D I R A Y A

Health Care Infomation and Management Integrated System

Servicio Andaluz de Salud
CONSEJERÍA DE SALUD

1. DIRAYA, much more than a digital medical record

Diraya is the computer system that the Andalusian Public Health System uses as an information and care management support. The first aim of Diraya is to integrate all the information on each user, irrespective of the health professional or care area generating it, into a Single Health Record, so that it is available where and when it is needed for his/her care. Accordingly, the medical record model permits reference to and annotation of data on all devices and at all care levels: primary care, specialized care, emergency rooms and hospitalization. The use of telecommunications permits access to a citizen's health record from anywhere within the Andalusian public health network. It is a case, therefore, of a single health record per citizen.

The second aim of Diraya is to facilitate accessibility to all the services and provisions of the health system. It enables the flow of patients to be monitored in order to assure efficient coordination of all the actions required in the diagnosis and treatment of each process.

Lastly, the third aim is ensure that all the relevant information is structured. As opposed to systems that merely assemble the different records generated during the care of a citizen, the design of the applications in Diraya uses common tables, codes and catalogues. All this permits the incorporation of expert backup systems for the patient's diagnosis and treatment and the consistent and comparable use of information useful for the generation of knowledge, for research and for clinical and resource management.

Diraya, which not in vain means "knowledge" in Arabic, is the outcome of the Organization's shared knowledge. Responsibility for the design of Diraya lies in more than 500 professionals of the Andalusian health system and is, therefore, a product of professional consensus. This has been one of the basic requirements right from the outset.

Although the functional requirements of Diraya are not linked to a given architecture, the decision was made to opt for using centralized architecture for Primary Care and dual for Specialized Care.

This option facilitates maintenance and administration, enhances the security of the system and assists to updating tables and versions. What is more, it is an economically efficient solution.

We have to add a further feature: Diraya is a solution that is actually operating. While the implementation of new services in new areas of care is going ahead, in January 2010 it already covers the healthcare of over 94% of the Andalusian population.

2. A corporate information system for a Public Health Service

The Andalusian Health Service as a supplier of health services.

Andalusia is a region situated in the South of Spain with an area of 87,579 km². Its 8,302,923 inhabitants represent 17.8% of the Spanish population, which makes it the country's most highly populated Autonomous Community.

The Andalusian Public Health System (SSPA) administers the whole public primary care network and 33 hospitals areas of its own. Its function is to provide health care for the Andalusian community, offering quality public health services, assuring accessibility, fairness and user satisfaction, and seeking efficiency and optimum utilization of resources.

The SSPA has an integrated and organized network of healthcare services to assure the accessibility of the population and fairness in the distribution of resources. The services portfolio offers both preventive and care activities to the Andalusian population in a system of universal cover

The first level of care is primary healthcare, which integrates preventive and curative care, rehabilitation and the promotion of community health. There are more than 1,500 Primary Care centres, so that all Andalusians have one within just a few minutes from their home. The second level, specialized care, attends to those patients who need hospitalization and has outpatient clinics both at hospitals and at peripheral centres.

The SSPA has health professionals to staff its care network: more than 20,000 in primary care and 60,000 in specialized care. As an example of the care activity, we may mention that every year some 70 million medical visits and half a million surgical operations are carried out or that some 10 million medical emergencies are handled.

Diraya, a corporate information system geared to the citizens' needs.

Today the large business organizations all tend to adopt corporate information systems. Clear advantages are obtained as regards training in their operation, reliability and comparability of the data, and major savings in development and maintenance.

In the healthcare area this strategy is even more necessary on account of the increasing mobility of the citizens and due to the participation of many professionals in attending to the processes, forming increasingly more complex multidisciplinary teams. All this, linked to the integrated concept of health and the leading role of the citizen in democratic societies, leads to the concept of the Single Health Record and the use of unified procedures for access to services and benefits.

The aim is to overcome the earlier situation with fragmentary and unrelated information systems, which in many cases do not go beyond the bounds of the department or centre; it is often a case of similar solutions in which efforts and resources are multiplied in addressing very similar problems.

3. Components of Diraya

Diraya consists of a set of related modules that share information. The components of Diraya dialogue with one another, offering their data to the rest. When a module of Diraya needs to identify a user it makes the request to the User Data Base; if it needs to identify a hospital department, it puts in a request to the Structure module... In this way, every item is recorded in the system just once.

The Diraya modules also offer their services to other information systems such as the Warning Network, Disability for Work Appraisal Unit Systems, etc.

For this reason there are three modules that are essential for all the others to work. They are the cornerstones of Diraya, as they identify the citizens, the operators who access the system, and the primary and specialized care resources.

Basic components

The first of these is the User Data Base (UDB), whose main function to supply every citizen with a Single Andalusian Health Record Number (NUHSA), to which all his health information is linked. UDB is the common table of patients of all the health centres and the Health Card is the key that permits access to the user information. The UDB also contains the citizen's administrative data.

Secondly, the Centralized Operator Access Module (COAM) is the entrance to Diraya. When a health professional is going to use Diraya, this module identifies his access code and enables him to use the functions of the different modules for which he is authorized. Thus, for instance, a family doctor who has to use the care primary care module, the interconsultation request module, and the vaccine module will not have to be identified in respect of each of them, as COAM qualifies him for all of them at one go. In other words, just as happens with UDB in relation to the citizens, all the Diraya modules receive from COAM the identification of the professionals who access them. Likewise, any external system that asks Diraya for data has to be identified beforehand in respect of COAM.

The cornerstones of Diraya are completed with the Structure Module, which includes the Departments and Functional Units, as well as the physical locations of Primary and Specialized Care. This module enables us to identify every hospital department, every Primary Care centre, every Emergency Room... i.e. the functional organization of healthcare. It also enables us to pinpoint the physical locations of the centres: floors, beds, boxes, clinics... It also establishes the relationship between the two care levels for the arrangement of the interconsultations and performance of diagnostic tests. It also manages the corporate catalogues and the main system master tables. If UDB identifies the users and COAM the operators who access Diraya, Structure identifies the resources and range of services offered by the health system.

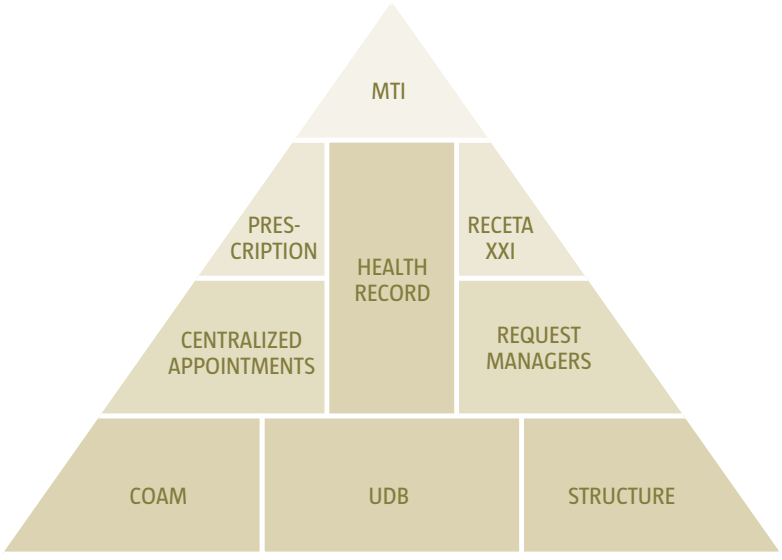
Health Record

It is the heart of Diraya and it is made up of the set of modules that enable the health professionals to manage the patient's clinical information. All the information is integrated through its link to NUHSA, and irrespective of its location it is accessible to the health professionals who need it from anywhere in the network.

The information is organized on a hierarchic basis, with different configurations according to the type of health professional who uses it and permitting personalization in accordance with the professional and the patient. There are three blocks of information. The first consists of the basic health data: socio-familial, health problems, past personal and familial medical record and allergies. The second is made up of the data relating to the diagnostic and therapeutic measures: interconsultations, analyses, diagnostic tests, pharmacological therapies and examination questionnaires. These two blocks are shared by the modules of the different care environments (primary, outpatient clinics, emergency rooms). The differentiation between each of them lies in the visit sheets that record the user's different contacts and which form the third block of information. These sheets contain all the care contact information and supply the two previous blocks. Although they share common elements, there are differentiated sheets for primary care doctors, specialists, nurses, social workers, emergency room, health programmes, care processes...

To facilitate clinical decision making, the visit sheets and the diagnostic and therapeutic elements may be grouped together in episodes and processes. In each of these we will have the set of contacts that the patient has made on account of a certain problem, as well as the diagnostic tests and treatments used, which thereby remain linked to a specific clinical context.

All the clinical modules share tools such as



the Prescription Sheet, report generator, examination questionnaires, ICD 9 and NANDA, thesaurus for diagnostic coding, Process Sheets...

A number of different modules are needed for handling medical information. Some of them are shared, whilst others are specific for each care level with special features for each professional profile. Thus, Diraya has modules for primary care, specialized care consultations, emergencies (hospital and primary care) and hospitalization.

Prescription XXI

The Diraya system has furthermore permitted development of the electronic prescription, a new medicine prescribing and dispensing model. By means of this system, all the prescriptions of every user produced by the Diraya Prescription Module are recorded in a "Central Dispensing Module", where a "pharmaceutical credit" with the full treatment prescribed by your family doctor or by the specialist who intervenes in a given clinical episode. Both the primary care doctor and the specialist may establish treatment durations of up to one year. The patient presents his health card at the pharmacy, with which the pharmacist may access the data on the prescription, check the medication that he has to dispense, annotate the medicines served or even inform the doctor of any event. For this purpose, the pharmacy uses the Dispensing website module developed in the project.

The main advantage of this project is that chronic patients do not have to be continually going to their health centres to renew the treatments prescribed. This fact also enables primary care physicians to have more time to attend patients requiring medical care through cutting down medication prescription visits and, furthermore, it facilitates doctor-pharmacist communication, thus improving the quality of the service provision.

Appointment

This module manages Primary Care, Outpatient Specialized Care Consultation and Diagnostic Test agendas. It is the gateway through which users access these services, offering the list of patients to the professionals attending them. Along with the Emergency Admission and Hospital Admission modules, it facilitates monitoring of the flow of patients and efficient coordination of all the actions required in the diagnosis and treatment of each process.

The inclusion of all the agendas in the module means that an appointment for a visit or diagnostic test may be obtained from any centre, providing that the necessary authorization has been received. The user may obtain an appointment for his family doctor by way of a number of different channels; if his doctor tells him that he should be seen by a specialist or that a diagnostic test should be performed, he may obtain the appointment before leaving the Health Centre; and if the specialist tells him that he has to come back for a check-up, he may give him the appointment from the actual clinic. In this way, the user has a better chance of choosing the appointment that suits him best, coordination of the different appointments needed is facilitated, and it enables the health professionals to follow them up as a whole.

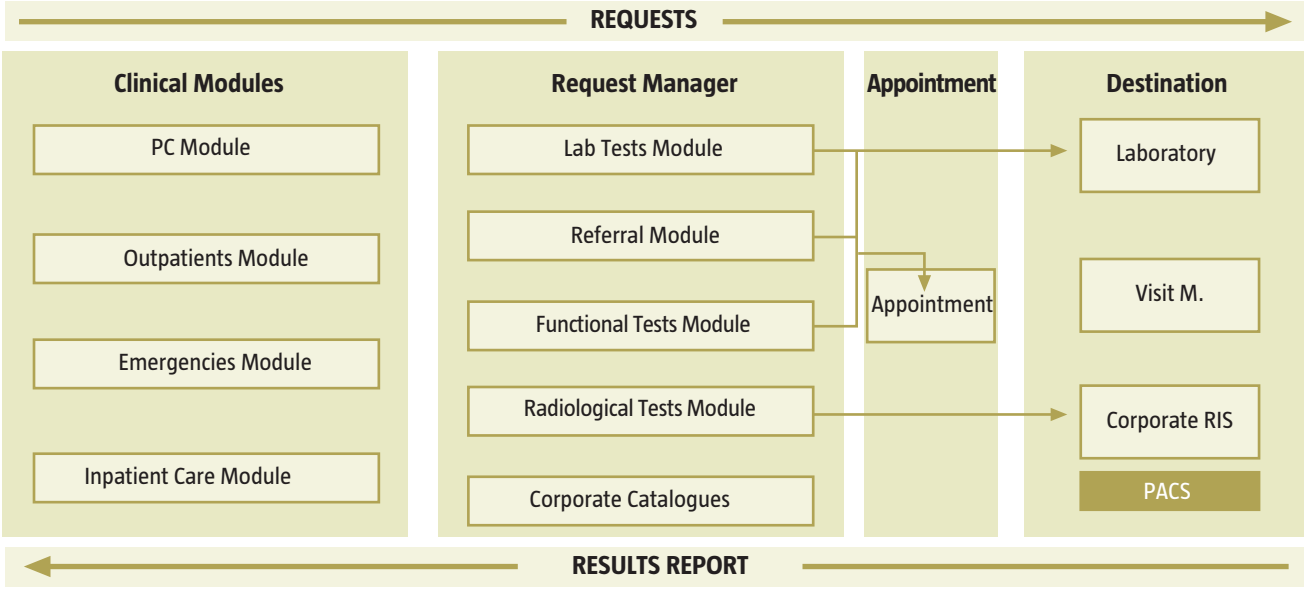
This module has made it possible to offer the user the possibility of obtaining an appointment for his primary care centre by way of different off-site channels: by means of a mobile telephone message, via the Internet, or by calling a single telephone number.

At the present time appointments are assigned by an off-site system in over a third of family doctor or paediatrician visits, while the single telephone is the means most widely used for requesting an appointment (24%), followed by the Internet (11%) and lastly by SMS (short mobile telephone messages).

The single telephone is attended by Salud Responde (The Health Service Responds), a centre installed in Jaén, which operates all round the clock every day of the year, accesses the agenda requested and assigns the appointment, recording an average response time of between 4-6 seconds. The appointment assignment process is completed in less than one minute

Access to the centralized information supplied by Diraya allows Salud Responde to offer users not only this appointment service (origin and grounds for its creation), but also a whole portfolio of information and health management services, in the process of ongoing expansion.

Integration of the agendas in order to facilitate access to them is no impediment for their management to continue being decentralized and under the responsibility of the units that have been performing this task until now. For instance, Salud Responde has access to the Primary Care agendas for the sole purpose of



assigning appointments, and only in those activities and segments in which it is authorized by the health centre; definition, modification and closure continue to be the responsibility of the Primary Care Centre.

This appointment module, integrated with referral module and diagnostic tests that relate to it, works in health centers and hospitals since March 2005. The system is designed for the results of diagnostic tests to be received by telematic means and be included automatically in the patient's Health Record. For this purpose it has been integrated with the present information systems of the hospital laboratories and with the corporate Radiological Information System (RIS).

InterS@S

Diraya has permitted the start-up of the Public Health System Virtual Office on the Internet: Inters@s. It was created in December 2002 so that the citizens could interact with the Public Health System. It allows users to be able to carry out such individual operations as changing their doctor, updating their personal data, requesting a second medical opinion, consulting their entry in the surgical demand register for those waiting for an operation subject to guarantee, etc.

Prior appointment via the Internet was introduced in 2006 and since then both the number of appointments made and the percentage of the total number of appointments that they represent has gone on increasing.

Barely three years after its introduction users were obtaining over 18,000 appointments a day via InterS@S, which represented more than a third of off-site appointments and over 11% of the total number of family doctor and paediatrician appointments.

Management of knowledge and use of information.

In order that the extraction of large volumes of information will not compete in data processing resources with the normal work on individual records, the Diraya operational systems (UDB, HDS...) do not carry out information use processes.

Diraya is completed with information systems based on Data Warehouse systems and OLAP technologies. It enables reports to be obtained containing listings, recounts or graphics. These reports may be pre-compiled, although the operator can modify and personalize them in accordance with his needs. Thus, in the different dimensions considered, it is possible to browse around data from aggregated to the most disaggregated information levels. In addition, it enables you to filter, arrange or group by the variables incorporated. The reports may be exported in different formats.

Functional Architecture

Diraya consists of a set of related elements that share information. The component elements of Diraya dialogue with one another on the basis of a 'single datum' philosophy: the datum is only in one component and the others ask for it when they need it.

UDB lies at the centre, organizing all the components by means of the identification of the citizens and their administrative information. Along with this, the Primary Care Structure (Districts, Areas, Centres, Functional Units, Medical Codes), integrated in UDB by the user-medical code relation, and the Specialized Care Structure (Areas, Functional Units, Care Lines, Centres, Locations and Relation to PC), complete the tripod on which all the other system components rest.

The following layer is composed of the Health Record, which contains the clinical information. The common tools are located in a more external stratum (Prescription, Receta XXI, Centralized Appointment-Making, Request Managers, Analytical Tests and RIS) all this supplying data to CPM (MTI). The departmental information systems and other external systems with which Diraya is related lie on the outside.

To these modules we have to add those are currently at the development or piloting stage: corporate RIS, Analytical Tests and Hospitalization Modules (admission, clinical and care station...)

Technological architecture and equipment.

Diraya is supported by a complex architecture in which the safety and performance elements have been developed to the maximum. The solution architecture called for the implementation of two Information Processing Centres (IPC) where the applications and data bases which are accessed by all the centres via the Junta de Andalucía Corporate Network are installed on a redundant basis.

In order to optimize and get the best performance, the load has been spread over both facilities, dividing users in such a way

LIST OF MODULES IN PRODUCTION

Structural	Clinical Stations	Tools	Use	Records and Outpatient Services
- Users (UDB) - Structure (Resources) - Centralized Operator Access (COAM)	- Primary Care - Outpatient Clinics - Emergency Rooms	- Appointment - Referrals - Functional Tests - Analytical Tests (MPA) - Radiology Information System (RIS) - Vaccines - Record Browser - Receta XXI - Admission	- Information Processing Modules	- InterS@S - AGD - Outpatient Visit Record - Diagnostic Test Record - Process Record

that the Western Andalusia health centres are attended by the Seville IPC, while Eastern Andalusia centres are connected to the Malaga IPC. The Seville and Malaga facilities, where the Diraya project information is processed, are amongst the most complex and secure in Europe, thus enabling the computer equipment at hospitals and health centres to be simpler.

Each one of these IPCs is capable of supporting the whole Andalusian Health Service and, in case of need, one of the IPCs could take over the whole service. They support the whole Primary Care management process as well as management of the centralized data common to this and Specialized Care. All the hospitals in the Andalusian Public Health System network have their own IPC, dimensioned in line with the size of the hospital.

All the information included in the system is duplicated every day. The project has 500 servers with a capacity on a par with over 10,000 PC's. More than 500 professionals are currently working on the development, support and implementation of this application.

To date Diraya has involved an investment of 70 million euros, an amount that includes funds supplied by the European Regional Development Fund (ERDF).

State of development and implementation plan.

Diraya is designed to be implemented gradually, both in the geographic and the foundational aspect, so that the territorial extension to new centres but also the addition of new services are done on a progressive basis.

The first step was to incorporate the Primary Care network into the system (coverage of 90% of the population was achieved in 2007), after which inclusion of the Emergency Services and Hospital Outpatient Clinics was addressed.

With the Primary Care network almost entirely included in the system, the incorporation of small rural clinics is continuing. Implementation is also practically completed at Andalusian Health Service Emergency Rooms and Hospital Outpatient Clinics, which continue to record an increasing level of use.

The extension of the hospital admission module currently in progress will enable the clinical data on the care received by citizens during hospital admission to be included in the Single Health Record. In this way, a regional Electronic Health Record system will be completed.

PRIMARY CARE

- Health Record → 732 centres, 7,554,438 residents (94.8%)
- Receta XXI → 724 centres, 7,536,985 residents (94.6%)
- Appointment via call center (Salud Responde) → 677 centres, 7,473,032 residents (93.8%)
- Appointment via Internet (InterS@S) → All centres and population with Health Record
- Appointment for Specialized Care → All centres and population with Health

SPECIALIZED CARE

- Emergency Rooms → 27/33 hospital areas
- Outpatient Clinics → 27/33 hospital areas

4. Bottom line

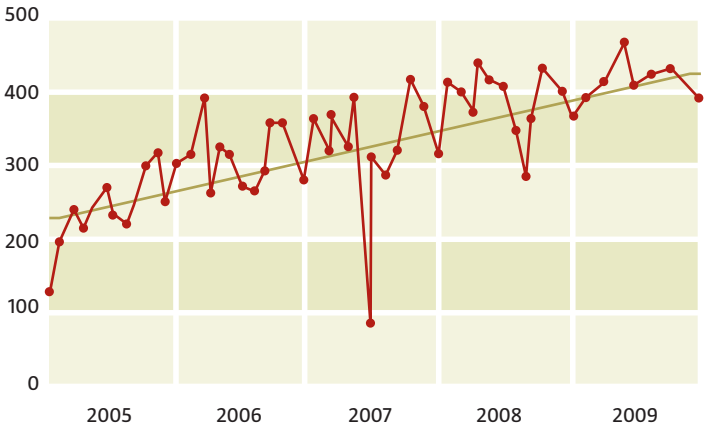
Diraya is now an information system fully integrated into SAS healthcare activity, backing up the quality enhancement initiatives that involve the use of information, recording and result evaluation technologies.

Aside from qualitative evaluations, some data are already available in relation to the impact of the implementation of Diraya.

Activity data confirm that Diraya is a widely used system. At December 2009, over seven and a half million users were covered by the Single Health Record system and almost 200 million prescriptions had been dispensed by the Receta XXI system. Every month the system assigns around 7 million Primary Care and 1 million Specialized Care appointments. As for clinical use, we should mention that every month more than 3 million primary care visit forms, over 200,000 emergency episodes and more than 70,000 specialist consultation episodes are recorded. Activity has gone on increasing continually with the inclusion of new centres in the system, although that is not the only reason: a considerable part of the increase in activity is due to the fact that health professionals make more and more use of the system.

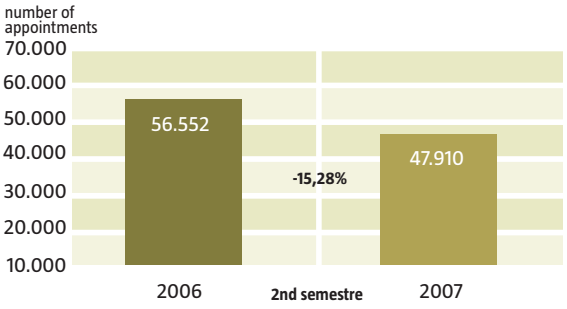
Public satisfaction with accessibility to the services (primary and specialized care appointments, primary care centre formalities, possibility of telephone contact with the centre) measured through annual surveys and expressed as the proportion of people who say that it is "easy or very easy", has risen by over 40 percentage points since the implementation of the Diraya central appointment-making module, thereby breaking with a long-term trend.

Nº OF VISIT FORMS PER 1000 INHABITANTS COVERED BY DIRAYA



A considerable part of the increase in activity is due to the fact that health professionals make more and more use of the system. This graph, adjusted for population covered at the time by Diraya, shows that every primary care physician recorded twice as much in 2009 as he or she did in 2005.

RECETA XXI: EFFECT ON THE NUMBER OF VISITS



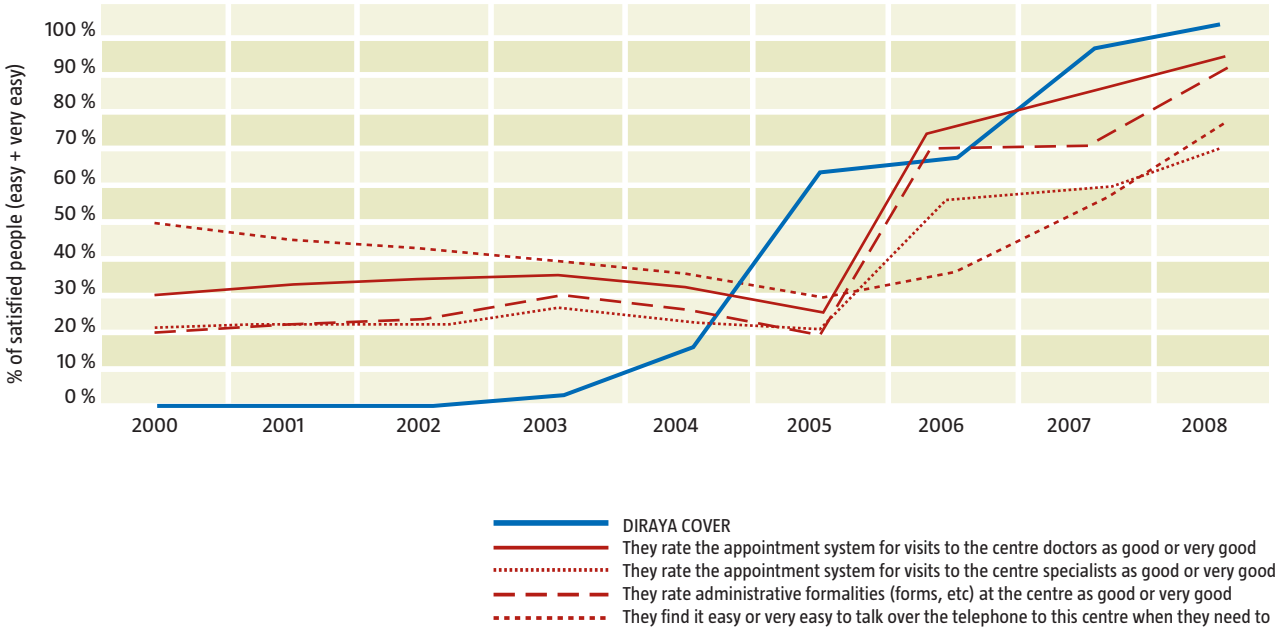
Visits by patients with first prescription by RXXI in January 2007

The prescription module, Receta XXI, which had amongst its aims that of eliminating the paperwork of doctors and saving the public from having to make unnecessary journeys, has reduced visits by 15.28 %, so the introduction of the electronic prescription is increasing the time the health professional has available for clinical work.

The conclusions of a study on the socioeconomic impact of Diraya (an assignment carried out for the European Commission by Empírica) indicate that not only have the users of the services obtained benefits through the implementation of Diraya, but the improvements in quality (17% of the benefits) and efficiency (80% of the benefits) also affect health professionals and the Andalusian Health Service as the care provider. With regard to the socioeconomic evaluation, the same study concludes that by 2010 the accrued benefit-cost ratio is expected to reach +1.77, which means that every €100 of costs produces €277 of socioeconomic benefits.

Andalusian Health Service.
March, 2010

TREND IN PUBLIC SATISFACTION WITH THE ACCESSIBILITY OF THE SERVICES



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