to the aforementioned NHS management formulas implemented in order to solve these problems may have contributed to exacerbate the same.

Another important problem is information security and confidentiality. Although the Spine features several data protection mechanisms, its efficiency has often been jeopardised and several internal documents stating the existence of system design security failures have been leaked and then published by the press. This controversy has been fuelled by the fact that most NHS professionals oppose having their personal health record stored in electronic format. Pressure groups have taken the opportunity to encourage patients to oppose having their personal data stored in an electronic health record.

All of this has led to substantial criticism against the NHS, which has been accused of not knowing how to manage risks associated to the strategic outsourcing model applied and not knowing how to transmit the benefits of these new systems, calling into question both the clinical value of NPfIT and the NHS commitment and causing a lack of commitment by healthcare professionals. The fact that the Department of Health refuses to provide concrete information about projects or to allow audits about their progress status has been another source of setbacks. There is currently a lot of uncertainty about return on investment (12.4 billion pounds in ten years, with a final cost estimated at 20 billion pounds between 2014 and 2015, almost eight times higher than the original budget in 2000). This has been a subject of debate in Parliament, as stated in The National Programme for IT in the NHS: Progress since 2006.

At the time this study was executed, project continuity was awaiting a decision by the new coalition government between conservatives and liberals.

TABLE 18
NPFIT PROGRESS STATUS IN 2006 AND 2009

SYSTEM	PROGRESS STATUS – 2006	PROGRESS STATUS – 2009
Appointment management Starting date: 2003	Observance of the system commissioning date (2004) and successive delays since then. 12% of all appointments processed using the new system (the original objective was 90%). Users complain about the system being slow and technicians state that the technological platform is obsolete.	Approximately 50% of all appointments are processed using the new system. Additional user training has been required.
Spine Starting date: 2003	Some deliveries on time, but others are behind by almost a year. The deadline was moved from 2005 up to 2007.	Implementation well underway.
PACS Starting date: 2003	Project delay due to filing of a lawsuit opposing the contract award. 25% implemented. Provider replaced after the contract was completed.	Project completed in late 2007 with 130 implementations. Provider is executing maintenance services and awaiting formalisation of the corresponding contract.
QMAS Starting date: 2003	System commissioning date observed (2004). Implementation completed in early 2005.	System maintenance and development up until December 2008.
E-prescription Starting date: 2003	Pilot project date observed (2005). 8% of all prescriptions were processed using this system in early 2006.	70% of all physicians and pharmacies access the system but only 40% of all patients receive dispensing without any type of printed document.
New National Network – N3 Starting date: 2004	Connectivity objectives met, some before deadline.	Implementation practically at 100%.
Health Record – NCRS Starting date: 2004	Very limited progress. NHS CFH believes that the work pace will increase but has not set a delivery deadline.	System not yet implemented at any hospital. Generalised disappointment at NHS. Delivery date delayed until 2014-2015, currently considered unlikely.
NHSmail/Contact Starting date: 2004	System commissioning date observed (2004). In early 2006, 13% of all healthcare professionals were incorporated into the system. Half of these are frequent users.	25% of healthcare professionals were incorporated in the system in early 2008.

Source: King's Fund, Our Future Health Secured? (2007) and The National Programme for IT in the NHS: Progress since 2006. Second Report of Session 2008-2009. House of Commons – Public Accounts Committee (2009).

E. Sweden

1. Historical overview

The Swedish healthcare system had its first experiences with the transformation of clinical information in the field of telemedicine, which was due to the Swedish population's geographical dispersion. The first documented milestone is the remote reading of electrocardiogram signals in 1915, followed by the implementation of a telemedicine system for assisting Swedish vessels on the high seas in the 1920s, making Sweden one of the pioneers in the field of telemedicine. ICT

progress led to the development of more advanced solutions in the second half of the twentieth century, enabling the transmission of electroencephalogram signals in the late 1960s, the introduction of teleradiology services in the 1970s and communication between ambulances and emergency services in the 1980s.

2. The first eHealth projects

Multiple telemedicine systems were incorporated in the 1990s, but the use of ICTs surpassed the limits of the same and branched out into global treatment of clinical information, with the first projects executed in the following stages:

- 1989-1994: parallel development of information systems for use by physicians (clinical reports, laboratory tests and requests, result consultation, etc.), telemedicine applications (teleophthalmology, teleodontology, transplant assistance via videoconferencing, teledermatology, telepsychiatry, tele-homecare, etc.). This stage was divided into two phases, the first featuring a budget amounting to 20 million euros for the execution of 30 projects between 1989 and 1991 and the study of project viability as one of its main objectives. The second phase, between 1991 and 1994, featured a budget of 100 million euros in order to perform 63 implementations.
- 1994-2002: creation of regional networks for sharing clinical information and developing e-prescription and home care systems. Just like the former case, the working plan was divided into two phases, with the first phase featuring a budget of 140 million euros in order to execute 158 projects between 1994 and 1998. The most important milestone took place in 1997 with the launch of the SJUNET project, which aimed to develop a network for the safe interchange of clinical information between healthcare centers in the different regions. A directory of national healthcare professionals was created for this purpose and each user was required to use a smart card with a digital certificate for authentication and access to SJUNET.

The second phase had a budget amounting to 200 million euros for the execution of 125 projects between 1998 and 2002. Carelink, a national organisation for the coordination and promotion of eHealth was created in 2000 as part of this phase, representing the Federation of Swedish County Councils, the Swedish Association of Local Authorities, the pharmaceutical company Apoteket (owned by the Swedish government up until 2009) and the Association of Private Healthcare Providers. 50% of Carelink is financed by its members and the other 50% is financed by the Ministry of Health and Social Affairs.

3. Result assessment and formulation of a new strategy

As of 2003, the number of projects completed to date was highly positive, with a high degree of electronic health record implementation at most primary care centers and at a significant number of hospitals throughout the country. It was concluded that the main problems found were due to unfavourable conditions at the project onset: absence of legal frameworks, organisational shortcomings, leadership problems and interoperability limitations between systems. In addition, it was considered that some good results had not been conveniently disseminated, understood or even evaluated.

Under Carelink coordination and with the express purpose of guaranteeing access to patient information from any point of the Swedish healthcare network, new projects were launched in order to solve the problems identified, fundamentally the problem of interoperability, considering a future space in Europe for sharing clinical information. The solution to this problem was to bring

together shared management of patient and healthcare professional identification, adopt communication standards, semantic interoperability, as well as data security and confidentiality.

The working plan established featured the development of an electronic health record shared at a national level, e-prescription expansion and participation in international collaboration projects. The layout to be used was presented as an infrastructure similar to a railway system, with *SJUNET* as the train tracks, the different technological services (directory, authentication, patient database, etc.) as the trains, and with applications and databases (e-prescription, radiological imaging, laboratory test results, etc.) as the passengers. The Swedish central government was clearly involved, including a specific section in its strategy for springboarding the Information Society and actively collaborating with the Baltic countries (Denmark, Norway, Finland, Estonia and Lithuania) in the Baltic eHealth project framework.

The conservative party came into power in 2006 after twelve years of the Social Democratic Government. The new government committed to undertake a major Swedish healthcare system reform, establishing eHealth development as one of the main points on the agenda. A situation diagnosis was executed for this purpose and reported the following results:

- Widespread use of the electronic health record, amounting to 95% for primary care services and to 69% in the hospital sector.
- Widespread use of the e-prescription, with 55% of prescriptions and dispensing managed using this system.
- Existence of systems mainly focused on recording information, but not on data interchange.
- Difficulties when it came to nation-wide coordination and decision making, due to the level of self-government in regions.
- A need for close collaboration between the different agents participating in the healthcare sector as the only way to implement eHealth at national and international levels.

A new strategy was formulated based on these results, designed to improve patient security and accessibility, healthcare quality and continuity; enable national and international patient mobility; meet the demand to integrate healthcare and the information society by patients and healthcare professionals; and make eHealth the main instrument for renewing and improving healthcare services. This strategy was broken down into six main action lines:

- Legal framework and regulation.
- Information structure: specification of standards and implementation of the same at a national level.
- Technical infrastructure: communication networks, e-directory of patients and professionals, security mechanisms for user identification and authentication, etc.
- Efficient and interoperable ICT systems: electronic health record, administration and support services, decision-making support, prescription assistance and a summarised patient clinical record at a national level.
- Access to information beyond organisational limits.
- Citizen access: healthcare information, consultancy and services.

This strategy is closely in line with its predecessor and execution of the following projects is currently underway:

- National summarised patient health record.
- E-prescription: implementation of a national format for e-prescriptions and standard medication database maintenance.
- Maintenance and development of the SJUNET network, with video systems for videoconferencing and RGS Web for decision-making support.
- Maintenance of the HSA directory of professionals and services.
- SITHS project for information security and confidentiality.
- 1177.se web portal and 1177 hotline for citizen information.
- International collaboration, with promotion of the SNOMED CT standard in order to guarantee semantic interoperability, participation in the CALLIOPE project for creation of a single European interoperability platform and coordination of the epSOS project in order to facilitate patient mobility in the European Union. The latter two points are described in a separate section. The information referred to is provided as follows:

F. International collaboration

Three international collaboration experiences in which some of the countries studied participated are summarised hereinafter.

The eHealth-i2010 initiative has been highlighted among the action lines specified in the European Union 2004 Action Plan to develop the information society. This initiative set a series of concrete eHealth objectives and the CALLIOPE project for the creation of a single European interoperability network and the epSOS project for facilitating patient mobility in the European Union are being executed in the same framework.

On the other hand, several Baltic countries are executing the Baltic eHealth project, which was designed to create an international clinical information interchange network.

1. The CALLIOPE Project

The CALL for InterOPErability project: Creating a European coordination network for eHealth interoperability implementation (CALLIOPE) aims to create a cross-border interoperability network within the European Union, as well as forums and platforms for dialogue and collaboration between participants in the project. The project has a view to develop unified eHealth services and promote implementation of the same by the member States and to disseminate experiences, results and good practices.

The CALLIOPE network is made up of 28 organisations representing central governments, eHealth competency centers, professional associations from the healthcare sector, patient associations, insurance agencies and the healthcare ICT industry.

2. The epSOS Project

The European Patient – Smart Open Services (epSOS) project is based on two eHealth service lines:

- Access to the Summarised Patient Health Record, enabling professionals to quickly consult essential information related to a patient requiring assistance outside his or her country of origin. This is therefore an instrument similar to what was included in the SNS Digital Clinical Record described in the section on Spain.

- E-prescriptions, featuring two different dispensing scenarios: the assumption that a patient requiring medication prescribed in his or her country of origin to be dispensed while he or she is outside of this country, and the case of a patient who has received a new prescription while he or she was outside of the country and requires this medication to be dispensed once he or she returns to the country of origin. This has been possible for some years now between Denmark and Sweden.

The choice of these two elements is based on importance and usefulness for providing emergency clinical care and may largely help to meet the needs of patients in the European Union requiring medical attention outside of their country of origin. System implementation will require each country to establish a National Contact Point (NCP), whose responsibilities are listed as follows:

- Management of communication between the NCPs and all other member States.
- Patient and healthcare professional identification and authentication.
- Maintaining an updated index of countries where the patient's clinical information can be found.
- Patient clinical information management:
  - NCP in the patient's country of origin: sending the information requested and guaranteeing reliability of the same.
  - NCP in the country where the patient receives care: information reception, creation or updating of the corresponding Summarised Health Record with data generated during the healthcare process and notification of this creation or updating to the contact point in the country of origin.

Just like the Spanish HCDSNS, the following elements are indispensable: meeting basic patient and healthcare professional identification needs, semantic and technological standardisation, compatibility with member State information systems, data protection measures, reaching a compromise between patient information availability and confidentiality in the event of additional difficulty, such as the existence of different legal frameworks in each member State, which may lead to differences in competencies, listed in each professional profile. Depending on the country, nurses are entitled to prescribe medication and pharmacists are entitled to inform patients regarding several aspects of their medication plan, while psychologists can be considered clinical professionals.

This is therefore a large-scale project that will be executed in five main working areas:

- Analysis and evaluation of the starting status of each participating country.
- Legislation and regulation.
- Specifications and implementation.
- Fieldwork.
- Project management.

The epSOS pilot project features the participation of 12 member States including Denmark, Spain, the United Kingdom and Sweden. Sweden acts as project coordinator and work officially started 1 July 2008. Project execution is estimated at three years for an investment of 22 million euros, with 50% funded by the European Commission and the other 50% funded by the participating member States.

3. Baltic eHealth

The Baltic eHealth project was designed to promote eHealth implementation in rural areas of Denmark, Sweden, Norway, Estonia and Lithuania by means of a transnational network known as the Baltic Health Network, created starting with the interconnection of national and regional networks already existing in these countries. The new network enables cross-border service provision, especially telemedicine, which is of great interest for countries whose population features major geographical dispersion. Access to healthcare is therefore guaranteed throughout the entire territory while contributing to counteract depopulation in rural areas.

Teleradiology and tele-X-ray diagnostic projects are currently underway and have been well accepted by patients and especially healthcare professionals assigned to rural areas, who see eHealth as a means to support decision making, request a second opinion and even provide training.

III. Analysis and conclusions

This section summarises the aforementioned healthcare system overviews, describing their strengths, weaknesses and possible causes.

Lastly, keeping this analysis in mind, some key aspects for national eHealth project planning are described.

A. Healthcare system features

Section I describes the scenario this study was based on, providing brief general overviews of the countries analysed and their healthcare systems. Table 19 displays the most important of these.

From a demographic point of view, total population and population density data show that this study focuses on three small countries and two large countries; two are densely populated; two feature population density close to the European Union average (114 inhab./km^2); and one has very low population density, indicating high geographical dispersion of its population.

The five healthcare systems offer universal coverage to citizens and are financed using public funds, most of which come from tax collection. The only exception is Belgium, whose main source of financing is the country's social security system. 2008 healthcare expenditure is close to the EU-15 group average (9.5% GDP), with an approximate difference amounting to three-quarters of a point higher in the case of Belgium and three-quarters of a point lower for the United Kingdom. Private sector participation is minoritary, but slightly higher in Belgium and Spain.

TABLE 19
FEATURES OF THE HEALTHCARE SYSTEMS STUDIED

	Belgium	Denmark	Spain	United Kingdom	Sweden
Demography					
Total population (inhab.)	10 396 421	5 534 738	45 989 016	62 041 708	9 354 462
Population density (inhab./km^2)	340.6	128.4	91.1	253.4	20.8
Coverage					
Degree of coverage	Universal	Universal	Universal	Universal	Universal
Funding					
Funding model	Public	Public	Public	Public	Public
Main source of funding	Social security	Taxes	Taxes	Taxes	Taxes
2008 healthcare expenditure (% of GDP)	10.2%	9.7%	9.0%	8.7%	9.4%
2008 public healthcare expenditure (% of total healthcare expenditure)	72.5%	84.5%	72.5%	82.6%	81.9%
Decentralisation level of healthcare competencies and social care					
Competent administration	Regional	Regional – Local	Regional	Regional - Local	Regional - Local
Degree of patients' freedom to choose					
Family physician	Subsidised	Limited	Limited	Limited	Free
Gatekeeping	Subsidised	Compulsory	Compulsory	Compulsory	No
Specialist physician	Free	Limited	Limited	Free	Free
Hospital center	Free	Free	Limited	Free	Free

Source: Prepared by the authors.

Competency distribution is decentralised in all systems. Regional administrations are in charge of healthcare management, and local administration is responsible for social service provision in some cases. Lastly, the five countries offer patients different degrees of freedom to choose physicians and hospital centers. Spain is the most restrictive and Sweden is the most open.

B. *e*Health project characteristics

Section II describes eHealth strategies, implementation status and results obtained in each of the countries studied.

Table 20 summarises the eHealth implementation strategy adopted by five countries, according to the following criteria:

- Area: geographic scope of each project.
- Solution architecture: existence of a single global clinical information system or several specific interrelated systems for data interchange.
- Degree of capillarity: execution of a macroproject or several projects depending on the solution architecture.

TABLE 20
STRATEGIES EMPLOYED BY THE EHEALTH PROJECTS STUDIED

Country	Level	Solution architecture	Degree of capillarity
Belgium	Regional	Information system integration. Shared access to scattered information.	Several parallel projects for the development of specific systems.
Denmark	National	Information system integration. Shared access to scattered information.	Several parallel projects for the development of specific systems.
Spain	Regional	Information system integration and shared access to scattered information, although some communities have single systems.	Mostly specific system development, although some communities have macroprojects.
United Kingdom	National	Local implementation of one same system, with centralised access to shared information.	Macroproject divided into geographic zones with a different provider in each of the same.
Sweden	National	Information system integration. Shared access to scattered information.	Several parallel projects for the development of specific systems.

Source: Prepared by the authors.

Three of the five countries studied have designed a nationwide eHealth strategy, while Belgium and Spain have a different strategy in each region. As for solution architecture, the most widespread model consists of the development and integration of several specific information systems in order to share information existing in each of the same. However, the United Kingdom and some autonomous communities of Spain have chosen to develop single systems. Project execution depends on this decision: an integrated architecture implies parallel development of several specific systems, while a single system means macroproject execution. In the case of the United Kingdom, the latter model has been combined with the division of England into several geographic zones in such a way that each of the same has a different private provider for project execution.

Table 21 summarises the planning and coordination model for eHealth implementation at national level.

TABLE 21
PLANNING MODELS AND COORDINATION FOR THE EHEALTH PROJECTS STUDIED

Country	Planning	Coordination
Belgium	• No formal milestone calendar.	• No coordination mechanisms or organisations. • Federal organisations promote the adoption of standards at a national level, but their recommendations are not legally binding.
Denmark	• 2-3 year cycles.	• The national MedCom organisation has been in charge of coordination since 1994.
Spain	• Each community has determined its own planning independently.	• Each community is independent, although the projects are similar. Coordination provided by the Ministry of Health and Social Policy for the HCDSNS project (national) and the epSOS project (European).
United Kingdom	• Initial 9-year timeframe, currently extended to 13 years. • Project continuity currently depends on a decision by the new government.	• Coordination provided by the national organisation NHS Connecting for Health between 2004 and 2007. • Each Strategic Health Authority controlled project execution in its region before 2004 and after 2007. • No coordination between NHS eHealth projects in the four member countries of the United Kingdom.
Sweden	• 4-5 year cycles.	• Coordination provided by the national organisation Carelink since 2000.

Source: Prepared by the authors.

The planning models used are very different. Denmark works with short-term milestone calendars, following cycles that never last any longer than two or three years. Sweden uses a similar medium-term method with cycles ranging from 4 to 5 years, and initial planning in the United Kingdom featured a nine-year outlook milestone calendar, but this has been extended to 13 years after constant project execution delays. Continuity of this plan currently depends on the decision made by the new British government. As for Spain, each region features its own planning that is independent of all other regions, as is the case with Belgium, which also lacks a formally established milestone calendar.

There is also a wide range of coordination methods. Project management in Denmark and Sweden is centralised into a national organisation specifically created for this purpose. The United Kingdom commissioned project management to different regional healthcare administrations, subsequently adopting the Danish and Swedish model and finally returning to the initial model. As was the case with the project calendar, continuity of this model depends on what decision is made by the new government. In Spain, national coordination is associated to the HCDSNS project, focusing on access to information shared between healthcare services and communities, and coordination of Spanish community participation in the European epSOS project. Belgium lacks any national coordination structure, limiting the role of federal agencies to the formulation of recommendations regarding the implementation of standards.

Lastly, all countries in the study participate or have participated in international collaboration projects. Denmark and Sweden are the most active, participating in the epSOS and Baltic eHealth projects to promote interoperability in the European Union and in some Baltic countries, respectively. Spain and the United Kingdom also participate in the epSOS project, while Belgium collaborated with Ireland and Poland between 2006 and 2008 to develop the *e*Prescript electronic prescription system as part of the European *e*TEN programme.

C. Results analysis

Healthcare systems in the five countries studied evidence several common features: universal coverage, a public financing model, similar levels of healthcare expenditure and decentralised healthcare system administration, although the extent of decentralisation varies from country to country. Despite these baseline similarities, the level of eHealth development is different in the five countries. Summarising these results into a single phrase, it can be stated that eHealth implementation is highly advanced in the Nordic countries Denmark y Sweden; at an intermediate level in Spain and in the United Kingdom; and somewhat backlogged in Belgium.

Development of eHealth in Denmark and Sweden has typically met a large number of project objectives in terms of both deadlines and costs. This success has especially been achieved in primary care and social services, somewhat less when it comes to implementing the electronic health record in hospitals, although a lot of headway has been made in this area. Sweden also evidences precocious and satisfactory implementation of telemedicine systems, which is presumably due to the geographical dispersion of the country's population. Both countries have a highly advantageous scenario in terms of system integration and access to shared information.

Even though Spain has a totally decentralised healthcare system with regard to eHealth, the country evidences different degrees of implementation depending on system type: massive when it comes to the electronic health record for primary care; unequal in the case of hospitals, although excellent in terms of departmental solutions and digital medical imaging; and high in the case of the e-prescription, only surpassed by the Nordic countries included in this study.

The United Kingdom eHealth project has featured phenomenal political and budget support, but it seems that results reported were not up to initial expectations, despite the success of several systems implemented. Several problems have come up throughout project management, possibly due to the scope of these projects, which have led to several changes in work methods and coordination.

Although eHealth implementation is less substantial in Belgium, this country's initiative with regard to human resources training in this field of knowledge should be highlighted, together with implementation of systems most often used by physicians in their daily work, such as medical order management and access to diagnostic test results and hospital discharge reports.

The following tables show the strong and weak points detected in each of the five countries, listing possible causes behind the same. Several useful conclusions can be drawn from this analysis when it comes to formulating strategies for future eHealth development, especially considering the fact that these are based on the results of five different national projects.

TABLE 22
STRONG POINTS OF THE *E*HEALTH PROJECTS STUDIED

Country	Strong points	Possible causes
Belgium	• Access to shared information strategy • Development of administrative and financial systems • Creation of national information network • Human resources training for eHealth	• Healthcare competencies assigned to regions • Healthcare center ownership variability • Existence of independent professionals
Denmark	• Inclusion of eHealth in the national ICT strategy • Access to shared information strategy • Scope, deadline and budget observance • Creation of a national information network • Telemedicine system development • Regular and public evaluation of MedCom projects • New projects adhering to information sharing standards • International collaboration	• Pursuit of added value for healthcare professionals • Short-term global planning, obtaining and evaluating results at each stage • National coordination with the participation of all parties involved • Execution of pilot projects in order to study system improvement feasibility and possibilities • Pilot project consolidation and dissemination • A first phase in order to share existing information and a second phase for generating information in a shared format • Online data network featuring strict security measures • International collaboration feasible thanks to previous national collaboration
Spain	• Similar trends between different communities • EHR implementation for primary care • HCDSNS national collaboration project • Collaboration with national ICT programmes • Collaboration between regions, the Ministry of Health and Social Policy, and the Ministry of Industry (Avanza Plan)	• Sharing of experiences and good practices • Participation and involvement of primary care physicians in development of their EHR • Health system decentralisation completed in 2002
United Kingdom	• ICT strategy aligned with the healthcare strategy, with an ICT plan as part of the NHS Plan, which in turn is part of the government plan	• Exhaustive national planning studies • Political and budget support • Delays in the application of a strategy for access to shared national healthcare information

Table 22 (concluded)

Country	Strong points	Possible causes
Sweden	• Inclusion of eHealth in the national ICT strategy • Access to shared information strategy • Development of information systems for medical use • Creation of a private and safe national information network • Telemedicine system development • Use of digital certificates for information access • Scope, deadline and budget observance • Project feasibility studies • International collaboration	• Pursuit of added value for healthcare professionals • Short- and medium-term global planning • National coordination with participation of all parties involved • Interest in telemedicine due to the population's geographical dispersion • Strategy continuity in the event of changing government administrations • International collaboration feasible thanks to previous national collaboration

Source: Prepared by the authors.

TABLE 23
WEAK POINTS OF THE *E*HEALTH PROJECTS STUDIED

Country	Weak points	Possible causes
Belgium	• Patient identification • Slow clinical system development • Over-extended deadlines • Multiple information systems that depend on regions	• Establishment of different priorities and methods in each region • Non-existence of national coordination mechanisms • Absence of a formal milestone calendar • Execution of pilot projects without subsequent consolidation or expansion
Denmark	• Electronic health record implementation slower in hospitals • Long but realistic execution deadlines	• Increased difficulty for implementing EHR in hospital environments
Spain	• Extended coexistence of former systems with new developments • Development of macroprojects with partial success in some communities • No real collaboration experience between communities for shared project development • Slow incorporation of EHR in hospitals, with the exception of new centers	• Establishment of different priorities and methods in each region • Fast pilot project execution, but slow consolidation and expansion • Budget restrictions • Strategy discontinuity in the event of changing government administrations • Increased difficulty when implementing EHR in hospital environments
United Kingdom	• Repeated non-observance of deadlines • High overcosts • Working team instability • Healthcare professional mistrust and resistance • Non-existent coordination with the health services in Scotland, Wales and Northern Ireland	• Long-term planning • Change management • Provider management, with several cancelled or non-renewed contracts • Constant changes made to management and coordination formulas • Deficient deployment planning (for example, e-prescription) • Premature and optimistic assessment of results • Information security failures • Planning stays the same after budget restrictions • Establishment of different priorities and methods in each country
Sweden	• Long but realistic execution deadlines • Less impressive results in hospitals • Communication strategy • Initial absence of a legal framework • Difficulties when it comes to national decision making	• Increased difficulty for implementing EHR in hospital environments • Healthcare system decentralisation

Source: Prepared by the authors.

1. Added value for healthcare professionals

The pursuit of added value, especially for physicians, is one of the success factors of eHealth projects. Healthcare professionals should perceive that the effort behind changing working methods entails tangible benefits for their daily work performance, such as increasing care quality or reducing time spent on unimportant tasks.

Since fast, simple and secure access to patient information is highly appreciated by physicians, all of the countries studied have included sharing information already available at the start of these projects among their most important objectives. Several integration mechanisms were required in order to meet this objective and these were based on the extraction of data proceeding from different systems and conversion to a shared format enabling use of this data at any point of the healthcare network. Treatment of this information implies the use of semantic and technological standards, the establishment of reliable patient identification mechanisms and the implementation of data protection measures. The problem of patient identification has been resolved by the creation of a single patient identifier in Denmark, Spain, Sweden and the United Kingdom, while Belgium is currently working on development of a similar solution.

Once this milestone was reached, system architecture to be developed in the future had to base on already existing standards in order to ensure that new information is directly generated in these formats and can be integrated and shared from the very start, substantially reducing the scope of the complex task of system integration. Some of the countries studied have already acted accordingly.

An example of added value as a success factor can be found in e-prescription projects, at least in Spain. This system increases medication dispensing security and reduces the amount of time patients spend in primary care services, preventing appointments lacking clinical value and providing subsequent benefits for physicians, pharmacists and patients themselves.

2. Planning featuring tangible results at each stage

Besides the fact that these systems contribute value for healthcare professionals, this value being perceived in a timely manner seems to be critical for the success of eHealth projects. Consequently, projects must essentially be planned in such a way that benefits are gradually presented throughout execution of the same, with initial benefits presented in the short term, as was the case with experiences in Denmark and Sweden. When a project lacks milestones with concrete short-term results, these either fail to meet expectations generated or healthcare professionals get discouraged, hampering change management. This risk is especially high for large-scale projects with a long timeframe where there is also a possibility of the technological platform becoming obsolete during project execution.

One of the most important project planning milestones is execution of a pilot project in order to put system validity and solutions developed to the test in a controlled environment that accurately represents the final scenario. Likewise, it is important that the system be consolidated by incorporating corrections and improvements required after conclusion of the pilot project and expansion must be undertaken with no delay. The extended coexistence of old and new systems, as well as the repetitive testing of systems whose final implementation is delayed lead healthcare professionals to feel like tasks are being duplicated. This generally leads these professionals to reject the new solution, despite the fact that the solution works using more modern technological platforms and offers more facilities for integration with other systems.

Another fundamental element for the perception of added value is dissemination of results obtained. If a project meets its objectives within the deadline and contributes added value but the success story is not announced to the general public, use of the systems implemented will be

scarce. Good communication management is therefore required in order to properly disseminate the results obtained.

Lastly, continuity with regard to political changes is a factor that may affect eHealth project planning. Since these are mostly pluriannual projects, execution of the same may be affected by election calendars and changes in government administrations. There have been two examples of this situation among the countries studied: in 2006 a new Swedish government was voted in, maintaining the general lines of the national eHealth project. A similar change recently took place in the United Kingdom, with the decision to continue, reform or cancel the NHS ICT programme still pending.

3. National coordination, regional management and participation of all parties involved

The eHealth strategy should be a consequence of the general healthcare system and is therefore encompassed within the same. Healthcare services perform an important investment in ICT incorporation because this is considered necessary in order to meet the objectives of improving quality and efficiency. If the healthcare strategy is determined by regional or local governments, it is therefore logical that eHealth projects should be planned and executed at that same level and this should not hamper the success of these projects. However, this should not impede or hamper the existence of national coordination for implementing eHealth at said scale and it is also recommendable that the eHealth strategy be in line with the national ICT strategy. For example, Spain has a collaboration framework between the Ministry of Industry, the main agency responsible for developing the information society, the Ministry of Health and Social Policy and the autonomous communities.

Despite decentralised service management, which was the case in most of the countries studied, there must be coordination when it comes to setting standards used to share information generated in the different institutions, to deploy the corresponding basic infrastructures, to determine patient and healthcare professional identification mechanisms, and to determine legislation required, among other measures.

Participation of all parties involved is also indispensable, regardless of whether project management is executed at a national, regional or local level. Physicians, nurses, pharmacists and other professionals whose working methods will be affected by these projects must clearly define their needs and express their preferences with regard to the different solutions. In turn, their proposals must be taken into consideration. A clear example of the same is the electronic health record used for primary care in Spain, whose success is closely related to the work of physicians who participated in designing the record in the mid-90s and who have subsequently been working to develop and perfect the same.

With regard to the participation of all parties involved and decentralised management, there is another factor that must be taken into consideration: the need to share good practices. Healthcare professionals, whether these are clinicians, technicians or administrative personnel, must have the chance to disseminate their work and share their experiences with respect to eHealth project development, presenting results obtained, success factors and also their reasons for failure.

4. Telemedicine

One of the most attractive sides of eHealth is telemedicine, which presents multiple applications: teleradiology, tele-X-ray imaging, teledermatology, telemonitoring of vital signs, teleconsultation, etc. Solutions of this kind are more developed in areas where the population features major geographical dispersion, since this allows healthcare system resources to be better used.

However, we must consider that telemedicine works based on the prior existence of clinical information systems and situations may come up requiring direct care. Telemedicine must never be considered to be a substitute, but rather assistance for access to care, improving care quality and fairness. This is the case in Denmark and Sweden, which have faced telemedicine system development after consulting several basic systems and aim to improve care access and quality in rural areas, among other objectives.

5. Citizen perspective and participation

Most patients understand the benefits of eHealth implementation and accept the need to create shared electronic health record systems that will make their clinical information available at the time and place required, independent of the time and place said data has been recorded. In the event of these new possibilities of accessing and using their healthcare information, patients' main concern is information confidentiality, meaning that a healthcare system must be implemented in order to determine the corresponding access permits, identify and authenticate persons with access to data, and to record this access and operations performed.

Widespread expansion of ICT use, with Internet as the best example, has opened a telematic access route for citizens to some clinical-administrative healthcare system services and the advancement of digital television is expected to lead to availability of a new means of access in the future. Denmark hosts the portal Sundhed.dk, which allows patients to manage appointments and activate corresponding reminder mechanisms, while the United Kingdom is considering a similar milestone as part of its planning process.

Some patients have stated that they wish to participate more actively in the process, suggesting the possibility of accessing their health record in order to incorporate information and more fully complete the same, foreseeing its potential to encourage self care and the care of chronic illnesses. In Spain, the HCDSNS project plans for direct citizen participation in treatment of his or her health information, allowing the citizen to see who has accessed this information and to block access to certain data sets if he or she wishes to do so. However, current experience is very limited in this sense and is restricted to the pilot project, since implementation of the same requires prior existence of an integrated set of information systems that would be used to determine a new access profile.

On the other hand, before taking on an active role in managing their information, patients must understand the possible consequences of their direct participation, especially when it comes to blocking access to data. The ongoing advancement of ICTs means that citizens will be increasingly knowledgeable in this field and will be able to easily manage information systems. However, the vast majority of these citizens lacks clinical information management experience. Therefore, it is indispensable that patients be informed and educated as to how these systems work. It is recommendable that patients be involved in the design, development and exploitation of the same.

6. Legislation and security

Security for eHealth projects can be considered from three different perspectives:

- Information security, understood as the balance between information availability and confidentiality.
- Patient security, reducing the possibility of being affected by mistakes made during care provision, improving service quality and guaranteeing privacy.
- Security for healthcare professionals, who provide services in the right legal framework with instruments to facilitate their work.

Systems must meet technical information security requirements and include procedures needed in order to guarantee patiently security in their functional design to satisfy these three security aspects. Likewise, all of this shall be executed within a legal framework that establishes data protection and clinical information treatment standards, starting with clinical record validity and e-prescriptions for all purposes. Legislation regulating data protection in the European Union is Directive 95/46/CE dated 24 October 1995 regarding the protection of physical persons for processing of personal data and free circulation of this data. Member States have incorporated this directive into their national legislation.

7. International collaboration

Citizens are more and more internationally mobile, due to the creation of shared economic spaces and major transport and communications development. This means that clinical information must be shared between healthcare systems in different countries, thus guaranteeing quality care for patients outside of their countries of origin.

This implies the establishment of an international level for eHealth implementation, above national, regional and local levels, with the aforementioned key factors remaining perfectly valid. Some of the countries studied have been participating in projects of this kind for several years now. Denmark and Sweden are currently even collaborating closely, which was facilitated by their advanced eHealth implementation at national levels.

The following benefits stemming from international collaboration have been highlighted:

- Supply of new healthcare services and provisions for citizens due to the incorporation of new technologies and organisation processes.
- Increased qualification and training for healthcare system professionals by attending international meetings or visiting healthcare centers in other countries in order to further their training and subsequently apply this new knowledge to institutions in their countries of origin: work methods and discipline, standards, data protection, healthcare legislation, etc.
- Economic savings stemming from the contribution of knowledge and resources by all participating partners, enabling the sharing of prior experiences that were successful or failed and avoiding costs stemming from mistakes made in the past. Likewise, the grouping together of several partners means that economies of scale can be applied when hiring services and purchasing goods needed in order to execute different collaboration activities, getting special treatment and price discounts.
- Development and consolidation of specific international networks for incorporating ICTs into healthcare, facilitating continuity of different collaboration activities and new project execution.
- Overall corporate network generation in the ICT sector by the participating countries, increasing this sector's competitiveness and empowering economic activity in European regions. Likewise, cooperation facilitates national and international corporate penetration in the healthcare sector and reduces investment costs required for the same.
- Reinforcement of foreign policy in participating countries, encouraging the establishment of mutual benefit collaboration venues and lines of research, the sharing of know-how and experiences, and the creation of new lines of cooperation in other areas (economic, legal, educational, etc.).

D. Some key aspects in eHealth project planning

1. *e*Health and innovation strategy

As stated beforehand, we must not lose sight of the fact that eHealth is not an end in itself, but rather an instrument for meeting healthcare objectives. This means that the eHealth strategy should be a part of the general healthcare system strategy:

In the United Kingdom, the NHS Plan was designed in order to ensure quality, universality, security, speed and proximity to care services, making the required equipment and know-how available to healthcare professionals. The role of ICTs was considered to be essential for meeting these objectives, since this guarantees each NHS professional immediate and safe access to patient information and knowledge stemming from the experience of other professionals.

New systems will enable fast access to clinical test results, prescription and revision of treatment with enhanced security, the sharing of patient information between primary care services and hospitals, more efficient management of patient appointments, the studying of treatment cost and efficiency, as well as the detection of system shortcomings or inequalities, among other features. In order to meet these objectives, work methods needed to be changed and standardised and information management had to be improved, especially information recorded in patient clinical histories.

The Nordic countries in Europe, such as Denmark and Sweden, have been developing e-administration for several years. This is conceived as the incorporation of ICTs into public services in order to improve their quality, security, efficiency and accessibility for the benefit of citizens. Implementation of e-administration is considered to be essential in order to improve coordination between different government levels, which are highly complex due to a series of decentralisation processes executed. This means actions in different fields in addition to the technological, legislative, organisational and commercial sectors.

The health and social care sector is no exception, especially within the current framework of budget restriction, population ageing, service specialisation and rising service costs, as well as the demand for personalised and ongoing care. The Nordic countries have developed strategic ICT planning with several elements in common for this purpose. The main objective of the same is to guarantee that all clinical information is shared in a timely and secure manner within each healthcare system.

This entails several concrete actions related to the electronic health record and collaborative networking (shared information and knowledge management); e-prescriptions (patient security); process classification and standardisation (efficiency and coordination); and telemedicine (improved patient accessibility to the healthcare system).

Spain has a specific plan for developing the information and knowledge society, the Avanza Plan. From a budget perspective, Avanza Plan funding came to over 5 billion euros provided by the Ministry of Industry, Tourism and Trade through the State Secretariat for Telecommunications and the Information Society between 2005 and 2008. In addition, several Avanza Plan measures were cofinanced by other public and private institutions and by the corporate sector itself, which have contributed and mobilised over 3.8 billion euros more to date. In keeping with the same, over nine billion euros were invested in specific information society development programmes in Spain between 2005 and 2008 alone.

Quality Plans are prescribed in the Cohesion and Quality in the National Health System Law. The first was committed to in the President of the Government's inaugural address and made up part of the agreements made at the 2nd Conference of Presidents, where an additional 50 million

euros per year were allocated. During the first years of the Quality Plan, efforts concentrated on the areas of health promotion, equality, clinical excellence, digital clinical record and information systems. The method employed was joint work with experts, autonomous communities, scientific associations, patients associations and social associations, seeking agreement between and involvement by all parties.

The end result of an agreement made with 32 scientific associations and patients associations, as well as with experts from the autonomous communities and the Online Health Programme is the National Health System Digital Clinical Record. Development of the same has enabled completion of the pilot phase in two autonomous communities and this phase is to be extended to the rest of the communities.

Information system improvement driven by the Quality Plan has led to commissioning of the standardised Health Information System agreed to with the autonomous communities. All of this entailed the improvement of existing information subsystems that affect large-scale healthcare areas: health status, the health system and citizen satisfaction.

On the other hand, all autonomous communities have included information technology and health information development in their strategic and management plans. Some of these have specific master plans for technologies and information systems and these even make up part of their health service identity signs. This is the case with the communities of Andalucía (the DIRAYA project), Castilla-La Mancha (Mambrino and Ikonos), Valencia (Orion) or Galicia (Ianus). Although other communities simply call these system plans, these communities also have specific programmes associated to strategic healthcare service planning available.

Under ideal circumstances, eHealth development should also be associated to the national Information Society promotion strategy. This should consider that healthcare is one of the sectors that stands to benefit most from the use of ICTs, since it is highly information and knowledge management intensive and is also a sector featuring high social return on investment. On the other hand, high returns such as ICT knowledge and innovation can also be expected from eHealth. Investment in this field encourages knowledge generation and specialised human resources training, since a transfer of these takes place to other sectors of the economy.

In order to ensure that all of this takes place, eHealth investment must always come in hand with innovation. The incorporation of ICTs must be a part of continuous innovation and improvement processes. Otherwise any headway made will be limited to the direct consequences of mere process mechanisation, such as bureaucratic process execution speed and improvement.

The clearest example of ICT use in the healthcare process is the electronic health record (EHR). This assumes the introduction of these technologies at the core of healthcare activity, which is the relationship between the physician, other healthcare professionals and the patient. The EHR ensures that patient clinical information is always available to the professional providing care for the same at all times, regardless of where and when care is being provided or where and when this information was generated. This is the main innovation produced by the introduction of ICTs into the healthcare process.

Healthcare professionals and administrative personnel need an innovative attitude in order for this change to take place. Merely computerising currently existing processes is not enough. If this were the case, the end result would be an electronic reproduction of the clinical record on paper, but this would lack features provided by the capacity to improve healthcare continuity, quality and efficiency. Another example of ICT use as a powerful tool for innovation is the creation of virtual radiology services to service several hospitals simultaneously, enabling optimal use of radiological physicians: a highly specialised resource that is hard to come by in some countries.

As stated beforehand, the innovative concept of healthcare knowledge and information management implies the possibility of sharing the same. Information about each patient is shared between different healthcare centers and levels, as well as between other services and healthcare system centers. For example, the EHR enables the transfer of information required for epidemiology, research, evaluation, teaching, planning and healthcare management activities. In this case, innovation means modifying the concept of clinical record in order to ensure that information flows to where it is needed for patient care or processed properly for execution of healthcare research, management, evaluation and planning processes.

Persons making decisions related to investment in health information systems are often under pressure to provide short-term returns. This pressure may lead to the mechanisation of the current processes without in-depth analysis of the same, without searching for innovative solutions and therefore without incorporating healthcare system efficiency and quality improvements. This short-term outlook entails the risk of settling for simple improvements made for bureaucratic procedure efficiency, which are attractive at first but unsatisfactory for healthcare professionals, patients and citizens, who are precisely the people improvement efforts should be focused on.

Besides the limited short-term outlook, an outlook with limited range is another risk that can come up. Solutions are often sought for centers, services or concrete problems without considering the global health system perspective. Proceeding in this manner means that one of the greatest benefits of eHealth is lost: sharing information in order to generate knowledge. In addition, higher investment will subsequently be required in order to set things right.

The eHealth strategy must therefore show an innovative attitude when it comes to incorporating ICTs into the health system value chain, integrating the same in the general strategy and making up part of the national strategy for promotion of the Information Society.

2. Prerequisites

The implementation of eHealth is not limited to the development of several information systems, but also requires that several prerequisites be met. Absence of these prerequisites will make success very difficult or impossible to achieve.

2.1 Infrastructure

The first requirement is purely technological and consists of providing the basic infrastructure needed for information systems to work. Elements making up this infrastructure are listed as follows:

- Hardware:
  - Data processing centers with computer equipment required for the housing and centralised management of the different systems: applications servers, database servers, data storage units, equipment for recording and recovering security copies, etc. A data center also needs accessory infrastructures such as a sufficient and redundant power supply and a heating and air conditioning system.
  - Customer posts in order for healthcare professionals to use these systems: personal computers, portable computers, slim clients, smart phones, etc.
- Core software*:* operating system; database manager; development environments, testing and production of information technology applications; network management software; security copy software; etc.
- Communications: fixed, wireless or mobile telephony network infrastructure; network management and security devices; communication line redundancy; etc.

2.2 Patient, healthcare professional and healthcare center identification

In order to ensure that all applications operating in the health information systems can communicate between each other or interchange data with regard to a person, it is indispensable that this person be singly identified. The fact that data transmission is executed automatically means that individual identity must be absolutely certain.

Just like any other real world system, a classification system is based on the synthesis of basic entities participating in the same and on its subsequent incorporation into a database where these entities become a set of tables with corresponding attributes and interdependence relations. A normalisation process must be executed in order for the system to work correctly. Among other normalisation regulations, the existence of a primary code is essential. This is understood as the element that singly identifies each system entity. This primary code cannot depend on the attribute values of said entity.

In the case of health systems, patient identification consists of defining a primary code for the patient entity, assigning each person an aseptic code, which is to say that this does not depend on patient characteristic values, such as his or her name, last names, date of birth or sex. A system based on the formulation of identifiers by means of a combination of these characteristics has been used in some cases. However, if these are characteristics that may vary (changes of name and last names, mistakes made in the system when discharging the person, etc.), each change means going back to create the person's code, which brings up the initial problem once again: existence of a patient with several identifiers. On the other hand, the values of these characteristics can be repeated for different persons, meaning that there may be a case of different patients with the same identifier. It seems that best solution for all of this is the assignment of sequential codes.

After determining which system will be used to generate identification codes, an entity responsible for assigning and managing the same must be created. This entity shall oversee code integrity, guaranteeing that no person has more than one identifier and that this identifier does not make reference to more than one person. The application area for this code must also be determined and use of the same may be exclusively limited to the health system or associated to other information systems such as social services, social security and driver's licenses, among others. In order to safeguard citizen privacy, some countries limit the use of patient identification codes strictly to the health system, or make the same only extensive to the social security system.

Professionals accessing the health system must also be duly identified, making the existence of a list of professionals with authorised access to clinical information indispensable in order to meet system security objectives (authentication, confidentiality, authorisation, auditing and non repudial, among others). In keeping with the same, the healthcare center or hospital where access to this information and treatment of the same is taking place must be identified, meaning that there must also be a list of healthcare establishments.

2.3 Catalogues

The concept of information system interoperability includes matters as elemental as use of common coding for medication and healthcare products. There must therefore be constantly updated corporate catalogues in order to allow any healthcare system professional to clearly identify different medication and products referenced in patient clinical information.

2.4 Specialised ICT personnel and clinical personnel in charge of the same

As stipulated by the Spanish Health Informatics Society (SEIS) in its strategic lines,[9] proper ICT execution for healthcare and efficient harnessing of potentials depend on the quality and availability of human resources. This requires proper staffing, with well-trained and experienced

[9] Strategic lines in Information and Communication Technologies for Healthcare in Spain. Spanish Health Informatics Society (SEIS).

persons filling every post and level. Healthcare ICT professionalization must be empowered for this purpose, with specific programmes as part of the regular training of undergraduate, graduate and further education studies. In addition, the development of informatics solutions requires collaboration between clinical and technical personnel. In addition to knowledge of the sector and processes involved, clinical personnel contribute innovative proposals for system improvement. All things considered, human resources with a professional ICT profile and experience in the healthcare sector are required, as well as human resources from the healthcare sector with ICT knowledge enabling these to collaborate with the former professionals.

Improving health sector efficiency: The role of Information and Communication Technologies is a study published by the OECD in 2010. This study specifies professional involvement as one of the main requirements in order for eHealth to be successful. This aspect is critical in the case of clinicians, since their priorities focus on care, investigation, teaching and (in the case of positions with responsibility) management. In order to facilitate the active participation of professionals in ICT project execution, one possibility is to offer these professionals bonuses associated to the meeting of objectives associated to healthcare system priorities. To this regard, it is fundamentally important to consider that eHealth is not just about ICT system development, but also involves its subsequent implementation, use and ongoing development in order to consolidate an innovative and sustainable business model.

Proper bonus system operation requires a clear and preferably jointly agreed definition of its terms and conditions: objectives to be met, characteristics of the bonuses offered, assignment of the resources required, methods for evaluating compliance levels, transferring of the same to bonuses, etc.

There are several different kinds of bonuses: economic bonuses (financial aid, subsidies, extraordinary salary increases, etc.), improved working conditions by means of added value, professional development, etc. Effectiveness of each bonus will depend on healthcare professionals' working conditions, among others. For example, economic bonuses will always elicit great interest, but application of the same will be simpler and more effective in the case of independent professionals, since the amount tends to be variable and associated to activity, while public employees are paid salaries featuring a mostly fixed component. The latter would greatly appreciate any added value provided by eHealth that would make their work safer and more efficient, such as automating unimportant tasks or creating new healthcare possibilities, such as those stemming from telemedicine (telemonitoring, teleradiology, teledermatology, teleconsultation, etc.). In turn, independent professionals would not only appreciate these added values, but also improvements made to administrative systems they use for invoicing and logistics management, as well as all other core activities for the provision of clinical care.

Lastly, it is also critically important to consider healthcare ICT knowledge as another element behind the professional capacity of all healthcare actors, meaning that users (healthcare professionals, administrative personnel and citizens in general) must be trained and educated in order to more efficiently use eHealth systems.

2.5 Legal framework

As stated beforehand, incorporation of ICTs into healthcare activity requires a legal framework to guarantee information security and provide legal validity for the recording and processing of healthcare information using electronic procedures. Factors such as citizen insecurity with regard to the confidentiality of their clinical information, or healthcare professional insecurity as to the availability or validity of said information lead to rejection and hamper the implementation and use of these systems.

Several prerequisites must therefore be taken into consideration when designing an eHealth strategy, including hardware, software and communications infrastructure; patent, healthcare

professional and healthcare center identification; healthcare product and medication catalogues; human capital required for all of the same; and a legal framework guaranteeing information security and providing validity for digital clinical data records.

3. ICT application to clinical information and clinical-administrative information in order to assist health system management: the healthcare information system

Healthcare information is not an isolated entity, but rather part of a system that includes clinical-administrative, planning and management, clinical care and knowledge management applications.

The clinical system includes records of the relationship between patients and professionals caring for the same and making up departmental systems (clinical laboratories, diagnostic imaging, pharmacies, etc.) and in general all systems containing information about their health, independently of the care network point where this information was generated. In addition, this must be integrated to the clinical-administrative system, which is the health system organisation instrument, and with economic-financial management systems that provide logistics management required in order to carry out clinical activity. On the other hand, the processing of clinical, administrative and financial data enables management of knowledge required for biomedical research, as well as health system planning, evaluation and management and public health management.

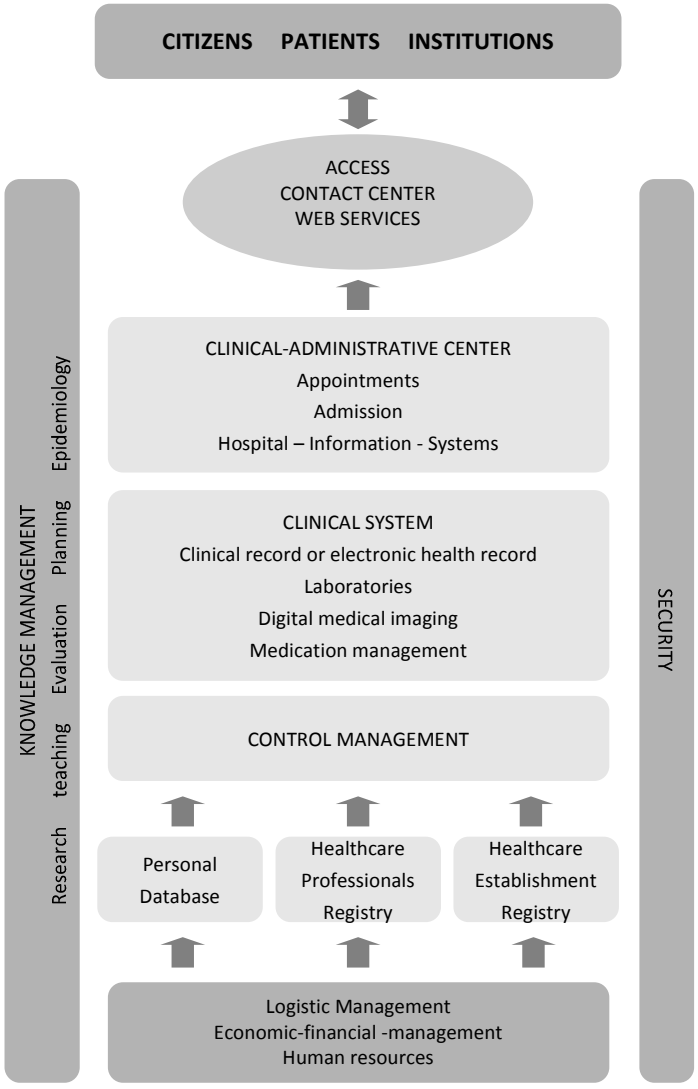
As a consequence of this integrated system, a patient's healthcare information includes data proceeding from at least the following systems:

- A personal identification database where the single patient identification code is stored.
- A list of healthcare professionals identifying professionals who care for patients.
- A list of healthcare establishments identifying healthcare network points where patient health information is generated.
- Electronic health record or electronic health record.
- Medication and healthcare product catalogues.
- E-prescription system.
- Departmental clinical systems, such as clinical laboratories and diagnostic imaging.
- Health promotion and illness prevention programmes.
- Clinical information from other centers and services.

In addition, clinical-administrative systems facilitate the management of several procedures required in order to care for patients at a hospital or medical center: assigning the patient a bed, an operating room, appointment or diagnostic test, and coding the hospital discharge report. Clinical information is also a valuable source for public health management. Lastly, all of this activity requires the assignment of human resources and materials, generating costs managed by means of economic-financial management systems.

Healthcare information therefore makes up part of an interwoven complex through which data flows, and which makes up the health information system. Figure 11 describes the layout of this system.

FIGURE 11
HEALTHCARE INFORMATION SYSTEM



Source: Prepared by the authors.

4. Knowledge management

Existence of an integral healthcare information system provides added value to conventional paper-based systems, with a series of advantages. In keeping with the Escolar layout (Escolar, 2003), these can be classified into three interrelated levels:

- The vegetative level, which encompasses improvements stemming directly from the use of ICTs, which are feasible due to their large storage and information processing capacity: more efficient file management, the possibility of immediate and concurrent access to information, more exhaustive access control, the making of security copies, etc.
- The operating level, made up of functional improvements stemming from specific developments such as the automation of repetitive tasks (for example, report formulation

and prescription issuing) or assistance and error control for the execution of clinical actions (for example, detection of medication prescription interactions and contraindications).

- The epistemological level, made up of improvements focusing on knowledge generation and management, enabling the detection of guidelines or problems and the development of new operational functionalities:
  - Clinical management assistance, enabling physicians and other healthcare professionals to review their activities and cases, self-evaluating their results and proposing improvement objectives.
  - Healthcare system management assistance, with integral scorecards and decision-making support systems based on the concept of performance assessment, which enables the transfer of strategic healthcare system objectives to the operating level, associating certain critical success factors and key activity indicators to each of the same.
  - Public healthcare management assistance, enabling the availability of firsthand clinical information for monitoring, promoting and protecting the population's healthcare.
  - Promotion of evidence-based medicine by means of decision-making support systems that make use of the available duly contrasted and evaluated scientific information.
  - Artificial intelligence, by applying expert systems environments such as diagnosis or surgery.
  - Research support, enabling researchers access to higher quality information and accuracy while facilitating the generation of new lines of work by developing diagnostic and therapeutic solutions, the study of patient results, analysis of process efficacy and efficiency, etc.
  - Teaching support, making a source of information based on experience available to students and professors and enabling the use of new educational tools, such as the creation of reference databases, the use of decision-making support systems, simulator development, educational programme formulation assistance and patient learning personalisation.

5. Final considerations

In the event that the healthcare information system is to be built from scratch, this construction should logically start by meeting prerequisites and subsequently continuing to develop clinical-administrative and economic-financial management systems, followed by clinical systems and finally those systems designed to facilitate knowledge management. However, ideal situations do not exist in practice. There are generally several disconnected heterogeneous solutions that use different core technologies. Priorities must therefore be established and work must be started on a healthcare information system in order to integrate the existing systems in order to share information that has already been generated. This will require a solution to the problem of identifying patients, persons and healthcare establishments; the use of semantic and technological standards for data interchange; and guaranteed information security.

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Appendix

Healthcare legislation

Belgium:

Social security law for migrant workers, passed in 1944. Revised in 1969 and completed in 1981 with the General social security principles law for migrant workers.
Medicines Act of 25 March 1964.
Urgent Medical Assistance Law of 8 July 1964.
Royal Decree of 27 July 1967, social security for self-employed workers.
Healthcare Profession Practice Law of 10 November 1967.
Royal Decree of 10 November 1967, Order of Physicians.
Institutional Reform Law of 8 August 1980.
Royal Decree of 14 September 1984 on the setting of rates for compulsory health insurance.
Law on Hospitals passed in 1963 and revised 7 August 1987.
Decree by the French community dated 19 June 1989 on accreditation and funding of home care.
Healthcare Financing Law of 6 August 1990.
Health Insurance Law passed in 1963 and revised 14 July 1994.
Royal Decree of 3 July 1996 on application of the compulsory insurance law for medical care, revised 14 July 1994.
Decree by the French community dated 14 July 1997 on health promotion organisation.
Decree by the Flemish community dated 14 July 1998 on the accreditation and funding of home care provision.
Non-conventional Practices Law of 29 April 1999.
Royal Decree of 25 April 2002 on budget allocation and negotiation for hospitals.
Decree by the Waloon region dated 13 June 2002 on the organisation of healthcare institutions.
Patients Rights Law of 22 August 2002.
Decree by the Flemish community dated 17 October 2003 on health and welfare provision quality.
Decree by the Flemish community dated 3 March 2004 on primary care and cooperation between healthcare professionals.
Royal Decree of 21 September 2004 on the accreditation of home care and general day care centers.
Royal Decree of 12 January 2006 on nursing care records.
Royal Decree of 12 February 2008 on the use of antibiotics in hospitals.
Royal Decree of 7 June 2009 on the use of e-prescriptions by physicians and odontologists in hospitals.

Denmark:

Health Law of 24 June 2005.
Law for the Authorisation of Healthcare Professionals and Healthcare Activity of 22 May 2006.
Ministerial Order on central administration in healthcare services of 10 September 2002.
Pharmacy Act of 12 December 2005.
Act on the Right of Appeal and Compensation within the National Health Service of 24 June 2005.
Ministerial Order on infectious diseases of 14 June 2007.
Law on a Scientific, Ethical Committee System and the Handling of Biomedical Research Projects of 28 May 2003.
Ministerial Order on the use of force for psychiatric treatment of 1 November 2006.
Act on Psychiatric Treatment according to Legal Procedure of 21 December 2005.

Spain:

General Law of Social Security, 1967.
Law 2/1974, 13 February of the Professional Colleges amended by Law 74/1978, Law 7/1997, Royal Decree 6/1999, and Royal Decree 6/2000.
General Health Law 14/1986.
Royal Decree 1088/89 on universalisation of healthcare.
Law on Medication 25/1990.
Royal Decree 83/1993 regulating the selection of medication by means of National Health System financing.
Royal Decree 63/1995, 20 January on the ordering of healthcare provision by National Health System.
Royal Decree-Law 7/1996 on the liberalisation of pharmaceutical services.

Law 15/1997 Enabling New Management Models in the National Health System.
Royal Decree 39/1997 on the Regulation of Prevention Services.
Royal Decree 165/1997 on the establishment of dispensation to the public of types of pharmaceuticals for human use.
Royal Decree 1663/1998 extending the list of drugs not to be funded by Social Security or by funds related to healthcare.
Royal Decree 1035/1999 calculating the reference price for drugs funded by Social Security or by funds related to healthcare.
Law 41/2002 regulating patient autonomy and health documentation and information-related rights and obligations.
Royal Decrees 1471–1480/2001.
Law 16/2003 on Cohesion and Quality of the National Health System.
Law 44/2003 on health professionals order.
Law 55/2003 on the Framework Statute of the Health services statutory staff.
Royal Decree 605/2003 establishing measures for the homogeneous treatment of waiting list information in the National Health System.
Royal Decree 1555/2004 on the basic organisational structure of the Ministry of Health and Consumption.

United Kingdom:

White Paper "Working for Patients", 1989.
NHS and Community Care Act, 1990.
Green Paper "Health of the Nation", 1991.
Health Authorities Act, 1994.
White Paper "Choice and opportunity: primary care, the future", 1996.
NHS Primary Care Act, 1997.
White Paper "The new NHS: modern, dependable", 1997.
"Our Healthier Nation" study, 1998.
"A First Class Service: Quality in the new NHS" document, 1998.
White Page "Designed to Care – Renewing the NHS in Scotland", 1998.
White Page "NHS in Wales: Putting Patients First", 1998.
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White Page "Saving Lives: Our Healthier Nation", 1999.
Document "Fit for the Future – A New Approach", 1999.
Care Standards Act, 2000.
NHS Reform and Health Care Professions Act, 2002.
Health and Social Care Act, 2003. Revised in 2008.
Human Tissue Act, 2004.
Health Protection Agency Act, 2004.
Mental Capacity Act, 2005.
NHS Redress Act, 2006.
Mental Health Act, 2007.
Local Government and Public Involvement in Health Act, 2007.
Human Fertilisation and Embryology Act, 2008.
Decree on Home Care, 2009-2010.

Sweden:

Abortion Act, 1974, revised in 1995.
Act concerning Support and Service for Persons with Certain Functional Impairments, 1993.
Right to Roam Act, 1994.
Infectious Diseases Act, 1988.
Compulsory Mental Care Act, 1991.
Dental Care Act, 1985.

Family Medicine Act, 1993.
Forensic Psychiatric Care Act, 1991.
Decree 1994/95:25 on certain economic policy measures.
Decree 1994/95:150 on budget regulation for the 1995/96 fiscal year.
Decree 1995/96:207 on economic policy for reducing employment by fifty percent in the year 2000.
Decree 1996/97:60 on the assignment of healthcare priorities.
Decree 1997/98:113 on the national plan of action for the care of senior citizens.
Decree 2002/03:35 on public healthcare objectives.
Health and Medical and Service Act, 1982.
Professional Activities in the Health and Medical Care Field Act, 1998.
Supervision Act, 1996.
Medicinal Products Act, 1992.
Medicinal Products Trading Act, 1996.
Patient Injury Act, 1996.
Public Health Service Act, 1992.
Social Services Act, 2001.
"Stop" Law, 2000.
Prescription Medicines Registration Act, 2005.
Patient Data Act, 2008.

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