



EHR IMPACT

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Report on

The socio-economic impact of Receta XXI, the regional ePrescribing system of Andalucía's public health service, Spain

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About EHR IMPACT

The EHR IMPACT study was commissioned by DG INFSO and Media, unit ICT for Health, and will result in ten independent evaluations of good practice cases of interoperable electronic health record (EHR) and ePrescribing systems in Europe and beyond. The goal of the study is to support ongoing initiatives and implementation work by the European Commission, Member States governments, private investors, and other actors. The study aims to improve awareness of the benefits and provide new empirical evidence on the socio-economic impact and lessons learnt from successfully implemented systems.

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Receta XXI

The regional ePrescribing system of Andalucía's public health service

Socio-economic impact and lessons learnt for future
investments in interoperable electronic health record
and ePrescribing systems

Spain

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Bonn, July 2009

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Contents

Executive Summary	9
1 Background	11
1.1 Health system setting	11
1.2 Place of EHR, ePrescribing and interoperability in the framework	12
2 The regional ePrescribing system Receta XXI in Andalucía, Spain	14
2.1 Organisations involved	14
2.2 The context of the initiative and eHealth dynamic.....	14
2.2.1 <i>Context and historical development</i>	14
2.2.2 <i>eHealth dynamic and scope of the evaluation</i>	15
2.3 The health services affected.....	17
2.4 Components and functionalities.....	17
2.5 The system in practice.....	20
2.6 Technology	23
2.6.1 <i>Architecture</i>	24
2.6.2 <i>Security and confidentiality</i>	25
2.7 Level of interoperability.....	26
3 Case analysis	27
3.1 Stakeholders	27
3.2 Process change	28
3.2.1 <i>Workflow</i>	28
3.2.2 <i>Clinical practices</i>	29
3.2.3 <i>Working practices</i>	30
3.2.4 <i>Reaction and acceptance of users</i>	30
3.3 Timeline and milestones.....	31
3.4 Supporting take-up	32
3.5 Benefits.....	33
3.5.1 <i>Main types of benefits for stakeholders</i>	33
3.5.2 <i>Patients, informal carers and other people</i>	34
3.5.3 <i>Health service teams</i>	35
3.5.4 <i>Healthcare Provider Organisations (HPOs)</i>	35
3.5.5 <i>Third parties</i>	36

3.6	Costs.....	36
3.6.1	<i>Patients, informal carers and other people</i>	36
3.6.2	<i>Health service teams</i>	36
3.6.3	<i>Healthcare Provider Organisations (HPO)</i>	36
3.6.4	<i>Third parties</i>	37
3.7	Socio-economic analysis	37
3.7.1	<i>Summary of methodology</i>	37
3.7.2	<i>Net benefits</i>	38
3.7.3	<i>Distribution of costs and benefits to stakeholders</i>	42
3.7.4	<i>Sensitivity analysis</i>	44
3.8	Financing and financial impact	45
3.8.1	<i>Financial impact</i>	45
3.8.2	<i>Financing arrangements</i>	46
3.9	Legal aspects	46
4	Conclusions	48
4.1	Future potential.....	48
4.2	Transferability.....	48
4.3	The role of interoperability in realising the benefits.....	49
4.4	What it means for decision makers	49
4.4.1	<i>Useful experience</i>	49
4.4.2	<i>Summary of lessons</i>	50
	References.....	51
	Appendix 1: Summary of evaluation data	54
	Appendix 2: Cost and benefit indicators.....	55

List of figures, tables and charts

List of figures

Figure 1: eHealth dynamic of SAS' ePrescribing system and ePrescribing procedures	16
Figure 2: List of medications organised by active ingredient	18
Figure 3: Electronic prescriptions, ePrescribing and eDispensing	20
Figure 4: ePrescription flow in Receta XXI.....	22
Figure 5: The web dispense module in Receta XXI	23
Figure 6: Receta XXI and the related modules comprising Diraya	24
Figure 7: The green Andalusian public health system card.....	25

List of tables

Table 1: Scope of interoperability of the regional ePrescribing system Receta XXI.....	26
Table 2: Distribution of benefits by benefit categories	33
Table 3: Distribution of all benefits by stakeholder benefits	34
Table 4: Cost indicators & variables	55
Table 5: Benefit indicators & variables	56

List of charts

Chart 1: Estimated annual costs and benefits.....	39
Chart 2: Estimated cumulative costs and benefits	40
Chart 3: Link between net benefits and utilisation	41
Chart 4: Annual net benefit to cost ratio	42
Chart 5: Distribution of costs and benefits per stakeholder group	43
Chart 6: Distribution of cumulative net benefits per stakeholder group.....	44
Chart 7: Financial and non-financial impact	45

Abbreviations

ADE	Adverse Drug Event
CACOF	<i>Consejo Andaluz de Colegios Oficiales de Farmaceúticos</i> , Andalusian Council of Official Colleges of Pharmacists
CADIME	<i>Centro Andaluz de Información del Medicamento</i> , Andalusian Centre for Drug Information
DDD	Defined Daily Dosage
DSS	Decision Support System
EHR	Electronic Health Record
EHRI	The EHR IMPACT study
GP	General Practitioner
HL7	Health Level 7
HPO	Healthcare Provider Organisation
INSALUD	<i>Instituto Nacional de la Salud</i> , National Institute of Health
MoH	Ministry of Health and Social Policy
MTI	Information Treatment Module
NHS	National Health System
NUHSA	<i>Número Unico de Historia de Salud de Andalucía</i> , Unique Health Record Number for Andalucía
OCAM	Operator-Centralized Access Module
PHC	Primary Healthcare Centres
SAS	<i>Servicio Andaluz de Salud</i> , Andalusian Healthcare Service
SEMFYC	<i>Sociedad Española de Medicina de Familia y Comunitaria</i> , Spanish Society of Family Medicine and Community
TASS	<i>Tarjeta de Afiliado a la Seguridad Social</i> , Affiliated Card for Social Security
UDB	User Data Base
XML	eXtensible Markup Language

EXECUTIVE SUMMARY

Many healthcare professionals say it is unimaginable working without the ePrescribing features provided by Diraya and its ePrescribing module Receta XXI. Better continuity of care and improved provision are highly valued, with a strong feeling of pride, professionalism and satisfaction.

The Andalusian ePrescribing system Receta XXI is a module of Diraya, the region's EHR and general health information system. It is analysed as one of ten implemented and ongoing European good practice cases as part of the EHR IMPACT (EHRI) study. EHRI investigates the socio-economic impact of eHealth utilisation, with specific focus on interoperable Electronic Health Record (EHR) and ePrescribing systems in Europe.

The Autonomous Community of Andalucía is the second largest and most populated region in Spain. It has a population of over 8 million inhabitants, representing about 18% of the Spanish population. The *Servicio Andaluz de Salud* (SAS, the Andalusian Health Service) is responsible for public healthcare provision in Andalucía on behalf of Andalucía's Ministry of Health (MoH) and the Junta de Andalucía, the regional government. It deploys an infrastructure of 1,500 primary healthcare centres and 28 hospital areas. There are 3,584 private pharmacies in Andalucía.

Electronic prescribing functionalities such as printing prescriptions electronically and storing medication data locally were part of TASS, Diraya's predecessor. TASS is a local health information system for each primary healthcare centre (PHC), and operational from 1999/2000. Receta XXI facilitates prescribing, dispensing, control of drugs and, through its connection with Diraya, it also supports the compilation of medical histories in patients' EHRs. From 2004, it enabled sharing of patients' medication information between doctors in primary care, and hospital specialised outpatient and emergency care. Integrated prescribing decision support tools enable the application of regional standards and facilitate prescribing procedures. Receta XXI allows pharmacies to access centrally stored electronic prescriptions directly, and to share information on patients' current and long-term medications with doctors in primary healthcare centres. With Receta XXI, general practitioners (GPs) can prescribe for periods of up to one year, and pharmacists' can cancel prescriptions and send them back to the relevant GP for revision.

Receta XXI's functionalities are available for all physicians who have access to Diraya. However, primarily physicians in PHCs issue electronic prescriptions that pharmacists can access. In November 2008, 46% of all prescriptions used Receta XXI, with more than 1.9 million patients, benefiting from ePrescriptions. The data are stored in patients' medical records in Diraya, and all authorised specialised and emergency care professionals in hospitals can access these to view information on patients' medications. They can also use the decision support tools for prescribing.

Better quality and efficiency are the most prominent benefits of Andalucía's ePrescribing system. Quality gains account for 26% of all benefits. They include improved patient safety by reducing the risk of adverse drug events by using explicit, proven prescribing protocols and prompt monitoring by pharmacists. Efficiency gains represent 74% of the benefits. The main contributors include fewer GP visits for patients with long-term prescriptions and sustainable generic prescribing by active ingredient. Efficiency gains result in significant time savings for patients and doctors, reduced travel costs for some patients and cash savings from generic prescribing.

The socio-economic evaluation, based on cost benefit analysis, shows that Receta XXI achieves a significant cumulative net benefit to cost ratio of almost 1.12 over the twelve-year period up to 2010. Examples of significant benefits are:

- Reduction of more than 15% in GP visits for patients who have their first prescription using Receta XXI for an episode of care, resulting in savings in time and travel cost for patients and time saving for healthcare professionals and provider organisations
- Sustained cumulative cash savings from generic prescribing, adjusted for the time value of money and contingencies, of some 17 million EUR
- Application of standards and protocols throughout the region, improving the quality of prescribing procedures and reducing the risk of prescription errors
- Pharmacists using Receta XXI's information to improve their professionalism.

The first year of cumulative net benefits is 2008, five years after large scale implementation. The annual performance shows the first net benefit in 2006, rising to an annual return in 2010 of 9.95 times the annual cost. The value of estimated total cumulative costs is about 113 million EUR, and cumulative benefits are over 240 million EUR.

The cumulative net benefits curve rises steeply from 2004 to 2010. The annual benefits curve exceeds the annual cost curve significantly by 2010. After 2008, annual costs decrease significantly, and the benefits curve begins to level off. This matches an equivalent change in Receta XXI's utilisation. From 2004 to about 2007, the number of Receta XXI users increased as implementation proceeded. From 2008, existing users increased their utilisation of Receta XXI, without new adaptation needed.

Net benefit is not a measure of financial returns, but of the value of all estimated positive and negative effects. The financial classification of cumulative costs shows that Receta XXI needed over 62 million EUR of extra finance over the twelve-year period. Receta XXI generated estimated cash savings of more than 46 million EUR for healthcare providers, mainly from generic prescribing. Other benefits are some 118 million EUR of redeployed finance and some 75 million EUR non-financial benefits. Non-financial gains include some 7 million EUR from the expansion of proven clinical protocols and guidelines for prescribing. Finance redeployed arises from several efficiency gains that benefit patients, healthcare professionals and healthcare provider organisations.

Healthcare provider organisations have about 59% of the cumulative benefits. Patients have nearly a quarter, some 23%, with healthcare professionals having about 16% and third parties about 3%. This distribution does not match the cost distribution, where HPOs, especially SAS, carry about 91% of costs, and healthcare professionals about 9%, mainly by allocating some of their free time to engagement and development activities.

On transferability, Receta XXI integrates directly with Diraya as its ePrescribing module. Whilst the engagement, health informatics, coding, security confidentiality and ICT themes are transferable, Receta XXI as a whole is probably more transferable along with its Diraya context, such as the link into Diraya's EHRs. The Receta XXI experience offers extremely valuable knowledge and insights for planned ePrescribing developments in other health services and countries.

Lessons learnt from Receta XXI include the importance of integrating eHealth investment with the health and healthcare strategy of a region or country, thus mainstreaming the associated new working and clinical processes. Undertaking the changes needed for successful eHealth must be within realistic, unhurried timescales to engage stakeholders. This also applies to developing complex, interoperable, usable and tested EHR and ePrescribing solutions for healthcare professionals to use and share patient and clinical information that meets the needs of each type of stakeholder, and especially citizens, patients, carers, and healthcare professionals. Receta XXI was not an isolated eHealth project. It has a foundation in previous eHealth solutions, and will develop further as part of the region's continued eHealth investment in Diraya.

1 Background

1.1 Health system setting

After re-introducing the constitutional monarchy in Spain, the government adopted a decentralised structure, consisting of 17 autonomous regional communities, 50 provinces and 8,110 municipalities.¹ The General Healthcare Act consolidated the Spanish healthcare system in 1986 into an integrated National Health System (NHS). The Ministry of Health and Social Policy (MoH) and the regional governments assume roles and responsibilities for the healthcare system. The MoH is the key authority in drafting basic health legislation and policy, and dealing with the general co-ordination of public health and healthcare services and international and inter-territorial health issues. The autonomous regional governments implement legislation enacted by the MoH.² Each regional health ministry plans and operates the organisation of its healthcare provision in their community. Responsibility for establishing health policy, assigning resources and guaranteeing citizens' rights to health lies with the Regional MoH. Starting in Catalonia in 1981 and Andalucía in 1984, the process of transferring healthcare competences from the national to the regional was finished in 2001. All regions in Spain assumed full responsibility for their own regional healthcare delivery from 2002. Until then, the National Institute of Health (INSALUD) managed social security and healthcare services for the regions that had not assumed full responsibility for their own healthcare provision. Now, the central government manages social security and regions deliver healthcare. Each region is organised into healthcare districts and areas, then healthcare zones, which are the smallest unit in this hierarchy.

Spain's NHS is largely tax-funded and provides universal access to healthcare.³ It integrates different health service networks into the NHS structure. In addition to the General Healthcare Act of 1986 that established the NHS, the Royal Decree of Services Provision of 1995 set out financial responsibilities and the requirement of regional governments to provide minimum levels of services. It covers public health, primary, secondary and emergency healthcare and to some extent social care. The Act on Cohesion and Quality in the National Health System of 2003 guarantees citizens equity, quality and participation. Regional and national taxes are the sources of funding of the communities' health services. The transition from a health insurance system to a taxation model started in 1986. In 2001, the transition was completed.

Out-of-pocket payments by patients complement public finance for the public system and the private sector. Only a small percentage of drugs and orthopaedic devices require co-payments. Contributions to voluntary insurance often cover specialised healthcare services.⁴

The Autonomous Community of Andalucía comprises eight provinces organised into 33 primary care districts and 32 hospital and specialised care areas, with 44 public hospitals. According to information from the Andalucían MoH, the annual budget for healthcare in 2009 was 9.78 billion EUR. In Andalucía, healthcare services are primarily provided by the *Servicio Andaluz de Salud* (SAS), the health organisation of the Andalucía's *Consejería de Salud*, the regional MoH. Additionally, five public companies owned by the regional MoH are in charge of

¹ Protti, Denis et al. (2008): Comparing the application of Health Information Technology in Primary Care in Denmark and Andalucía, Spain. In: International Journal of Medical Informatics, 78(4): 270-83, p.274

² European Observatory on Health Systems and Policies (2007): Health Systems in Transition. Spain. Health System Review. Vol. 9, No. 1. Copenhagen: World Health Organisation, Regional Office for Europe., p. 19ff, Available at: <http://www.euro.who.int/Document/E89491.pdf>

³ *ibid*, p. 19ff

⁴ *ibid*, p. 19ff

healthcare delivery in the region. A contract for each healthcare programme sets the district budgets administered by one manager in each district, and defines objectives and key action plans. GPs, paediatricians and nurses work in clinical management units, forming primary healthcare teams in PHCs. In Andalucía, all PHCs and about 72% of hospital care (93% of hospital beds) are part of the public health system. The other 27% of hospital care is delivered by privately owned hospitals, and less than 2% by the national public system linked to defence and interior services.

The MoH is responsible for the registration of drugs. All pharmacies in Andalucía are private. Pharmacists must register with the *Consejo Andaluz de Colegios Oficiales de Farmacéuticos* (CACOF), the Official Colleges of Pharmacists. Patients can choose any pharmacy they prefer.

Patients' co-payments vary by their employment status. Patients who are active workers pay social contributions and are charged 40% of the medicine's retail price as a complementary payment. Chronically ill patients pay 10% of the price of the prescribed drug and in this case there is a cap on patients' co-payments, currently 2.64 EUR per medication, and updated annually.⁵ Inpatients, retired and handicapped people, as well as people who have suffered occupational accidents make no co-payments for their medication. The MoH determines the price of each drug.

1.2 Place of EHR, ePrescribing and interoperability in the framework

In its *Plan Estratégico del SAS* (1997-1999), the strategic plan of SAS, the Region of Andalucía acknowledged the importance of information and communication technologies (ICT) in healthcare. The strategy acknowledges that healthcare professionals and citizens are the major beneficiaries of ICT in healthcare because the relationship between healthcare professionals and patients significantly influences many of the outcomes of the healthcare system. Healthcare professionals' decisions determine the delivery and performance of healthcare. Delivering the best possible healthcare needs prompt access to the health and medical histories of their patients. An EHR provides this. Whilst healthcare professionals constitute the clinical and treatment side of eHealth, patients are at the centre of healthcare provision. Modern and comprehensive healthcare relies on collaborative multi-disciplinary healthcare teams. Their collaboration is much easier when they use information systems that integrate these concepts, especially for effective continuity of care. Against this background, the *Plan Estratégico del SAS* presented the first step towards employing a comprehensive health information system. A core part of the plan was the introduction of a comprehensive regional EHR.

Following the *Plan Estratégico del SAS*, numerous additional action plans laid down and amplified the way ahead to establish an integrated system based on EHRs. The Second Andalucía Healthcare Plan (*II Plan Andaluz de Salud*) determined that both primary and specialised care were to be adapted to the requirements as set in the strategic plan. Following these, the *III Plan Andaluz de Salud* (2003) proposed the integration of all healthcare information about each Andalucía citizen into their unique electronic record, available whenever and wherever needed to improve continuity of care and enhance the quality of healthcare provision. The *II Plan de Calidad* (2005-2008), includes the use of ICT in healthcare in several action points. Objective 2.6 is to "continue developing a single transparent information system that incorporates new ICT developments" by "complet[ing]

⁵ European Observatory on Health Systems and Policies (2007): Health Systems in Transition. Spain. Health System Review. Vol. 9, No. 1. Copenhagen: World Health Organisation, Regional Office for Europe., p. 19ff, Available at: <http://www.euro.who.int/Document/E89491.pdf>

the development and implementation of the Citizen's Single Digital Record at all Andalusian Public Health Service centres and services"⁶.

Nationally, the Plan Avanza is Spain's eGovernment strategy for 2006 to 2010.⁷ It coordinates the Spanish regions' policy objectives and activities with those set by the European Commission in the strategic framework i2010. Digital Public Services is one of Plan Avanza's five topics, and is directly relevant for eHealth. The Plan for Quality in the National Health System is the national programme for the healthcare system in Spain. Its strategic goals include improving citizen participation in their own healthcare, increasing patient safety through improved quality of care, intensifying the security of ICT in healthcare by continuous assessment and increasing the use of ICT by adapting the human resources policy to changing service needs.

Andalucía had already anticipated, and partly implemented the national strategies, and complies with the Plan for Quality from the healthcare perspective, and the Plan Avanza, from the ICT in healthcare perspective. Citizens' health information is integrated and will be available to authorised healthcare professionals when citizens need healthcare.⁸ This helps "[t]o transform the accumulated knowledge within the different channels of the Andalucía Public Health System into new processes, services and technologies in order to improve healthcare quality; to make the system more accessible and personalised for the citizen and also to create better opportunities for professional development for its employees"⁹. These objectives embody Andalucía's concept of healthcare innovation.

⁶ Ministry of Health (2008). Presentation of the Second Healthcare Quality Plan. Regional Government of Andalucía. Available at:

<http://www.juntadeandalucia.es/salud/%5Ccontenidos%5Ciiplanalidad%5CQuality%20Plan%20General%20English.pdf>

⁷ European Commission (2008). Priorities and Strategies in European Countries, Factsheet Spain. eHealth ERA Report. Available at: <http://www.ehealth-era.org/database/documents/factsheets/Spain.pdf>

⁸ Protti, Denis. (2007). Moving toward a single comprehensive electronic health record for every citizen in Andalusia, Spain. *Healthcare Quarterly* 10(4): 114-123, p.16.

⁹ Rivero, P. (2008). Presentation on: International Collaboration and Innovation in Citizen Engagement. Available at: <http://www.longwoods.com/website/events/docs/BWTCTRiveroMay012008.pdf>

2 The regional ePrescribing system Receta XXI in Andalucía, Spain

2.1 Organisations involved

SAS was responsible for the development and take-up of the EHR system Diraya¹⁰ and Receta XXI. SAS' goal is "to provide healthcare to the citizens of Andalucía, offering quality public health services, ensuring its accessibility and fairness and the satisfaction of its users, and aspiring to be efficient and take maximum advantage of available resources"¹¹. From the outset, the main objective was to integrate ePrescribing in the EHR system, and thus enable the sharing of electronic prescriptions and supporting information with pharmacies.

These activities affect several healthcare organisations. ePrescribing begins with doctors, so PHCs and hospital outpatients and emergency care departments are the organisations that initiate ePrescriptions. Pharmacies then dispense ePrescriptions and claim for reimbursement and agreed rates from SAS. Each of these organisations has a role in Receta XXI's development, implementation, operation, and continuous development. Healthcare professionals' representative bodies also have a role in Receta XXI. The role of doctors' groups and CACOF is continuous.

Health services provided by SAS are for the Autonomous Community of Andalucía, the second largest and most populated region in Spain covering an area of more than 87,000 square kilometres and a population of over 8 million inhabitants, about 18% of the Spanish population and land area.¹² SAS, a public body, owns and manages all 1,500 primary healthcare centres and 28 of the region's 32 hospital areas. There are 3,524 pharmacies in Andalucía, all privately owned.

2.2 The context of the initiative and eHealth dynamic

2.2.1 Context and historical development

Diraya is at the core of Andalucía's eHealth strategy, a unified EHR system. It integrates information about patients' information about their health and clinical history in primary care, emergency services, mental health services and ambulatory specialised care in the region. Receta XXI is the ePrescribing module of Diraya. Data needed for ePrescribing is in Receta XXI and other modules of Diraya, such as the EHR backbone and the patients' registry. Diraya's history and development determines the place of Receta XXI in the framework.

Receta XXI's history connects directly to Diraya's. The strategic healthcare plan to improve healthcare, set by the *Junta de Andalucía*, the regional government, triggered the development of Diraya. The regional government's strategy to improve healthcare provision included an ICT network infrastructure for all public services, healthcare being one of them.

¹⁰ EHR IMPACT (2009): The socio-economic impact of Diraya, the regional EHR and ePrescribing system of Andalucía's public health service. Available at: http://www.ehr-impact.eu/cases/documents/EHRI_case_DIRAYA_final.pdf

¹¹ Ministry of Health, Andalucía. Consejería de Salud: Misión. Servicio Andaluz de Salud. Available at: http://www.juntadeandalucia.es/servicioandaluzdesalud/principal/documentosAcc.asp?pagina=gr_conocerelSAS&version=En

¹² Board of Andalucía. Conoce Andalucía. Available at: <http://www.juntadeandalucia.es/conoce-andalucia.html>

For health issues, the network aimed to improve the management of healthcare, centralise health and healthcare information, and integrate all health information on each patient into their single, unique record, available whenever and wherever needed.

Diraya's predecessor was *La Tarjeta de Afiliado a la Seguridad Social* (TASS). It included a card affiliated to social security, a stand-alone system with its own database installed on each PHC's own local server. It did not facilitate data exchange between PHCs, and between PHCs and pharmacies. TASS was not available for hospitals. The inability to align national and regional interests on some issues, such as restrictions for reimbursement of some medications, and the lack of health information on their patients, led to the proposal by the *Junta de Andalucía* to have its own network of public services that it could adapt to its needs. The idea of developing Diraya was born and with it the opportunity to realise the dream of combining an EHR, ePrescribing and eScheduling in a single, interoperable system.

TASS included some functions of ePrescribing, in the first steps of the drug management process. From 1999, GPs in each PHC entered prescriptions electronically into their stand-alone system, then printed paper forms for patients to take to the pharmacy. Communication between PHCs and the pharmacies were not part of TASS. TASS improved prescribing quality in primary care, but more was possible. Structural aspects additionally hampered the prescribing process. Only one type of drug was on a prescription, in order to comply with the pharmacists' reimbursement arrangements. When patients needed several drugs, several prescriptions were issued. Consequently, TASS prolonged prescribing. Physicians wanted a centralised database of available, prescribed medications, so they could share crucial information about patients with their colleagues. Providing these functionalities to physicians and pharmacists required a new solution, and Receta XXI is the outcome.

In 2002, CACOF and SAS signed a formal agreement to change the process of prescribing and dispensing of drugs. It cleared the way to develop and introduce Receta XXI. Receta XXI supported longer cycles of repeat prescriptions of up to one year and a more rational use of drugs. This agreement automatically renews every four years unless amendments are agreed.

As public funding pays for the vast majority of healthcare services and the provision of drugs, SAS is responsible for reimbursing pharmacists for the cost of the drugs they dispense. Consequently, SAS is the major responsible healthcare organisation that provides the health service background against which the ePrescribing and eDispensing systems are evaluated; they are all integrated in Diraya and the system comprises prescribing decision support tools and the ePrescribing module Receta XXI, which includes dispensing. As they were all developed as part of Diraya, right from the beginning, interoperability is effectively achieved.

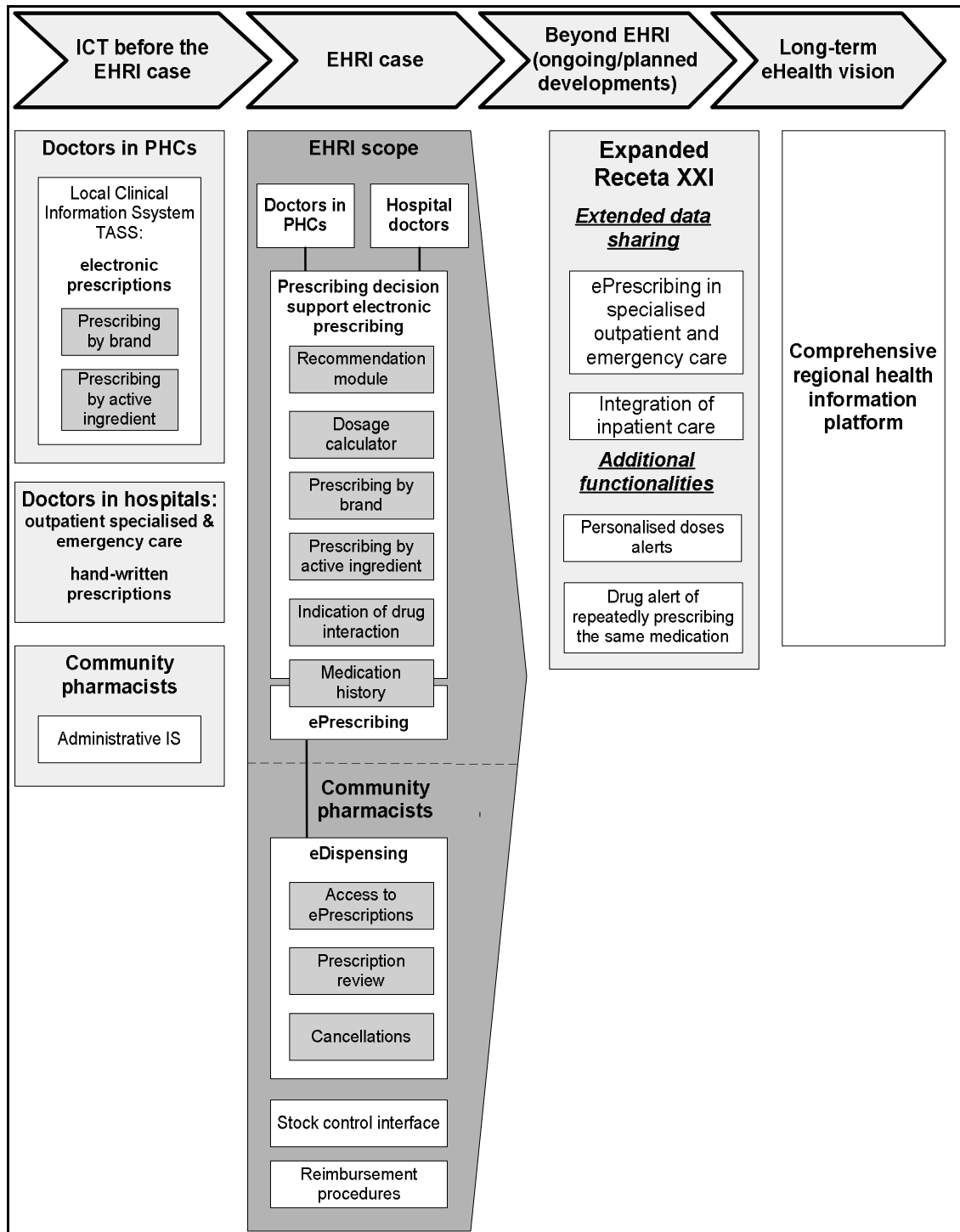
2.2.2 eHealth dynamic and scope of the evaluation

Receta XXI is available throughout all healthcare services connected to Diraya, currently primary care and outpatient specialised and emergency care in hospitals. Up to 2008, 94% of GPs and paediatricians and specialists and emergency doctors in one hospital in the region used Receta XXI. Doctors in private healthcare do not have Receta XXI at their disposal. Through their integration with Diraya, physicians in emergency and specialised outpatient care in hospitals can use all prescribing decision support tools and view patients' medication records. But as the most of these doctors do not use Receta XXI, pharmacists cannot access their prescriptions. ePrescribing will be extended to all the hospitals in 2009/10.

Figure 1 shows the scope of the evaluation, comprising all prescribing and dispensing activities facilitated by Receta XXI. Being a module of Diraya makes it difficult to confine Andalucía's ePrescribing system to Receta XXI. It would not be possible to draw a comprehensive picture. Prescribing procedures are distinguished and defined as electronic prescribing, ePrescribing and eDispensing, based on the use of different functionalities and

the opportunity to share information between healthcare professionals. Chapter 2.5 describes these.

Figure 1: eHealth dynamic of SAS' ePrescribing system and ePrescribing procedures



Source: EHR IMPACT study

More features are being added to Receta XXI, including:

- Personalised alerts on maximum doses.
- Drug alert of repeatedly prescribing the same medication.

In the longer-term, a planned development is diagnosis-based prescribing decision support. Receta XXI will use diagnoses to suggest a list of possible medications. For the near future, the aim is to deploy Receta in all healthcare services integrated with Diraya. Then, pharmacists will be able to access current and long-term ePrescriptions issued by hospital doctors in outpatient specialised and emergency care.

2.3 The health services affected

All healthcare facilities integrated into Diraya rely on prescribing and so ePrescribing, defined as using ICT facilities to prescribe, dispense and record these activities in patients' EHRs. The main activities affected are:

- Prescribing by GPs and paediatricians in PHCs
- Dispensing by local pharmacists
- Doctors in PHCs and hospitals specialised and emergency departments viewing and using patients' medication records and histories and prescribing DSS tools.

In 2008, the main share of drug expenditure was on anti-hypertensive drugs costing some 272 million EUR, COPD medication at 170 million EUR and medication that lowers cholesterol and triglycerides at 143 million EUR.¹³ This amounted to growth of 6.09%, 8.24%, and 11.3% respectively, compared to 2007. The policy on the rational use of drugs (RUD) emphasises generic prescribing and dispensing by referring to active principal ingredients. In line with this aim, SAS and the CACOF agreed in 2001 to pay pharmacists the price of the second least expensive drug in the class of an active principal ingredient. In 2006, this agreement passed into law. In the same year, 71% of all prescriptions referred to active ingredient rather than to a specific brand. In primary care it was 73%. In 2008, 77% of all prescriptions have been made by active ingredient. According to SAS sources, this led to savings of more than 253.3 million EUR for SAS from 2001 to 2008.

In 2009, 94% of all PHC professionals, employed in 683 PHCs, were Diraya users. Besides primary care, Diraya is also available for hospital-based accident and emergency (A&E) services and outpatient specialised care in all of SAS' hospitals. In hospitals, it is used by 7,204 hospital outpatient specialists, emergency doctors and nurses in hospital-based specialised outpatient and emergency care. However, the largest hospital does not yet have all functionalities available. Currently, 17.2% of consultations in specialised care and 75% of A&E episodes rely on Diraya.

Pharmacies in Andalucía provide all services related to drug dispensing in communities outside hospitals. Together with primary health services, Receta XXI directly supports pharmacists' services. 3,541 pharmacies (99%) are connected to Receta XXI. Dispensing improvements have affected the relationship between physicians and pharmacists, and the relationship between pharmacists and patients.

2.4 Components and functionalities

Receta XXI facilitates prescribing, dispensing, and the control of drugs. It provides DSS and is integrated with Diraya's central databases. Every month, the MoH updates the Official Nomenclature of Pharmaceutical Products Information, which SAS incorporates into Receta XXI. It contains the codes and names of all medical products included in the

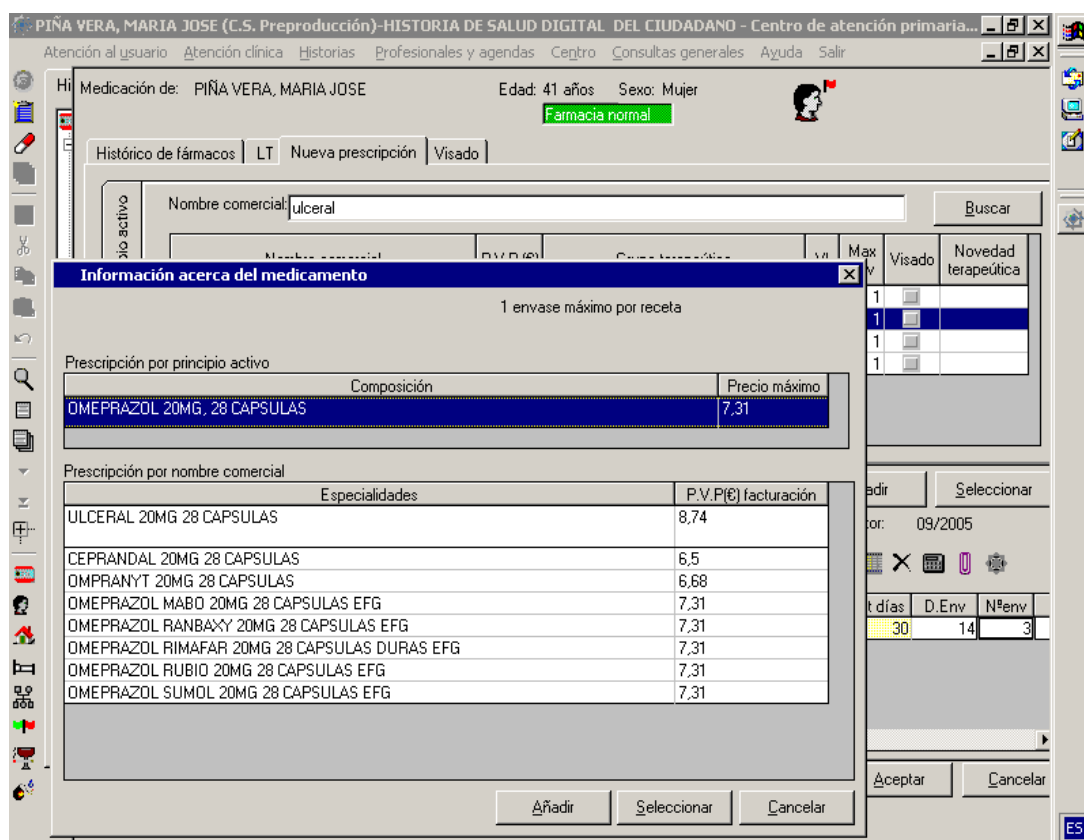
¹³ Servicio Andaluz de Salud (2006): Memoria 2006. Consejería de Salud, Junta de Andalucía. Sevilla, p. 100

prestación farmacéutica, the pharmaceutical services of the Andalusian NHS. Data in the nomenclature includes:

- Defined Daily Dosage (DDD)
- Number of DDDs per unit
- Defined effect and value of medication
- Therapeutic guidelines published by the *Sociedad Española de Medicina de Familia y Comunitaria (SEMFYC)*, the Spanish Society for Family and Community Medicine
- Lists of drugs requiring clinical reports for dispensing.

Generic prescribing by **active principal ingredient** is a significant measure for the rational use of drugs (RUD) and restricting the power of the pharmaceutical industry. When doctors prescribe a drug, they can refer to a list of drugs grouped by their active principal ingredients. It also shows the price of each drug. Doctors can also prescribe drugs by brand if they prefer. When a doctor prescribes by brand, Receta XXI identifies the active ingredient and compiles a list of all drugs with the same active ingredient. It also selects generic drugs with prices below the branded drug price, as shown in Figure 2. From this list, doctors can choose the best and most affordable drugs. If clinically justified, doctors can also insist on a certain brand, but need to explicitly state the need. SAS transferred this tool from TASS into Receta XXI.

Figure 2: List of medications organised by active ingredient



Medicación de: PIÑA VERA, MARIA JOSE Edad: 41 años Sexo: Mujer
Farmacia normal

Historico de fármacos | LT Nueva prescripción | Visado

Nombre comercial: ulceral Buscar

1 envase máximo por receta

Prescripción por principio activo

Composición	Precio máximo
OMEPRAZOL 20MG, 28 CAPSULAS	7,31

Prescripción por nombre comercial

Especialidades	P.V.P(€) facturación
ULCERAL 20MG 28 CAPSULAS	8,74
CEPRANDAL 20MG 28 CAPSULAS	6,5
OMPRANYT 20MG 28 CAPSULAS	6,68
OMEPRAZOL MABO 20MG 28 CAPSULAS EFG	7,31
OMEPRAZOL RANBAXY 20MG 28 CAPSULAS EFG	7,31
OMEPRAZOL RIMAFAR 20MG 28 CAPSULAS DURAS EFG	7,31
OMEPRAZOL RUBIO 20MG 28 CAPSULAS EFG	7,31
OMEPRAZOL SUMOL 20MG 28 CAPSULAS EFG	7,31

Añadir Seleccionar Cancelar

Source: SAS

The **drug alert** was also available for physicians in TASS. Receta XXI warns the prescribing physician if an active prescription with the same active ingredient already exists.

Another **alert** system supports physicians in detecting and preventing interactions, contraindications, and allergic reactions. GPs use Diraya to record patients' allergies on their

first visit. Then, prescribing doctors can choose to have the information about allergies in advance or receive an alert popping up when Receta XXI detects a potential allergic reaction. The pop-ups also display risk of adverse interaction or a contraindication.

Doctors can ask the **recommendation module** for alternative drugs they want to prescribe based on the active principal ingredients. The module uses therapeutic guidelines on efficacy, safety and cost effectiveness. In 2004, SAS signed an agreement with the SAMFYC to provide the guide to doctors in primary care. A multi-disciplinary group of experts for the RUD helped to introduce the guide into Diraya and Receta XXI. The guide was updated in May 2007. If a doctor prescribes a medicine not included in the guide, Receta XXI offers an alternative drug.

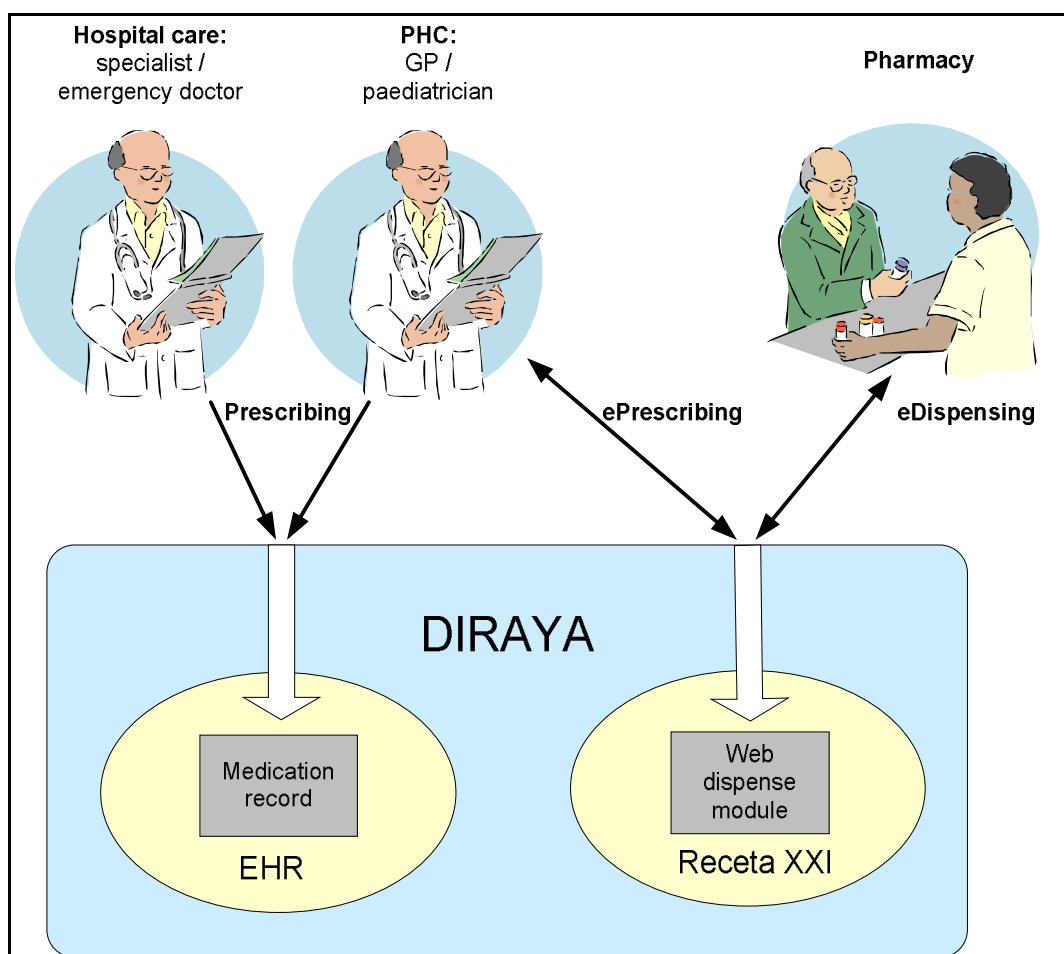
The *Centro Andaluz de Información del Medicamento* (CADIME), the Andalusian centre for information on medication, is a multi-disciplinary expert group that determines the therapeutic value of medication. When doctors prescribe particular drugs, Receta XXI shows the recommended therapeutic value in red letters. Since its introduction, the number of newly introduced medications with little or no therapeutic effect has reduced to a minimum.

The ePrescribing system supports various **reporting functionalities**. It allows physicians to complete the yellow card, a document for reporting new adverse drug reactions. Patients' medication records can include this information. Physicians also receive messages when the medication they are about to prescribe requires additional information that has to be set out in a clinical report before dispensing. This saves time and effort for all stakeholders involved, especially patients.

Prescriptions that can be accessed by authorised pharmacists are registered in the **central dispense module**. It contains the same information as the ePrescribing form, specifying the active medication cleared for dispensing. The **web dispense module** is another interface available to pharmacists. It retrieves data from patients' prescriptions of medication that has not been dispensed yet, comprising patients' current and long-term prescriptions, and the facility to cancel prescriptions on the few occasions necessary, and to communicate the reasons of the cancellation to the appropriate physician.

2.5 The system in practice

Figure 3: Electronic prescriptions, ePrescribing and eDispensing



Source: EHR IMPACT study

Describing Receta XXI in practice distinguishes three different ways of prescribing in Andalucía, and includes dispensing. This reflects the different definitions of prescribing used in this report.

- 1) **Manual prescriptions:** GPs and paediatricians use handwritten prescriptions mainly during home visits, then enter the data into Diraya when they return to the PHC. Specialists and emergency care doctors use manual prescriptions more often than GPs. Manual prescriptions are outside the scope of evaluation.
- 2) **Electronic prescriptions:** details of prescriptions are entered into the system, printed out then given to patients, who take them to pharmacies for dispensing. All doctors in primary, outpatient specialised and emergency care can prescribe in this way. DSS tools are available and Diraya saves the data in patients' EHRs.
- 3) **ePrescribing:** after physicians have entered the prescription data into Receta XXI, they click on a box, and the ePrescription is saved in the central dispense module where it can be accessed by pharmacists. Except for outpatient specialists and emergency doctors in one hospital in Andalucía, only doctors in primary care use this functionality. Patients then receive an ePrescription only. If patients prefer, they can receive a print-out of the ePrescription with the details of their prescription, the dosage, frequency and the time period. Similarly to electronic prescriptions, GPs and paediatricians can use DSS tools. In Diraya, prescriptions' details in Receta XXI transfer to the medication record of Diraya's

EHR. Additionally, pharmacists share GPs prescribing information by accessing the central dispense module. This is only possible with Receta XXI.

- 4) eDispensing: this follows from ePrescribing. Pharmacists can access current and long-term prescriptions when patients provide their healthcare ID cards to authorise access to their prescriptions. This is only possible with Receta XXI.

Receta XXI supports ePrescribing and eDispensing, which are not available in TASS.

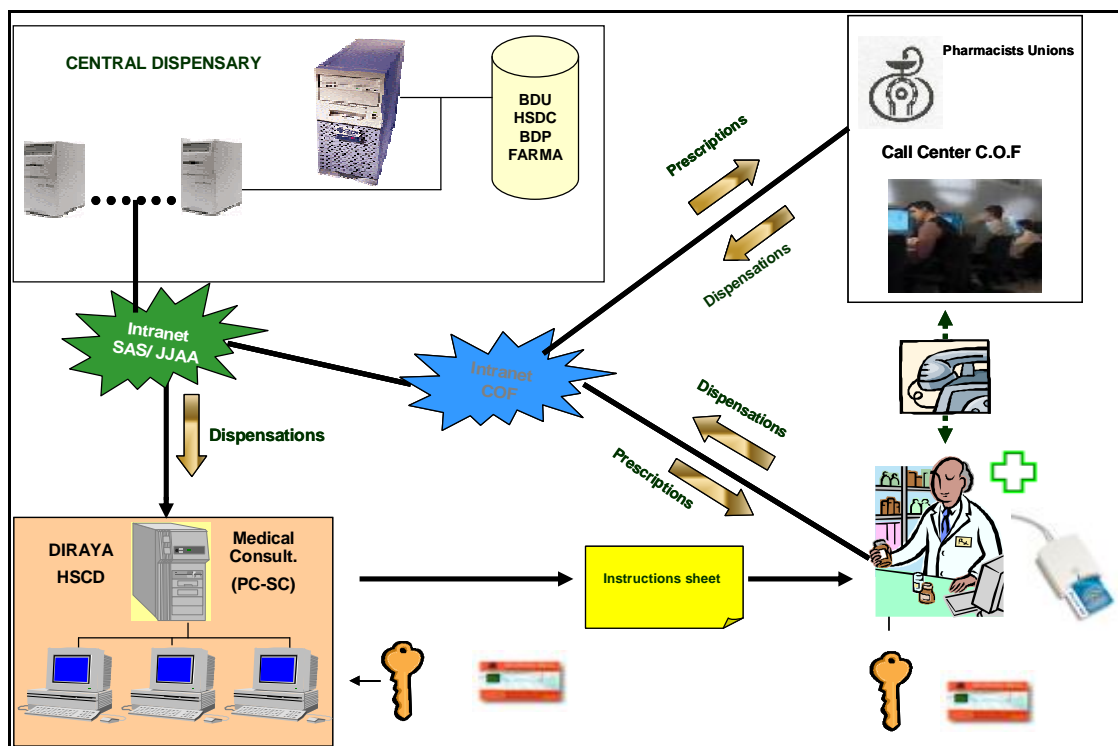
Doctors using Diraya are assisted in electronic prescribing and ePrescribing by several DSS tools, such as the allergy alert and the recommendation module described in detail in section 2.4. When completing electronic prescription forms, they need to enter the reimbursement codes and the names of the drugs, the dosage, the duration of ingestions and the dates of the prescriptions. Doctors in hospitals have to stop here, and their prescribing information transfers to the medication record of Diraya's EHR. Physicians in PHCs can choose between Receta XXI, meaning electronic transmission to the central dispense module, and using printed, paper prescriptions. In both cases, the prescription details transfer to patients' medication records in Diraya. Doctors can also add instructions to prescriptions that display automatically when pharmacists access ePrescriptions. Receta XXI enables pharmacists to avoid using paper prescriptions. In November 2008, 46% of all prescriptions used ePrescribing, with more than 1.9 million patients receiving ePrescriptions.

With Receta XXI, patients who need long-term medication can have prescriptions for up to one year, with regular dispensations. These patients need only return to their GPs during the prescription period if they need their condition reviewed. Physicians take the decision whether they want to issue long-term prescriptions. In November 2008, about 55% of prescriptions for chronically ill patients were ePrescriptions, requiring long-term medication treatment.

Receta XXI's pharmacy interface provides pharmacists with all the information about prescribed medications entered by physicians, including reliance on active principal ingredients. Pharmacists cannot use other Diraya modules to view medication data entered by physicians and recorded in its EHRs' medication records.

Figure 4 below illustrates the flow of ePrescriptions in Receta XXI.

Figure 4: ePrescription flow in Receta XXI



Source: SAS

When patients go to their pharmacies to collect their prescribed drugs, they identify themselves with their unique, healthcare ID cards. When Receta XXI accepts the card as valid, pharmacists are authorised to access prescription information for the identified patient. Where physicians have prescribed drug by active ingredient, the pharmacy only gets reimbursed the cheapest alternative, so pharmacists make use of this authorisation. This role for pharmacists has enabled SAS to shift the prescribing emphasis away from the pharmaceutical industry and to the NHS.

Providing the list of medications and prices to doctors may have raised their awareness of some of the financial aspects of prescribing, leading to changes in prescribing practices. The agreement does not prevent doctors from prescribing drug brands. It provides information to support their informed choices. For example, for those patients who are used to a particular brand of drug and find generic drugs unhelpful, doctors can continue to prescribe by brand, and reimbursement uses the price of the branded drug to reimburse pharmacists.

Pharmacists exercise their rights to cancel the prescriptions judiciously. For example, they may cancel prescriptions where they have concerns regarding patients' safety, such as contraindications or potential adverse drug events (ADE). In 2007, pharmacists precautionarily cancelled 2,395 prescriptions, about 0.05% of the total in Receta XXI. The patients returned to their GPs who issued the prescription, who either confirmed or rejected it. Of the pharmacist cancellations, GPs agreed with the pharmacists in 96.3% of the precautionary cancellations and reissued 3.4% of the original prescriptions.

The web dispense module in Figure 5 shows information on all prescriptions initiated for an illustrative patient. Information included is:

- Medications where dispensing can be completed
- Medications where dispensing cannot be completed and the reason for this
- Availability of medications at the moment

- Prescriptions precautionarily cancelled by pharmacists and notification of GPs
- Prescriptions where dispensing is not possible because they need a previous authorisation
- Long-term prescriptions and their status as active or inactive and the appropriate timing of the next dispensation.

Figure 5: The web dispense module in Receta XXI

ESTADO	FECHA PRESCRIPCIÓN	P.ACT.	PRODUCTO		POSOLOGÍA		FECHA FIN TTO.	CAUSA ANULAC.	AC.OBS.
			NOMBRE		UDS./ TOMA	CADA			
	18/12/2008			SIMVASTATINA ACOST 10MG 28 COMPRIMIDOS		5 COMPRIMIDOS	24 Horas		
	18/12/2008			DOLALGIAL 125MG 10 COMPRIMIDOS RECUBIERTOS		1 COMPRIMIDO	12 Horas	CCTM	
	15/10/2008			SIMVASTATINA ACOST 10MG 28 COMPRIMIDOS		1 COMPRIMIDO	24 Horas	OMA	
	20/06/2008			ABSORBENTE INCONT ORINA DIA ANATO ELASTICO - ABS ECO ELASTICOS T. GRANDE 80U		1 UNIDAD	24 Horas		
	01/07/2008			URBAL SUSPENSION 50 SOBRES		1 SOBRES	24 Horas		
	20/06/2008			ALGIASDIN 400MG 30 COMPRIMIDOS RECUBIERTOS		1 COMPRIMIDO	24 Horas		
	30/04/2008			CAPTOPRIL BEXAL 25MG 60 COMPRIMIDOS EFG		1 COMPRIMIDO	24 Horas	CCTM	
	15/05/2008	P.ACT		ACETAZOLAMIDA 250MG, 20 COMPRIMIDOS		1 COMPRIMIDO	24 Horas		
	16/06/2008			DOLAK RETARD 60MG 30 COMPRIMIDOS LIBERACION PROLON		1 COMPRIMIDO	24 Horas		
	14/05/2008			SIMVASTATINA ACOST 10MG 28 COMPRIMIDOS		1 COMPRIMIDO	24 Horas		
	07/02/2008			DOLALGIAL 125MG 20 COMPRIMIDOS RECUBIERTOS		1 COMPRIMIDO	24 Horas	CCTM	
	29/04/2008			ULTRAMICINA 250MG 10 COMPRIMIDOS		1 COMPRIMIDO	24 Horas		
	30/04/2008			CAPTOPRIL QUALIGEN 25MG 60 COMPRIMIDOS		1 COMPRIMIDO	24 Horas	OMA	

<<Anterior Página 4/5 Siguiente>>

Dispensable No Dispensable Temporalmente No Dispensable Renovación
 Disponible Fuera de Margen Agotado Fin de Tto. alcanzado con último envase dispensado
 Anulado Anulado Cautelariamente Pendiente de Visado o Autorización

Fin tto. hasta 30 días

https://10.234.31.97/rxxi/prescripciones.popup.asp Internet

Source: SAS

Patients with prescriptions for up to one year avoid visits to their GPs to collect repeat prescriptions during this period. Their dispensing frequencies comply with protocols for short-term prescriptions, so patients still have to visit pharmacies regularly. Information on long-term medication treatment provided in the web dispense module informs pharmacists when patients can have the next dispensation.

Having Receta XXI integrated with the pharmacies' local information systems enables pharmacists to provide better pharmaceutical advice and care and reduces the time they need to manage their expenses and reimbursement procedures. It provides information and analyses for health administrators that help them to improve their follow-up and control of RUD and monitor the correct assignment of responsibility in RUD. The reimbursement and administrative control are performed by the CACOF, in the upper right-hand corner of figure 4 above.

2.6 Technology

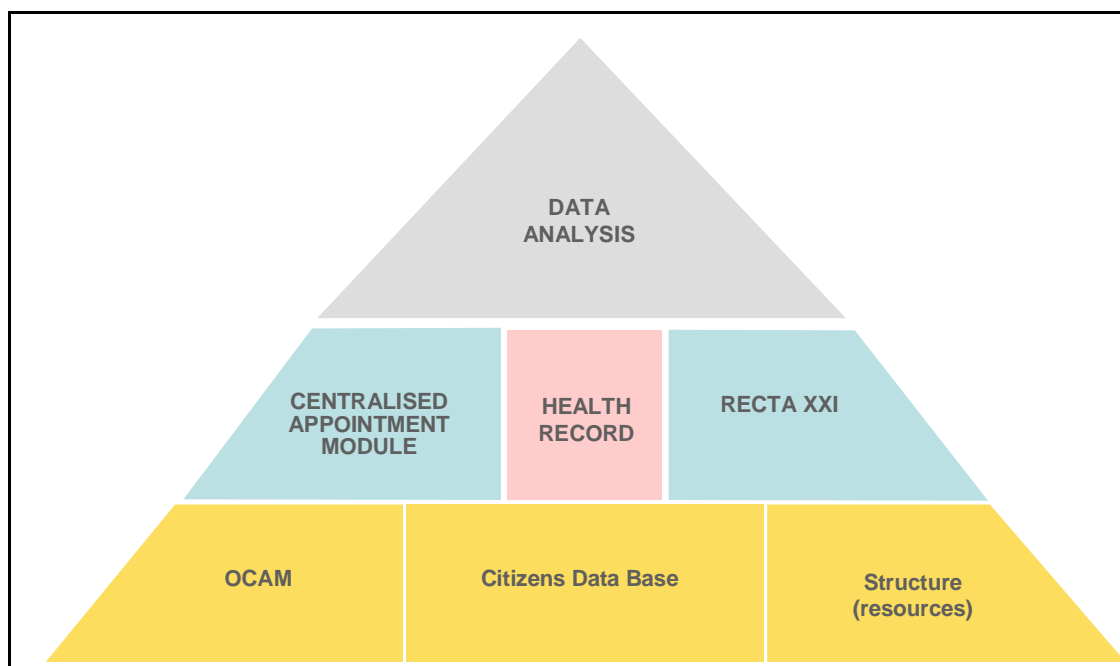
SAS developed Diraya, including Receta XXI. It was a natural step from its development of the TASS and SAS benefited from the experience. SAS collaborated with the IT vendor INDRA.

Other vendors also contributed to the wide range of tools used in Diraya and Receta XXI. SAS owns all rights.

2.6.1 Architecture

Receta XXI is one of the central modules of Diraya's architecture. The system has several interrelated modules integrated as a pyramid, shown in Figure 6.

Figure 6: Receta XXI and the related modules comprising Diraya



Source: SAS

Diraya's EHR consists of centralised and distributed data. Centralised data include basic health data, such as demographic and social data, personal and family antecedents, information on allergies and contraindications and health problems. Distributed data consist of diagnostic-therapeutic data, including information on consultations, analyses, and pathology and radiological tests. The following modules take data inputs and store them centrally:

- OCAM, the health provider registry
- UDB, the user database with the citizen register
- STRUCTURE, the resources registry
- The centralised appointment module
- RECETA XXI, the ePrescribing module
- MTI, the information treatment module
- EHR, the backbone of the system.

GPs use Receta XXI as part of the interoperable set of Diraya modules, which illustrates the challenge of evaluating Receta XXI in isolation. The pyramid also shows how technically, electronic prescriptions and ePrescribing (Receta XXI) are different, yet both connected to the EHRs and all administrative and other modules.

Diraya's modules, including Receta XXI, use XML web services for communication. The exchange between laboratory tests modules and systems uses HL7 version 2.5 messaging standards.¹⁴

2.6.2 Security and confidentiality

Access to patient information is restricted and controlled to preserve data security and confidentiality. Patients' registered GPs have automatic rights of access to their patients' information transferred from Receta XXI in Diraya's EHRs. Other GPs can access records if patients provide explicit consent by using their green Andalusian public health system cards (Figure 7) or, if it is not available, by signing a formal consent document. Pharmacists always have to enter their patients' green card for access to their prescription information.

Figure 7: The green Andalusian public health system card



Source: SAS

Patients have a legal right of access to their records and information in Receta XXI. On request, they can either have a print out, or they can view it on GPs' and pharmacists' screens. A plan is in place to provide access from patients' homes. Additionally, patients can choose to share confidential data only with their GPs. On request, their GP can block any other physician's or pharmacist's access to the EHR.

The following features are part of Diraya's data security regime and are valid for Receta XXI:

- Physical security through being a centralised model
- Data integrity: the same data cannot be edited by different people at the same time and the user is logged out after a certain period of time
- User profiles: every health professional can only access the data of his/her patient
- Traceability: all logs and authors of information entered can be identified
- Blocking EHR elements: maintain confidentiality of a GP's patient EHR
- Access with the Andalusian public health system card providing explicit consent
- Data analysis levels: traceability of reports, anonymity of data for research purposes.

If Receta XXI or PHCs' hardware crashes or is unavailable, doctors can continue prescribing using manual prescriptions. Data can be entered into Diraya later. If Receta XXI or pharmacies' hardware is unavailable, pharmacists can continue dispensing. COCAF has continual direct access to the Receta XXI module. Using the number on the prescription

¹⁴ For more information on the technical side of Diraya, please EHR IMPACT (2009): The socio-economic impact of Diraya, the regional EHR and ePrescribing system of Andalucía's public health service. Available at: http://www.ehr-impact.eu/cases/documents/EHRI_case_DIRAYA_final.pdf

information sheet, CACOF can check that dispensing should proceed. In these circumstances, pharmacists cannot access patients' medication details in the dispensing module. When Receta XXI is available again, pharmacists have to validate all the prescriptions dispensed during the downtime.

2.7 Level of interoperability

Of the three EHRI interoperability classifications of potential interoperability, limited connectivity and extended actual connectivity,¹⁵ Receta XXI is in the third category of **extended actual connectivity**. It enables exchange of prescriptions between PHCs and pharmacies and information sharing between multi-disciplinary teams in primary healthcare, ambulatory specialised care and emergency care services teams and community pharmacists throughout Andalucía. Hospital inpatient services are not yet part of this information network. They will be included in 2009. The different types of participants involved in the information exchange determine the boundaries within this network. GPs and paediatricians, and specialists and emergency care doctors share the data in the medication record as part of Diraya's EHR. PHCs and pharmacies share information about medication prescribed using Receta XXI. Receta XXI is also interoperable, and integrated with pharmacists' own, local software supporting reimbursement, stock management, and other administrative processes.

Regional connectivity is the classification of the ePrescribing system's level of interoperability. Interoperability and interoperation facilitate collaboration by teams of doctors, and nurses, pharmacists and health administrators. Informal carers and patients have no direct access, which is in line with the design and philosophy of the system to support healthcare professionals and health authorities. Classification according to type of connectivity is summarised in Table 1 below.

Table 1: Scope of interoperability of the regional ePrescribing system Receta XXI¹⁶

Type of Connectivity	Characteristics	ECS
Single site	People within teams and between teams in one organisation	Yes
Multi-site	People within teams and between teams in one organisation	Yes
Regional	People, teams and organisations in one region	Yes
National	People, teams, organisations and regions in one country	No
International	People, teams, organisations, regions and countries	No

Source: EHR IMPACT study

¹⁵ EHR IMPACT (2008): Methodology for evaluating the socio-economic impact of interoperable EHR and ePrescribing systems, Bonn (Available online: http://www.ehr-impact.eu/downloads/documents/EHRI_D1_3_Evaluation_Methodology_v1_0.pdf)

¹⁶ Ibid

3 Case analysis

3.1 Stakeholders

Patients, carers and other people

Patients, carers, including family carers, neighbours, friends, and all citizens of Andalucía are stakeholders. They can all receive ePrescriptions and have their medication dispensed by pharmacists using Receta XXI. Their NUHSA provides a unique patient identifier. Currently, there are more than 8 million people registered in Diraya, with each one being a potential stakeholder. In 2009 more than 2.7 million people, about 34% of those registered in Diraya, receive ePrescriptions with Receta XXI.

Many patients, especially those over 65 and those with long-term conditions, frequently change their residences as they move to members of their extended families for temporary care and support. When their GPs use Receta XXI for their prescriptions, these patients can have follow-up prescriptions from any convenient GP, and their medications dispensed from any nearby pharmacy in Andalucía, provided the PHCs and pharmacies connect to Diraya. Receta XXI's interoperability supports this culture of extended families sharing the role of informal carers.

Health services teams

This group of stakeholders comprises doctor in primary care, specialists, outpatients, and emergency departments in hospitals, as well as pharmacists. GPs and paediatricians can utilise Receta XXI and DSS to use ePrescribing actively as part of their daily clinical and working practices. Healthcare teams in hospitals use Diraya's DSS tools for prescribing and use its EHRs to enter new prescriptions and view the medication histories of their patients. Pharmacists use Receta XXI to access prescriptions from GPs and dispense controlled drugs and medicines to patients.

The perspective of this stakeholder group regards health services team members as individuals, not as employees of the PHCs, the hospitals or the pharmacies. The impact of ePrescribing and eDispensing on their private lives and their private experience is evaluated with EHRI. It is important to recognise the effect on health professionals as they use Receta XXI. If they receive few, or no, net benefits, they will not integrate it into their daily working routine, inhibiting ePrescribing fulfilling its potential.

Healthcare provider organisation (HPO)

HPOs are the PHC's, hospital services owned by SAS, and pharmacies in communities. All benefits and costs arising from Receta XXI hence accrue to SAS as a holding organisation and the pharmacies as independent organisations. SAS' responsibility in decision taking, planning, developing, implementing and operating Receta XXI adds to the significant role of SAS. As it is also responsible for reimbursing pharmacists for the cost of drugs, it directly benefits from improvements to the RUD initiative. Pharmacies are private entities. Responsibility for the services they provide is borne by each pharmacy's owner. Some of the costs and benefits of Receta XXI accrue to them.

Third parties

By allocating the funding of the healthcare delivered in Andalucía to SAS, the regional MoH assumes the role of a third party payer. ePrescribing affects Andalucía's MoH directly, related to its strategic role to ensure that healthcare and public health improve. This impact follows

from improving healthcare quality by expanding clinical and prescribing protocols and disseminating these comprehensively to doctors and pharmacists using decision support tools.

As a consequence of the developments in healthcare funding as described in chapter 1.1, the health insurances' share in drug reimbursement is far smaller than the MoH's. About 91% of Andalusian citizens rely on the public health system exclusively, 2% have private health insurance and 7% use private health insurance to supplement their public health insurance with private ones.

CACOF is not included in this group of stakeholders. As a professional and regulatory body, the impact of Receta XXI affecting CACOF is a second-order effect. However, it is a critical protagonist in the development, implementation and utilisation of Receta XXI. Its technical engagement and negotiations with SAS on behalf of the region's pharmacies was essential in securing Receta XXI's success, and it is likely that it has enhanced CACOF's professional reputation and that of its pharmacists in Andalucía's healthcare community.

3.2 Process change

Following on from TASS, the introduction of ePrescribing resulted in several process changes and improvements in the performance of existing processes. Access by doctors to DSS and patients' medication histories supports their prescribing decisions and practices. Access by pharmacists to current and long-term ePrescriptions for review and dispensing supports their daily work. Sharing and using this information helps them to improve the performance of their clinical and working practices. Receta XXI supports changes in prescribing regulations that now permit GPs to prescribe for up to one year if they deem it appropriate. A common feature of Receta XXI is that GPs can choose their prescription methodology. ePrescribing is encouraged, but not enforced by SAS, creating a constructive atmosphere of ownership of manageable change. Doctors have flexibility, and they exercise their choices.

3.2.1 Workflow

With Receta XXI, some workflows have changed; others retain the previous sequence of operations but are more efficient. GPs have a choice of prescribing methods. About 46% of prescriptions use Receta XXI, the other 54% rely on electronically printed or manual prescriptions, continuing the workflows in place before Diraya. GPs tend to use Receta XXI to save time both for patients and themselves. It offers the opportunity to reduce the need for patients' visits for some repeat prescriptions needed for long-term conditions.

Probably the most substantial change in workflow is where GPs use Receta XXI to prescribe for periods of up to one year. GPs have the option to switch from a sequence of short-term prescriptions to single long-term prescriptions with phased dispensing. Instead of regularly and frequently visiting their attending GPs for repeat prescriptions, chronically ill and long-term patients and carers can go directly to their pharmacies when their next batch of prescribed medications is available. In these cases, the prescribing workflow is changed and the amount of work needed for prescribing reduces where the number of visits to GPs decreases.

With TASS, reimbursement required GPs to prescribe separately for each type of medication for patients, rather than include several medications on one prescription form. Receta XXI does not need this separation, so that an ePrescriptions can be for more than one drug.

Saving the prescription data in the central dispense module enables authorised pharmacists to view prescriptions in almost every pharmacy in Andalucía. Now, patients can spend less time

at PHCs and pharmacies because of the reduced time needed to deal with their repeat prescriptions.

The interface of the pharmacies' local information systems with Receta XXI also enables pharmacists to transmit dispensing data to SAS for reimbursement. The integration of Receta XXI with the local pharmacy systems also facilitates real-time stock control at the pharmacy. This concerns both directions - adjusting the inventory statistics when drugs are dispensed, and avoiding manual checks for availability of a medication prescribed through Receta XXI.

3.2.2 Clinical practices

There are several changes resulting from using information in Receta XXI. They include access by doctors to patients' medication histories in Diraya, the use of DSS to inform clinical decisions and practices, prescribing for up to one year, and review of prescriptions by pharmacists before dispensing.

Access to patients' medication histories by different doctors treating patients provides them with current and reliable information that they can use in taking clinical decisions. Doctors can use information about patients' allergies, contraindications of drugs and their current medications in taking new prescribing decisions. This is especially valuable where patients visit other GPs and doctors in hospitals' specialised and emergency care services. With Receta XXI, all authorised doctors have access to the same medication histories. When these doctors prescribe, the information is immediately available in patients' EHRs, so available to support the clinical decisions of the next doctor, supporting effective continuity of care.

This is especially valuable when patients receive drugs when they visit A&E, especially during the night or at the weekend when GP services are not available for providing information over the phone. All the information is available promptly to GPs for the subsequent decisions and actions. As a result, prescribing can rely on more information than with TASS.

DSS tools provide doctors with prompt information about clinical protocols and standards that they can apply directly in their clinical practices. With Receta XXI, new prescribing standards and protocols are available immediately to all doctors, ensuring that clinical and prescribing practices comply with the latest standards and are consistent across the region.

Prescribing for one year ahead can need different clinical practices. It needs a longer view from clinical assessments of patients' conditions and the equivalent assessment of the impact of prescribed medication. GPs do not routinely adopt the one year time-scale, preferring to fit prescribing timescales to patients needs, sometimes retaining conventional prescribing time periods and the clinical practices that require more frequent repeat prescriptions, or periods shorter than a year. The choice remains with GPs.

Pharmacists' access to the electronic prescriptions from PHCs contributes to improved prescribing practices as pharmacists can monitor and improve patient safety by reviewing patients' current prescriptions, and prescriptions of medication that cannot be dispensed, yet. These clinical decisions are part of pharmacists' involvement in the prescribing process. Information allows them to check prescriptions before dispensing, and, if they consider it necessary, cancel them precautionarily and communicate their concerns directly and promptly to the prescribing GP. Previously, patients could go to another pharmacy where they may have received the medications that may harm them. Pharmacists' concerns about safety have prevailed, and with Receta XXI the relevant GPs or paediatricians must review the cancellations before dispensing by any pharmacy can proceed. Additionally, for doctors' notifications on prescriptions pharmacists can now rely on robust information rather than on the reducing number of manual prescriptions with potentially undecipherable hand-written comments on the print-out of the prescription or patients' sometimes imprecise knowledge. The ease of completing these checks with Receta XXI makes clinical practices for pharmacists

and doctors more rigorous and transparent. There are few cancellations, about 0.05% of all ePrescriptions.

3.2.3 Working practices

New information with Receta XXI, such as patients' medication histories, DSS, cancelled prescriptions and dispensing records has resulted in some changed working practices.

Shared, comprehensive prescribing and dispensing data in patients' records leads doctors to adapt their working practices so they can view this information when patients are with them during consultations. In this setting, doctors listen to patients whilst accessing and reading information on Diraya and Receta XXI's screens. This occurred with TASS, but with more information in Receta XXI and Diraya, it is a more extensive working practice. Similar working practices prevail when doctors use information from DSS during patients' visits. As the volume of DSS information increases, access during consultations is likely to increase.

The small number of prescriptions cancelled by pharmacists relies on a new working practice of immediate electronic communication with the prescribing GPs. This prepares GPs before patients turn up at the PHC for the required reviews.

Receta XXI allows pharmacists to develop their working practices by expanding their dispensing role to increase the emphasis on counselling patients and monitoring prescriptions. Receta XXI provides pharmacists with prompt knowledge of prescriptions and generic prescribing that they can use to extend their role as patient advocates on drug regimes. Generally, pharmacists feel that Receta XXI enables them to enhance their professionalism considerably.

Seamless integration of Receta XXI with local information systems in pharmacies facilitates improved pharmacists' management and administrative working practices. They no longer need to enter dispensed medications into local systems. Direct connection supports their stock control and reimbursement and invoicing procedures. Instead of sending a pile of paper prescriptions to SAS for reimbursement, they now send their invoices produced electronically with details of the medications dispensed, the reimbursement codes and the reimbursement rates. They still have to assemble and despatch labels from dispensed cartons to support their claims.

3.2.4 Reaction and acceptance of users

The common reaction to the process changes is very positive, mainly because they support healthcare professionals' aspirations to improve their professional performance and give them choices about the rate of change that they pursue. Many GPs see the benefits from ePrescribing as primarily for patients needing long-term medication. Some GPs say that using Receta XXI for other patients needs too much time to explain the whole process. Consequently, some of them still prefer to continue with printed prescriptions. Patients needing long-term medication consider it worth spending the time needed for explanations of procedures at their first ePrescription so they can reap the subsequent benefits. Users' acceptance and the utilisation of Receta XXI depend on users' assumption of patients' reactions. Doctors as regular TASS, and now Receta XXI users, are very familiar with ePrescribing. Their acceptance is not in doubt. However, the influence of their judgement on patients' reaction and benefit seems to limit the growth in utilisation of Receta XXI. From 2003, the year of Receta XXI's small-scale implementation, up to 2008, ePrescribing has risen to about 46% of all prescriptions.

Demand to increase interoperability by expanding Receta XXI to outpatient specialised and emergency care and to integrate private physician services show the level of acceptance that Receta XXI has already achieved. Now, many doctors and pharmacists recognise that working without Diraya and Receta XXI is unimaginable.

3.3 Timeline and milestones

Receta XXI is a module of Diraya, so ties into Diraya's development, and the region's social, political and organisational context of Diraya's genesis. The decision of the *Junta de Andalucía* to build an information infrastructure integrating all public services provides one of Receta XXI's foundation stones. Receta XXI's overall goal is to improve prescribing and so healthcare. Now, it supports prescribing, dispensing and provides data for each patients' unique EHRs in Diraya. The timeline below outlines the most important steps that led to the development and the implementation of Receta XXI:

- 1990s EMR deployment starts, involving several industrial partners and providers supported by SAS
- 1995 Agreement of the Andalucía's Ministry of Health and the Ministry for Labour and Social Security on introducing a health card and of a common ICT solution for the primary healthcare network
- 1996 Distribution of the citizen cards starts
- 1997 TASS implemented
- 1998 Decision on the eHealth strategy to improve PHC management by creating an information system to develop Diraya to integrate all health data about patients into their single, unique EHR
- 1999 Decision taken to create Diraya as a system with Receta XXI as the ePrescribing module
- 2000 Set up of the Diraya working groups
- 2001 User data base (UDB) operation starts in October
- 2002 Design phase started with the first stage of implementation to validate Diraya's functionalities starting with the local applications in PHCs in Santa Rosa in Córdoba and El Saucejo in Sevilla
 - Citizens are granted access to the UDB to change their administrative information
- 2003 Many PHCs receive the first release of Diraya with a mixed architecture of centrally and locally stored data
 - Simultaneous testing of the centralised appointment model, the call centre Salud Responde and Receta XXI, the electronic prescribing and dispensing module
 - 04/2003 Virtual pilot of Receta XXI starts, involving one PHC and one pharmacy in different municipalities
 - 10/2003 Real pilot of Receta XXI starts, slowly extending to eight PHCs in eight different municipalities and all pharmacies
 - Validating of the final Diraya model with centralised architecture in the North of Córdoba healthcare area
 - Integration of the structure module and OCAM, the health provider registry
- 10/2004 Official roll-out of Receta XXI, starting in Huelva

- 12/2004 On December 13, final implementation starts and a completely centralised version of Diraya is released
- 2006 The EHR first deployed in hospitals' emergency room and specialist outpatient services
- 2007 Receta XXI implemented in Hospital Pozoblanco in Córdoba
- 2008 Receta XXI integrated in 93% of primary care
- 2009 Plan agreed to introduce Diraya for hospital inpatient services
- 2009/10 Intention to provide Receta XXI to all hospital doctors

The timescale of the EHRI evaluation reflects the scope defined in Chapter 2, leading to the evaluation start year of 1999. This is the year of the decision for an eHealth strategy to integrate all patients' health and healthcare data into their single, unique EHRs in Diraya and to include ePrescribing. The EHRI timeline includes all milestones up to and including developments in 2008. It extends to 2010 so that the impact of developments and implementations in 2008 are included. Costs and benefits of functionalities and modules planned and envisaged for 2009 onwards, such as expanding Receta XXI to hospital inpatient services in 2009 and 2010, are not part of the EHRI evaluation.

3.4 Supporting take-up

Organisational cooperation

Collaboration between SAS and the CACOF contributed significantly to Receta XXI's take-up. Agreements on implementing Receta XXI signed in 2002 cleared the way for its introduction. The supporting expert group comprised GPs, a pharmacist, an engineer of the *Dirección Regional de Informática* of SAS, pharmacists of the *Subdirección de Farmacia* of SAS and CACOF. The expert group meets whenever necessary to improve Receta XXI. All pharmacies had connections to the regional network to enable Receta XXI's implementation. Formal agreements between SAS and CACOF required pharmacists to acquire an appropriate PC, a card reader and to link to the network. These formal arrangements for engagement with the pharmacists as a profession, and pharmacists' individual enthusiasm for Receta XXI, ensured the pharmacies' commitment in the region.

Testing and roll-out

A virtual pilot ensured a smooth transition to sharing of ePrescriptions between GPs and pharmacists. One PHC and one pharmacy in Torreblanca comprised the pilot site. An engineer of the *Dirección Regional de Informática*, pharmacists of the *Subdirección de Farmacia* and a pharmacist of CACOF participated in this testing phase. The iterative process that created a virtual medical record as part of ePrescribing tested the technicalities. Doctors and pharmacists regularly provided their feedback on Receta XXI and its functionalities to help to improve it before implementation across the region. After six months, the pilot was scaled-up and gradually rolled out to pharmacies and different PHCs across other provinces in Andalucía. A technical commission of pharmacists of the *Subdirección de Farmacia y Prestaciones*, engineers of the *Dirección Regional de Recursos Informáticos* and pharmacists of CACOF monitored the ePrescribing processes. After this eleven-month testing period, Receta XXI's roll-out started in Huelva.

Training

Training was before implementation and included instructions from SAS members to physicians and from CACOF members to pharmacists. After training a group of professionals, mainly PHC heads, some pharmacists and local ICT staff members became trainers and taught

their colleagues how to prescribe or dispense with Receta XXI. An electronic training module and a paper handbook complemented the training activities. Training is continuous so that users can become familiar with new functionalities and changes.

3.5 Benefits

There are three main types of benefits, quality, access and efficiency, for each stakeholder group.¹⁷ Quality has five factors: better-informed citizens and carers, timeliness of care, safety, streamlined care, and modernised care. Access has two main features. One is improved equity of access to healthcare for all those in need and access for citizens who previously had no access. Efficiency is gained from improved productivity, avoided waste and a more optimal allocation and utilisation of resources.

3.5.1 Main types of benefits for stakeholders

There is a heavily skewed distribution of the value of benefits. Quality of care and efficiency are the prominent benefits in this case. Table 2 shows that HPOs benefit most from the quality gains, about 67% of all estimated quality improvements. Other stakeholder groups benefit by about 11% each. HPOs also benefit from most efficiency gains at over 54%. Citizens have about 28% of the efficiency benefits, including reduced travel time and costs with fewer repeat prescriptions and more timely care when they are away from home, and reduced needs to see GPs. The table also shows that Receta XXI has no impact on access to healthcare.

Table 2: Distribution of benefits by benefit categories

Distribution of Benefits %	Quality	Access	Efficiency	Total
By Benefit Category	%	%	%	%
Citizens	11%	0%	28%	23%
Healthcare Professionals	12%	0%	18%	16%
HPOs	67%	0%	54%	58%
Third Parties	11%	0%	0%	3%
Total Value	100%	0%	100%	100%

Source: EHR IMPACT study

The main drivers of benefits are data sharing between the healthcare professionals in primary, hospital outpatient specialised and emergency care, and pharmacies. Using long-term prescriptions boosts benefits. DSS tools play a less important role as some were already available in TASS, so the impact with Receta XXI is the increase and sophistication of the tools. An example is the increased speed of disseminating new protocols and standards. Through its link to Diraya they can be applied to all GPs and pharmacists across the regions and hospital doctors using Diraya. The effects of DSS are included in the benefits to this extent. Continued improvements in generic prescribing show a similar position. The large gains occurred from 2001 with TASS, so the benefit of Receta XXI in generic prescribing is its

¹⁷ EHR IMPACT (2008): Methodology for evaluating the socio-economic impact of interoperable EHR and ePrescribing systems, Bonn (Available online: http://www.ehr-impact.eu/downloads/documents/EHRI_D1_3_Evaluation_Methodology_v1_0.pdf)

estimated impact in sustaining the continued, but slower growth rate in generic prescribing form 2005 onwards.

Table 3: Distribution of all benefits by stakeholder benefits

Distribution of Benefits %	Quality	Access	Efficiency	Total
By Stakeholder Benefits	%	%	%	%
Citizens	12%	0%	88%	100%
Healthcare Professionals	19%	0%	81%	100%
HPOs	30%	0%	70%	100%
Third parties	100%	0%	0%	100%
	26%	0%	74%	100%

Source: EHR IMPACT study

Table3 shows the skewed distribution of all benefits for each stakeholder group. For citizens, 88% of their benefits are from efficiency gains, 12% from quality gains. Healthcare professionals have a similar distribution, 81% and 19% respectively. The HPO split is about 70% from efficiency, about 30% from quality. All the third party benefits are quality gains.

3.5.2 Patients, informal carers and other people

Improved quality of care and more efficient healthcare are the main benefits for citizens, patients and their carers. A core part of quality is improved patient safety, and with the ePrescribing system, patients benefit from more rigorous prescribing and dispensing. DSS tools for prescribing improve patient safety as they assist physicians in prescribing by providing them with information about the characteristics of drugs, such as potential ADEs and contraindications, and important aspects about their use. Patients and their carers also benefit from prescribing that relies on shared patients' medical histories, including allergies and information on patients' past and current medication. This is especially important where patients see several GPs over time and when they move between primary and hospital services. GPs can use this type of information to assess the potential for efficacy and to mitigate the risk of adverse drug events.

Dispensing with Receta XXI also improves patient safety. Pharmacists can view patients' current and long-term prescriptions and check new prescriptions. If necessary, they can precautionarily cancel them and refer patients back to their GP, who receives immediate notification from pharmacists. Cancelled prescriptions are about 0.05% of all ePrescriptions. Receta XXI prevents other pharmacists from dispensing patients' cancelled medications. As patients have to return to the GP who prescribed the medication, either to receive a different prescription, or to have the original one reactivated, the risk to patients of ADEs reduces.

Pharmacists can help patients with long-term prescriptions to manage their continuing medication. Receta XXI enables pharmacists to match subsequent dispensations with specifications in long-term prescriptions. All patients with ePrescriptions and their carers across Andalucía can benefit.

Patients also benefit from improved efficiency. They save time and travel costs by avoiding appointments for some repeat prescriptions.

Patients and carers also save some time during consultations, as it is not necessary to question them about past medical or medication information. As physicians have the

information required to ensure safe prescribing, patients are spared prolonged consultations in primary, specialised and emergency care.

Using Receta XXI to transfer information about problems or incidents with medications to regional and national bodies quickens the dissemination of appropriate action. Prompt responses, such as calling in patients and substituting their medications, benefit patients by reducing their exposure to risk.

3.5.3 Health service teams

Healthcare professionals benefit by having information they need to improve the quality and efficiency of their services, mainly by promptly sharing data between them so that they have access to information they need about their patients. Information available to healthcare professionals across the entire region enables doctors to access patients' health histories and their current health status to make better-informed clinical decisions. They also benefit by using DSS to help them with their prescribing choices. This has increased their professional satisfaction.

Receta XXI facilitates GPs' decisions when they choose to prescribe for periods of up to one year for some patients. When they do, it results in a reduction in GP visits with consequent workload reductions and time-savings for GPs. When patients have their first ePrescription, their subsequent visits reduce by an average of more than 15%. GPs can allocate the time saved to other patients and activities, so value the reduced workloads realised with Receta XXI.

Pharmacists are clear that Receta XXI has improved their relationship with GPs and their patients. Information available for them to review prescriptions when they are dispensed allows pharmacists a more constructive role in the prescribing process. They are able to develop their role to counsel their patients, and thus augment their professionalism.

All interviewees from primary, specialised and emergency care confirmed the importance of Receta XXI. Even though most of specialists and emergency care doctors cannot use Receta XXI to prescribe, they acknowledge the value of electronic access to comprehensive medication records and their contributions to helping them to improve healthcare quality in Andalucía.

3.5.4 Healthcare Provider Organisations (HPOs)

Benefits for HPOs derive mainly from the benefits for the healthcare teams in PHCs, hospitals and pharmacies. Increased patient safety and other healthcare qualities, and improved efficiency and productivity, accumulate to benefit HPOs' resource utilisation. Reduced risks of ADEs benefit HPOs too.

SAS benefits from the reduced number of patients who visit GPs to renew their long-term prescriptions. It enables these resources to be allocated to other patients, and forms part of SAS's response to manage increasing demand.

Generic prescribing by active ingredient as part of RUD leads to cost savings for SAS as the healthcare financing organisation. Receta XXI helps to sustain the continued growth in generic prescribing initially supported by TASS, so Receta XXI is assigned a proportion of the continuing savings.

3.5.5 Third parties

This stakeholder group's benefits arise from its public health role. The MoH prepares and releases evidence-based clinical standards and protocols. These are released with Diraya's, and so Receta XXI's DSS tools. Some of these include prescribing protocols and Receta XXI offers benefits to the MoH as a more effective facility to disseminate this information rapidly and comprehensively across the region. This enables their consistent application by healthcare professionals and can benefit all Andalucía's citizens over time. As the MoH expands these activities, the benefits will increase beyond 2010, the last year of EHRI's evaluation.

3.6 Costs

Two major components of costs associated with eHealth activities are ICT-related investment and any negative impacts by using Receta XXI. The step-by-step implementation and continuous development results in ICT-related investment stretching across the whole life-cycle. Negative impacts include initial resistance and events that impede workflows. Because GPs can choose the types of patients that offer benefits with Receta XXI, GPs can avoid some negative impacts.

3.6.1 Patients, informal carers and other people

Direct costs for patients are nil.

3.6.2 Health service teams

Three types of health services teams' costs are Receta XXI's development, implementation and operation. Adapting Receta XXI to healthcare professionals' requirements needed a significant, sustained time commitment by several GPs and pharmacists from the start of the development phase. Much of this time invested by members of the expert group was from their private time, so each one incurred these costs.

Implementing Receta XXI needed pharmacists to allocate their time to training and adapting slightly some of their existing and continuing systems for pharmacy administration and management. Even though many of the health service teams involved were familiar with TASS and a digital environment, they still experienced initial inconvenience and irritation caused by the system. This is a negative impact, as part of Receta XXI's costs.

Operating Receta XXI initially needed additional effort from health service teams. They had to use the new tools and information, needing slight changes from the previous prescribing and dispensing practices and processes. These were not onerous for pharmacists, who are enthusiastic about Receta XXI.

3.6.3 Healthcare Provider Organisations (HPO)

SAS initiated Receta XXI and incurred most of the costs at local and regional levels. These costs include systems design, development, testing, implementation, operation, engagement, training and other costs of organisational change.

Pharmacies incurred the costs of card readers. They also allocated their time for Receta XXI from resources available from SAS reimbursements and income from commercial activities.

Development costs include engagement with healthcare professionals in expert groups and the costs of the SAS ICT teams working with vendors in setting requirements, designing architectures and functionalities, using new tools and compiling code to produce and develop pilot versions. SAS tested these in 2003 and 2004 in PHCs and hospitals. Existing healthcare staff allocated to these Receta XXI activities is a cost redeployed away from direct healthcare activities. SAS finances the additional costs of contractors and vendors.

SAS provided extra resources for implementation and these worked alongside healthcare professionals who allocated their time away from direct healthcare to work with project teams and trainers and review and develop clinical and working practices. New hardware, especially servers and networks, are part of implementation. SAS also finance the costs of Receta XXI operation, including contracts and payments to vendors, maintenance and obsolescence as part of the cost of Diraya.

3.6.4 Third parties

The estimated costs to third parties are nil.

3.7 Socio-economic analysis

3.7.1 Summary of methodology

The theoretical foundation for an EHR IMPACT (EHRI) evaluation is cost benefit analysis (CBA)¹⁸. The UK Treasury's Green Book¹⁹ and Germany's WiBe²⁰ specify the CBA methodology as an appropriate tool for analysing the impact of investments and activities in domains of public interest, including healthcare. CBA enables the impact on all stakeholders to be included in a socio-economic evaluation and the financial implications estimated over the selected timescales, extending from 1999 to 2010 for the EHRI evaluation. Three datasets are: statistics, costs and benefits.

Statistics include data about the population affected by the EHR or ePrescribing solution, the number of users, eHealth transactions, and changes in healthcare activity. Indicators can be available from healthcare provider organisations (HPO), but not always for the whole evaluation life-cycle, so some estimation is needed. These assumptions are held separately from data of actual activity, increasing transparency and helping identify critical assumptions. A feature of the EHRI methodology is that information gathering has to rely on existing data and expert estimates. It is beyond the temporal and budgetary constraints of the study to perform detailed observational studies in order to investigate precise changes in time allocations or in quality of care. Thus, the results are to be interpreted within their order of magnitude instead of absolute values. Despite this limitation, the evaluations provide a sufficient level of rigour to support the qualitative analyses and the conclusions on the overall impact and performance of the evaluated sites.

Information on monetary values of all relevant costs and benefits described in the above sections is seldom readily available from HPOs because their statistical and financial records

¹⁸ EHR IMPACT (2008): Methodology for evaluating the socio-economic impact of interoperable EHR and ePrescribing systems, Bonn (Available online: http://www.ehr-impact.eu/downloads/documents/EHRI_D1_3_Evaluation_Methodology_v1_0.pdf)

¹⁹ HM Treasury (2003). The Green Book, Appraisal and Evaluation in Central Government. Treasury Guidance. London. Available at: http://www.hm-treasury.gov.uk/media/05553/Green_Book_03.pdf

²⁰ Röthig, P. (2004). Recommendations on Economic Efficiency Assessments in the German Federal Administration, in Particular with Regard to the Use of Information Technology. WiBe Economic Efficiency Assessment. Available at: http://www.eu.wibe.de/wibe_framework/wibe_framework2/0806_WiBe-Framework.pdf

do not record most of these routinely. Unit costs of resources need to be estimated at constant prices over the whole investment life-cycle of design and development, engagement, testing, implementation, operation and change. Estimates of all stakeholders' involvement rely on assumptions about the time allocated to these activities. Doctors' time redeployed from other activities and additional costs, such as new project teams are examples. Actual payments to ICT suppliers are usually the bases for the estimated ICT costs over whole life-cycles.

Estimating the monetary value of impact uses several techniques. Time savings of staff and numbers of tests can be estimated from unit cost calculations. Quality gains have five categories of better-informed patients, timeliness of care, effectiveness of care, patient safety and streamlined care. Some of these can be estimated using unit cost calculations, such as avoided hospital admissions. Intangible benefits, such as the value to patients and organisations, rely on willingness to pay estimates inferred from stakeholder behaviour, usually with very small values for some patients who enjoy a new benefit. The same technique is used for benefits to healthcare professionals who can be adamant that eHealth could not be removed because it benefits their working days. The same technique is also used for intangible negative impacts such as irritations and inconvenience. Intangible benefits for HPOs, such as reductions in risk exposure, are valued using insurance-based models. Benefits from efficiency gains are valued using estimates of the changes in unit costs from productivity improvements. Some benefits realise cash benefits, such as identifying increased activity that can be billed. Estimates of extra activity multiplied by prices provide the monetary value. Details on the impact indicators and the quantification methods involved in this particular case study are presented in Appendix 2.

These techniques provide baseline estimated costs and estimated benefits, where costs include all negative impacts and benefits all positive impacts. Contingency adjustments are used to reflect the reliance on estimation. They increase costs and reduce benefits. Contingencies can be as high as 70% for some baseline monetary values. Adjusted estimated costs and benefits are discounted to net present values then tested for sensitivity to identify the impact of the reliance on estimates on the findings.

The overall impact is measured by the estimated monetary values of annual and cumulative benefits, and so net benefits over time. These show the time taken to realise net benefits and their scale. They also reveal the distribution of the costs and benefits between stakeholders and the distributions of extra finance, redeployed finance and non-financial costs and benefits. Judging eHealth impact requires the focus on relative, not absolute monetary values, especially cost benefit ratios and correlations of costs, benefits and eHealth utilisation.

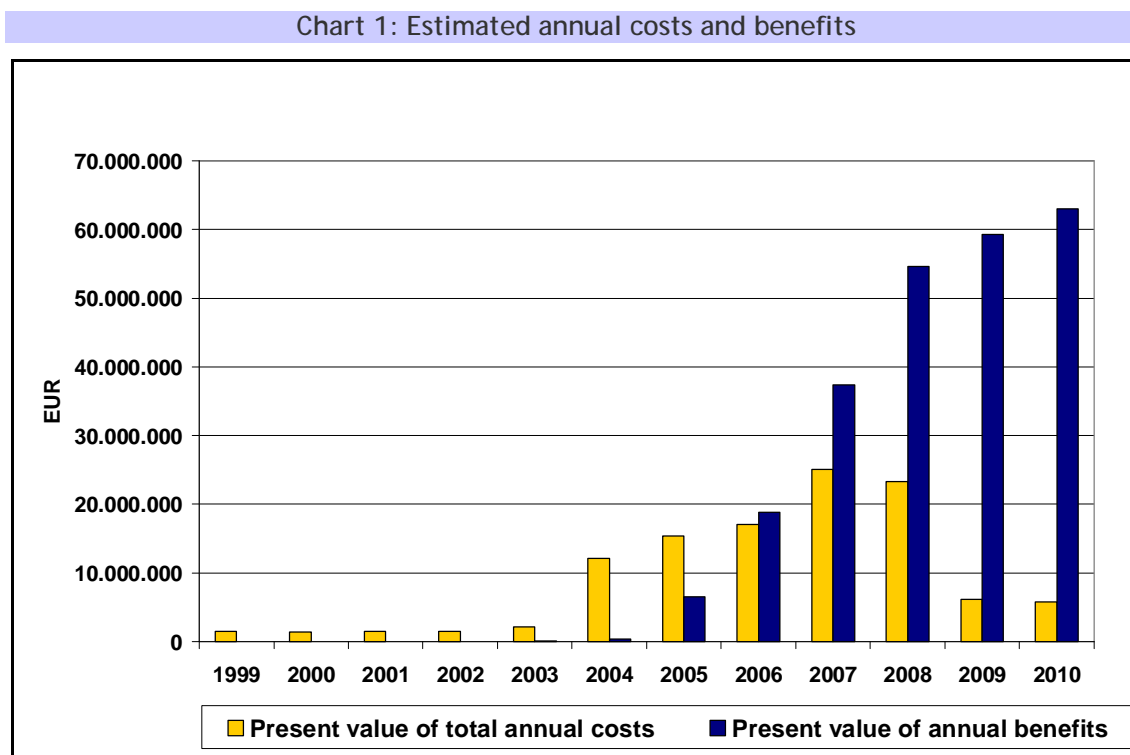
3.7.2 Net benefits

Net benefit over time is the critical measure of the overall socio-economic impact of eHealth. It identifies when and by how much, benefits exceed costs over time. Two important features of the net benefit estimates are:

- Net economic benefit is a monetary measure of the net value of all costs, benefits and positive and negative impacts, not a measure of financial returns, and a brief analysis of the financial impact follows the distribution of costs and benefits into different categories, including financial, in section 3.8 below
- Value is in the overall position and performance, not in the absolute values presented, and tested for sensitivity as described in section 3.7.4 on sensitivity of results.

3.7.2.1 First year of annual net benefits

Chart 1 below shows the present values of estimated costs and benefits for each individual year over the relevant lifecycle.



Source: EHR IMPACT study

Estimated annual net benefits took eight years to be realised, some two years after the start of Receta XXI's official roll-out. From the first year of annual net benefits in 2006, the margin is substantial and increasing, indicating a strong, sustainable positive impact.

The increase from the third year of annual benefits in 2004²¹ to the following years is steep. In 2004, annual benefits amounted to less than 400,000 EUR while in 2005 they had reached an estimated value over 6.5 million EUR. After accelerated growth up to 2008, the growth rate of annual benefits slows down as Receta XXI growth in utilisation begins to slow down. At the end of the EHRI evaluation period in 2010, annual benefits reach an estimated value of about 63 million EUR.

From 2003 to 2004 estimated costs increase rapidly. 2004 is the year in which Receta XXI is rolled out, so costs such as for servers and operating systems were incurred to introduce the system. Together with expenses on training for health professionals and the negative impact of their initial inconveniences, the value of annual costs accumulates to an estimated 12 million EUR in 2004. The initial low number of users limits the scale of benefits to be realised in the same year. Afterwards, annual costs' growth rate is decelerated and after reaching its peak in 2007, they reach an estimated 6 million EUR in 2010.

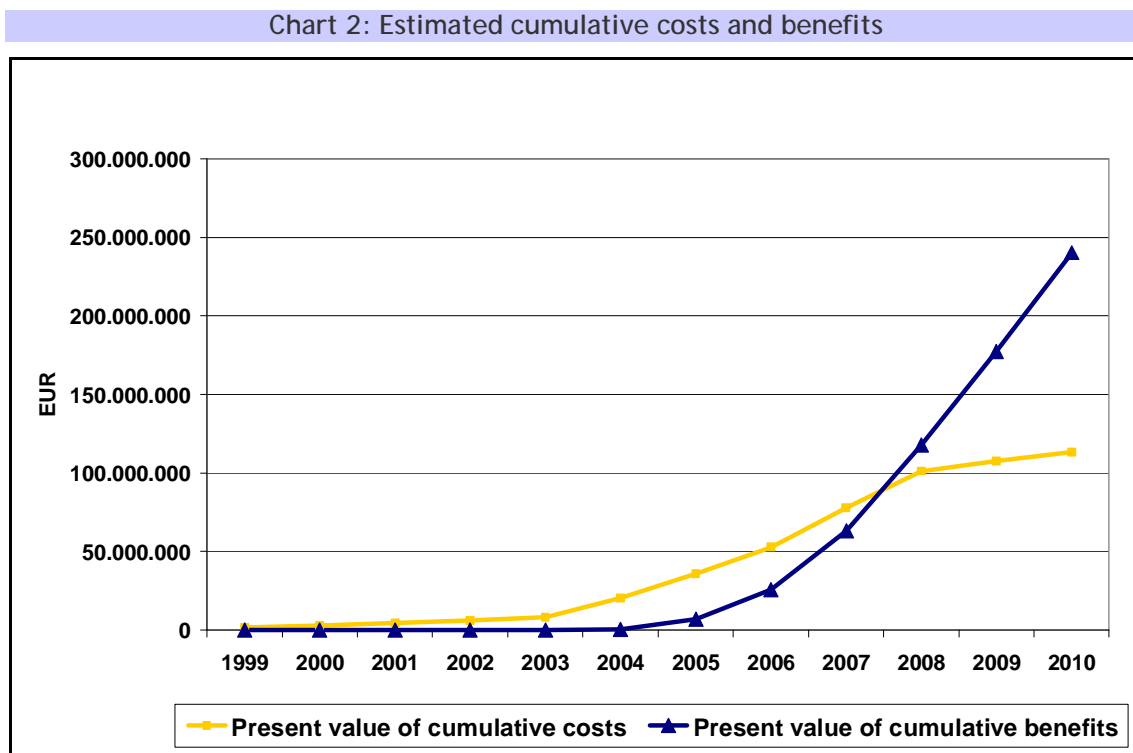
From 2009 onwards, the year in which annual costs decrease to operational level, annual net benefits remain at a comparatively high and sustainable level at an estimated 57 million EUR in 2010.

²¹ The scale of benefits in 2003 is too small to be seen on the chart, cf. Appendix 1.

The comparatively long period of steadily increasing costs and zero benefits from 1999 to 2002 reflects the region's implementation strategy, with Receta XXI being an integral part of Diraya.²² Users' engagement straight from the beginning, cooperation with different actors and the iterative process of testing the system and its gradual roll-out fostered the ePrescribing system's seamless integration. Having technical, political and organisational issues as a core part of the overall investment paved the way for the system's long-term viability.

3.7.2.2 First year of cumulative net benefits

The aggregation of the annual costs and benefits to cumulative values shows the overall socio-economic impact over time. Chart 2 shows the costs and benefits curves.



Source: EHR IMPACT study

Receta XXI yields a positive cumulative net socio-economic benefit from 2008, year ten of the lifecycle and in the fifth year of its large scale implementation. The gap of only two years between realisation of annual and cumulative net benefits is consistent with observations at other sites, and attributed to the relatively fast increase in utilisation and the net benefit margin once annual benefits start exceeding annual costs.

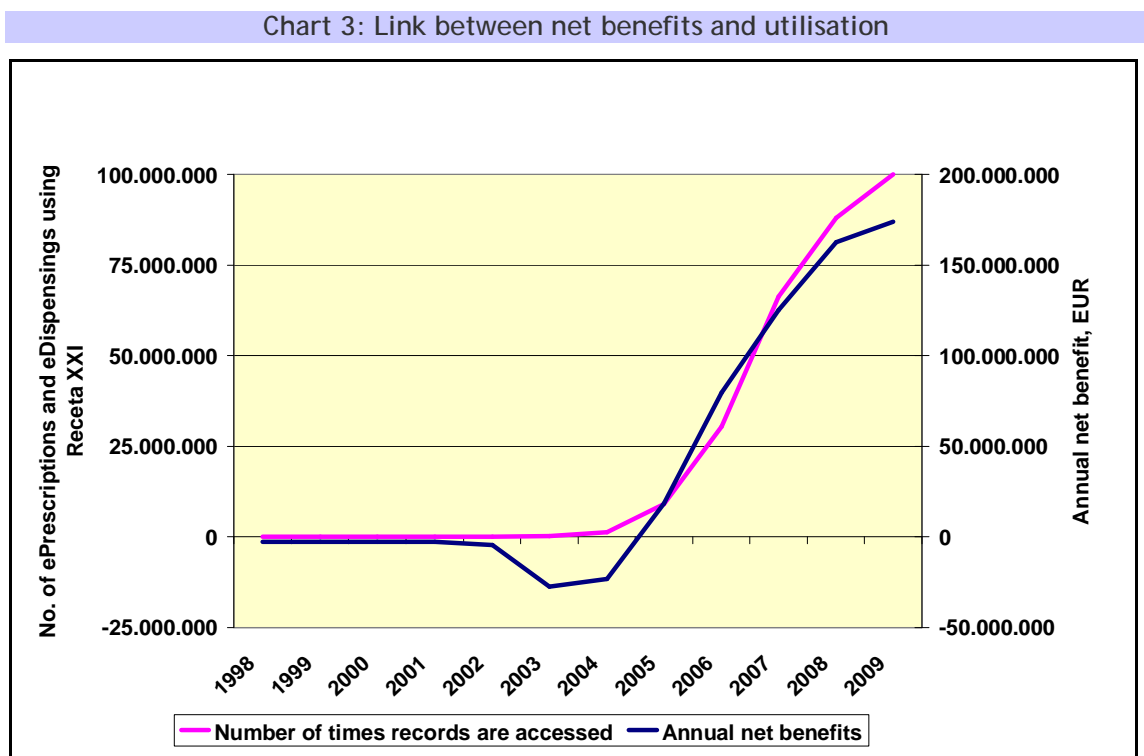
The cumulative cost curve increases gradually over the development and implementation period, decelerating in the late years of the life cycle, whereas the benefit curve rises steeply in the years after implementation. The characteristics of the cumulative net benefits mirror the annual impact. In the first year when cumulative benefits exceed cumulative costs, cumulative net benefits total around an estimated 16.6 million EUR. In 2010 the value amounts to an estimated 127 million EUR. While the rate of increase of cumulative benefits

²² The eHealth IMPACT average time to annual net benefits was 4 years, cf. reports Stroetmann, Karl A.; Jones, Tom; Dobrev, Alex; Stroetmann, Veli N. (2006): eHealth is Worth it - The economic benefits of implemented eHealth solutions at ten European sites. Luxembourg: Office for Official Publications of the European Communities. Available at: <http://www.ehealth-impact.org/download/documents/ehealthimpactsept2006.pdf>

remains high, cumulative costs' growth rate decelerates to lower levels from 2008 onwards. The stable rate of increase of cumulative costs reflects the stabilised level on annual basis, shown in Chart 1. This is a critical relationship, indicating the long-term economic sustainability of the application.

3.7.2.3 Net benefits and utilisation

The relationships between annual costs, benefits and utilisation of Receta XXI show a strongly positive correlation between annual benefits and utilisation. Utilisation reflects Receta XXI's use, and so potential to drive net benefits. Chart 3 below demonstrates the link between Receta XXI's net benefits and utilisation.



Source: EHR IMPACT study

If Receta XXI is underutilised, net benefits are difficult to realise. However, the obverse is not always true. That a system is fully utilised does not automatically mean that net benefits accrue unless it provides usable and useful information and if total costs are a reasonable proportion of total benefits. In this setting, matching utilisation and net benefits curves after implementation reveals these relationships. Utilisation includes the number of ePrescriptions dispensed electronically with Receta XXI.

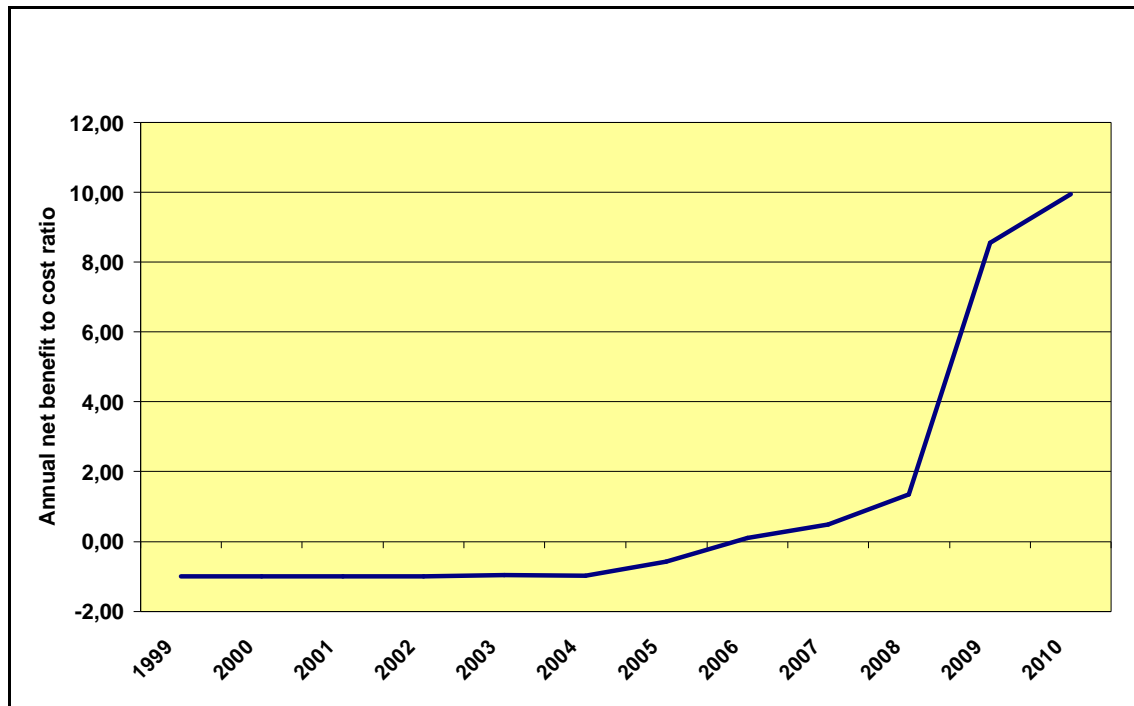
The increase of annual net benefits mirrors the development of the utilisation curve. From 2005 onwards, one year after Receta XXI's roll-out, both factors experience accelerated and similar growth. The high positive correlations of utilisation to benefits of +0.99 and utilisation to net benefits of about +0.97 indicate this interrelationship.

3.7.2.4 Net benefit to cost ratio

The net benefit to cost ratio provides a comparison of the net benefit of Receta XXI to the estimated costs, including negative impacts. A positive ratio indicates a worthwhile socio-

economic endeavour. A ratio of zero equals an implicit break-even point of net benefits and costs.

Chart 4: Annual net benefit to cost ratio



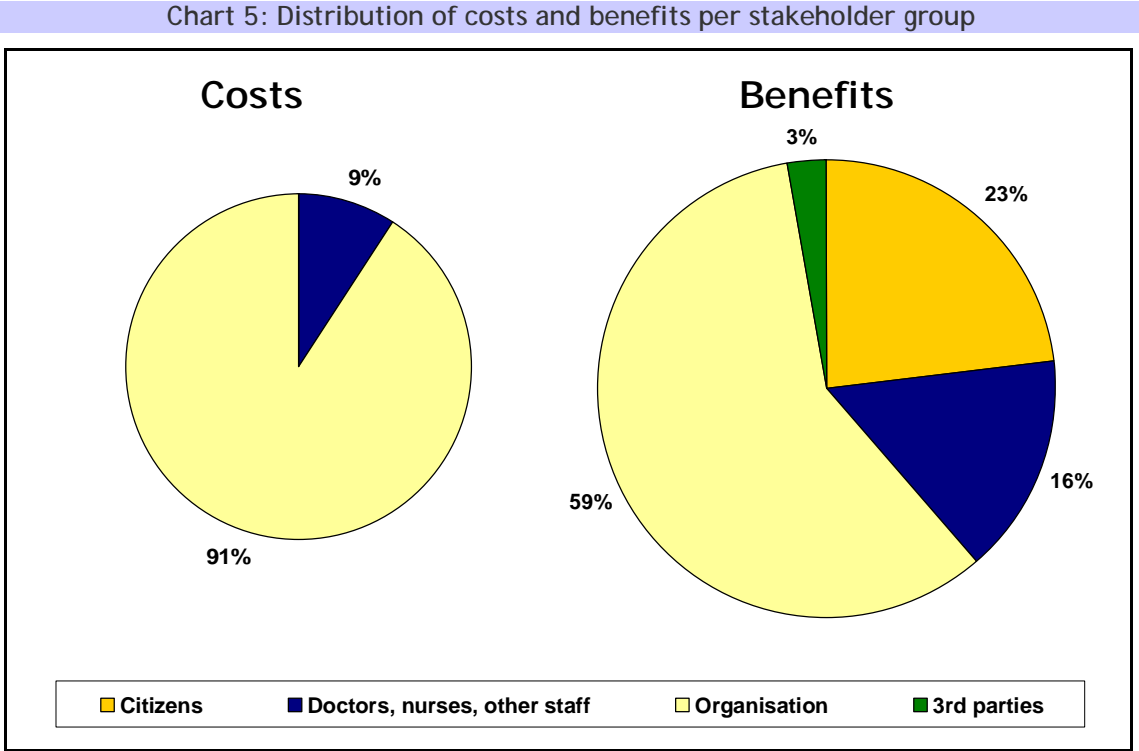
Source: EHR IMPACT study

Chart 4 shows the annual net benefits to costs ratio remaining at a constant negative value up to 2005, becoming positive with +0.1 in 2006. After moderate growth up to 2008, the net benefit to cost ratio rises steeply and reaches an impressive value of +9.95. The quick increase is a result of implementation costs going down much lower to operation cost levels after 2008.

Two years after the annual ratio, the cumulative net benefit to cost ratio turns slightly positive in 2008 at +0.16 and shows a similarly impressive development over the lifecycle. By 2010, the cumulative net benefit to cost ratio reaches +1.12.

3.7.3 Distribution of costs and benefits to stakeholders

Chart 5 shows the distributions of Receta XXI’s costs and benefits of between the main stakeholder groups.

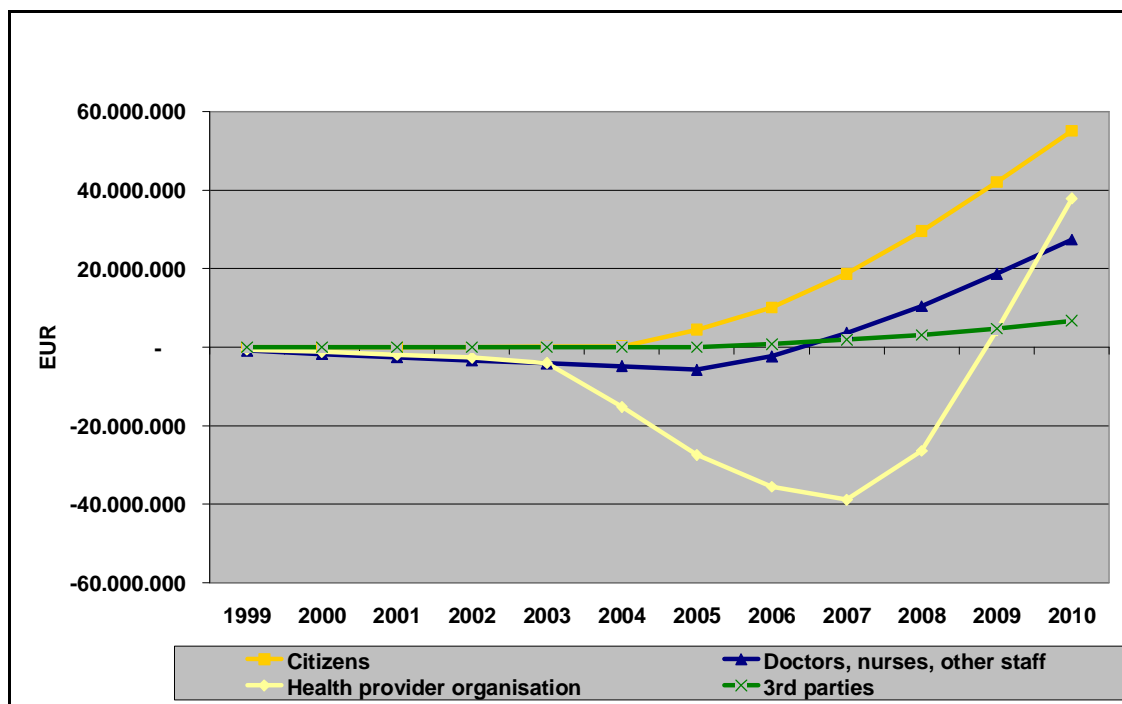


Source: EHR IMPACT study

HPOs carry the largest share of the costs. SAS as the main health provider in Andalucía, is responsible for the implementation of Diraya and, as so Receta XXI. It pays for the biggest share, including the vendor contracts and ICT infrastructure. About 60% of costs for PHCs, hospitals and pharmacies accrue from ICT expenses and the remaining costs are allocated to organisational issues. Healthcare professionals bear the negative impact stemming from disruptions, inconveniences to and engagement in development and implementation, accounting for 9% of the overall costs. Similar to other eHealth projects, citizens do not have a portion of the costs.

The benefit and cost distributions are different. This is a common feature of successful eHealth. HPOs receive about 59% of the benefits and, similar to the cost distribution, they have the largest share. Third parties receive only around 3% of the overall benefits even though they carry no costs. Citizens' cost benefit allocation is similarly diverged but at a bigger scale: zero costs compared to about 23% of the benefits. 16% of the benefits are for health professionals as individuals.

Chart 6: Distribution of cumulative net benefits per stakeholder group



Source: EHR IMPACT study

Chart 6 shows the development of cumulative net benefits for each stakeholder group, which is consistent with the net benefits described. All stakeholder groups receive positive cumulative net benefits. HPOs' cumulative net benefits remain negative for a longer period than the other stakeholder groups. However, once they turn positive in 2009, the curve rises steeply and exceeds the others. From an estimate of 5 million EUR in 2009, their growth rate is the steepest and reaches the highest value at the end of the EHRI evaluation, with an estimated 39 million EUR.

In contrast, third parties' cumulative net benefits experience the most moderate increase. They stabilise at the lowest level. However, after several years as zero, they remain positive each subsequent year.

Since citizens do not have to carry any costs, their cumulative benefits leave them with an estimated 55 million EUR cumulative net benefits at the end of the EHRI evaluation period. Time-savings from the availability of patients' medication history and avoided travel costs from long-term prescriptions significantly contribute to them receiving the second biggest share of cumulative net benefits.

Healthcare professionals' cumulative net benefits turn negative from the start of Receta XXI's development and turn positive only in 2007. They reach an estimated 29 million EUR of cumulative net benefits in 2010.

3.7.4 Sensitivity analysis

The sensitivity analysis consisted of 24 separate tests, focusing on all possible estimated variables that the outcomes of the socio-economic analysis could be sensitive to. Such variables include a number of probabilities based on secondary literature, as well as estimates of willingness to pay values inferred from behaviour, and estimated time changes for which no scientific proof was available.

The tests involved changing the values of blocks of variables included in the calculation of the monetary values of costs and benefits towards a pessimistic scenario. Values were lowered or increased by between 50% and 500%, depending on the variable in question, and in a direction potentially reducing the net benefit over time. The discount rate has been tested for sensitivity at plus 100% and minus 50% of the EHRI rate of 3.5%.

The overall results of the socio-economic analysis are not sensitive to any individual block of estimations. The impact of manipulating assumptions is minimal, with highest impact involving a deferral of annual or cumulative net benefits by one year; in one occasion by two years. The overall socio-economic impact for the EHRI evaluation timeline, measured by the cumulative net benefit to cost ratio in 2010, worsens within a range of up to 90%, yet still leaving a positive cumulative result of 0.07.

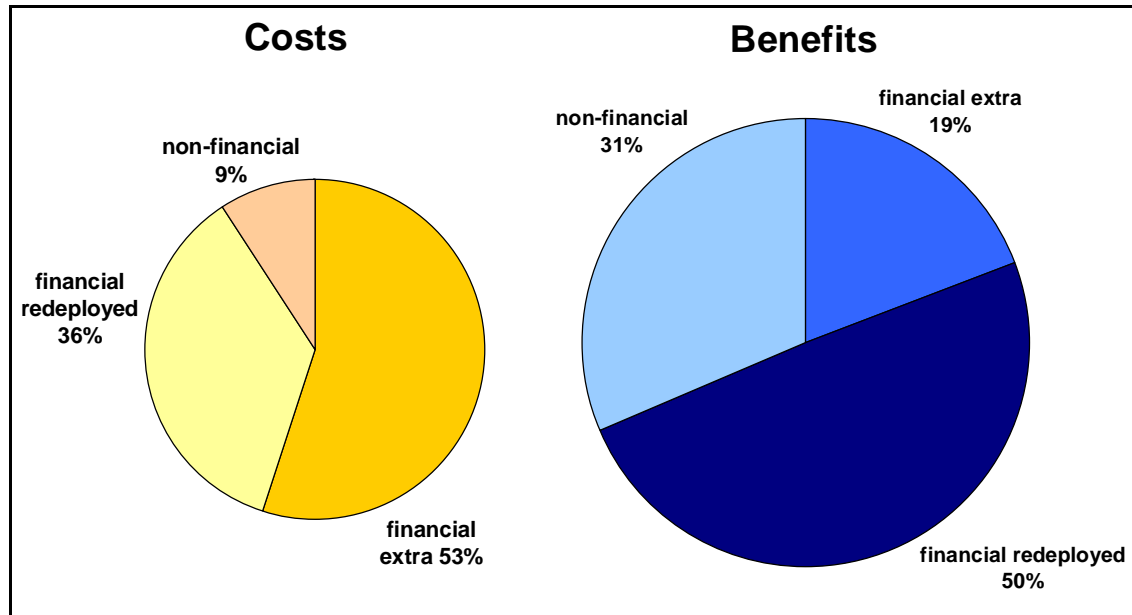
The results of the sensitivity analysis thus show that the conclusions drawn from the socio-economic analysis are robust, and do not depend on individual estimations or assumptions.

3.8 Financing and financial impact

3.8.1 Financial impact

Receta XXI's financial impact is differs from the cost benefit performance. Each cost and benefit is assigned to on of three categories, extra finance, non-financial, or redeployed finance, to show the financial implications of the investment. Chart 7 shows the results.

Chart 7: Financial and non-financial impact



Source: EHR IMPACT study

One-fifth of the overall benefits are classified as extra finance released, estimated as some 46 million EUR. This high proportion of extra released finance is an uncommon feature of general eHealth. These financial savings arise from the SAS policies for generic prescribing, so accrue exclusively to SAS. One third financial savings are for citizens, another untypical feature of eHealth. It includes fewer trips to GPs for repeat prescriptions.

The equivalent analysis of costs shows that more than the half of all costs needs additional finance. The estimate of 62 million is exclusively borne by HPOs, and is primarily based on investment in ICT.

Comparing annual net financial benefits and costs shows that two stakeholder groups receive a positive net financial impact. HPOs reap an estimated 1 million EUR of extra finance in 2010 and citizens, patients and carers an estimated 4 million EUR. Only citizens make a positive cumulative financial return over the EHRI horizon.

About half of all benefits have the potential for redeployment. As the only beneficiaries of this benefit type, HPOs benefit from around an estimated 118 million EUR of resources released for redeployment to other activities. About 36% of the costs are redeployed resources from other activities, of which again, HPOs bear the entire amount, accounting for come some 40 million EUR. This leaves HPOs with net benefit of redeployed resources of some 78 million EUR. Although resources for redeployment are in many small pockets and difficult to redeploy as a set of corporate decisions, they can help HPOs to meet increasing demand in healthcare.

About 31% of all benefits are non-financial benefits. Three stakeholder groups benefit from this category, HPOs do not. The biggest beneficiaries are health professionals as individuals, receiving non-financial benefits with an estimated value of 37 million EUR. Whilst they profit from improved working convenience and the feeling of increased professionalism, citizens', patients' and carers' share of 31 million EUR is based on enjoying enhanced quality in prescribing and dispensing, primarily resulting in reduced exposure to risks of ADEs. The facilitated application and dissemination of prescribing and health protocols benefit third parties with non-financial benefits of some 7 million EUR. Health professionals are the only stakeholders with non-financial costs, with an estimated value of some 10 million EUR. This means that the system's positive outcome as perceived by healthcare professionals outweighs the inconveniences they experience through Receta XXI making it worth investing their time in participating in its development, implantation and operation.

3.8.2 Financing arrangements

As Receta XXI is a module of Diraya, and its funding arrangements are the same. SAS financed part of the cost of Diraya from its annual allocation from the regional MoH. The other part relied on funding from the European Regional Development Fund (ERDF) and Red.es, the Spanish federal body for the promotion of the information society across Spain. Between 2005 and 2008, the ERDF contributed over 3.6 million EUR. Red.es provided over 10.5 million EUR between 2007 and 2009.

3.9 Legal aspects

Data confidentiality law in Spain covers legal issues regarding personal data and health data. It does not explicitly deal with confidentiality issues regarding EHRs and ePrescriptions, leaving room for interpretation and inconsistencies. As a result, confidentiality and data protection, including data access, is a constant concern as Diraya has reached a level of sophistication that may exceed the health informatics context of the legal framework.

National legislation enables citizens in Andalucía to access their medical records whenever they wish. This applies to information in, and generated by, Receta XXI and held in Diraya's EHR. Each citizen's ID number, the NUHSA, is a simple, sequentially generated number, and contains no personal information that can identify a citizen. Nor does the card carry any data.

It serves only as a key to the EHR, the medication record, and the information saved in Diraya's central data repository and the local data stores.

4 Conclusions

Receta XXI illustrates the impact of ePrescribing combined with an interoperable EHR system on a region's healthcare provision. This case study shows good practice as a benchmark for similar investments. The general conclusion from the case study is that investing in interoperable ePrescribing systems, in particular as part of a large-scale project covering an entire region and in connection to an EHR system, is a worthwhile endeavour, provided the investment is well grounded and an integral part of the region's health strategy. The investment and negative impacts are more than covered by the benefits of using Receta XXI.

4.1 Future potential

The value of Receta XXI's current use is sustainable because:

- Improved prescribing procedures are the main benefit driver, comprising prescribing that can refer to patient's medication histories and prescribing DSS
- Long-term prescription, yielding a significant share of benefits predominantly pertains to prescriptions initiated in primary care
- Pharmacists are enthusiastic about Receta XXI's benefits.

A common feature of sustainable eHealth applications is their continuous improvement and Receta XXI is no exception. Development of expanding ePrescribing functionalities is already underway. DSS tools are currently being improved. Particularly as ePrescribing is interoperable with citizens' EHRs, DSS for prescribing bears enormous potential. It can facilitate personalised and diagnosis-based prescribing and be integrated into the region's integrated care plans.

Expanding the range of Receta XXI will tap its full potential. It will widen information exchanges to include ePrescribing by hospital outpatient specialised and emergency care, with all patients using these services benefiting from increased patient safety and efficiency.

4.2 Transferability

Receta XXI is an interoperable module of Diraya, the regional EHR, and depends on data in other Diraya modules, such as the citizen registry and the EHR. Receta XXI can transfer to other locations only if these interoperable facilities and data are available. Receta XXI is transferable if Diraya and its databases are transferred with it.

The experience of developing Receta XXI is transferable. Planning features, such as time for effective engagement, developing and testing and progressive implementation offer good practices to other locations.

Two important features of Receta XXI derive from its comprehensive interoperability with Diraya's EHRs. Where HPOs have this in place across several types of healthcare, extending prescribing information may not need additional interoperable interfaces with a range of EHRs. Second, developing Receta XXI started from previous experience with TASS. This continuous expansion rolls experience, learning and knowledge through time in an organisation, creating a stable and improving human resource that can succeed with complex solution like Diraya and Receta XXI. Transferring Receta XXI should include the expertise now in the regional MoH, SAS, CACOF, and HPOs.

4.3 The role of interoperability in realising the benefits

As Receta XXI is part of Diraya, interoperability is at its core. It enables the use of common technical and data standards and definitions so that healthcare professionals can share information securely. Shared information is essential to Receta XXI's benefits. Pharmacists can access GPs ePrescriptions and dispense them, review them, cancel them on the few occasions necessary and communicate the action immediately to GPs, reducing the risk of ADEs. Long-term prescriptions are manageable and avoid the costs of patients' visits to GPs for some repeat prescriptions. Without interoperable data and connectivity, it would be difficult to prescribe medication for a period of up to one year, manage regular dispensing and be confident about maintaining patient safety. Repeated questioning by GPs of patients about their medication is avoided and prescribing errors less likely, especially in outpatients and A&E.

Effective interoperability is essential to access data in other parts of Diraya, such as the citizen's registry and DSS. It is essential to transfer information from Receta XXI to Diraya's EHR and so compile patients' medication histories in their comprehensive records.

4.4 What it means for decision makers

Experience from Receta XXI is valuable for decision makers in planning and managing investments in interoperable EHR and ePrescribing systems. For analysing success factors it must be kept in mind that Receta XXI is intrinsically tied to Diraya. Even though Receta XXI has its own environment, it is in the context of the bigger, comprehensive context and strategy of Diraya.

4.4.1 Useful experience

Leadership & long-term health strategies

Sustainable effective leadership over the long-term helps to stabilise large-scale projects when governments can change more than once. Many large projects fail because of the change of competent authorities and priorities. Diraya and Receta XXI benefit from two factors. One is the continuous support and commitment of senior managers and politicians. The other is its part in the region's long-term health strategy that aimed at continuously improving Andalucía's healthcare provision and its citizens' health. Joint endeavours to pursue this strategy have additionally created an effective leadership. The political strategy has then created the background against which the benefits were reflected. As Diraya shows, successful projects drive their positive results from the perspective of benefits, not from the perspective of costs.

Continuous user engagement and involvement

Continuous engagement of healthcare professionals from the beginning of Receta XXI's development was crucial for the ePrescribing system's sustainability.²³ The regional eHealth strategy set the framework and physicians and pharmacists working with SAS determined the tools. The involvement of expert groups, such as CACOF and multi-disciplinary teams, created

²³ European Commission (2009): eHealth in Action. Good Practice in European Countries. Good eHealth Report, p. 9

a constructive environment that enabled Receta XXI users to realise benefits by integrating it into their daily clinical practices and healthcare professionals' daily routines.

Adaptation to the clinical context

Doctors can choose when to use Receta XXI. They use it for about 46% of prescriptions where they judge that it benefits clinical and patients' requirements. Some patients with long-term conditions benefit from Receta XXI where they can have prescriptions for up to one year. For most prescriptions, doctors rely on facilities to print prescriptions for patients to take to pharmacists for dispensing. This flexibility ensures doctors can use that Receta XXI when it benefits the clinical context, and avoids costs where it does not. The regional MoH and SAS recognise that it is better to implement Receta XXI gradually.

Receta XXI provides doctors with fast access to patients' EHRs and medication records for doctors to see the comprehensive medication histories they need before completing prescriptions. Doctors in primary, and specialised and emergency hospital departments share these medication histories.

They can also access DSS tools in Diraya and containing prescribing advice and information. The regional MoH's initiatives with SAS to convert more evidence into practice will expand these into the future.

ePrescribing integrated in an EHR system

Receta XXI is an interoperable module of Diraya. This allows Receta XXI to share Diraya's other modules' features, including registers of patients and authorised healthcare professionals, DSS and transferring data of ePrescriptions and dispensing data into patients' EHRs. Sharing patient's information between authorised doctors in primary, and specialised and emergency hospital services, relies on Diraya's EHR. It includes patients' medication records, and Receta XXI's integration ensures that prescriptions are promptly captured and available to share with other doctors. Similarly, pharmacists' dispensations are available promptly in EHRs. This integration is a core feature of success, distinguishing Receta XXI from simple solutions dealing only with the act of transmitting prescriptions electronically. Many of the benefits from Receta XXI are directly linked to its integration within Diraya.

4.4.2 Summary of lessons

- Pursue eHealth investment as a **contribution to the overall and long-term health and healthcare strategy** of a region or country
- Undertake the changes needed for successful eHealth within **realistic, unhurried timescales** that allow sufficient time to engage stakeholders and develop complex, interoperable, usable and tested solutions for healthcare professionals to share patient and clinical information
- Consider that **changes to prescribing rules can increase the benefits from ePrescribing** by saving patients time and travel costs with fewer visits, saving GPs time and enhancing the role of pharmacists
- Be aware that **ePrescribing can be developed as an integrated, interoperable module of EHR systems** rather than an stand-alone eHealth project, and take advantage of common databases, such as citizen registries, DSS and transfer into patients' EHRs
- **Allow doctors to use ePrescribing when they choose**, do not impose its use for all patients, for some of whom doctors see no or few benefits compared to printing electronic prescriptions.

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Appendix 1: Summary of evaluation data

<i>EHRI generic data summary</i>	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Receta XXI	€	€	€	€	€	€	€	€	€	€	€	€
Estimated COSTS												
Citizens	0	0	0	0	0	0	0	0	0	0	0	0
HPOs												
Doctors, nurses, other staff	880.079	850.317	821.563	793.780	766.938	748.307	954.423	855.990	1.002.932	1.652.057	510.843	465.372
Organisation	620.768	599.776	713.320	689.198	1.450.247	11.410.106	14.457.908	16.203.178	24.047.550	21.671.368	5.691.261	5.286.928
Third parties	0	0	0	0	0	0	0	0	0	0	0	0
Present value of total annual costs	1.500.847	1.450.094	1.534.883	1.482.979	2.217.185	12.158.413	15.412.331	17.059.168	25.050.482	23.323.425	6.202.104	5.752.300
Present value of cumulative costs	1.500.847	2.950.941	4.485.823	5.968.802	8.185.987	20.344.399	35.756.730	52.815.898	77.866.380	101.189.805	107.391.909	113.144.209
Estimated BENEFITS												
Citizens	0	0	0	0	95.051	96.957	4.270.894	5.607.328	8.574.763	10.884.214	12.503.059	13.013.130
HPOs												
Doctors, nurses, other staff	0	0	0	0	0	8.837	43.592	4.315.644	6.945.058	8.441.805	8.792.334	9.152.294
Organisation	0	0	0	0	635	259.664	2.254.754	8.099.377	20.756.835	34.101.398	36.404.139	38.799.013
Third parties	0	0	0	0	0	0	0	775.692	1.123.987	1.208.180	1.606.692	2.039.222
Present value of annual benefits	0	0	0	0	95.686	365.458	6.569.239	18.798.042	37.400.643	54.635.597	59.306.224	63.003.659
Present value of cumulative benefits	0	0	0	0	95.686	461.144	7.030.383	25.828.425	63.229.069	117.864.666	177.170.890	240.174.549
Net benefits												
Present value of annual net benefits	-1.500.847	-1.450.094	-1.534.883	-1.482.979	-2.121.499	-11.792.954	-8.843.092	1.738.874	12.350.162	31.312.172	53.104.120	57.251.360
Present value of cumulative net benefits	-1.500.847	-2.950.941	-4.485.823	-5.968.802	-8.090.301	-19.883.255	-28.726.347	-26.987.473	-14.637.311	16.674.861	69.778.980	127.030.340
Net benefits over cost ratio - annual	-1,00	-1,00	-1,00	-1,00	-0,96	-0,97	-0,57	0,10	0,49	1,34	8,56	9,95
Net benefits over cost ration - cumulative	-1,00	-1,00	-1,00	-1,00	-0,99	-0,98	-0,80	-0,51	-0,19	0,16	0,65	1,12
Number of records	0	0	0	0	318	15.733	46.764	342.730	1.148.669	1.946.321	2.743.973	3.541.625
Number of times records are accessed	0	0	0	0	4.415	337.011	1.539.040	11.409.442	38.443.303	81.013.763	86.000.000	93.000.000
Distributions												
		Costs			Benefits				Type of costs		Type of benefits	
Citizens			0%			23%			financial extra		54,93%	19,28%
HPOs									financial redeployed		35,96%	49,28%
Doctors, nurses, other staff			9%			16%			non-financial		9,11%	31,44%
Health provider organisation			91%			59%						
Third parties			0%			3%						
Base year: 2008; Discount rate:												
	3,5%											

Appendix 2: Cost and benefit indicators

Table 4: Cost indicators & variables

Stakeholder Group: HPO staff	Cost Indicator	Clarification	Variables
HPO - healthcare staff	Engagement in expert groups	Doctors' personal time given up	Doctors' time engaged in Receta XXI development; doctors' value of time
		Pharmacists' personal time given up	Pharmacists' time engaged in Receta XXI development; pharmacists' value of time
	Initial inconveniences (PC; OP; A&E & pharmacies)	GPs' and paediatricians' adaptation to the system	Uptake rate; total number of patient consultations registered in Diraya; adaptation to the system (in hours); value of time for PC doctors
		Pharmacists' adaptation to the system	Number of dispensing procedures with Receta XXI; uptake rate; adaptation to the system (in hours); value of time for pharmacists
		Outpatients (OP) and A&E doctors' adaptation to the system	Number of electronic prescribing procedures in OP and A&E; uptake rates; adaptation to the system (in hours); value of time for OP and A&E doctors
	HPO - ICT costs	Server & network infrastructure	Costs of servers & operation systems
Network infrastructure			Costs of network infrastructure
SQL licences			Costs of licenses
HPO IT team		Extra IT staff needed to maintain Receta XXI	Number of hospitals; IT team per hospital; FTE IT staff
HPO - organisational issues	SAS team	Additional IT staff needed in the transition period from TASS to Receta XXI	SAS transition team; FTE IT staff
	Engagement in development	Doctors' time engagement in development	Doctors' time engaged in Diraya development; FTE doctors
		Pharmacists' time engagement in development	Pharmacists' time engaged in Receta XXI development; FTE pharmacists

Stakeholder Group: HPO staff	Cost Indicator	Clarification	Variables
	Adaptation to the system	PC doctors' time needed to adapt to using Receta XXI reduces their time spent on healthcare provision	Uptake rate; total number of prescribing procedures with Receta XXI in primary care; adaptation to the system (in hours); FTE PC doctors
		Pharmacists' time needed to adapt to using Diraya reduces their time spent on their work	Number of dispensing procedures with Receta XXI; uptake rate; adaptation to the system (in hours); FTE pharmacists
		OP and A&E doctors' time needed to adapt to using electronic prescribing reduces their time spent on healthcare provision	total number of electronic prescribing procedures in OP and A&E hospital care; uptake rate; adaptation to the system (in hours); FTE OP and A&E doctors
	Training	Doctors' time invested in training	Total number of family doctors in PHC Diraya; OP/A&E number of users (doctors); training time (in days); FTE PC/OP and A&E doctors
		Pharmacists' time invested in training	Total number of pharmacists using Diraya; training time pharmacists (in days); FTE pharmacists

Table 5: Benefit indicators & variables

Benefit Indicator	Clarification	Variables
Stakeholder Group: Patients; carers; and other citizens		
Primary healthcare		
Quality	Patient safety (relocating patients and their carers)	Reduced risk of adverse drug events (ADE) for patients changing their GP
		Reduced risk of ADE through decision support (DSS)
		Relevant number of citizens; risk of adverse drug events in ePrescription; WTP
		Relevant number of patients; risk of ADEs in ePrescription; WTP

Benefit Indicator		Clarification	Variables
		Identity errors are avoided through a unique patient identity number and the eCard	Relevant population with a NUHSA; risk of being mistaken for someone else during a primary care (PC) visits; WTP for avoiding identification errors
	Patient Safety (non-relocating patients and their carers)	Reduced risk of an ADE for patients changing their GP	Relevant number of patients; risk of adverse drug events in ePrescription; WTP for avoiding ADEs
		Reduced risk through of ADE through decision support (DSS)	Relevant number of patients; risk of ADEs in ePrescription; WTP for avoiding ADEs
		Identity errors are avoided through a unique patient identity number and the eCard	Relevant population with a NUHSA; risk of being mistaken for someone else during a primary care (PC) visits; WTP for avoiding identification errors
Efficiency	Productivity (relocating patients)	Avoided visits for reassessments related to time and travel costs	Avoided appointments for patients with long-term conditions; relevant number of patients; time value for patients; patients' return travel costs to hospitals and GPs
		Avoided visits for carers related to time and travel costs	Avoided appointments for patients with long-term conditions; relevant number of patients; time value for carers; carers' return travel costs to hospitals and GPs
		Visits to GPs need less time (including extra questions about medication history)	Relevant number of patients; time value for patients
	Productivity (non-relocating patients)	Visits to GPs need less time (including extra questions about medication history)	Relevant number of consultations; relevant number of patients; time value for patients
	Avoided GP visits	Time saving through avoided GP visits for long-term prescriptions (up to one year)	Long term conditions covered by clinical protocols; relevant number of patients; avoided patient visits to GPs for long term prescriptions and other reasons; time value for patients and carers
		Travel and cost savings through avoided GP visits for long-term prescriptions (up to one year)	Long term conditions covered by clinical protocols; relevant number of patients; avoided patient visits to GPs for long term prescriptions and other reasons; travel costs

Benefit Indicator		Clarification	Variables
Pharmacy			
Quality	Better informed patients	Public health - better drug surveillance	Number of ePrescriptions cancelled and reactivated; WTP for better drug surveillance and less ADEs
	Patient safety	Reduced risk of overdoses; and ADE through decision support for allergy alerts	Number of dispensing procedures with Receta XXI; WTP for avoided risk
Specialised outpatient care			
Quality	Patient safety	All relevant medication information for specialists reduces risk	Relevant number of episodes registered in outpatient clinics; risk of adverse events during OP visits; WTP
Efficiency	Productivity	Outpatient visits need less time; including extra questions on medication history	Relevant number of episodes registered in outpatient clinics; time value for patients
A&E			
Quality	Patient safety	All relevant medication information for A&E doctors reduces risk	Relevant number of A&E episodes registered in Diraya; risk of adverse events during A&E visits; WTP
Efficiency	Productivity	Visits to A&E need less time; including extra questions on medication history	Relevant number of A&E episodes registered in Diraya; estimated time saving; time value for patients
Stakeholder Group: HPOs-staff			
Primary healthcare			
Quality	Patient safety	Better professional standards with more prescribing decisions using reliable information	Number of ePrescriptions with Receta XXI; GP WTP for better care
	Effectiveness	Higher GP satisfaction from practices with ICPs	Relevant number of consultations; number of conditions covered by ICPs; WTP for specific benefits
Efficiency	Productivity	Time saving for doctors by avoiding reassessment of relocated patients in less than two months	Relevant number of patients; relevant number of GP appointments saved; doctors' WTP for more efficient consultations

Benefit Indicator		Clarification		Variables
		Doctors using DSS tools to avoid some adverse events; Time avoidance as proxy		Number of ePrescriptions with Receta XXI; risk of adverse events during PC visits; doctors' WTP for reducing risks to patients
		GP time saving from avoided visits through long-term prescriptions		Avoidable appointments through ePrescription for patients with long-term conditions; GPs' WTP for more efficient prescribing and reduced workload
		GPs' time saving from shorter visits		Relevant number of patient consultations; estimated share of shorter visits; doctors' WTP for more efficient consultations
Pharmacy				
Quality	Timeliness	Higher work satisfaction of pharmacists		Number of pharmacists connected to Receta XXI; WTP for pharmacists for general satisfaction
	Effectiveness	Improved decision-making and professionalism		Number of dispensing procedures with Receta XXI; WTP pharmacists for specific benefits
Stakeholder Group: HPOs - organisation				
Efficiency	Productivity	Fewer support staff with centralised database		Staff saved through central data warehouse; costs of IT staff
Primary Health Care				
Quality	Patient safety	Improved prescribing procedure reduces risk of ADE		Number of dispensing procedures with Receta XXI; risk of ADE for ePrescriptions; estimated value of reduced clinical risk
		Shared data reduces risks		Long term conditions covered by clinical protocols; share of patients affected by these long-term conditions; reduced risk of ADE; estimated value of reduced clinical risk
Efficiency	Productivity	Fewer GP visits through long-term prescriptions		Number of patients receiving long-term prescriptions; avoided patient visits to GPs for long term prescriptions; FTE PC doctors
		Time saving for doctors by using DSS to avoid some ADE - without DSS, checking will take longer		Number of ePrescriptions with Receta XXI; relevant number of patients; risk of ADE during PC visits; time saved through DSS; FTE doctors;
		Cash releasing	Savings through generic prescribing by active principal ingredient	Cash savings since the introduction of Receta XXI

Benefit Indicator		Clarification	Variables
Pharmacy			
Quality	Patient safety	Improved dispensing through shared data	Number of dispensing procedures with Receta XXI; risk of adverse events during dispensing; estimated value of reduced risk to pharmacy
Efficiency	Productivity	Improved billing for dispensing referring to pharmacies and SAS	Number of dispensing procedures with Receta XXI; time saving for billing per dispensing procedure; FTE pharmacists
Specialised outpatient care			
Efficiency	Productivity	Outpatient visits need less time; including extra questions about medication history	Relevant number of outpatient care episodes registered in Diraya; time saved during OP consultation; FTE OP doctors
A&E			
Efficiency	Productivity	A&E visits need less time; including extra questions about medication history	Relevant number of A&E episodes registered in Diraya; time saved during A&E consultation; FTE A&E doctors
Stakeholder Group: Third Parties			
Quality & efficiency	Patient safety /effectiveness/streamlined care	Application of prescribing protocols	Relevant number of prescriptions; estimated € value of one SAS prescribing protocol