



---

*EHR IMPACT*

European Commission, DG INFSO & Media  
e-Mail: [ehr-impact@empirica.com](mailto:ehr-impact@empirica.com)

Report on

# The socio-economic impact of the health information platform Sistema SISS in the region of Lombardy, Italy

**Final DRAFT**

Version 1.0

January 2010



**European Commission**  
Information Society and Media

## 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.

## Full project title

Study on the economic impact of interoperable electronic health records and ePrescription in Europe

## Contract detail

Contract Number: 30-CE-0161851/00-30

## Number and title of deliverable

This report is deliverable D2.3i of the EHR IMPACT study. It addresses the socio-economic impact evaluation of SISS, the health information platform in the region of Lombardy, Italy.



## Authors

Alexander Dobrev<sup>1</sup>, Yvonne Vatter<sup>1</sup>, Tom Jones<sup>2</sup>

<sup>1</sup>empirica Communication & Technology Research, Germany; <sup>2</sup>TanJent Consultancy, UK

## Contact

For further information about the *EHR IMPACT* study, please contact:

	
<p><b>empirica</b> Communication and Technology Research Oxfordstr. 2, 53111 Bonn, Germany Fax: (49-228) 98530-12 <a href="http://www.empirica.com">www.empirica.com</a> <a href="mailto:ehr-impact@empirica.com">ehr-impact@empirica.com</a></p>	<p><b>TanJent</b> Hereford UK Tel: +44 7802 336 229 <a href="http://www.tanjent.co.uk">www.tanjent.co.uk</a> <a href="mailto:tomjones@tanjent.co.uk">tomjones@tanjent.co.uk</a></p>



# The health information platform SISS in the region of Lombardy

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

Italy

**Alexander Dobrev<sup>1</sup>, Yvonne Vatter<sup>1</sup>, Tom Jones<sup>2</sup>,**  
1 empirica Communication & Technology Research, Germany  
2 TanJent Consultancy, UK

Bonn, January 2010

## Acknowledgements

This report is part of a study on the economic impact of interoperable electronic health records and ePrescribing systems in Europe ([www.ehr-impact.eu](http://www.ehr-impact.eu)) commissioned by the European Commission, Directorate General Information Society and Media, Brussels. We thank our colleagues at the European Commission, in our organisations and our partners in this study for their critical input and review.

We particularly thank the case study site team that enabled and co-organised the research activities on site: Roberto Zuffada, Natalia Allegretti, Claudio Beretta, and Corti, Carlo from regione Lombardia, Ettore Fiore from Lombardia Informatitca, as well as all doctors, nurses and other professionals participating in interviews and discussions.

## Disclaimer

The views expressed in this report are those of the authors and do not necessarily reflect those of the European Commission. Neither the European Commission nor any person acting on behalf of the Commission is responsible for the information provided in this document.

## The study team

This study is conducted by:



In cooperation with:



## Rights restrictions

Any reproduction or republication of this report as a whole or in parts without prior authorisation is strictly prohibited.

Bonn, January 2010

# Contents

<b>Executive Summary</b> .....	<b>9</b>
<b>1 Background</b> .....	<b>11</b>
1.1 Health system setting .....	11
1.2 The place of EHR, ePrescribing and interoperability in the relevant eHealth strategy setting.....	12
<b>2 Sistema Informativo Socio Sanitario (SISS)</b> .....	<b>14</b>
2.1 Organisations involved .....	14
2.2 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> .....	16
2.3 The health services affected.....	18
2.4 Components and functionalities.....	18
2.5 The system in practice .....	19
2.6 Technology .....	22
2.6.1 <i>Overview</i> .....	22
2.6.2 <i>Technology principles and setup</i> .....	22
2.6.3 <i>Security and confidentiality</i> .....	23
2.7 Level of interoperability.....	24
<b>3 Case analysis</b> .....	<b>25</b>
3.1 Stakeholders .....	25
3.2 Process change .....	26
3.2.1 <i>Workflow</i> .....	26
3.2.2 <i>Clinical practices</i> .....	27
3.2.3 <i>Working practices</i> .....	27
3.2.4 <i>Reaction and acceptance of users</i> .....	28
3.3 Timeline and milestones.....	28
3.4 Supporting take-up .....	29
3.5 Benefits .....	31
3.5.1 <i>Patients, informal carers and other people</i> .....	32
3.5.2 <i>Health service teams</i> .....	33
3.5.3 <i>Healthcare Provider Organisations (HPOs)</i> .....	33
3.5.4 <i>Third parties</i> .....	34

3.6	Costs.....	35
3.6.1	<i>Patients, informal carers and other people</i> .....	35
3.6.2	<i>Health service teams</i> .....	35
3.6.3	<i>Healthcare Provider Organisations (HPOs)</i> .....	36
3.6.4	<i>Third parties</i> .....	36
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 by stakeholders</i> .....	42
3.7.4	<i>Sensitivity analysis</i> .....	44
3.7.5	<i>Financial impact</i> .....	44
3.7.6	<i>Financing arrangements</i> .....	46
3.8	Legal aspects .....	46
<b>4</b>	<b>Conclusion</b> .....	<b>47</b>
4.1	Future potential.....	47
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> .....	49
	References.....	50
	Appendix 1: Summary of evaluation data .....	52
	Appendix 2: Cost and benefit indicators.....	53

## List of figures, tables and charts

### List of figures

Figure 1: Increase in healthcare expenditure in Lombardy and Italy.....	15
Figure 2: eHealth dynamic & evaluation scope.....	17
Figure 3: Access to and information flows in the SISS network.....	19
Figure 4: SISS architecture .....	22
Figure 5: SISS hospital integration platform.....	23

### List of tables

Table 1: Scope of interoperability of the regional health information system SISS.....	24
Table 2: Timeline of SISS development .....	29
Table 3: Distribution of benefits within benefit categories .....	31
Table 4: Distribution of benefits within stakeholder groups .....	31
Table 5: Cost indicators and variables .....	53
Table 6: Benefit indicators and variables.....	55

### 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: Distribution of costs and benefits by stakeholder group .....	42
Chart 5: Cumulative net benefits by stakeholders .....	43
Chart 6: Financial and non-financial impact .....	45

## Abbreviations

A&E	Accident & Emergency
CBA	Cost Benefit Analysis
CRS	<i>Carta Regionale dei Servizi della Lombardia</i> , regional service card
IHE	Integrating the Healthcare Enterprise
EHR	Electronic Health Record
EHRI	EHR IMPACT study
GP	General Practitioner
HIS	Hospital Information System
HL7	Health Level 7 interoperability standard
HPO	Health Provider Organisation
IRAP	<i>Imposta Regionale sulle Attività Produttive</i> , modified payroll contribution system
IRPEF	<i>Imposta sul reddito delle persone fisiche</i> , income tax
LHA	Local Health Agency
LISIT	<i>Lombardia Integrata Servizi Infotelematici per il Territorio</i> , regionally integrated ICT services in Lombardy
NHS	National Health Service
NSF	National Solidarity Fund
PIN	Personal Identification Number
SISS	<i>Sistema Informativo Socio Sanitario</i> , social service and health information system
SOA	Service Oriented Architecture
TSE	<i>Tavolo di lavoro permanente per la Sanità Elettronica</i> , Italian eHealth board
VPN	Virtual Private Network

## EXECUTIVE SUMMARY

The health information platform of the Italian region of Lombardy (SISS) is analysed as one of nine implemented and ongoing European good practice cases in the context 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.

The region of Lombardy, located in the north of Italy, is one of Italy's twenty administrative regions. With around 9.5 million inhabitants, it presents about 16% of the Italian population. The regional government, Regione Lombardia, is responsible for healthcare delivery in the region. Lombardy has an infrastructure including 34 public hospitals, of which 5 are public medical research institutes, 7,700 general practitioner (GP) and paediatrician practices, and 2,500 pharmacies. Against the background of a growing discrepancy of demand and resources, the Lombardy Region has recognised that a change in the provision of healthcare is needed. The introduction of a local Hospital Information System (HIS) in each hospital and the implementation of a regional network were considered to help meet these challenges.

After the project requirements had been defined and feasibility analysed in 1999, the Lombardy Region started with an on-site project. The pilot of the SISS network was conducted from 2000 to 2002 before the health information network's expansion to all districts in the region was initiated in 2002. In 2005 the entire region was connected, comprising all public hospitals, 7,700 GPs, all 2,600 pharmacies, and around 9,500,000 citizens. Since 2008, the Lombardy Region has been expanding the network to the private sector. As of January 2010, about 70% of all 350 private healthcare providers are interconnected with SISS and 50 of them have integrated their information system with the Regional health network.

The connected healthcare providers have access to a variety of reports, thus complementing the information in their local patient record systems with information from other health provider organisations (HPOs). Reports available through SISS include lab tests, examination reports, referrals, discharge letters, and ePrescriptions. The eSignature functionality is critical for exchanging medical information as all documents available in SISS must be digitally signed before they are made available to other healthcare providers. eBooking further adds to the overall positive performance of SISS.

The main drivers for benefits are data sharing and eBooking functionalities. Data sharing renders safer healthcare provision, especially in cases where patients would otherwise not bring their referrals or discharge letters. It allows for data validation and counter-checking of test results, for preparation of consultations in advance, for the creation of new healthcare models, and time savings and increased productivity. eBooking fosters HPOs' resource planning and allocation, saves time and travel costs and makes scheduling much more convenient for patients. Besides ICT-based costs for Regione Lombardia, organisational costs includes informing patients on SISS so that they give their explicit informed consent, temporary decreases productivity, and time redeployed to activities such as scanning emails for notifications from SISS and eBooking in pharmacies.

2007 is the first year in which estimated annual net benefits were realised. It took some five years from SISS' implementation. After temporarily accelerated growth in 2007 and 2008, annual net benefits reach a sustainable and stable level from 2009 onwards. In year nine of the evaluation period and year six after implementation, SISS yields a positive cumulative net socio-economic benefit. Cumulative net benefits reach about 143 million EUR in 2010. Both the high level of cumulative net benefits and the stable growth rate of cumulative costs at a lower level than the growth of cumulative benefits imply long-term sustainability for SISS.

The net benefit to cost ratio turns positive with +0.45 in 2007 and leaves the EHR IMPACT timeline in 2010 at +0.86. By 2010, after continuous and less unbalanced growth the cumulative net benefit to cost ratio reaches +0.24. This indicates an overall socio-economic

return (SER) from SISS of about 24% over a period of 11 years. Estimated annual SERs increase steadily in the late years of the EHRI horizon, reaching 86% in 2010, and the cumulative returns are thus expected to stay on a rising path.

HPOs have the biggest share in benefits, about 65% or some 475 million EUR, primarily attributed to improved and more efficient healthcare delivery. Third parties receive the second largest share of benefits, with some 20%. Increased convenience from better informed decision-taking and their patients' increased safety amounts to a value of almost 36 million EUR for healthcare teams, leaving health professionals with some 5% of the overall benefits. Patients, their carers and citizens have nearly 10% of all benefits. The lion's share, both of benefits and costs accrue to HPOs.

About 94% of costs are borne by HPOs, the smallest share is assigned to third parties. Costs for public hospitals, pharmacies and GPs and paediatricians accrue from ICT expenses and organisational costs. ICT costs present about 63% of the overall costs and 67% of HPOs' total costs. Regione Lombardia is the main financing body for SISS. Disruptions, inconveniences to, and engagement of, HPOs and end-users of the ICT applications account for about one-third of overall costs and are distributed among Regione Lombardia, pharmacies and GPs and paediatricians. Health professionals incur around 3.5% of the costs, patients, carers and citizens just over 2%.

The financial position is an extra financial release of less than 3% of benefits. This is attributed to financial incentives for GPs and pharmacists and financial savings from avoided travel costs for patients. This extra released finance compares to 68% extra financial investment as a share of overall costs. Around two-thirds of benefits can be classified as redeployed resources. HPOs have the biggest share, mainly based on efficiency gains. Time savings from more efficient healthcare provision and administrative procedures can be allocated to additional patients. 26% of costs are redeployed resources from other activities. Again, the biggest share accrues to HPOs.

About 31% of all benefits are non-financial benefits. All stakeholder groups benefit in this category. It comprises quality gains, such as increased patient safety, leading to improved working convenience and the feeling of increased professionalism for health professionals, better healthcare for citizens, patients and carers, healthcare facilities improved clinical governance and the region's capability of meeting increasing demand in healthcare through providing more effective and more efficient services.

Three important lessons from SISS for future investment decision makers and development teams are:

- Users were allowed to get used to working with the application and gradually integrate it into their daily working routine, while at the same time the importance of the initiative was stressed by making training compulsory and connecting to SISS mandatory for each public healthcare organisation
- Implementation started with administrative functionalities as their employment is easier for users, and the benefits are easier to realise, at a much more faster pace than clinical features alone
- Explicit support was provided to HPOs with developing, implementing and maintaining the central data repository, its integration with local databases at central and individual level. Support included provision of guidelines, consultancy, ICT products, and certification of vendors and their products.

# 1 Background

## 1.1 Health system setting

Italy's healthcare system is organised on three levels. These are national, regional, and local, of which the regional is the central level. The National Health Service (NHS) provides universal coverage free, or near-free, of charge at the point of service. On the national level, the Ministry of Health is responsible for the overall coordination of the healthcare system. The healthcare system management, including eHealth, is exclusively in the control and responsibility of regional governments. All 20 regional authorities have some power to approve regional legislation and freely allocate the funding received from the central government, in particular for healthcare delivery. Special regions enjoy wider autonomy in this respect and also receive a higher than average share of government funding. The local level in the Italian health system is represented by the Local Health Agencies (LHAs) - *Agenzie Sanitarie Locali*. Similar to health boards, for example in Scotland, they are responsible for the administrative organisation of healthcare services in a geographical sub-area of the respective region.

Healthcare services in Italy are structured in four layers:

- Primary care, ambulatory specialist medicine, residential, and day care, organised at the level of health districts
- Secondary care provided in hospitals, organised and managed at the level of LHAs
- Public hospital trusts, which provide highly specialised tertiary hospital care, have the status of quasi-independent public agencies, and fall under the direct responsibility of regional health departments
- Health prevention and promotion programmes, which operate within public health divisions.

Primary care is provided by general practitioners (GPs), paediatricians, and self-employed and independent physicians working alone under a government contract. Although primary care physicians are given financial incentives to share clinic premises with their colleagues, they usually work in single practices. These health service providers are paid a capitation fee, based on the number of citizens registered with them. Each citizen is registered with one doctor, and as long as responsibility is not transferred, this doctor is in charge of the citizen and his/her medical information. General practitioners and paediatricians act as gatekeepers for access to secondary services. Nevertheless, people may choose any physician for a first point of contact. Hospital care is delivered mainly by public and a limited number of private hospitals, which provide both outpatient and inpatient services. LHAs contract services to private hospitals on the same conditions as they reimburse public facilities.<sup>1</sup> Public hospitals' investment financing is based on the investment budget given to them by the regional government. Currently, about one quarter of healthcare expenses in Lombardy is allocated to the private sector.

General taxes are the main financial source of the Italian NHS. They are complemented by patients' co-payments, so-called "healthcare tickets". According to the latest fiscal reform of 2000, since 2001 regional financing of healthcare comes from:<sup>2</sup>

<sup>1</sup> European Commission (2008). Priorities and Strategies in European Countries, Factsheet Italy. eHealth ERA Report. Available at: <http://www.ehealth-era.org/database/documents/factsheets/Italy.pdf> (11-08-2009)

<sup>2</sup> European Observatory on Healthcare Systems (2001): Health Systems in Transition. Italy. Copenhagen: World Health Organisation, Regional Office for Europe., p. 94ff, Available at: <http://www.euro.who.int/document/e73096.pdf>

- The modified payroll contribution system, IRAP (*Imposta Regionale sulle Attività Produttive*)
- The regional share of the IRPEF (*imposta sul reddito delle persone fisiche*, income tax); regions are allowed to modify the total regional IRPEF rate and therefore have a limited ability to increase their resources; and
- A defined amount of the petrol excise tax per litre; regions have the right to increase the petrol excise by up to €0.026 per litre.

In addition, a fixed proportion (25.7%) of the national VAT revenue is used to build a National Solidarity Fund (NSF), in charge of redistributing funds across regions. The funds transferred to or received from the NSF are determined as the difference between two estimates of the VAT revenue quota. This mechanism transfers funds to the regions unable to raise sufficient resources. It is needed because of the high discrepancies in tax revenue and per capita healthcare spending between the regions. Regionally raised taxes (IRAP, IRPEF and petrol excise tax) accrue to the regions that have raised them and are not used for the NSF.

## 1.2 The place of EHR, ePrescribing and interoperability in the relevant eHealth strategy setting

The Italian eHealth strategy is strongly influenced by the radical change in the relative roles and responsibilities of the state and the regions embodied in the constitutional reform of 2001.<sup>3</sup> Since then, the Italian strategy comprises three interconnected programmes addressing national, semantic, and territorial needs in order to achieve the following key objectives: to improve the efficiency and effectiveness of the healthcare system as a whole, to assure fundamental levels of healthcare services throughout the territory, and to speed up the processes of technological innovation of citizen/patient-centred social and healthcare services.

The Italian “eHealth Board” (*Tavolo di lavoro permanente per la Sanità Elettronica*, TSE) forms the setting for the technical discussion and consultation in order to harmonise the national and regional eHealth policies and to help coordinated implementation of the respective action plans. The TSE’s “Architectural strategy for eHealth” (*strategia architetture per la Sanità Elettronica*) sets out the following requirements:

- All clinical information of the patient is available anytime and anywhere
- The system respects the federated architecture of the Italian healthcare system
- The system has a high level of security and respects the Italian legislation on privacy
- The system has a high level of reliability and availability
- The system has a modular structure, which enables a progressive implementation nationwide
- The system safeguards existing investments and takes into account the interactions required with existing legacy systems
- The system is based on the use of open standards.

From a regional perspective, the most important healthcare planning and guideline document issued by the Lombardy region, *Regione Lombardia*, is the Lombardy Regional Social Services and Healthcare Plan, 2007-2009<sup>4</sup>. The plan has two lines of action, the continuous

<sup>3</sup> European Commission (2007): eHealth Priorities and Strategies in European Countries. eHealth ERA Report. Towards the Establishment of a European eHealth Research Area. Fact Sheet Italy, p. 48f. Available at: <http://www.ehealth-era.org/database/documents/factsheets/Italy.pdf>

<sup>4</sup> Regione Lombardia Sanità (2008): Lombardy Region Social Services and Healthcare Plan, 2007-2009

improvement of the quality of the Lombardian healthcare system and the modernisation of the region's healthcare provision. One of the plan's aims is to promote the development of eHealth, telemedicine and tele-diagnostic applications. These are considered "useful means of providing diagnostic and treatment procedures and achieving integration with the Regional Service Card - Social Services and Healthcare IT System, which will be extended to cover those working within the regional healthcare system [...]"<sup>5</sup>.

The creation of a local and regional ICT infrastructure based on the Lombardian eCard, *Carta Regionale dei Servizi della Lombardia*, the regional service card of Lombardy, and the region's health information system, *Sistema Informativo Socio Sanitario*, is considered the cornerstones of Lombardy's eHealth strategy. The strategy consists of five objectives, one of which is "to increase health workers' ability to share relevant individual data and give them the easiest possible access to up-to-date medical knowledge from accredited sources"<sup>6</sup>. ICT is considered essential in achieving this goal as, on the one hand, it allows for the genesis of high-quality data, and, on the other hand, it offers the key for health professionals to access this high-quality information. Towards this end, the region supports projects and trials aiming at developing semantic standards and ICT architectures, necessary to expand the scope and enhance the quality of data and data sharing, at European, national and regional level.

<sup>5</sup> Ibid, p. 7

<sup>6</sup> Ibid, p. 34

## 2 Sistema Informativo Socio Sanitario (SISS)

### 2.1 Organisations involved

The region of Lombardy, located in the north of Italy, is one of Italy's twenty administrative regions. With around 9.5 million inhabitants, it presents about 16% of the Italian population and contributes approximately 20% to Italy's Gross National Product. SISS involves all healthcare-related organisations in the region.

The regional government, *Regione Lombardia*, is responsible for healthcare delivery in the region. The General Directorate for Health is the governing authority holding the regulatory and administrative competencies in the healthcare domain, including planning and supplying, quality monitoring and control, appropriateness and efficiency of services.<sup>7</sup> Lombardy has an infrastructure including 150,000 health and social care staff in hospitals and other larger organisations, 7,700 general practitioner (GP) and paediatrician practices, and 2,500 pharmacies. All together, Lombardy has 34 public hospital entities, of which 5 are public medical research institutes. The total bed capacity is 42,000 beds. The private sector comprises 2,500 private HPOs. According to internal sources, in 2008 the global regional budget for healthcare amounted to 16 billion EUR, or about 5.1% of the overall regional budget<sup>8</sup>.

Lombardia Informatica is a publicly owned IT service company, founded by the Lombardy regional government in December 1981. With some 700 staff, Lombardia Informatica is primarily involved in the healthcare sector. In charge of the development and design of the region's IT systems and the maintenance of the already existing ones, it has the overall responsibility for the Regional Service Card and Healthcare and Social Service Information System (*Carta Regionale dei Servizi della Lombardia - Sistema Informativo Socio Sanitario, CRS-SISS*).

### 2.2 Context of the initiative and eHealth dynamic

#### 2.2.1 Context and historical development

The project's corner stone was laid in the late 1970s with compiling and filing of data on hospitalisations, demographic data of citizens and professionals in the healthcare sector, pharmaceuticals and outpatient visits. The decision for expansion towards a comprehensive system covering the whole region and eventually all clinical information was driven by pressing needs recognised over the last decade.

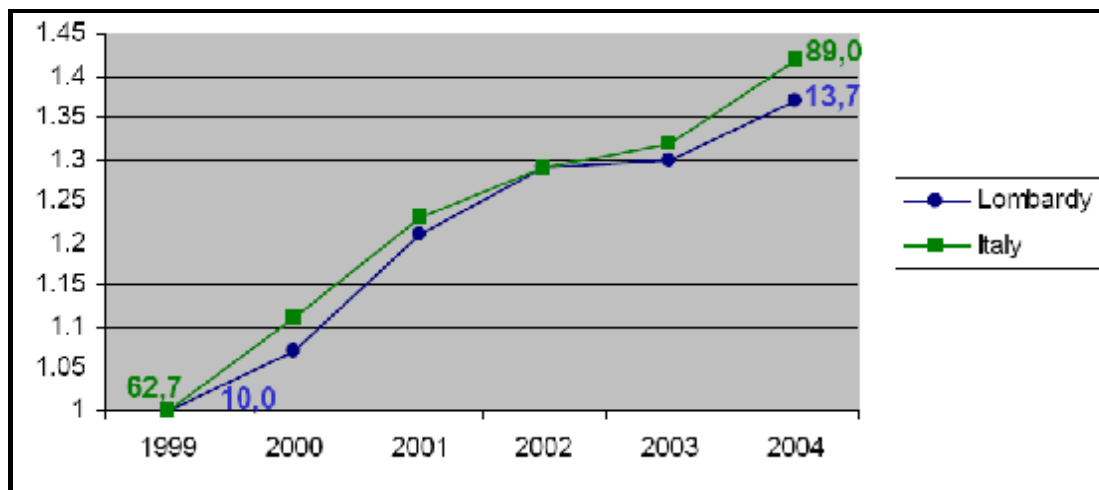
As depicted in Figure 1, healthcare expenses in the early 2000s have constantly increased both on the national and the regional level. Lombardy's healthcare expenses have increased from 10 billion EUR in 1999 to 13.7 billion EUR in 2004. According to information from the regional government, 45% of the region's healthcare budget is currently spent on hospital care, of which 30% are used for pharmaceuticals, and only 5% for prevention. Hospital expenses are mainly based on the healthcare provision for chronically ill patients and the

<sup>7</sup> European Observatory on Health Systems and Policies (2001): Health Systems in Transition. Italy. Health System Review. Vol. 9, No. 1. Copenhagen: World Health Organisation, Regional Office for Europe., p. 94ff, Available at: <http://www.euro.who.int/document/e73096.pdf> (11-08-2009)

<sup>8</sup> Presentation by Claudio Beretta, Regione Lombardia

elderly. It was recognised by health authorities that if the traditional way of healthcare delivery was maintained, healthcare expenditure would rise from a current 6.4% of GDP to a share of 12-15% in 2030, and 25% in 2050 on the national level.

Figure 1: Increase in healthcare expenditure in Lombardy and Italy



Source: Regione Lombardia

In addition to demand driven rising costs, Lombardy has experienced cuts in real healthcare resources in 2000. The number of hospital beds in the region was reduced from 50,000 to 42,000 and the number of staff members from 110,000 to 100,000. Against the background of a growing discrepancy of demand and resources, the Lombardy Region recognised the need to change the way healthcare organised and provided.

In order to meet these challenges, the objectives of SISS are to:

1. Improve healthcare and social services for citizens by simplifying procedures and reducing waiting time
2. Improve the quality of prescriptions, diagnosis, and care by sharing clinical data among healthcare professionals
3. Improve the administration of social and healthcare system costs by enhancing planning and controlling instruments
4. Improve the efficiency of HPO's internal processes through the deployment of new technologies such as digital signature, electronic filing, and electronic prescriptions.

The introduction of a local Hospital Information System (HIS) in each hospital and the implementation of a regional network were considered a good basis for meeting these requirements.

After the project requirements had been defined and feasibility analysed in 1999, the Lombardy Region started with an on-site project. The pilot of the SISS network was initially implemented in the Lecco Province from 2000 to 2002. It connected three hospitals with 3,500 professionals, 275 GPs, 88 pharmacies and 305,000 citizens.

The results of the pilot ensured financial arrangements for the health information network's expansion to all districts in the region, starting in 2002. Two years later, it covered two million citizens. In 2005 the entire region was connected, comprising all public hospitals, 7,700 GPs, 2,600 pharmacies, and around 9,500,000 citizens. Since 2008, the Lombardy Region has been expanding the network to the private sector. As of January 2010, about 70%

of all 350 private healthcare providers are interconnected with SISS and 50 of them have integrated their information system with the Regional health network.

With SISS, Lombardy adopted a “non-invasive” approach, respecting the independence of the region’s hospitals and integrating already existing local systems rather than replacing them. In order to create new services on the regional level for both citizens and healthcare professionals, such as the EHR and ePrescribing, it was necessary for HPOs to have a local information system. The Lombardy Region supported the integration of almost all existing systems from a technology perspective, providing an enabler for information sharing and exchange. The responsibility for the quality of data shared throughout the network is with healthcare providers.

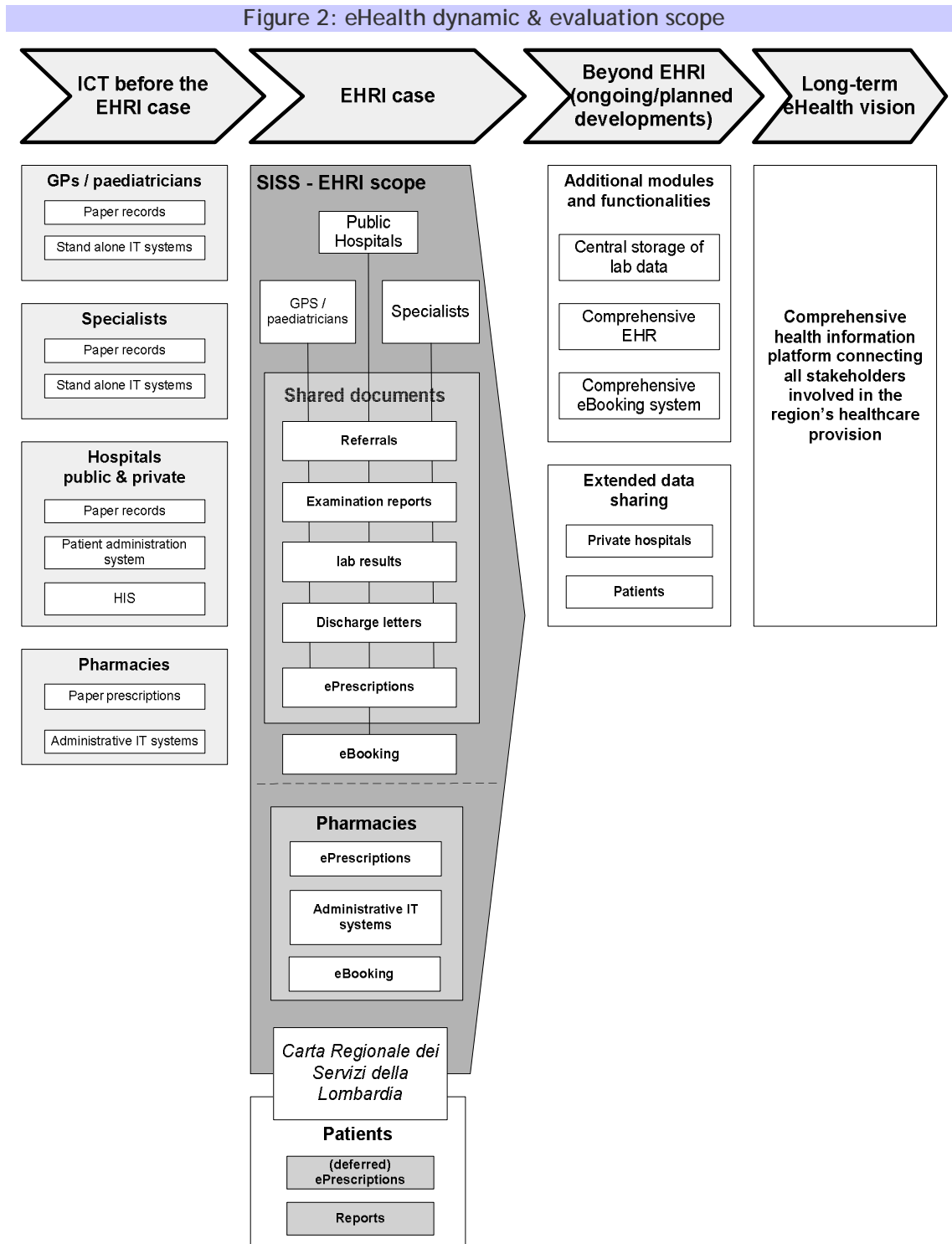
## 2.2.2 eHealth dynamic and scope of the evaluation

The Lombardian health information network SISS connects all public hospitals, GPs and paediatricians, specialists, and pharmacies in the region. Currently, all private HPOs are being integrated in the network, but the initial focus was set on the public sector. The connected healthcare providers have access to a variety of reports, thus complementing the information in their local patient record systems with information from other HPOs. Reports available through SISS include lab tests, examination reports, referrals, discharge letters, and ePrescriptions. Currently, data are stored as free text documents, except for ePrescriptions. Pathology networks already exchange documents that are based on structured data, and for future documents shared in SISS are envisaged to consist of structured data.

Considering the long-term objectives of the region, the stage of development of SISS today is considered a relatively early one. By targeting an ambitious goal to build a comprehensive network for access and exchange of patient data among all healthcare providers in the whole region, the tactic is to solve relatively small issues at a time, but for the whole region. Thus, the focus till now has been on a basic information infrastructure capable of meeting the demands of such a comprehensive network. The first building blocks include a robust identification and authorisation solution, support with building local level information systems, as well as some basic exchange of information.

For the near future, it is envisaged to finish the integration of the entire public sector into the network. After the completed integration, more and more health data will be added to the EHR and some information will be stored in a structured way, allowing automated analyses. Gradually, the entire region of Lombardy will have comprehensive, interoperable EHR system available.

The dynamic of the network’s past development, current activities and future visions is depicted in the eHealth dynamic diagram in Figure 2.



Source: EHR IMPACT study

The scope of the EHR IMPACT analyses includes all developments that are in routine operation at the time of evaluation. The currently tested and planned developments will carry their fruits beyond the time-horizon of the EHR IMPACT evaluations, which ends in 2010. The quantitative evaluation does not include the cost and benefits from these upcoming developments.

## 2.3 The health services affected

SISS affects all public healthcare services provided throughout the entire region of Lombardy. It affects primary care at GP practices, as well as in- and outpatient secondary care at specialist practices and hospitals. These healthcare services exchange reports and documents integrated in the patient's local EPRs. Additionally, SISS connects healthcare services related to drug prescribing in GP practices and dispensing in community pharmacies.

Currently, the processes primarily affected are referrals from primary care to hospitals, laboratory tests in external facilities from the ordering entity, and drug prescriptions and dispensing.

## 2.4 Components and functionalities

The currently available components of the interoperable health information system in Lombardy fall under two broad categories: administrative components managing identification and authorisation issues, and clinical data exchange components.

### Patient and professional identification & eSignatures

Access to the SISS network is based on smart cards, granting access for both citizens and professionals. Citizens use the **citizen card** *Carta Regionale dei Servizi della Lombardia (CRS)*, professionals use the **health professional card** *Carta SISS*. The citizen card is used to identify the patient. It also serves as a form of providing explicit consent for healthcare professionals and healthcare administrators to access personal health information. The health professional card allows authentication according to the professional's profile, as accredited by the regional health authorities.

The health professional card, together with the health professional's personal identification number (PIN), is the key to digital signatures on documents. This functionality is critical for exchanging medical information, as it enables professionals to trust the information they access. All documents available in SISS must be digitally signed before they are made available to other healthcare providers.

### Health information network SISS

The SISS network allows for the gathering and organisation of documents for clinical purposes. All citizens registered in the Regional General Registry have a citizen card and an EHR. The information can be accessed by all healthcare professionals and administrators connected to SISS, provided appropriate identification and the citizen's explicit consent. SISS contains metadata that points to the synthesis reports of all healthcare events. If more detailed information is required, SISS facilitates the request and access to information stored at the point of creation. The following EHR documents can be accessed via SISS, independent of the location of the point of care:

- Drug prescriptions
- Vaccination records
- Test results
- Hospital discharge letters
- Therapeutic plans
- Referral letters
- Emergency Services reports.

Consistent with the goals and approach of developing SISS, the functionalities currently available are restricted to notifications via SISS on the availability of new documents and links to them. After authorisation is given, the health professional can access the documents from the information system of the organisation that has issued it. The information remains stored at its original location, but can be manually copied in a local information system if necessary. Further integrative functionalities are only planned for the future.

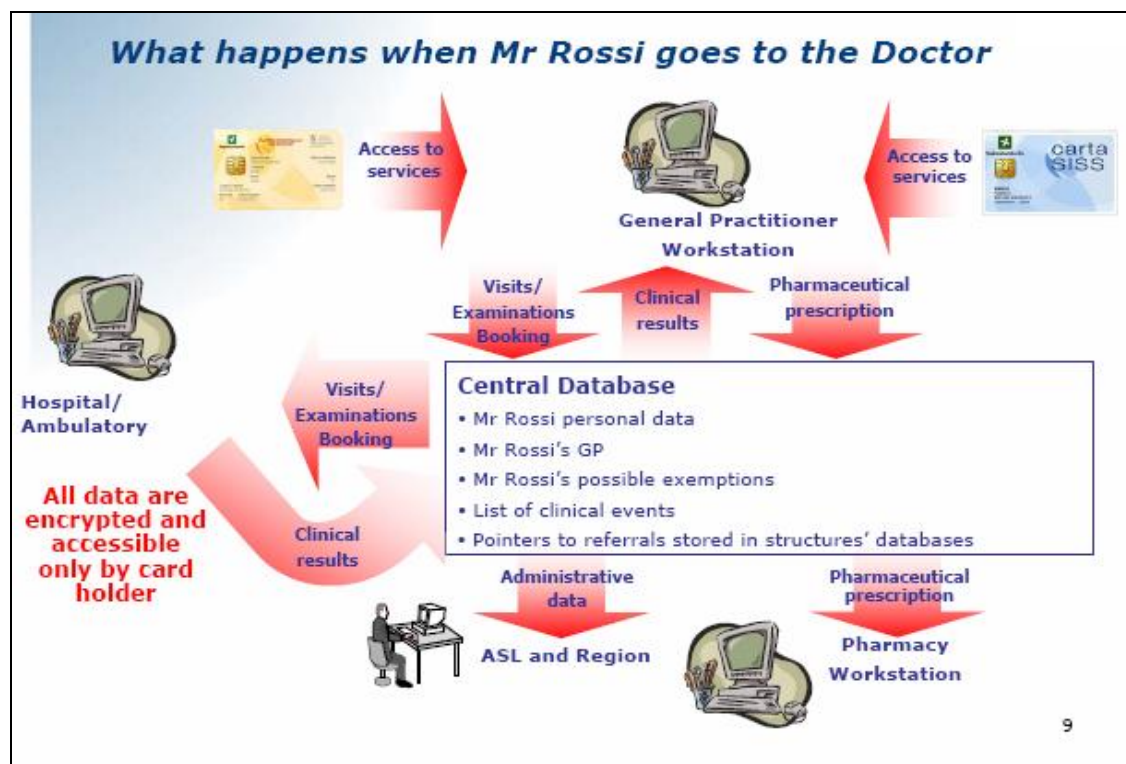
A regional **data warehouse** elicits the information contained in the EHRs and enables data analysis for institutional-administrative purposes, such as healthcare planning, resource planning, and epidemiological analysis.

**eBooking** services via internet and call centres facilitate citizens' access to the region's healthcare services, in particular to public hospitals.

## 2.5 The system in practice

Currently, 93% of all GPs and paediatricians in Lombardy, all public hospitals and all pharmacies are connected to SISS. Figure 3 shows the information flows related to an episode of care in the Lombardy healthcare system, an the example of a GP visit.

Figure 3: Access to and information flows in the SISS network



Source: Lombardia Informatica

### Access to SISS

As already mentioned, the SISS network requires the citizen and the health professional cards for access to personal patient data. The citizen card is automatically sent to Lombardian citizens by the Regione Lombardia. In order to activate the card and to allow for medical and health administrative data to be stored in SISS, it is necessary for citizens to give their consent. This can be done for example at pharmacies or hospitals. After this one-off consent

has been given, the LHAs and, as of soon, all public administration units, effect the activation of the card. As soon as this procedure is completed, patients regional EHR is created, data available can be accessed by healthcare professionals and (to a certain extent) by citizens, and it is possible to sign documents for public administration purposes. Citizens have the power to give or block access by some or all healthcare professionals and also either for all, or only for part of the information available through SISS.

Whenever healthcare professionals want to enter the SISS network, they need their professional cards and PIN. Information upload does not require the patient's card, but is authorised by a digital signature. Each information upload procedure requires an explicit entry of the professional's PIN, while the card is in the reader. GPs can access their patients' EHR data any time, as patients provide their formal consent upon their first registration.

In hospitals, in contrast, healthcare professionals need the patient's card whenever they wish to view the documents available in other HPOs' EHR systems. Only in case of an emergency any professional with a health professional card can access the record. A message will then be sent to the patient and his/her GP to inform them about this incident.

## eReferrals

When GPs refer their patients to specialists in practices or hospitals, it is required by law that they additionally use the paper form even when they refer their patients electronically. This also holds for drug prescriptions. The paper form, which is filled in electronically, contains a bar code, which identifies the referral details electronically.

GPs primarily use Lombardy's health information network to make referrals, to access their patients' lab or examination results from hospitals or specialists, and to communicate with the relevant physicians. Orders are sent to the central data repository of SISS at the time when the patient receives the corresponding paper form. The information contained in the paper form is then entered into the local HIS data repository in the hospital or into the specialist's practice local IS. Entry is facilitated by reading the bar codes off the paper referral form. One of them contains demographic information on the patient; another contains the details of the medical order. Potential uncertainties resulting from interoperability challenges must be addressed manually.

The lab and/or examination results generated in the hospital or the specialist's practice are also entered into the local HIS. When the physician makes a report of the test results, the local HIS creates a PDF document. These documents need to be signed digitally in order to trigger the transmission to SISS. A digital signature triggers a notification in SISS and to the referring physician about the availability of the report. Initially, hospital doctors had to initiate this process for each and every single report. Now, they can sign several reports at once. Physicians do not have to make all reports available through SISS, nor do they have to include all information in the reports. Before generating the PDF document, a doctor can decide to limit the information available. Reasons for such decisions include uncertainties and the need for further clarification, sensibility of information, especially regarding particular diseases such as HIV AIDS, or the need to provide information personally to the patient, for example in the case of cancer diagnoses.

After a notification about the report availability has been sent to SISS, an email, containing the link to the document, is sent to the referring GP. In order to view the information, GPs follow the link and identify themselves with the card and PIN. Following the same route, GPs receive messages when their patients are hospitalised or discharged. They can then access the documents stored in the patient's EHR.

By using the CRS, patients can also view their documents. They can ask at the post office to get a PIN and a card reader. They can then view their results without visiting their GP or the hospital. It also allows patients to decide not to impart their health information to certain

healthcare professionals. If they do not want to share their information with their GP, the latter will need the patient's card in order to view the information in SISS. In the other direction, doctors can hide information from the patient. For example, this is the case when a certain diagnosis must be explained by a professional rather than the patient reading it online. Each data item (signed report) is marked as "free for access by citizen" if not explicitly marked otherwise.

### ePrescribing

In contrast to referrals, prescriptions are saved centrally even though the prescription is issued on paper as well. Legislative changes are required to allow full implementation of ePrescribing, replacing the paper-based system. Nevertheless, pharmacists can access prescriptions also electronically. Pharmacists can view medication prescribed within the latest six months. Long-term prescriptions with repeat dispensings are limited to two months. After these two months, patients have to return to their GP to receive a new prescription. Dispensed drugs are also registered and made available via SISS, bringing the drug management process a step further than the prescription itself.

Once a month, pharmacies send details on all the drugs they have dispensed to Regione Lombardia for reimbursement and statistic purposes. The details contain the prescription formalities, so that any specific prescription can be linked to a dispensing procedure. Since the pharmacies' local IS is interfaced with SISS, the electronic document is generated automatically and directly transmitted. Thus, patients' medication history is completely presented in SISS in near time. Since the medication data is uploaded in the EHR on a monthly basis, it is not available in SISS in real-time but deferred by up to one month.

### eBooking

Currently, eBooking for hospital ambulatory services can be done via the region's call centre, at pharmacies, at GPs, and via the Internet by citizens themselves. eBooking even triggers a reminder of an appointment via SMS. eBooking requires referrals. First encounters with GPs or paediatricians cannot be booked electronically yet. In order to make an appointment electronically, patients either have to use their citizen card, their fiscal number, which is on the citizen card, their identification number, or the referral code. All this information is also visible on the paper referral document. Once the information has been given, patients can choose the distance within which they can reach the specialist or the hospital, a particular hospital or LHA, and determine the particular day and time. SISS searches for and displays available time slots according to the indicated information and additionally provides information on the maximum waiting times. From this pool of appointments, patients can eventually pick the date, time and location that fit them best. It is also possible to cancel a scheduled consultation. A new appointment leads to an automatic cancellation of previous appointments for the same referral.

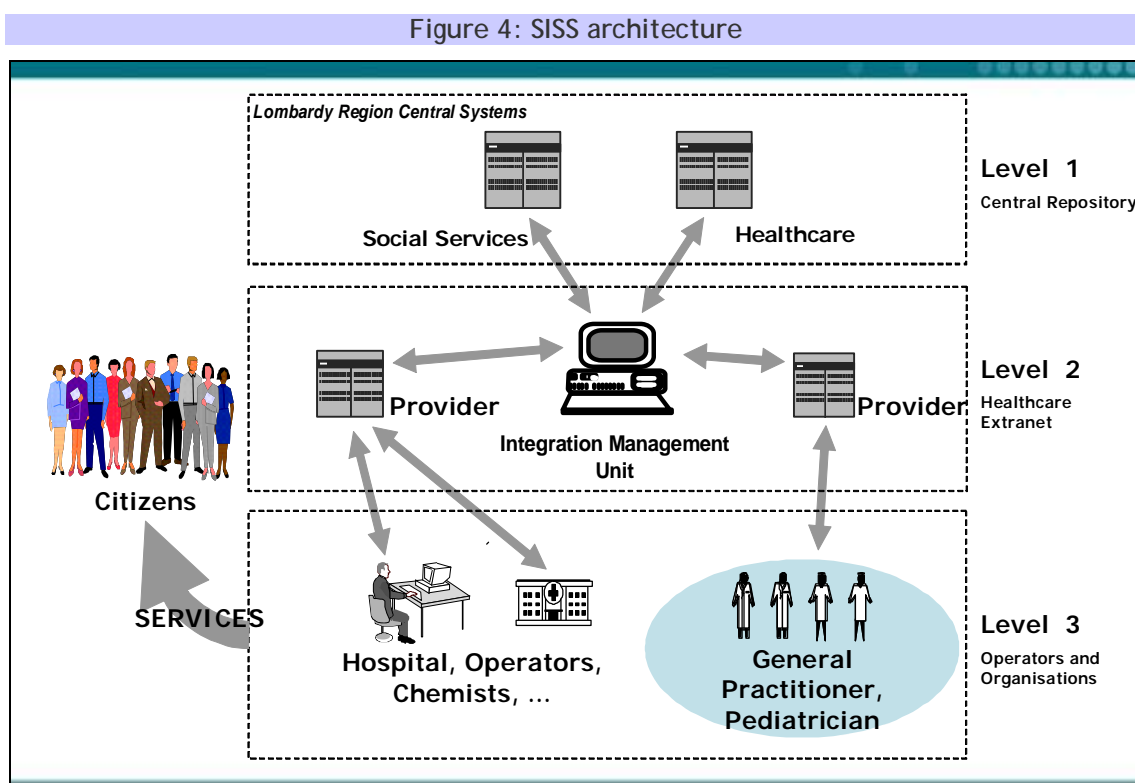
### Pathology networks

A new development is the establishment of pathology networks with the aim of utilising the opportunities provided by SISS for continuous and ubiquitous care for those who need it. Currently, there are three active pathology networks, for oncology, epilepsy and rare pathologies. Another five networks, covering cardio-vascular and stroke diseases, dialysis, hearing, and the phenomenon of infants death, are in the process of being implemented. These networks share data and documents more extensively and contribute this information to the patient's EHR. All health documents are stored in hospitals and consist of both structured documents and text files. A hospital is appointed to define the content standards and structures of the documents for the respective network.

## 2.6 Technology

### 2.6.1 Overview

The SISS health information network is based on the implementation of a Virtual Private Network (VPN) able to support communication between the different actors in the healthcare system. As Figure 4 shows, the SISS network has adopted a three level architecture. Level 1 is the regional central data repository, which is made accessible for the final users. Level 3 comprises the databases of the local health information systems. This is where the health information is stored. The EHR is a virtual data repository. Level 2 is the integration middleware, allowing for the connection between Level 1 and 2.



Source: Lombardia Informatica

The employment of a public network allows for reaching a high number of users and at the same time for avoiding the costs for creating a new private telecommunication infrastructure.

### 2.6.2 Technology principles and setup

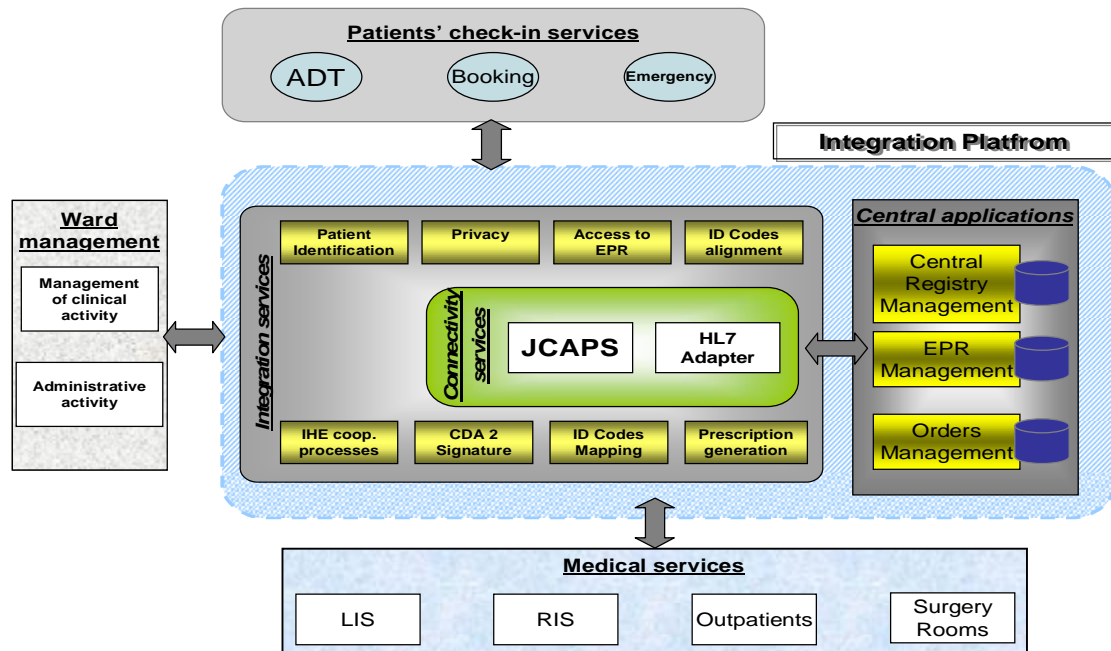
The main principles on which the project is built include the use of web technologies, including web services and web browsing, integration and not replacement of legacy applications, strict enforcement of data protection, security and privacy, hiding project complexity from the user, low level of disruption of daily activities, and large-scale deployment of digital signature and electronic documents.

The operating system for workstations is MS-Windows 2000 and XP. The software stack consists of smart card reader driver for MS Windows environment, cryptographic dll PKCS#11,

JNI to interface cryptographic dll to JAVA environment, Bouncy Castle as cryptographic middleware, and the signature application implemented by CRS-SISS project.

In support of integration, Regione Lombardia provides a hospital integration platform consistent with the SISS framework. The structure of the platform is depicted in Figure 5.

Figure 5: SISS hospital integration platform



Source: Lombardia Informatica

SISS promotes architectural standards for integration middleware, SUN's JCAPS, consistent with the main technological standards HL7 and IHE. The XML-based web services in a service-oriented architecture (SOA) allow the technology platform to work by processes, which ensures that existing sub-systems can be integrated and do not need replacement.

### 2.6.3 Security and confidentiality

From a technical perspective, privacy and data security is guaranteed by using a VPN accessed through a public network. The implementation of application layers allows for the encryption of the information exchanged, authentication, authorisation and identification of the users, electronic signatures, all in compliance with the national data protection policy and legislation. The security and confidentiality principles of SISS are the following:

- Citizen consent to processing their health data, in accordance to Art. 29
- Identification and authorisation of users
- Data security
- Limited access

The adoption of smart cards in this system has a vital role in terms of security mechanisms complying with the above described principles. The citizen card is used by patients to give their consent to their GP, specialists and hospital doctors to access their record. The health professional card serves for authentication and authorisation of users. The digital signature, combining health professional card and PIN, additionally validates the process of adding data to the virtual record. An automatic log-out helps to avoid unauthorised access and ensures

that only authorised professionals have access. The automatic log-out is executed after eight hours in GP practices and after 20 minutes in hospitals.

Access rights are defined according to the professionals' role in healthcare provision. Different profiles have different access rights. The following profiles are currently specified:

- GPs - see all data on their patients
- Specialists - only see data together with the citizen card
- Hospital doctors - only see data together with the citizen card
- Nurses - can see part of the data
- Pharmacists - can only see drug prescriptions and appointment booking information

In addition to these security mechanisms, patients have the choice to hide either all of their data or only part of it<sup>9</sup>, either from any healthcare professional or only particular ones.

## 2.7 Level of interoperability

Within the three EHR IMPACT (EHRI) interoperability classifications of potential interoperability, limited connectivity and extended actual connectivity,<sup>10</sup> SISS can be categorised as the third category of **extended actual connectivity**. Regarding the number of healthcare facilities connected and the number of healthcare professionals and citizens using the network, connectivity has reached a high level. It does neither create nor capture new information about patients. The virtual EHR consists of data that already exist in local health and hospital information systems.

Information that can be shared, however, is still limited to documents. It does not include all health data stored in local health and hospital information systems. Accordingly, the use of the network is limited to accessing data that is only available in external information systems. As there is no interface between the local systems and the network, the data is copied and pasted into the local records. The wide-scope interoperability feature of SISS concerns mainly the identification and authorisation challenges, which are now solved, and serve as a foundation for building clinical integration solutions. The lack of structured data exchange has not made it necessary to address the issue of semantic interoperability yet.

**Table 1: Scope of interoperability of the regional health information system SISS**

Type of Connectivity	Characteristics	SISS
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

<sup>9</sup> cf. Chapter 2.5

<sup>10</sup> EHR IMPACT (2008): The conceptual framework of interoperable electronic health record and ePrescribing systems, p. 30 Available at: [http://www.ehr-impact.eu/downloads/documents/EHRI\\_D1\\_2\\_Conceptual\\_framework\\_v1\\_0.pdf](http://www.ehr-impact.eu/downloads/documents/EHRI_D1_2_Conceptual_framework_v1_0.pdf)

## 3 Case analysis

### 3.1 Stakeholders

Stakeholders fall under the four groups defined by the EHR IMPACT methodology<sup>11</sup>: patients, informal carers and citizens, health service teams, health provider organisations, and third parties.

#### Patients, informal carers and other people

All of Lombardy's 9.5 million citizens have a stake in SISS. They are all either current or potential patients or carers. The latter also includes family carers, neighbours and friends. Previous Lombardian residents that have relocated their permanent residence outside Lombardy and still have their CRS are also considered stakeholders of SISS. However, the impact on this group is refined to effects on the administrative, non-clinical level as their card can only be used for administrative, primarily health insurance purposes.

The specific citizens affected by SISS at this point in time are mainly patients referred from GPs to specialists and hospitals, and patients receiving medication prescriptions.

#### Health service teams

Stakeholders in this group comprise all health professionals working with SISS. In this case study health professionals are either addressed in their role as employee or as individuals. This stakeholder group focuses on individuals, not on employees. It includes GPs and paediatricians, specialists, accident and emergency (A&E) care doctors, lab doctors, nurses in hospitals and in GP practices, and pharmacists as individuals performing their daily healthcare tasks. Impact in health service teams may range from an improved working environment over enhanced professionalism to increased work inconveniences. Until recently, SISS was focused primarily on doctors. Nevertheless, the role of nurses in designing and using SISS is expanding.

Health professionals are crucial for SISS' success. Even though it is possible to impose requirements on them, health professionals eventually decide whether they fully accept SISS and integrate it into their daily working routine or not. They are the custodians of the information available through SISS. They are responsible for data entry, albeit to different extents. It is their responsibility that the information they add is correct, comprehensive and reliable.

#### Health provider organisations (HPOs)

As the regional government is responsible for the provision of healthcare in public hospitals, it can be considered the region's healthcare holding organisation. Regione Lombardia is the representative of all public HPOs, including the group of 31 hospital management units, similar to hospital chains (*Aziema ospedaliera*), and a group of 15 healthcare management units (*Aziema Socio-Sanitaria*). As a result, a significant share both of the benefits and the costs attributed to this stakeholder group accrue to Regione Lombardia. The regional government's responsibility for the healthcare management and reimbursement further adds to Regione Lombardia's role.

Other stakeholders included in this category are GPs', paediatricians' and specialists' practices, and pharmacies. In contrast to the previous stakeholder group, the focus of the

<sup>11</sup> EHR IMPACT (2008): Methodology for evaluating the socio-economic impact of interoperable EHR and ePrescribing systems. Bonn, p. 43ff. Available at: [http://www.ehr-impact.eu/downloads/documents/EHRI\\_D1\\_3\\_Evaluation\\_Methodology\\_v1\\_0.pdf](http://www.ehr-impact.eu/downloads/documents/EHRI_D1_3_Evaluation_Methodology_v1_0.pdf)

analysis of positive and negative impact is put on health professionals as employees of GPs', paediatricians' and specialists' practices, hospitals and pharmacies. In particular, time savings, efficiency gains and changes in productivity are some of the effects.

### Third parties

The stakeholder analysis identified two stakeholders comprising this group. One is Lombardia Informatica, the region's software vendor providing the network's technology and services and acting as mediator between HPOs and certified ICT vendors.

Regione Lombardia presents the second stakeholder, assuming a different role from its role as the regional holding organisation of health provision. Here, it is analysed how the health information platform affects the regional government at a rather political level. On the one hand, SISS serves a purpose as determined from a healthcare policy perspective; on the other hand, it is incorporated in the overall regional ICT structures. Therefore, its influences are manifold and need to be taken into account accordingly.

## 3.2 Process change

### 3.2.1 Workflow

The changed organisation of and access to discharge letters and other medical reports shortens the workflow. GPs do not have to call hospitals for examination results or information on their patients' admission or discharge. Patients, on the other hand, do not need to come back to the hospital to get their report. Sometimes they do not even have to come back to a GP or specialist consultation, if the only reason for the visit is to hand over a test results report. If physicians compiling the examination and lab results do not decide otherwise, patients have the possibility to view their lab and examination reports via the Internet. Documents not marked "free for access by citizens" concern mainly severe cases, and/or cases in which doctors prefer to talk to their patients directly. This may also apply if the diagnosis requires particular instructions.

HIS' integration requirement to store reports from where they can be publicly accessible, and SISS' requirement to make them accessible, impedes physicians' workflow. While they previously only had to enter their results into the HIS (or the paper record) physicians now have to trigger the creation of a PDF document. This requires them to review the report and decide what they want to include, if they prefer to omit a piece of information and what they rather do not want to submit to other doctors and/or patients. Secondly, they have to confirm and digitally sign the PDF documents in order to send a notification containing the link to the report to the central database. Without SISS, the information would just have been entered into the report and automatically stored in the local database without any additional effort.

eBooking, as integrated in SISS, facilitates the entire booking and appointment management procedure. Before SISS, patients needed to call different hospitals, waiting for someone to answer the phone there. They tended to double or triple-book in search for an optimal appointment. Any appointments were fixed while searching for better ones. Once a suitable slot was found, patients did not cancel the previous options, but just failed to show up. With eBooking, they are not only provided with a selection of possible appointments, but an attempted double booking automatically cancels the first booking.

### 3.2.2 Clinical practices

The current impact of SISS on clinical practice is limited by the nature of project. The large scale of the information network and the necessity to bring local information systems up-to-date required a solid, but relatively slow approach. Regione Lombardia has now reached a stage in SISS where the infrastructure is implemented and work can focus on the clinical applications. The discussion below gives a glance of the potential, once the currently implemented functionalities are fully utilised.

From the physicians' perspective of prescribing, the availability of medication information that was previously not available may, at least for some patients, result in different clinical decisions about diagnoses and prescribing, despite the lack of real-time information. Access to reliable medication data may increase the awareness of the importance of generating, using and handling information. This knowledge may then lead to fewer medication errors, more effective prescribing and the reduced risk for patients experiencing an adverse drug event.

The set up and implementation of several pathology networks is already underway. The relationship between the pathology networks and SISS is twofold. Without SISS, the implementation of these networks would hardly be possible, as the opportunities provided by SISS make a meaningful, close, and most important timely cooperation between specialists possible in the first place. On the other hand, the networks contribute to the further development of Lombardy's health information network.

Health professionals' their clinical practices are currently in the progress of change. They are in the process of building multi-disciplinary teams, applying evidence-based medicine, and monitoring the appropriateness of procedures. This is all likely to have impact on clinical practices.

### 3.2.3 Working practices

Working practices regarding continuity and transfer between primary and secondary care have changed significantly through the availability of reports. With paper, GPs had to rely on their patients to bring the required documents to their consultations or they had to wait for the hospital to prepare the discharge letter or the examination report. In other cases they had to rely exclusively on patients' vague knowledge. The digital signature, however, demands specialists and hospital doctors to produce and publish the required information promptly. Following from the common habit to sign several reports at the same time at the end of the day, doctors receive the notification of the report being publicly accessible with only little delay and usually before seeing the patient again.

GPs do not need to enter their patients' information contained in the discharge letter, the examination and lab report manually. They can copy the relevant data from the reports stored in the local HIS and paste it into their own local EPR. Still not a full integration of systems, this practice is still more convenient than manual typing of information.

SISS is at the moment primarily used for having information at hand before or during consultations. Since patients frequently do not bring their medical reports with them, doctors, especially GPs, are required to check their emails for notifications or to scan through their patients' EHR in SISS. While this is positive from a clinical perspective, it nevertheless means an interruption to their previous working practices where they only would have looked for reports and other information while treating their patients.

Pharmacies used to construct the monthly reports manually, by extracting the information, including type of drug, quantity, and price, from their local information systems. These

reports are now automatically created and made available via SISS to Regione Lombardia for statistical and reimbursement purposes. The combination of information on prescriptions and dispensing enables the authorities also to monitor whether GPs adhere to their drug expenditure ceiling of 30% of their budget.

### 3.2.4 Reaction and acceptance of users

Similar to observations at other EHR IMPACT sites, health professionals felt initially insecure when they started working with SISS.<sup>12</sup> As SISS started from administration tasks and was only afterwards gradually integrated in healthcare, it had already reached a certain importance and standing without being used by everyone and without healthcare professionals being involved. As a result, its initial application tended to be administrative, rather than clinical. However, as soon as Regione Lombardia and Lombardia Informatica started to involve clinicians in designing, developing and implementing clinical guidelines, acceptance started to grow.

Once SISS had found its way to the clinical working environment, initial resistance had to be overcome. Healthcare professionals needed to recognise the benefit they can gain from working with SISS. The deployment of pathology networks facilitates this process. Improvements in recording, diagnosis and treatment affected physicians' attitude towards ICT deployment in health in general and SISS in particular. They started thinking in what way their working processes could be ameliorated and what role IT could play in this change for the better. This raised their willingness to contribute to the development of the regional health information platform, to create an environment in which it can unfold its potential, and to convince others of the opportunities SISS offers.

## 3.3 Timeline and milestones

Several activities preceded the implementation of Lombardy's regional health information system. The process of gathering and digitalising data started in the late seventies with inpatient data. Implementation of a region-wide information system could only be envisaged after citizens and GP data, information on pharmaceuticals and outpatient activity had been collected. The SISS project was defined in 1999 and feasibility studies aimed at determining its details. One year later, in 2000, a pilot project in the Lecco district, covering some 300,000 citizens, was initiated. The health information network's routine operation started directly after the pilot finished in 2002, and was quickly expanded across the public healthcare sector. Having completed a substantial amount of the work in the infrastructural side, developments of clinical functionalities started in 2006. In 2008 the region began to expand SISS to the private hospitals. Table 2 shows timeline of development according to the functionalities provided by SISS. The table is artificially constrained to the functionalities that fall within the scope of the EHRI evaluation.

<sup>12</sup> For other reports cf. EHR IMPACT (2008): Study on the socio-economic impact of interoperable electronic health record and ePrescribing systems. Available at: <http://www.ehr-impact.eu/cases/cases.html>

Table 2: Timeline of SISS development

Functionality / Service	Start Date (First issue/ Service Activation)	Estimation of the Status of work in Aug-2009 (deployment)	Finish Date (Full deployment and/or distribution)
eBooking	Before 2002	70%	2010
Digital Signature: Electronic Cards and Client Peripherals;	2002	90%	2010
Digital Signature: Infrastructure	2002	100%	2008
<b>Clinical applications:</b>			
Ambulatory reports	2006	70%	2010
Lab reports	2006	95%	2010
Radiology reports	2006	92%	2010
A&E	2006	88%	2010
Discharge letters	2006	88%	2010
Managing Prescribing	2006	100%	2009
ePrescribing of drugs	2006	88%	2010

Source: Regione Lombardia and Lombardia Informatica

### 3.4 Supporting take-up

The creation of new services and the integration of the individual information systems required the establishing of a central data repository, high quality clinical data repositories and the implementation of integration middleware. In order to succeed in implementing the regional health information platform and ensure its sustainability, the region opted for a mixture of bottom-up and top-down approaches in different settings. These two opposed methods were applied complementary, sometimes starting off with a bottom-up build-up of confidence and acceptance, followed by a top-down regulation that ensures universal use.

#### Technology take-up

Lombardia Informatica is in charge of developing, implementing and maintaining the central data repository, its integration with local databases through a basic integration platform, and the provision of all network services, such as the digital signature. HPOs have to ensure that their data recorded and made available across the region is of high quality. In order to fulfil this requirement, many HPOs either had to introduce a new information system or upgrade their existing systems. As part of the bottom-up approach, guidelines provided by Lombardia Informatica were supposed to support HPOs in both, selecting from different options for their, new or current, information system and integrating their local system with the regional health information network. Along with consultancy Lombardia Informatica offered a variety of products for integration, from which HPOs could choose. Hospitals could select from 13 to 14 certified regional vendors. GPs had the possibility to hire the services of one of 30 regional software houses, all previously certified.

## Incentives for users

During the period 2003-2004, Regione Lombardia provided GPs and pharmacists with financial incentives for actively feeding SISS with medical data, promoting it with their patients and using it. A threshold system was implemented, awarding GPs and paediatricians when 50% of prescriptions prescribing activity had been realised via SISS. GPs received an extra €2 per patient<sup>13</sup>, paediatricians and extra €3 per patient<sup>14</sup>. The incentive, extra money on top of the usual capitation fee, increased by 50% once the share of ePrescribing exceeded 70%.

Employing the regional health information platform became mandatory approximately five years after its introduction. In the meantime, the majority of healthcare professionals had recognised that the services and opportunities provided through SISS add value to the healthcare they deliver. On 31 July 2007 Regione Lombardia ruled the obligatory adoption of SISS for all health and social care service providers. In 2008 eBooking was introduced as a service provided by pharmacies. Similarly to the GPs' and paediatricians' incentive schemes, pharmacists receive a certain amount per eBooking procedure in order to foster utilisation.

## Implementation strategy

Regione Lombardia started with the integration of administration procedures and expanded the health information system to medical information. Along this extension of users, they started with the public sector and only after public health services had been integrated they recently started connecting private healthcare providers. Take-up strategy envisaged:

- Deployment of SISS in a specified area in the public sector only
- Expanding to other regions' public sector and starting a pilot in the region's private sector in parallel and
- Connecting the entire private sector.

## User engagement

While gradually increasing the number of health professionals and health services connected, user requirements were constantly taken into consideration. Healthcare professionals were engaged in so called "tables", addressing disease-oriented aspects of SISS' services. The combination of user orientation and user satisfaction is considered key to the system's success and sustainability, and is by now commonly recognised as good practice.<sup>15</sup> Nevertheless, it was impossible to meet all requirements as all hospitals differ in size and organisation. Significant efforts are being put in steadily convincing HPOs and health professionals of the health information network's advantages and simultaneously adapting SISS to the needs of users.

## Training

Training was made compulsory by Regione Lombardia. This had two goals. First, to ensure that users are familiar with the functionalities provided by SISS. The second motivation was to signal to healthcare professionals the importance given by Regione Lombardia to SISS.

<sup>13</sup> Contract information between GPs and LHAs, available at: [http://www.aslmi2.it/web/download.nsf/0/DA7284DCEAB97DEFC125714C003E8F86/\\$FILE/CONTRATTO\\_REGIONALE\\_MMG\\_ASL\\_MI2.pdf](http://www.aslmi2.it/web/download.nsf/0/DA7284DCEAB97DEFC125714C003E8F86/$FILE/CONTRATTO_REGIONALE_MMG_ASL_MI2.pdf)

<sup>14</sup> Contract information between paediatricians and LHAs, available at: [http://www.aslmi2.it/web/download.nsf/0/37569F87E5EDEC1C125714C003EA9AD/\\$FILE/CONTRATTO\\_REGIONALE\\_PLS\\_ASL\\_MI2.pdf](http://www.aslmi2.it/web/download.nsf/0/37569F87E5EDEC1C125714C003EA9AD/$FILE/CONTRATTO_REGIONALE_PLS_ASL_MI2.pdf)

<sup>15</sup> European Commission (2009): eHealth in Action. Good Practice in European Countries. Good eHealth Report, p. 8

### 3.5 Benefits

Identifying the full impact of SISS relies on collecting information about quality, access, and efficiency, which are the three main types of benefits for each stakeholder group.<sup>16</sup> The five factors facilitating benefits to quality are better:

- Informed citizens, patients and carers
- Timeliness of care
- Patient safety
- Streamlined care
- Effectiveness of care.

Better access implies both equity of access to all who are in need of it and access achieved by the provision of services to more citizens who had previously no access. Efficiency benefits are from improved productivity, avoided waste and optimal resource utilisation.

Tables 3 and 4 show two perspectives of benefits distribution between categories and stakeholders. Table 3 shows that quality gains are distributed among all stakeholders, albeit in varying degrees. Efficiency gains almost entirely accrue to HPOs.

**Table 3: Distribution of benefits within benefit categories**

	Quality	Access	Efficiency	Total value
Benefit category by stakeholders	%	%	%	%
Citizens	18%	0%	1%	10%
Healthcare Professionals	9%	0%	0%	5%
HPOs	33%	0%	99%	65%
Third Parties	39%	0%	0%	21%
Total Value	100%	100%	100%	100%

Source: EHR IMPACT study

Table 4 shows that the lion's share of citizens' benefits is attributed to an increase in quality, whereas the stakeholder group of HPOs mainly benefits from efficiency gains. Increased efficiency is only of little importance to third parties.

**Table 4: Distribution of benefits within stakeholder groups**

	Quality	Access	Efficiency	Total value
Stakeholder benefits by category	%	%	%	%
Citizens	96%	0%	4%	100%
Healthcare Professionals	100%	0%	0%	100%
HPOs	27%	0%	73%	100%
Third Parties	99%	0%	1%	100%
Total Value	52%	0%	48%	100%

Source: EHR IMPACT study

<sup>16</sup> EHR IMPACT (2008): Methodology for evaluating the socio-economic impact of interoperable EHR and ePrescribing systems. Bonn, p. 48f. Available at: [http://www.ehr-impact.eu/downloads/documents/EHRI\\_D1\\_3\\_Evaluation\\_Methodology\\_v1\\_0.pdf](http://www.ehr-impact.eu/downloads/documents/EHRI_D1_3_Evaluation_Methodology_v1_0.pdf)

The main drivers for benefits from SISS are the data sharing and eBooking functionalities. Data sharing leads to both quality and efficiency gains, from which each stakeholder group benefits in one way or the other, and to different extents. Data sharing renders healthcare provision safer, especially in cases where patients would otherwise not bring their referral or discharge letters to GPs, specialists or emergency departments. It allows for data validation and counter-checking of test results, for preparation of consultations in advance, for the creation of new healthcare models, and increased productivity through which more time can be allocated to clinical activities.

eBooking procedures are not of less importance, albeit their benefit genesis is based on entirely different aspects. Through eBooking, time is saved, both for HPOs and citizens, resources are more easily planned and allocated and the access to care is much more convenient.

A detailed description of the identified benefit indicators is provided in Appendix 2. The following sections give an overview of the benefits for each stakeholder group.

### 3.5.1 Patients, informal carers and other people

SISS significantly raises the quality of healthcare provided to patients. Several aspects contribute to safer and more effective healthcare. In hospitals, the data generated through lab test and examination tests is additionally validated through digital signatures of results. The eSignature procedure and the subsequent information upload demand hospital doctors to examine their results again. This decreases the risk of overseeing medical issues or inconsistencies. At the same time, they can easily ask colleagues for counter-checking the results in case they prefer to have their diagnosis confirmed, without undue delay.

The subsequent notification sent to the referring doctor and the availability of various reports in SISS provides particularly GPs with important, and sometimes even vital, information about their patients. The message on a patient's hospitalisation or discharge allows GPs to prepare timely follow-up treatment. In some cases, patients fail to bring their lab or examination results to their GPs; others do not recognise the need to visit their GP after a hospitalisation at all. In particular in A&E, patients hardly ever bring medical reports with them. With SISS, doctors have the information at hand whenever required.

The CRS as patient identifier has additional impact on patient safety. In bigger hospitals with a high number of patients, the identification of the right patient is difficult but essential. With the citizen card, healthcare professionals can immediately identify their patients and follow their journey through the hospital, while reducing the risk of applying the right treatment to the wrong patient.

Efficiency gains are another prevalent benefit for patients. These benefits are primarily based on time savings and savings of travel costs. eBooking facilitates scheduling procedures for patients and their carers as they do not have to phone at a myriad of hospitals and schedule numerous consultations before they have an appointment that suits them.

As citizens have the possibility to access reports via the internet, some appointments are avoided. In case they are not informed otherwise and the results do not require any additional treatment, patients can receive their results and are spared unnecessary consultations at their GPs or hospital for the only reason to receive their test results. These avoided consultations save both time and travel expenses. Even if a patient has to visit a GP in order to get the lab and examination results, repeated travel to the hospital is avoided as GPs have the test results available as soon as they are electronically signed by the responsible physician.

### 3.5.2 Health service teams

To the same extent as SISS contributes to the provision of better healthcare, it adds to healthcare professionals' feeling of professionalism, work satisfaction and convenience. GPs, for example are constantly kept informed about the status of their patients. Before SISS, it was practically impossible to know for each patient that they are hospitalised, that they are already discharged, or that their test results are already available.

Hospital doctors enjoy the comfort of using the necessary information to prepare consultations with patients in advance, especially in cases of complex pathologies. A&E nurses can be sure that the information they have is reliable and the patient they are attending is the patient they reckon to be their patient. From all of these aspects physicians and nurses gain enormous comfort. They can be sure that their decisions are based on robust information rather than on vague assumptions. This, in turn, allows them to provide care that is as effective as possible. In particular GPs mentioned that once SISS has covered all healthcare services across the entire region, and it is enabled to unfold its potential, it will be impossible and unimaginable to work without it. Professionals expressed the opinion that any negative impact arising in the context of developing, implementing and using SISS must be regarded against the background of its future potential and is therefore worthwhile the current efforts and inconveniences.<sup>17</sup>

### 3.5.3 Healthcare Provider Organisations (HPOs)

Similar to the previously described stakeholder groups, HPOs benefit from SISS' impact on the quality and efficiency of healthcare. However, the aspects that affect the provision of healthcare in the different healthcare facilities, and the extent to which the health services benefit, differ widely. In accordance with the increase of patient safety accruing to patients, their carers, and health service teams, GP practices and hospitals likewise reap the fruit from SISS. In general they all benefit from an overall improved clinical performance, better clinical governance and a reduced clinical risk.

Regione Lombardia, as an employer of healthcare professionals, additionally profits from efficiency gains stemming from time savings and enhanced resource utilisation. Time can be saved as medical reports are immediately available. Neither GPs nor other hospitals have to be consulted for previous medical information. At admission, A&E nurses do not have to question patients for personal and administration data, since they have all the information at hand. With SISS, time saved with different procedures by different health professionals adds up to a significant increase in efficiency. Time avoided for administrative purposes can be used for more important tasks regarding the delivery of healthcare.

Through its eBooking features SISS supports scheduling and better resource planning. On the one hand, appointments are much more convenient for patients, therefore attendance is more likely. On the other hand, patients do not book several appointments of which they can only attend one. Instead, they book the day and time that suits them best and are likely to attend this consultation. Therefore, the proportion of patients who do not attend their first outpatient consultation decreases. There is evidence of reduced no-show rates as a consequence of introducing the eBooking functionalities.<sup>18</sup>

Avoided overbooking help hospitals to plan their resources more efficiently and reduce waiting times. This aspect became particularly important following a new regulation on

<sup>17</sup> Source: Interviews with GPs and hospital doctors

<sup>18</sup> Battistotti, A., Quaglini, S., Couco, E. (2006): Reducing dropouts in outpatient care through an SMS-base system. In: Ubiquity: Technologies for Better Health in Aging Societies, A. Hasman et al. (Eds.), IOS Press, 2006

equality of treatment between private and public sector patients. Extra staff cost needed to meet the increasing demand for consultations was kept at a lower rate because of SISS.

A significant benefit to hospitals was an acceleration of development and deployment of information technology systems. Before the development of the region's health information network some hospitals had only an administrative information system implemented, others none at all. The introduction of SISS and the need for integration, and a certain requirement of information provision, made it necessary for the majority of hospitals to either acquire a HIS or upgrade their already implemented one. Even though it can be assumed that this would have been done anyway at some point in time, SISS has significantly contributed to improved ICT infrastructure, both within the region and hospitals. The scope of this evaluation does not include the individual HIS and their impact. However, the enabling role of SISS in bringing beneficial investments forward is a tangible gain from the region-wide initiative.

From GPs' perspectives, not as individuals but rather as health service providing entities, they save time by using SISS when feeding their local IS with medical information about their patients. Although full integration of the systems is not completed yet, the copy and paste option is already an improvement to manual entry from paper records.

Financially, GPs initially profited from financial incentives paid by the Regione Lombardia. These incentives supported GPs at an initial stage of implementation in coping with the inconveniences by using SISS for referral procedures. These incentives were offered until the adoption of SISS by all healthcare providers was announced obligatory in 2007.

Regarding pharmacies, the interface of their local IS with SISS allows them to compile and send the reports on prescriptions and dispensed medication to Regione Lombardia with minimal effort. As this document is automatically generated, statistical reporting and reimbursement procedures are significantly smoothed and time is saved.

eBooking for patients done by pharmacists is expected to affect customer loyalty, which is the main reason for participation. Financial incentives provided by Regione Lombardia in order to increase the number of pharmacists using eBooking for their patients serve as a facilitator in the early stages.

### 3.5.4 Third parties

The development of SISS anticipated aspects that can be additionally used for the exchange of information as part of the eGovernment infrastructure. A new law requires that all public administration services offered online need to be embedded in a secure card-based infrastructure, covering authorisation, identification, and signature as of the end of 2009. With SISS, and its card-based infrastructure CRS, Regione Lombardia avoids the costs of developing and implementing this infrastructure again. Therefore, Regione Lombardia is not only a beneficiary of SISS affecting the region's healthcare provision, but also as the regional government benefiting from SISS regarding the provision of eGovernment services.

As described in chapter 2.2.1, the increasing demand for healthcare in Italy in general and Lombardy in particular, requires changes in the provision of healthcare. A gradual move towards a new model of healthcare, which focuses more on prevention and primary care and avoidance of the need for expensive secondary care services, is anchored in the region's health strategy and eHealth strategy. SISS fosters the change of healthcare models and therefore allows for coping with the increasing demand for healthcare, in particular in hospitals. In the long run, this does not only affect HPOs and the delivery of healthcare at the point of care, but also the regional structures regarding healthcare quality and efficiency. The full impact of these features cannot be expected within the EHRI horizon ending in 2010. Nevertheless, the value of SISS in preparing the Lombardy healthcare system for the upcoming changes is reflected as a quality gain to Regione Lombardia in its political role.

## 3.6 Costs

Costs associated with eHealth activities comprise two major components: ICT-related investment and organisational change issues. The step-by-step implementation and continuous development results in the first component stretching across the whole life-cycle, although to changing extents. It is 63% of the overall costs. The second includes non-ICT-related investment costs and any negative impact arising in the context of using SISS. These costs may range from initial reduction in productivity over irritation to staff and work inconveniences during the phase of change, any aspect that may impede the workflow and demand extra efforts to financial incentives that need to be incurred. Non-ICT costs present 37% of the total costs.

### 3.6.1 Patients, informal carers and other people

Neither patients, nor their carers or citizens have to incur any direct financial expenses for SISS. Nevertheless, they have to bear some extra efforts in order to benefit from the health information network. If they wish to fully tap the potential of SISS, they have to give their consent that a regional EHR is created. This requires that they go through the information on CRS and SISS provided by the regional government and they have to go to particular facilities to hand in their formal consent. The costs involved here are based on the time invested in gathering information and triggering the creation of the EHR.

### 3.6.2 Health service teams

Doctors recognised how they could benefit from SISS. Based on that, a group of physicians decided to set up round tables and attend these meetings on a regular basis. There are over 80 different groups discussing various healthcare topics, often pathology based, and how SISS can be used and further developed in order to facilitate quality healthcare. Even though the participation is voluntary and the participants changing, the healthcare professionals' contribution to the development, implementation and steady improvement of SISS is a cost aspect. The time involved in this engagement has an opportunity cost. This time could have been invested in some other private or professional activities.

Initial irritation and inconveniences arising in the context of using the health information platform should not be underestimated. Many healthcare professionals look back to a long professional medical career in which they had, in their opinion, optimised their working processes and grown used to particular work flows and clinical practices. Even if they acknowledge the application's positive impact on healthcare provision, adapting to process changes remains inconvenient and irritating, if not difficult and hampering. It was reported that working processes were initially slowed down because healthcare professionals were not used to working with the system. Additionally, the response time was very slow. Therefore, the initial impact on costs was quite high, but fortunately this was a temporary phenomenon.

Additional irritation may follow from using the health professional card. All healthcare professionals having a card need to bring to their workplace every day. If they do not have their card with them, they cannot work with SISS. In some cases this means that they cannot work at all, in others that they cannot work properly and have to postpone some of their tasks. Help desk staff cannot work at all or they have to work in the back office, hospital doctors cannot sign their reports electronically and have to do it on another day, and GPs cannot access their patients' reports. No matter whether they have to go back home to get their health professional card or whether they have to defer their tasks, healthcare team members are exposed to inconveniences they would not have to bear without SISS.

Pharmacists are the only health professionals who are assumed to be excluded from this inconvenience as currently each pharmacy has only one card, which is kept at the pharmacy.

### 3.6.3 Healthcare Provider Organisations (HPOs)

ICT-related investment in SISS is exclusively incurred by Regione Lombardia and covered by a vendor contract with Lombardia Informatica. By receiving a certain amount per activated citizen card, Lombardia Informatica provides the development and implementation of the central data warehouse, the clinical databases, and the integration middleware. This amount additionally includes the provision of all services, such as training of health professionals, maintenance and running the call centre. Before the actual take-up of SISS, Lombardia Informatica was also in charge of the pilot project, conducted in the district of Lecco from 2000 to 2002.

Non-ICT costs are primarily based on reduced productivity through healthcare professionals who, deliberately or unintentionally, allocate their time away from direct healthcare. The introduction of SISS requires health professionals to assume tasks that were previously not necessary and as a result hospitals, GP practices, and pharmacies cannot allocate these sources to their original responsibilities. In hospitals, doctors particularly have to spend extra time on electronically signing the reports made available to SISS. If health professionals do not have their health professional card, they either cannot work, or at least not in the form they regularly do. Informing patients on SISS, their benefits of giving their explicit consent and the entire procedure of creating a regional EHR requires additional time. The time health professionals spend on training cannot be allocated to their healthcare work either.

Productivity of GPs is negatively affected by scanning through their emails in search for information on their patients. Before SISS, an equivalent activity would have been meaningless. Depending on whether they practice in a rural or urban environment, GPs reported to commit five minutes to half an hour daily to checking their emails for links that might be of importance for their respective consultations. In some cases, this leads to a significant decrease of productivity resulting in fewer consultations per day.

Similarly, pharmacists need to allocate time from their health-related work away to administrative tasks. eBooking requires extra time commitment for pharmacist for each eBooking procedure. Time they invest in training likewise generates negative impact with regard to productivity, at least temporarily.

Financial incentives, both for GPs during the first four years and for pharmacists since the end of 2008, are exclusively covered by Regione Lombardia.

While it can be assumed that hospitals benefit from being several years ahead in their IT development, the involved opportunity costs additionally have to be taken into account. The resources invested in HIS could have been spent on alternative investments.

### 3.6.4 Third parties

The only costs for this stakeholder group are expenses for Lombardia Informatica related to the pilot in the district of Lecco and not covered by the vendor contract with Regione Lombardia. Costs that exceeded the pre-set amount had to be borne by Lombardia Informatica.

## 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).<sup>19</sup> The UK Treasury's Green Book<sup>20</sup> and Germany's WiBe<sup>21</sup> 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 2000 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 HPOs, 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 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

<sup>19</sup> EHR IMPACT (2008): Methodology for evaluating the socio-economic impact of interoperable EHR and ePrescribing systems. Bonn, p. 41ff Available at: [http://www.ehr-impact.eu/downloads/documents/EHRI\\_D1\\_3\\_Evaluation\\_Methodology\\_v1\\_0.pdf](http://www.ehr-impact.eu/downloads/documents/EHRI_D1_3_Evaluation_Methodology_v1_0.pdf)

<sup>20</sup> 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](http://www.hm-treasury.gov.uk/media/05553/Green_Book_03.pdf)

<sup>21</sup> 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](http://www.eu.wibe.de/wibe_framework/wibe_framework2/0806_WiBe-Framework.pdf)

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 systems. It identifies when and by how much benefits exceed costs over time. Two important features of the net benefit estimates need emphasising. First, the net economic benefit is a monetary measure of the net value of all positive and negative impacts, not a measure of financial returns. A brief analysis of the financial impact follows in the distribution of costs and benefits into different categories, including financial, in section 3.8 below. Second, the measure of net benefits lies in the overall position and performance, not in the absolute values presented.<sup>22</sup>

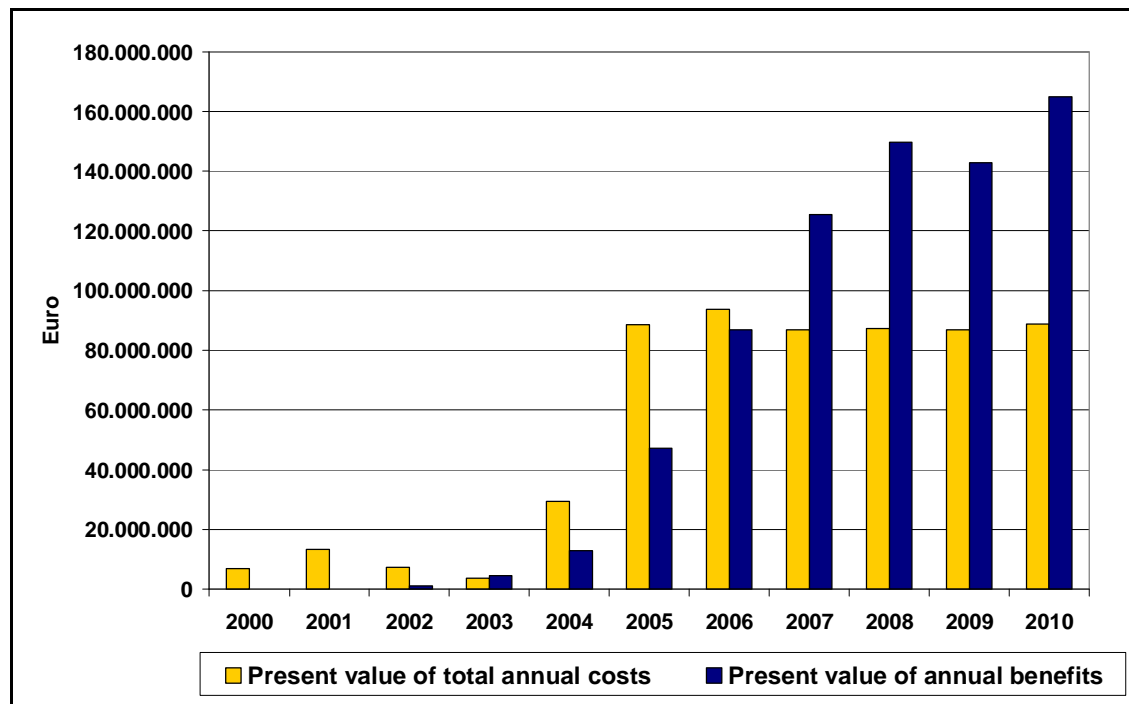
### 3.7.2.1 First year of annual net benefits

Chart 1 below shows the present values of estimated costs and benefits for each individual year over the relevant horizon of 2000 to 2010. 2007 is the first year in which estimated annual net benefits were realised. It took eight years from the pilot of the integrated EHR initiative in Lecco and five years after implementation of SISS began. Annual net benefits are observed only one year after the wide-scale deployment of first clinical features, which needed the infrastructure build in the preceding years. Initiatives of similar scope and complexity show a comparable timeframe.<sup>23</sup>

<sup>22</sup> Cf. Section 3.7.4 on sensitivity of results

<sup>23</sup> 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, p. 56. Available at: <http://www.ehealth-impact.org/download/documents/ehealthimpactsept2006.pdf> (08-07-09); other EHR IMPACT reports on [www.ehr-impact.eu](http://www.ehr-impact.eu)

Chart 1 Estimated annual costs and benefits



Source: EHR IMPACT study

From 2004 onwards, growth of annual benefits is accelerated. The significant increase in benefits in the period from 2004 to 2006 reflects the implementation rate. There is an abrupt rise in the number of hospitals, GPs and pharmacies connected to SISS. In 2005, the number of citizens having a citizen card doubled, and similarly the number of activated citizen cards experienced a sudden jump. In the same year, the eBooking functionalities were introduced and contributed to the genesis of additional benefits.

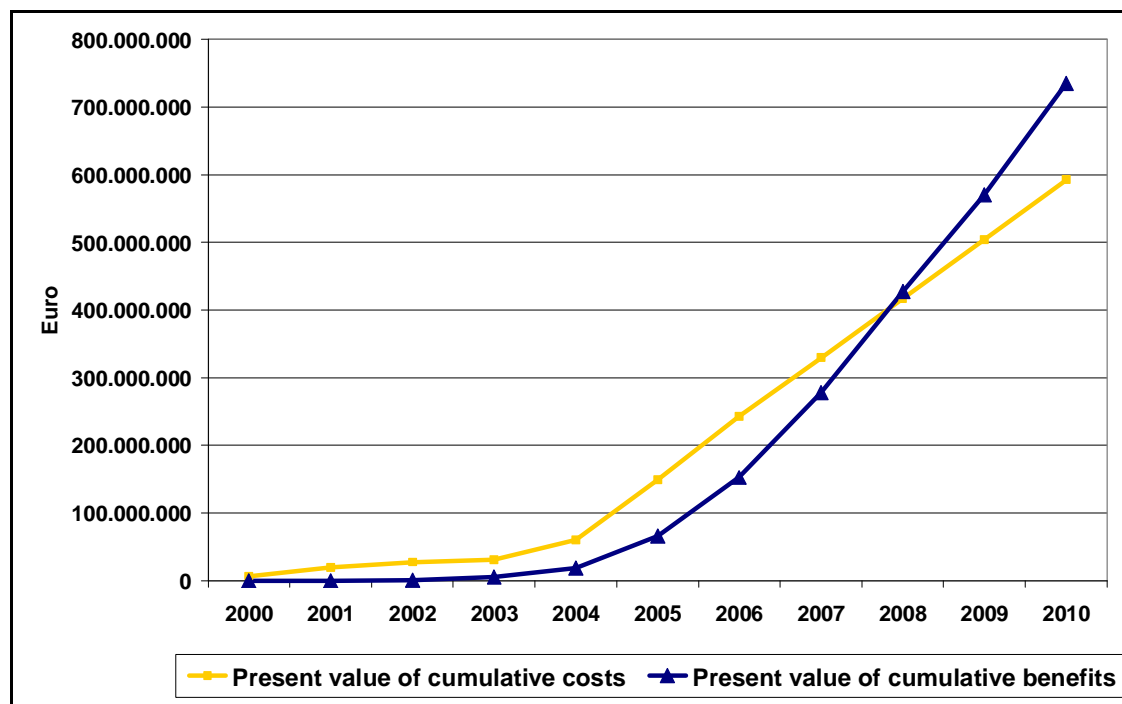
At first glance it seems as if the growth rate of annual benefits experienced a dip in 2009, from where it starts growing again. However, the otherwise steady growth is disrupted by the annual benefits of 2007 and 2008. These two years of exceptionally high annual benefits are based on SISS' contribution to the advanced deployment of ICT in hospitals, which is reflected in a significant one-off benefit over a period of some two to three years.

Annual costs reach their peak in 2006. The increase in annual costs between 2003 and 2006 mirrors the increase in the number of users, needing training and facing initial inconveniences in adapting to SISS. The expanding of functionalities, such as the introduction of eBooking, the integration of pharmacy information systems, the increasing number of patients giving their explicit consent and thus activate their CRS, and the financial incentives for GPs accumulates to over 93 million EUR in 2006. After 2006 the costs slightly decrease and reach a stable level. As operational costs are based on a fixed amount per activated citizen card, annual costs may increase to a level at which all citizens in Lombardy have activated their CRS for SISS. However, benefits are expected to grow beyond 2010 as well.

### 3.7.2.2 First year of cumulative net benefits

The aggregation of annual costs and benefits to cumulative values shows the overall socio-economic impact over time. The respective cost and benefit curves are depicted in Chart 2.

Chart 2: Estimated cumulative costs and benefits



Source: EHR IMPACT study

In year nine of the evaluation period and year six after implementation SISS yields a positive cumulative net socio-economic benefit. In the first year, 2008 the value of is more than 10 million EUR. The gap of only one year between realisation of annual and cumulative net benefits is consistent with findings from other successful eHealth initiatives.<sup>24</sup>

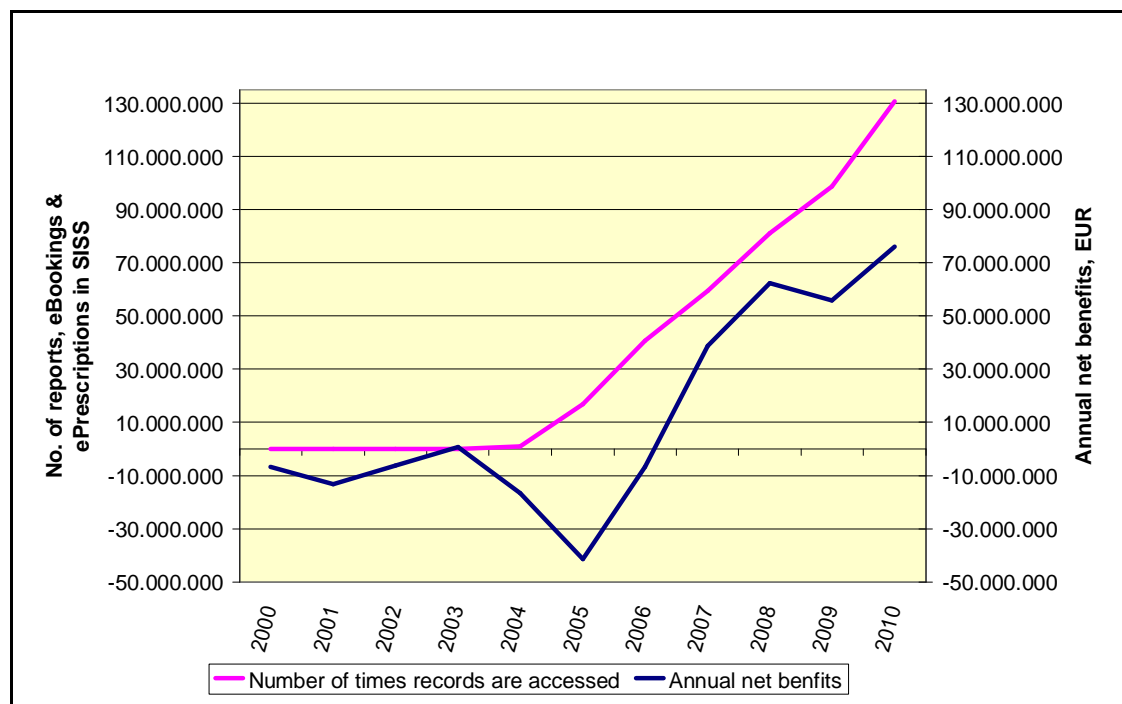
Similar to the annual cost curve, growth in cumulative costs is accelerated from 2004 but quickly switches to stable growth. Starting the same year, but gaining speed one year later, cumulative benefits grow at a faster rate than the respective costs. Once this crucial point is reached, cumulative net benefits begin to grow as well and reach about 142 million EUR by 2010. Both the high level of cumulative benefits and the stable growth of cumulative costs at a lower level than the cumulative benefits curve suggest a long-term sustainability of SISS.

### 3.7.2.3 Net benefits and utilisation

The use of SISS and its impact on clinical and working practices leads to net benefits. Utilisation is reflected in the number of records, as evidence of hospital doctors signing reports electronically and medical information available to physicians throughout the region, eBooking procedures, eReferrals, eOrders and ePrescriptions, as presenting the qualitative description and analysis. There is a general, broad positive correlation between annual net benefits and utilisation. Chart 3 below demonstrates the relationship.

<sup>24</sup> 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>; other EHR IMPACT reports on [www.ehr-impact.eu](http://www.ehr-impact.eu)

Chart 3: Link between net benefits and utilisation



Source: EHR IMPACT study

As the analysis of the annual and cumulative net benefits proves, SISS will only come to fruition if its functionalities are completely and extensively used. However, the obverse is not always true. The fact that a system is used does not automatically mean that benefits are realised at a value that exceeds costs, unless it provides usable and useful information. Matching SISS' utilisation and its net benefits curve after implementation reveals some of these relationships.

Before the implementation of SISS, annual net benefits are negative, with utilisation at zero, as Chart 3 shows. With an increasing number of reports, and so the beginning of a positive utilisation, net benefits take an even more negative direction. This is a rather uncommon feature of EHR IMPACT case studies. It is explained by the expansion of users and extension of functionalities, such as the introduction of eBooking in 2005. As soon as initial adaptation difficulties are overcome, benefits for all stakeholders increase and net benefits curve changes its direction.

The other uncommon feature is a faster growth in benefits compared to utilisation between 2007 and 2009. This is related to the accelerated deployment of HIS, which is independent of the utilisation of SISS.

Despite these features, net benefits are in general driven by utilisation, as indicated by the high positive correlations of utilisation to benefits of +0.96 and utilisation to net benefits of +0.90.

#### 3.7.2.4 Net benefit to cost ratio

The net benefit to cost ratio compares the net socio-economic impact of SISS to its costs, including negative impacts. A positive ratio indicates a worthwhile socio-economic endeavour. A ratio of zero equals a break even point.

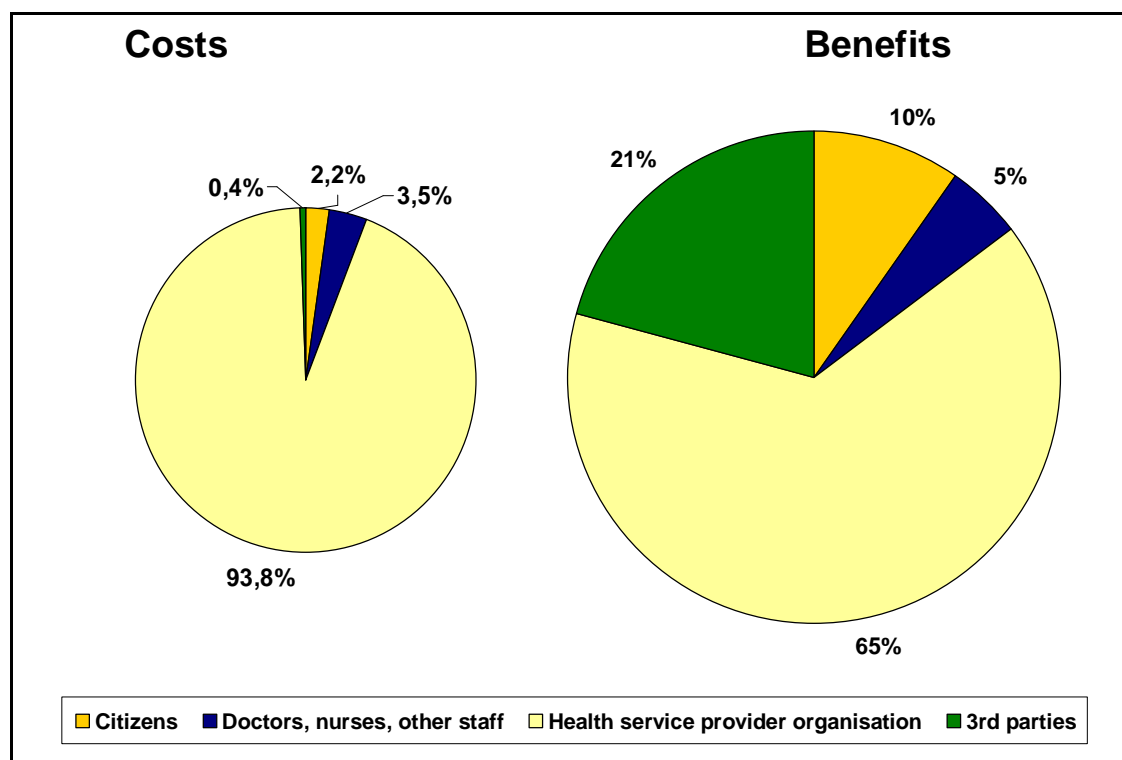
After three years of steady growth, the net benefit to cost ratio turns positive with +0.45 in 2007. As a result of accelerated ICT deployment in HPOs, it grows to 0.71 in 2008 before dips in 2009 and leaves the EHR IMPACT timeline in 2010 at +0.86.

Consistent with findings from other eHealth evaluations, one year after the annual ratio the cumulative net benefit to cost ratio turns slightly positive in 2008 at +0.03<sup>25</sup>. By 2010, the cumulative net benefit to cost ratio reaches +0.24. Understood as a rate of socio-economic, albeit not purely financial, return over a given period, this indicates an overall socio-economic return from SISS of about 24% over a period of 11 years. This means that for every 100 EUR worth of negative impact, there are 124 EUR worth of net positive impact.

### 3.7.3 Distribution of costs and benefits by stakeholders

Chart 4 shows the distribution of Lombardy's health information platform's costs and benefits among the main stakeholder groups. HPOs include public hospitals, GP and paediatrician practices, and pharmacies connected to SISS, as well as Regione Lombardia as a holding organisation of all public hospitals. 'Doctors, nurses and other staff' refers to these health facilities' employees and owners as individuals, not as human resource. Thus, impacts such as private time invested or saved, and inconvenience or satisfaction, are attributed to this group. 'Citizens' refers to patients and some informal carers. Third parties include Lombardia Informatica and Regione Lombardia as a political body.

Chart 4: Distribution of costs and benefits by stakeholder group



Source: EHR IMPACT study

<sup>25</sup> 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>; other EHR IMPACT reports on [www.ehr-impact.eu](http://www.ehr-impact.eu)

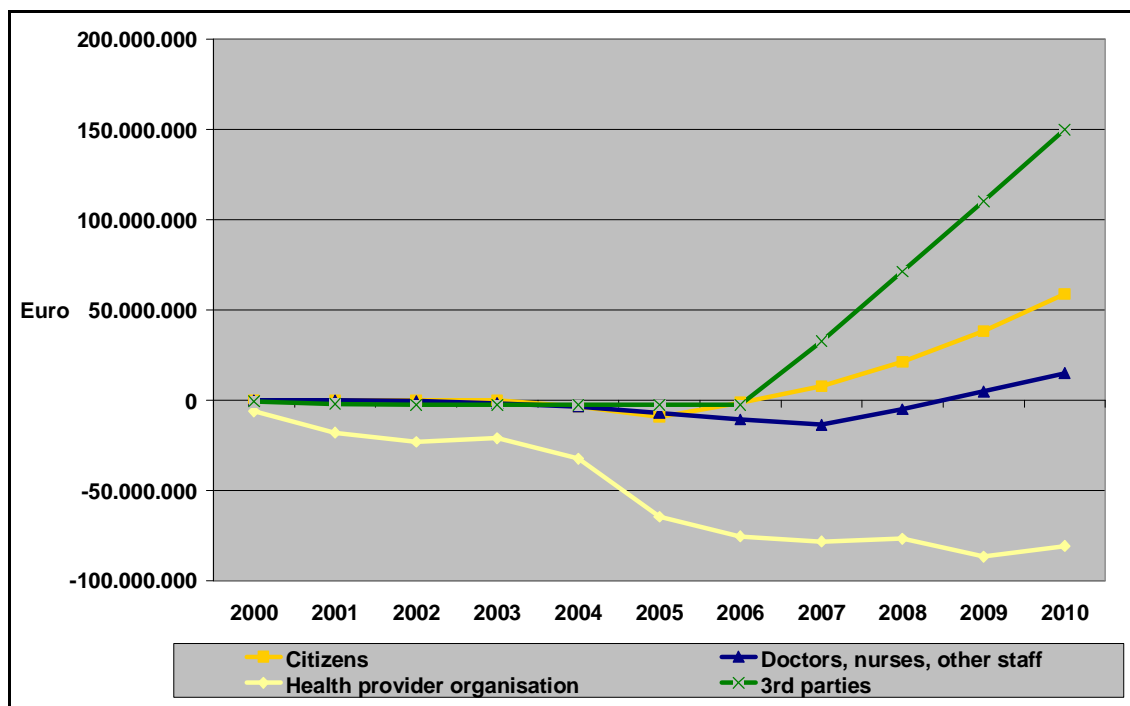
The lion's share, both of benefits and costs accrue to HPOs. About 94% of costs are borne by HPOs, the smallest share is assigned to third parties. Health professionals incur around 3.5% of the costs, patients, carers and citizens just over 2%.

In contrast to the cost distribution, third parties receive the second largest share of benefits, with 21%. Complying with the healthcare strategy of a change on the model of healthcare to the medium- to long run, and the avoided need for investment in a separate infrastructure supporting eGovernment services is estimated to have a cumulative value of more than 150 million EUR by 2010 for Regione Lombardia.

HPOs have the biggest share of benefits, primarily attributed to improved and more efficient healthcare delivery. This leads to HPOs having about 65% of the benefits, some 475 million EUR over 11 years. Increased convenience from better-informed decision-taking and their patients' increased safety amounts to almost 36 million EUR, leaving health professionals with some 5% of the overall benefits. Patients, their carers and citizens have 10% of cumulative benefits.

The unfavourable distribution of costs and benefits to HPOs, also clear in Chart 5 below, is not uncommon for large scale investments such as SISS. One reason is that large-scale investments need long timescales to unwrap their full potential. For SISS, this is beyond the EHRI timeline, which is artificially cut in 2010. Another aspect is that Regione Lombardia, although being one organisation, has two different roles: one as an HPO and one as a political body responsible for non-healthcare matters. The combined socio-economic benefit to Regione Lombardia is likely to exceed its investment faster.

Chart 5: Cumulative net benefits by stakeholders



Source: EHR IMPACT study

All other stakeholder groups realise net benefits even within the EHRI time horizon. HPOs do not, yet the flattening of their net benefit curve, together with the fact that the clinical utilisation is still in its early stages, indicate a positive trend for the years beyond 2010.

### 3.7.4 Sensitivity analysis

The sensitivity analysis consisted of 28 separate tests, focusing on all 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<sup>26</sup>, 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 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 six occasions, cumulative net benefits were delayed 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 0.20, still leaving a comfortable positive result of 4%.

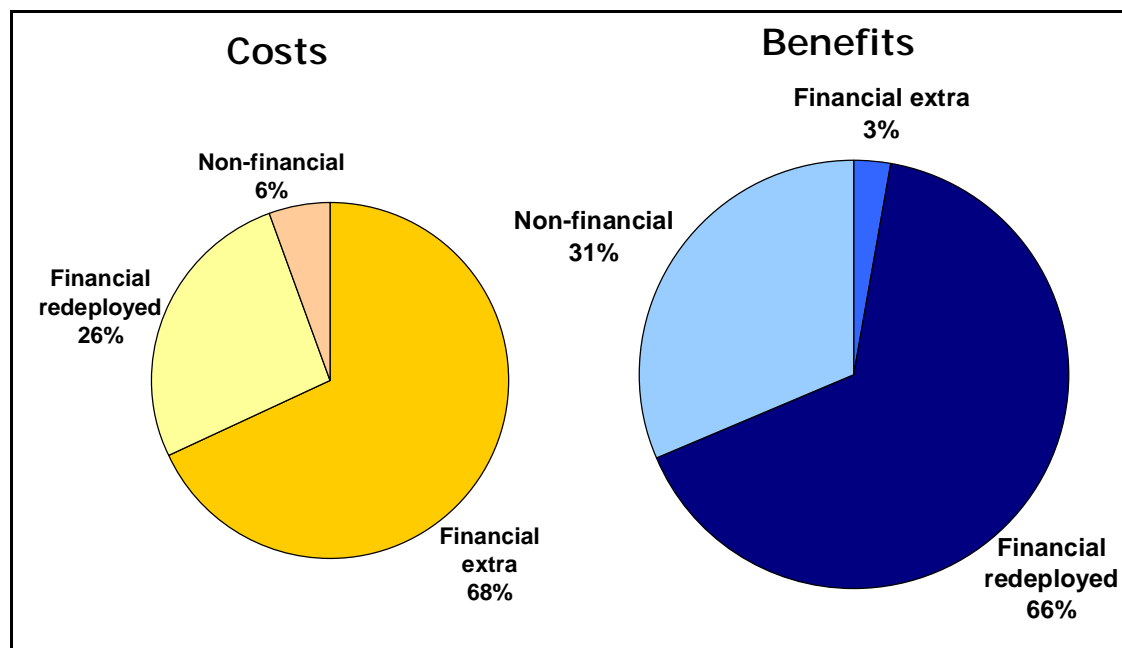
The results of the sensitivity analysis thus show that the conclusions drawn from the socio-economic analysis are robust, and do not depend on individual estimations or assumptions. Financing and financial impact

### 3.7.5 Financial impact

The financial impact of the regional health information platform SISS strongly differs from its socio-economic cost benefit performance. Each cost and benefit is assigned to a category of extra finance, non-financial, or redeployed finance to show the financial implications of the investment. Chart 6 shows the results.

<sup>26</sup> Cf. reference list

Chart 6: Financial and non-financial impact



Source: EHR IMPACT study

Compliant with findings from other EHR IMPACT evaluations, extra financial release is marginal with some 3% of all benefits<sup>27</sup>. Financial benefits of the case at hand can be primarily attributed to financial incentives for GPs and pharmacists. Around 460,000 EUR financial savings from avoided travel costs for patients present only a small proportion of a total of around 20 million EUR. This extra released finance compares to 68% of the overall costs being extra financial investment. More than 90% of this required additional finance, around 370 million EUR, is spent on ICT. Financial incentives for GPs and pharmacists complement this category.

Around two-thirds of the benefits are resources freed and ready for redeployment. These benefits amount to about 485 million EUR, distributed among HPOs, third parties and patients, their carers and citizens. With 434 million EUR, HPOs have the biggest share. This amount is most of all based on efficiency gains. Time savings from more efficient health care provision and administrative procedures can be allocated to additional patients and more care. While benefits with the potential for redeployment account for 66%, 26% of costs are redeployed resources from other activities. Again, the biggest share of the total of 155 million EUR accrues to HPOs. This leaves HPOs with net redeployable resources of some 280 million EUR. Resources for redeployment are in many small pockets and difficult to redeploy as a set of corporate decisions. Nevertheless, they can help HPOs at individual level to recover their investments.

About 31% of all benefits are non-financial. All stakeholder groups benefit from this category. Third parties' non-financial benefits amount to 151 million EUR, HPOs' benefits to 21 million EUR, health professionals to 36 million EUR and patients, their carers and citizens to 22 million EUR over the 11 years of this EHRI evaluation. This category comprises quality gains, such as increased patient safety, improved working convenience and the feeling of increased professionalism for health professionals, better healthcare for citizens, patients and carers, healthcare facilities' improved clinical governance and the region's capability of meeting an increasing demand in healthcare through providing more effective and more efficient healthcare in the future.

<sup>27</sup> For other EHR IMPACT reports cf. [www.ehr-impact.eu](http://www.ehr-impact.eu)

### 3.7.6 Financing arrangements

In 1999 Regione Lombardia published a call for a pilot project that paved the way for a region-wide government and health information system. Lombardia Informatica was finally assigned with the realisation of the project. The amount provided was used to establish LISIT (*Lombardia Integrata Servizi Infotelematici per il Territorio S.p.A.*), a public-private partnership comprising of *Telecom Italia*, *Finsiel*, one of Italy's leading IT consulting and service companies and the head of the *Telecom Italia Group*, *Lutech S.p.A.*, an Italian ICT engineering company, and Lombardia Informatica. The latter holds 56% of LISIT. The private partners paid for their 44% stake in LISIT in advance and receive income for the provision of their services over time.

In 2002, when Lombardia Informatica's tender was accepted it was agreed in the contract that Regione Lombardia pays a particular amount per activated citizen card. The agreed amount covers the regional call centre and a fixed amount for LISIT. LISIT is in charge operating the regional health information system.

Instead of transferring finance to HPOs for the purpose of updating information systems and integration with SISS, LISIT directly provided the service, hardware, manpower and training needed. Thus, Regione Lombardia is the main financing body for SISS.

## 3.8 Legal aspects

Both the health professional and citizen card are vital with regard to security mechanisms, ensuring identification, authentication, and data protection. From a health professional perspective, the digital signature is essential for the transformation from a paper to a digital environment as it validates the access to the record. SISS helps to determine and assign health professionals' responsibilities through its authentication functionality and clearly identifies physicians. This allows for documentation and tracing of, in particular doctors', healthcare activities. Therefore, they can be held responsible in case of medical errors. On the other hand, they are provided with a means to prove their innocence if necessary.

From a patient perspective, there is the possibility to hide personal data. Some information, including indications of HIV infection, abortion, and abuse is concealed by law. Any other information can be hidden completely, or from any particular doctor.

The two-stage explicit consent procedure gives citizens the necessary power over their health data. In the first stage, citizens have to give explicit, written consent to any health data being stored in SISS. Although only meta-data is actually stored in SISS, the possibility to access the actual data requires this consent. The second stage of consent is the requirement to provide the CRS, activated through the forts stage, as a key to access data. The provision of the card is a form of providing explicit consent to data access. Only GPs are exempt from this requirement, yet only for patients registered with them as the primary point of contact with the healthcare system.

## 4 Conclusion

Over the EHRI time scale ending 2010, the Lombardy health information network SISS achieves a cumulative net socio-economic benefit worth 143 million EUR. This represents a socio-economic return, from the perspective of society as a whole, of 24% over 11 years.

From a short-term perspective, a similar extent and scale of socio-economic return could have been achieved with less efforts and investment. However, accounting for Lombardy's health strategy, all what was invested by now, both at financial and organisational level, was necessary in order to ensure that future objectives are met. This includes firstly, that the system and its realised benefits are sustainable and, secondly, that the long-term change in healthcare provision model can be achieved. The gradual extension of functionalities, integration of healthcare services and users, follows this strategy. Only when all requirements are met, both from the user and the political perspective, the next step is taken. Financial incentives are employed as a tool to drive utilisation. Not all functionalities are in place yet, in order to allow health professionals to gradually adapt to SISS, which is a recognised good practice. Once they use it on a daily basis, incentives can be cut. In parallel, user engagement in development and implementation ensures that health professional recognise and shape SISS' potential. This is another recognised good practice towards moving from use to active integration of ICT into clinical and working practice. This leads to the further generation of benefits. From a short term perspective, this approach involves higher costs and lower benefits at initial stages.

Legislation has a direct impact on deployment of functionalities and benefit realisation. In a negative example, although ePrescribing functionalities are already integrated in SISS, legal requirement to sign each referral and ePrescription manually makes it necessary to issue both hand-written prescriptions and ePrescriptions. Only when this legal obstacle is abolished, will ePrescribing be able to fully unfold its potential. Other regulatory initiatives, such as the law on maximum waiting times, promote SISS' progress. It forces the regional government and Lombardia Informatica to incorporate functionalities that allow for adhering to these requirements.

The results of the socio-economic analysis prove that Regione Lombardia is on the right track. The scale and complexity of the initiative requires very careful planning and gradual implementation. The functionalities already in place generate a respectable socio-economic return. The performance becomes even more impressive when regarded from the temporal perspective of current achievements being only the beginning of a much larger and more powerful health information network covering the whole region and all healthcare services.

### 4.1 Future potential

The future potential of SISS lies in integration of HPOs not yet part of the network, which are mainly private sector providers, and expansion of functionalities to all healthcare services.

The first point is already underway, with the public sector completely connected and private hospitals currently in the process. At the moment, the importance of sharing health information across the region is not fully recognised as essential among health professionals. Especially in hospitals, many physicians consider it sufficient to rely on their HIS, where the majority of information is stored and can be effortlessly accessed. However, the only way to provide continuity of care throughout the whole of Lombardy, and to shift the provision of care away from hospitals, is by connecting all healthcare services. The provision of medical

information from as many healthcare services and facilities as possible increases the extent of benefits, especially regarding patient safety. This, in turn increases the necessity for healthcare professionals, both in GP practices and hospitals, to actively integrate information sharing into their clinical routine. The pathology networks already active in the process of establishment will both foster continuity of care and impact health professionals' attitude towards the necessity of data exchange without local restrictions. At a smaller scale, they will demonstrate what SISS can achieve on a larger scale.

Regarding functionalities, various tasks can be assumed through SISS. A specific example is ePrescribing, where still some potential is left. Features can include prescribing decision support for physicians, real-time prescribing and dispensing information available to doctors and pharmacists, eDispensing functionalities, such as precautionary cancellations by pharmacists, to mention but a few. The vertical expansion of SISS to granting citizens access to their medical information might be another step towards meeting increasing demand for healthcare in the region as a means of delivering patient-centred care. The EHR functionalities, currently in implementation phase, are expected to enable even better collaboration between different healthcare professionals, and foster the development of multi-disciplinary teams, which guarantee continuity and safety of care regardless of location and time.

The future potential of SISS is enormous. It remains to be seen how, and when it can be transformed from potential into performance, yet the direction of Regione Lombardia as the initiative driver is promising.

## 4.2 Transferability

Both technical aspects and Lombardy's approach to organisational change can be transferred to other sites. In a technical regard, the creation of a platform that allows healthcare facilities to connect to this platform via middleware serves as a useful example. This is of particular importance in an environment where certain ICT systems already exist and cannot be effortlessly replaced by the deployment of a regionally consistent system. Provided that the quality of the data produced by healthcare facilities is adequate (regional) integration via a health information platform is a transferable approach.

From an organisational point of view, the regional government's approach to implementing this platform is another aspect that can be transferred:

- Providing hospitals with everything they need for integration, ranging from service, hardware, and manpower to training
- Providing hospitals with a selected number of certified vendors from which they can choose in order to ensure the provision of high-quality data
- Combining a bottom-up approach of slowly introducing SISS and individual functionalities, with a top-down approach of introducing legislation that makes the use of the health information platform mandatory.

Additionally, financial arrangements serve as a good example for transferability. As necessary for the take-up of a large-scale system, public private partnerships provide governmental guidance, monitoring and the implementation of a fitting framework, while, on the other hand, private investors provide the necessary financial coverage.

Although the individual components are transferable, SISS as a whole is not. It cannot be taken to another region and implemented. The approaches can serve as useful experience to build on, but the regional context, including political structures, healthcare system and legacy ICT, and even culture, need to be accounted for in adapting SISS to any other environment.

## 4.3 The role of interoperability in realising the benefits

Interoperability plays an essential role in achieving the high level of SISS' positive socio-economic impact. It crucially contributes to enhanced quality of care, and in particular the increase in patient safety. In 2008 more than 90% of all GP practices, all public hospitals and all pharmacies are connected to SISS and share information on their patients' diagnosis, treatment, prescriptions, hospitalisation and lab tests. Sharing medical and medication data is the major driver of safety benefits. Similarly, the more healthcare facilities have their agenda connected to SISS, the more patients can schedule their consultations by eBooking.

In short, SISS is all about interoperability and data sharing between actors in the healthcare system. Thus, most benefits are directly related to interoperability. There is certainly room for improvement of various functions and connections, but these are technical details that will be solved with time. Without interoperation and the sharing functionalities SISS becomes a meaningless concept.

## 4.4 What it means for decision makers

### 4.4.1 Useful experience

The hybrid of a bottom-up and top-down implementation strategy provides time for users to grow used to the system and for the region to adapt health and legal structures. At the same time, legal measures that render the connection to SISS mandatory facilitate deployment.

Cooperation at the local HPO level and the regional level enables stakeholders to save money. Normally, the introduction of a new HIS or the upgrade of an already existing HIS would demand a bigger effort on the hospital side. Support provided by the region with regards to integration guidelines, certified vendors and support in development, implementation and maintenance presents a certain relief for hospital management. On the other hand, the region's requirement to connect to the network creates pressure and requires investment which would otherwise be postponed.

### 4.4.2 Summary of lessons

- Allow users to grow used to working with the application and gradually integrate it into their daily working routine, while stressing the importance of the initiative by making training compulsory and participation mandatory, if the context allows this.
- Start the implementation with administrative functionalities, as their employment is easier and benefits are easier and faster to realise than clinical features alone.
- Support HPOs with developing, implementing and maintaining a central data repository and its integration with local databases, and assist with offering guidelines, consultancy, products and certification.

This report provides many examples of how Lombardy has addressed the challenges of large-scale, complex interoperable EHR and ePrescribing systems. There is one feature common to all of them, and that is the main lesson for decision makers - the approach to eHealth, from planning, through development, implementation, and continuous refinement reflects the local specificities and environment. This is the factor of success that can and must be taken on by future initiatives.

## References

Alpern, Elizabeth R. MD, MSCE; Calello, Diane P. MD; Windreich, Randy MD; Osterhoudt, Kevin MD, MSCE; Shaw, Kathy N. MD, MSCE (2008): Utilization and Unexpected Hospitalization Rates of a Pediatric Emergency Department 23-Hour Observation Unit. In: Paediatric Emergency Care: September 2008, Volume 24, Issue 9. Available at: [http://journals.lww.com/pec-online/Abstract/2008/09000/Utilization\\_and\\_Unexpected\\_Hospitalization\\_Rates.1.aspx](http://journals.lww.com/pec-online/Abstract/2008/09000/Utilization_and_Unexpected_Hospitalization_Rates.1.aspx)

Battistotti, A., Quaglini, S., Couco, E. (2006): Reducing dropouts in outpatient care through an SMS-base system. In: Ubiquity: Technologies for Better Health in Aging Societies, A. Hasman et al. (Eds.), IOS Press, 2006

Contract information between GPs and LHAs, available at: [http://www.aslmi2.it/web/download.nsf/0/DA7284DCEAB97DEFC125714C003E8F86/\\$FILE/CONTRATTO\\_REGIONALE\\_MMG\\_ASL\\_MI2.pdf](http://www.aslmi2.it/web/download.nsf/0/DA7284DCEAB97DEFC125714C003E8F86/$FILE/CONTRATTO_REGIONALE_MMG_ASL_MI2.pdf)

Contract information between paediatricians and LHAs, available at: [http://www.aslmi2.it/web/download.nsf/0/37569F87E5EDECD1C125714C003EA9AD/\\$FILE/CONTRATTO\\_REGIONALE\\_PLS\\_ASL\\_MI2.pdf](http://www.aslmi2.it/web/download.nsf/0/37569F87E5EDECD1C125714C003EA9AD/$FILE/CONTRATTO_REGIONALE_PLS_ASL_MI2.pdf)

EHR IMPACT (2008): Methodology for evaluating the socio-economic impact of interoperable EHR and ePrescribing systems. Available at: [http://www.ehr-impact.eu/downloads/documents/EHRI\\_D1\\_3\\_Evaluation\\_Methodology\\_v1\\_0.pdf](http://www.ehr-impact.eu/downloads/documents/EHRI_D1_3_Evaluation_Methodology_v1_0.pdf)

EHR IMPACT (2008): Study on the socio-economic impact of interoperable electronic health record and ePrescribing systems. Available at: [www.ehr-impact.eu](http://www.ehr-impact.eu)

EHR IMPACT (2008): The conceptual framework of interoperable electronic health record and ePrescribing systems. Bonn. Available at: [http://www.ehr-impact.eu/downloads/documents/EHRI\\_D1\\_2\\_Conceptual\\_framework\\_v1\\_0.pdf](http://www.ehr-impact.eu/downloads/documents/EHRI_D1_2_Conceptual_framework_v1_0.pdf)

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

EHR IMPACT (2009): The socio-economic impact of the Kolín-Časlav health data and exchange network. Available at: <http://www.ehr-impact.eu/cases/cases.html>

EHR IMPACT (2009): The socio-economic impact of Receta XXI, the regional ePrescribing system of Andalucía's public health service, Spain. Available at: <http://www.ehr-impact.eu/cases/cases.html>

European Commission (2007): eHealth Priorities and Strategies in European Countries. eHealth ERA Report. Towards the Establishment of a European eHealth Research Area. Fact Sheet Italy. Available at: <http://www.ehealth-era.org/database/documents/factsheets/Italy.pdf>

European Commission (2009): eHealth in Action. Good Practice in European Countries. Good eHealth Report

European Observatory on Health Systems and Policies (2007): Health Systems in Transition: Spain. Health System Review 9(1). Available at: <http://www.euro.who.int/Document/E89491.pdf> (11-08-09).

European Observatory on Healthcare Systems (2001): Health Systems in Transition. Italy. Copenhagen: World Health Organisation, Regional Office for Europe. Available at: <http://www.euro.who.int/document/e73096.pdf> (11-08.2009)

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](http://www.hm-treasury.gov.uk/media/05553/Green_Book_03.pdf) (11-08-09).

Regione Lombardia Sanità (2008): Lombardy Region Social Services and Healthcare Plan, 2007-2009

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](http://www.eu.wibe.de/wibe_framework/wibe_framework2/0806_WiBe-Framework.pdf)

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>

Stroetmann, V.N., Thierry, J-P., Stroetmann, K.A., Dobrev, A., eHealth for Safety (2007): Impact of ICT on Patient Safety and Risk Management European, Luxembourg: Office for Official Publications of the European Communities, 2007, ISBN-13 978-92-79-06841-6; available at: [http://ec.europa.eu/information\\_society/activities/health/docs/studies/eHealth-safety-report-final.pdf](http://ec.europa.eu/information_society/activities/health/docs/studies/eHealth-safety-report-final.pdf)

<http://www.ehr-impact.eu/cases/cases.html>

## Appendix 1: Summary of evaluation data

<i>EHRI generic data summary</i>	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
SISS Lombardy	€	€	€	€	€	€	€	€	€	€	€
<b>Estimated COSTS</b>											
<i>Citizens</i>	0	0	0	96.682	3.375.662	8.228.487	811.969	374.978	61.413	242.468	60.956
<i>HPOs</i>											
<i>Doctors, nurses, other staff</i>	0	0	526.002	1.287.820	2.025.702	3.757.762	4.313.610	4.132.148	2.290.999	1.250.943	1.281.421
<i>Organisation</i>	6.156.082	11.895.811	6.228.297	2.321.510	23.938.906	76.581.446	88.565.977	82.352.133	85.025.048	85.374.792	87.377.305
<i>Third parties</i>	671.573	1.297.725	626.920	0	0	0	0	0	0	0	0
<b>Present value of total annual costs</b>	<b>6.827.655</b>	<b>13.193.536</b>	<b>7.381.220</b>	<b>3.706.012</b>	<b>29.340.270</b>	<b>88.567.696</b>	<b>93.691.555</b>	<b>86.859.260</b>	<b>87.377.460</b>	<b>86.868.203</b>	<b>88.719.681</b>
<b>Present value of cumulative costs</b>	<b>6.827.655</b>	<b>20.021.191</b>	<b>27.402.411</b>	<b>31.108.423</b>	<b>60.448.692</b>	<b>149.016.388</b>	<b>242.707.943</b>	<b>329.567.203</b>	<b>416.944.664</b>	<b>503.812.867</b>	<b>592.532.548</b>
<b>Estimated BENEFITS</b>											
<i>Citizens</i>	0	0	0	0	0	2.534.788	8.576.184	9.480.411	13.500.361	17.318.978	20.584.834
<i>HPOs</i>											
<i>Doctors, nurses, other staff</i>	0	0	23.977	86.270	168.296	305.402	632.271	1.213.140	10.984.673	11.027.855	11.440.443
<i>Organisation</i>	0	0	1.106.920	4.431.895	12.602.792	44.382.235	77.689.728	79.528.696	86.516.211	75.514.511	93.272.298
<i>Third parties</i>	0	0	0	0	0	0	0	35.358.362	38.593.123	38.939.859	39.585.701
<b>Present value of annual benefits</b>	<b>0</b>	<b>0</b>	<b>1.130.897</b>	<b>4.518.165</b>	<b>12.771.088</b>	<b>47.222.425</b>	<b>86.898.183</b>	<b>125.580.609</b>	<b>149.594.367</b>	<b>142.801.204</b>	<b>164.883.276</b>
<b>Present value of cumulative benefits</b>	<b>0</b>	<b>0</b>	<b>1.130.897</b>	<b>5.649.062</b>	<b>18.420.149</b>	<b>65.642.575</b>	<b>152.540.758</b>	<b>278.121.367</b>	<b>427.715.734</b>	<b>570.516.938</b>	<b>735.400.214</b>
<b>Net benefits</b>											
<b>Present value of annual net benefits</b>	<b>-6.827.655</b>	<b>-13.193.536</b>	<b>-6.250.323</b>	<b>812.153</b>	<b>-16.569.182</b>	<b>-41.345.270</b>	<b>-6.793.372</b>	<b>38.721.349</b>	<b>62.216.907</b>	<b>55.933.001</b>	<b>76.163.595</b>
<b>Present value of cumulative net benefits</b>	<b>-6.827.655</b>	<b>-20.021.191</b>	<b>-26.271.514</b>	<b>-25.459.361</b>	<b>-42.028.543</b>	<b>-83.373.813</b>	<b>-90.167.185</b>	<b>-51.445.836</b>	<b>10.771.071</b>	<b>66.704.071</b>	<b>142.867.666</b>
<b>Net benefits over cost ratio - annual</b>	<b>-1,00</b>	<b>-1,00</b>	<b>-0,85</b>	<b>0,22</b>	<b>-0,56</b>	<b>-0,47</b>	<b>-0,07</b>	<b>0,45</b>	<b>0,71</b>	<b>0,64</b>	<b>0,86</b>
<b>Net benefits over cost ratio - cumulative</b>	<b>-1,00</b>	<b>-1,00</b>	<b>-0,96</b>	<b>-0,82</b>	<b>-0,70</b>	<b>-0,56</b>	<b>-0,37</b>	<b>-0,16</b>	<b>0,03</b>	<b>0,13</b>	<b>0,24</b>
<b>Number of records</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>0</b>	<b>1.000.000</b>	<b>16.840.013</b>	<b>40.636.266</b>	<b>59.399.532</b>	<b>81.008.768</b>	<b>98.600.000</b>	<b>130.800.000</b>
<b>Number of times records are accessed</b>											
<b>Distributions</b>											
	<b>Costs</b>			<b>Benefits</b>			<b>Type of costs</b>			<b>Type of benefits</b>	
<i>Citizens</i>		2,24%			9,79%		<b>Financial extra</b>			68,17%	2,71%
<i>HPOs</i>							<b>Financial redeployed</b>			26,13%	65,98%
<i>Doctors, nurses, other staff</i>		3,52%			4,88%		<b>Non-financial</b>			5,69%	31,31%
<i>Health provider organisation</i>		93,80%			64,60%						
<i>Third parties</i>		0,44%			20,73%						
Base year: 2008; Discount rate:	3,5%										

## Appendix 2: Cost and benefit indicators

Table 5: Cost indicators and variables

Stakeholder group	Cost indicator	Clarification	Variables
<b>Patients, carers &amp; other individual people</b>	Efforts related to providing explicit informed consent	Time estimate serving as a proxy for the intangible efforts involved	Time for patients to provide explicit informed consent; annual new citizen registrations with SISS; average hourly rate
<b>HPO - healthcare staff</b>	Engagement in expert groups - "tables"	Doctors' personal time given up	Doctors' personal time engaged in SISS development; doctors' value of time
	Initial inconveniences (nurses not heavily involved, yet)	GPs' and paediatricians' adaptation to the system - time as proxy for value	New GPs and paediatricians registered; value of time for GPs and paediatricians
		Hospital doctors' adaptation to the system - time as proxy for value	New hospital doctors registered; value of time for hospital doctors
		Pharmacists' adaptation to the system - time as proxy for value	New pharmacists registered; value of time for pharmacists
Extra effort for having the health professional card always available (all users, except for pharmacists)	In cases of forgotten or lost professional card, workflow is disrupted at a personal expense in form of avoidable inconvenience	Relevant number of users; incidence of leaving the health professional card at home; estimated value of irritation to users	
<b>HPO - ICT costs</b>	Vendor contract with Lombardia Informatica on pilot project in Lecco district	2000-2002	Costs as determined by contract
	Vendor contract with Lombardia Informatica	Determined amount per activated card covers training, hardware and software, PR campaign, etc.	Annual number of activated cards; price per activated card; VAT

Stakeholder group	Cost indicator	Clarification	Variables
<b>HPO - organisational issues</b>	Engagement in development - "tables"	Doctors working time invested in SISS development	Number of discussion groups; number and type of participants; meeting duration and frequency; FTEs for relevant participants
	Extra time	Hospital doctors' extra time spent on signing reports digitally (incl. initial additional effort through signing each report individually)	Annual eSignature activity; extra time per signature; FTE hospital doctors
		Extra time for GPs to scan through emails for important SISS notifications	Number of GPs; extra time for scanning through emails; FTE GPs
		Extra time for pharmacists allocated from healthcare to eBooking	eBooking procedures done by pharmacists; time involved in eBooking; FTE pharmacists
	Extra effort	Extra time for hospital doctors if they leave the card at home - not their personal inconvenience, but HPO cost	Number of doctors; incidence of leaving the health professional card at home; estimated disruption time; FTE doctors
		Extra time for A&E nurses if they leave the card at home - not their personal inconvenience, but HPO cost	Number of A&E nurses; incidence of leaving the health professional card at home; estimated disruption time; FTE A&E nurses
		Extra time for help desk staff if they leave the card at home - not their personal inconvenience, but HPO cost	Number of help desk staff; incidence of leaving the health professional card at home; estimated disruption time; FTE help desk staff
		Extra time for continuously informing patients for giving consent	Time to provide information to patients for giving explicit informed consent; annual new citizen registrations with SISS; FTE medical secretary
	Training	Trained users' time as affecting productivity (hospital doctors, nurses, pharmacists)	Number of new users; time for training and adaptation to the system; share of FTE
	Opportunity costs	Opportunity costs for being three years ahead in IT deployment	Foregone interest from investment in alternatives
Additional costs	Financial incentives for GPs for using SISS, paid until it became mandatory	Relevant number of GPs; average value of financial incentive	
Additional costs	Financial incentives for pharmacists for eBooking	Relevant number of pharmacies; average value of financial incentive	
<b>Third parties</b>	Extra costs	Expenses on pilot project in Lecco, exceeding amount covered in vendor contract	Estimated additional costs

Table 6: Benefit indicators and variables

Stakeholder group	Benefit indicator	Clarification	Variables
<b>Patients, carers &amp; other individual people</b>	Time saving	Patients save time for booking procedures through eBooking	Number of eBooking procedures; average time saved; average wage
		Time saving from avoiding hospital and GP visits by accessing lab reports online	Annual number of reports accessed online; estimated share of accesses leading to avoided visits; estimated time saved per visit; average wage
	Avoided costs	Avoided travel costs from avoiding hospital and GP visits by accessing lab reports online	Annual number of reports accessed online; estimated share of accesses leading to avoided visits; estimated time saved per visit; average travel costs
	Increased convenience	More convenient and reliable consultation scheduling	eBooking procedures; WTP for better booking
	Increased patient safety	Avoided hospital consultation through checking test results online reduces exposure to health risk in hospital	Number of patients with EHR in SISS; share of avoided consultations through checking test results online; reduced risk of adverse event; WTP for avoiding adverse events
		digital signature allows for data validation & counter-checking of results	Annual number of reports that are digitally signed; avoided mistakes through counterchecking; WTP for increased safety
		GPs have discharge letters and test results available even if patients do not show or bring their reports with them, and thus act on more and relevant information	Annual number of reports in SISS; avoided adverse events and inconvenience through having medical information available; WTP for increased patient safety
		Hand-written reports were sometimes not available in A&E; with SISS they always are	Annual number of reports in SISS; share required in A&E; avoided adverse events through having medical information available in A&E; WTP for increased patient safety
<b>HPO - health-care staff</b>	Alleviation of work	For A&E nurses, as the information they have is reliable, also through patient identifier	Relevant number nurses; A&E nurses' WTP
		For hospital doctors, as they can scan through the report before the consultation, esp. in complex and difficult cases	Relevant number of reports, doctors' WTP
		For GPs and paediatricians from knowledge about their patients' status	Relevant number of reports; GPs' and paediatricians' WTP
	Satisfaction in work	GPs' increased satisfaction from knowledge that they contribute to future high-quality healthcare models	Relevant number of GPs and paediatricians; GPs' and paediatricians' WTP

Stakeholder group	Benefit indicator	Clarification	Variables
<b>HPO - organisations</b>	Accelerated IT deployment in hospitals	SISS fostered IT deployment assumed to be three years ahead compared to a non-invasive development	Number of hospitals; ration of value of comprehensive HIS and costs spent on implementation of HIS; investment in HIS
	Time saving	From registration at A&E: nurses enter patient information and admin data is available immediately	Relevant number of patients; time saved per registration; share of FTE A&E nurse
		For GPs from copying and pasting information from SISS into their local system	Number of relevant reports; time saved from copy/paste rather than entering data manually; share of FTE GPs
		For pharmacists from automatic compiling and transmission of prescription and dispensing reports	Number of relevant prescriptions; time saved from automatic report compilation - per prescription; share of FTE pharmacists
	Better resource planning and allocation	eBooking reduces non-attendances as it automatically cancels attempted multi-bookings and reminds patients of appointments	Number of eBookings; avoided non-attendances - reduction in no-show-rate; costs of non-attendances
	Productivity	eSignature avoids doctors manually signing reports	Estimated staff avoided; FTE doctors
	Better clinical governance	Increased patient safety through avoided technical mistakes	Relevant number of citizens; value of better clinical governance to HPOs
	Business incentives for pharmacies	eBooking in pharmacists increases customer loyalty	Number of relevant customers; average value of customer for pharmacy
	Cash income	For GPs from financial incentives for using SISS	Relevant number of GPs; average value of financial incentive
For pharmacists from financial incentives for eBooking		Relevant number of pharmacies; average value of financial incentive	
<b>3rd parties</b>	Saving on eGovernment infrastructure	From eHealth infrastructure contributing to eGovernment infrastructure for features that can be jointly used	Savings on eGovernment infrastructure. Proxy: costs of setting up an extra eGovernment infrastructure
	Improved healthcare quality	In the long term, SISS enhances the quality of healthcare provision in the region and contributes to changing healthcare models	Value of capability of meeting increasing demand in healthcare with available resources. Proxy: estimated productivity increase