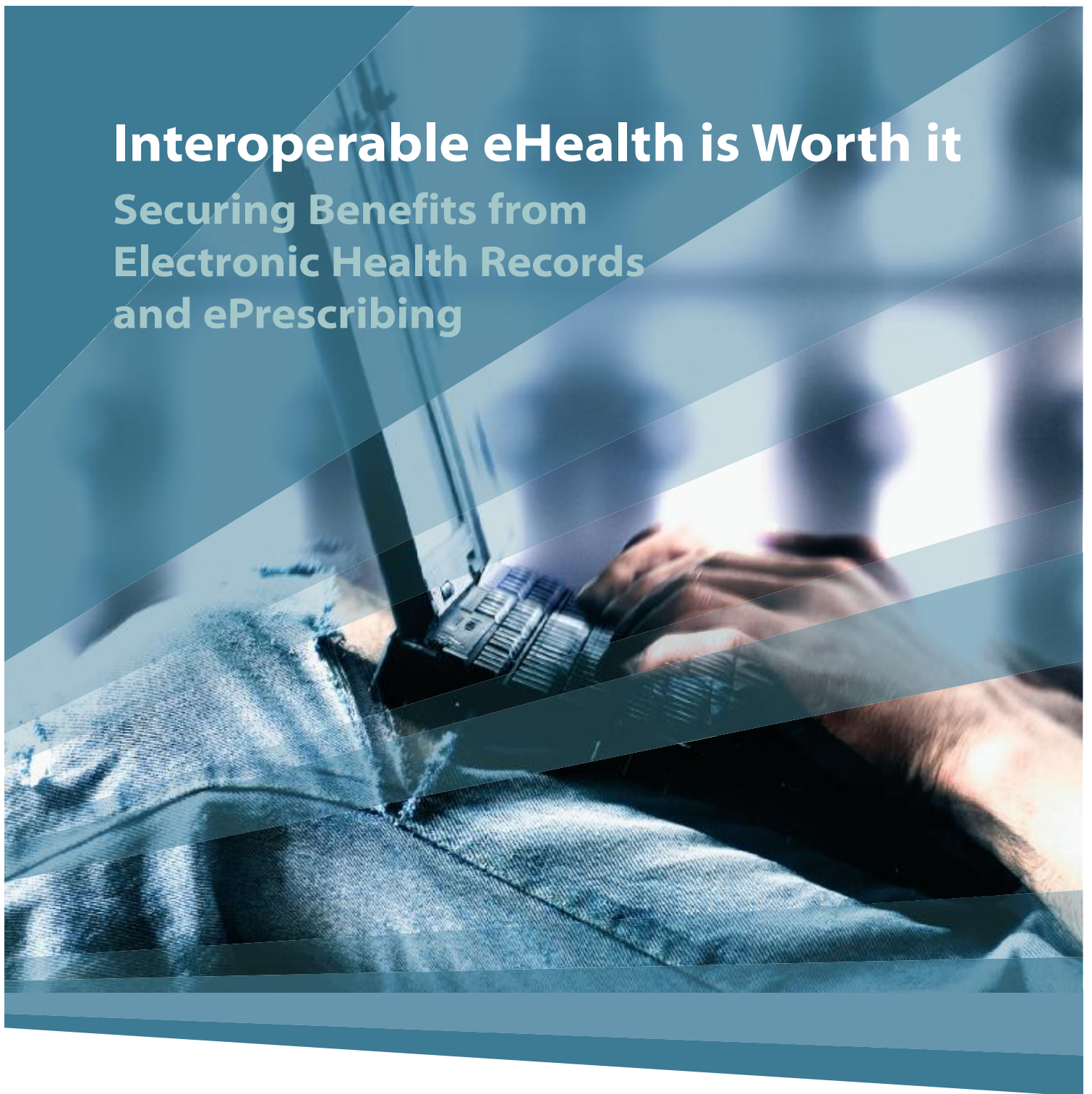


# Interoperable eHealth is Worth it

## Securing Benefits from Electronic Health Records and ePrescribing



**Study Report 2010**



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# Interoperable eHealth is Worth it

## Securing Benefits from Electronic Health Records and ePrescribing

Alexander Dobrev, Tom Jones, Veli Stroetmann,  
Karl Stroetmann, Yvonne Vatter and Kai Peng

Bonn/Brussels, February 2010



European Commission  
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## About EHR IMPACT

The EHR IMPACT study was commissioned by the European Commission, Directorate General Information Society and Media, Unit ICT for Health, and comprises of nine quantitative and two qualitative 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 inform and support ongoing initiatives and implementation work by the European Commission, Member State 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.

## Disclaimer

This publication is part of the study for the European Commission on the economic impact of interoperable electronic health records and ePrescription in Europe - EHR IMPACT. 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 liable for any use that may be made of the information contained in this report.

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# Foreword



**H**ealth delivery systems across Europe are forced to address similar and well known challenges. Increasing demand must be met by employing limited resources wisely. Well implemented eHealth services have shown to make a major contribution to improved healthcare, with a high socio-economic return, as this report succinctly demonstrates.

Fostering electronic health record (EHR) systems has been among the earliest research topics of the eHealth strand of the European Commission's Research and Development Framework Programmes. Twenty years later, this commitment is paying off. Projects initiated in the early 1990's have by now led to various regional networks and eHealth products benefiting patients, health delivery systems and the economy.

Real-time health information systems, integrating all relevant information on a patient and the healthcare process around him, can substantially improve coordinated care, patient safety, quality and efficiency. At the same time, they can support clinical research, training and public health. This 'holy grail' of connectivity and secure access to meaningful information is a cornerstone for reaping the full benefits of eHealth. However, fully realising this goal in the Union context of citizen mobility and cross-border healthcare

requires interoperability of such systems within and between health provider organisations, as well as across regions and countries.

This was recognised in the Council Conclusions on Safe and efficient healthcare through eHealth<sup>1</sup>, where Member states committed to cooperation on eHealth in view of maximising the benefits for their own patients. The Council also welcomes the collaboration between a number of Member States in the epSOS large scale pilot project<sup>2</sup>, the €22m initiative jointly funded by the Commission and 12 Member States, which seeks to develop cross-border interoperability of summaries of electronic health records and ePrescriptions. The Council calls upon Member States to create a high level eHealth governance group to address the issue of interoperability. It also calls upon the Commission to "organise an evaluation, at the appropriate intervals, of the health benefits and cost-effectiveness of the use of different eHealth services, building on knowledge accumulated at EU and national levels." Thereby, Member States underline the importance of studies like the one presented here. This report follows upon earlier work published by the EC in the booklet "eHealth is Worth it"<sup>3</sup> in 2006 and adds well-founded empirical evidence to the pool of knowledge about the potential of "eHealth in the context of healthcare reform programmes"<sup>4</sup>.

The EHR IMPACT study provides evidence on concrete implementations at the local and regional level. The gains from EHR and ePrescribing systems rely on access to information regardless of place and time, and from re-using information for multiple purposes. Without meaningful sharing and exchange of information, the gains would be marginal and not justify the cost of investments. Another condition for success is to ensure continuous engagement and a productive dialogue between clinical and administrative users on the one hand, and ICT experts on the other. Healthcare professionals, who are essential users of eHealth systems, are too often not sufficiently involved.

The results of the EHR IMPACT study give reason for optimism in the value of well designed and implemented interoperable eHealth systems across Europe. Its strategic recommendations should encourage and support future initiatives through the experience and lessons from the eleven cases presented.<sup>5</sup>

Brussels, February 2010

**Ilias Iakovidis**

*Acting Head of Unit*

*ICT for Health*

*DG Information Society and Media*

1. Council conclusions of 1 December 2009 on a safe and efficient healthcare through eHealth. Official Journal of the European Union (2009/C 302/06), <http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:C:2009:302:0012:0014:EN:PDF> (2980th Employment, Social Policy, Health and Consumer Affairs Council meeting, Brussels, 1 December 2009)

2. European Patients Smart Open Services – epSOS, [www.epSOS.eu](http://www.epSOS.eu)

3. eHealth is Worth it - The economic benefits of implemented eHealth solutions at ten European sites. Luxembourg: Office for Official Publications of the European Communities, 2006 (56 pp. - ISBN 92-79-02762-X). Electronic file:

[http://europa.eu.int/information\\_society/activities/health/docs/publications/ehealthimpactsept2006.pdf](http://europa.eu.int/information_society/activities/health/docs/publications/ehealthimpactsept2006.pdf)

4. Council Conclusions 1 December 2009, p. 2

5. The views presented are those of the author and do not necessarily represent the official view of the European Commission on the subject





# Executive Summary

A common challenge for health systems is to assure sustainability and use their limited resources more effectively to meet a demand with seemingly unlimited scope for increase. Ageing populations, rising expectations, as well as advances in life and engineering sciences increase demand for more and better health services. Challenges lying ahead are to reconcile all the individuals' needs with the available healthcare resources and potential improvements in performance. Awareness of the potential of eHealth solutions to help meet these challenges has been continuously rising across Europe and its Member States and other regions of the world. Simultaneously, awareness of the challenges in succeeding with eHealth has also increased. The European Commission (EC) EHR IMPACT study set out to add new empirical evidence to the pool of knowledge to help to expand this awareness.


The EHR IMPACT study investigated the socio-economic impact of interoperable Electronic Health Record (EHR) and ePrescribing systems in Europe and beyond. Core to the project was a detailed qualitative analysis of eleven good practice cases in Europe, USA and Israel. Nine of these also underwent a quantitative evaluation of their socio-economic impacts. Each case studied represents a sustained solution in routine operation.

This report addresses the context of the EHR IMPACT study, its design and approach, the essence of the impact analysis results, strategic recommendations for interoperable EHR and ePrescribing initiatives, and summaries of the eleven case study reports.

The goals of the EHR IMPACT study required an inductive and adaptive empirical approach. Two perspectives were applied, the socio-economic, and a narrower, financial one within the socio-economic. This dual perspective in the EHR IMPACT methodology provides a rigorous evaluation of the long-term impacts of interoperable EHR and ePrescribing systems. The case studies provide empirical insights that underpin findings on the socio-economic impact of interoperable EHR and ePrescribing systems and the factors that need to be in place to accelerate their successful deployment.

Selection criteria for study sites were comprehensive. They included the existence of operational, routine and effective use of EHR or ePrescribing systems used at the point of care or at the health system level. A certain level of interoperability was also required, ideally supporting some degree of transferability of the solution to other contexts, as well as the availability of economic and productivity data or agreement to develop and estimate these. Furthermore, permission to work with people at the site to collect the data required, and the commitment of top management to participate in and support the research was essential. Applying these criteria to a list of candidate sites, the following case studies were selected:

- The Emergency Care Summary of NHS Scotland, UK
- The Computerised Patient Record System at the University Hospitals of the Canton of Geneva, Switzerland
- The Hospital Information System at the two campuses of the National Heart Hospital Sofia, Bulgaria
- The regional EHR and ePrescribing system Diraya in Andalucía, Spain
- The regional ePrescribing system Receta XXI in Andalucía, Spain
- The regional integrated EHR and ePrescribing system across Kronoberg County, Sweden
- The Kolín-Čáslav regional health data and exchange network, Czech Republic
- Dossier Patient Partagé Réparti (DPPR) – Shared and Distributed Patient Record platform in the Rhône-Alpes Region, France

- 
- The regional health information platform Sistema SISS in Lombardy, Italy
  - A nation-wide health information network in Israel - qualitative report
  - The NorthShore University HealthSystem, Evanston, IL (Chicago), USA - qualitative report

An EHR IMPACT evaluation relies on a bespoke analysis with two start points. One develops an understanding of the healthcare and organisational setting in which the EHR and ePrescribing systems operate, identifies the development path of the project, the ICT functionality, its usability, and the users and stakeholders, all of which define the boundary of the case and its evaluation scope. The other identifies relevant impacts over time from initial hypotheses. This second part builds the qualitative analysis into a quantitative evaluation of each socio-economic impact indicator by assigning them monetary values.

Cost benefit analysis (CBA) is the methodological foundation for turning theory into a pragmatic evaluation tool<sup>1</sup>. The UK Treasury's Green Book<sup>2</sup> and Germany's WiBe<sup>3</sup> specify CBA as an appropriate method for analysing the impact of investments in domains of public interest, including healthcare. All stakeholders' perspectives can be included in a socio-economic evaluation based on CBA and such an analysis may extend over a long timescale. It also enables the separate identification and analysis of the narrower financial, or cash-flow, components within overall costs and benefits.

The EHR IMPACT evaluations use a consistent methodology, but the model constructed for each case reflects their specific settings. Close cooperation with teams on site ensured that the models are fit for purpose. This included continuous email and telephone exchange, a total of more than 20 site visits, and approximately 100 face-to-face interviews with some 500 people across all sites.

A total of 304 cost functions and 423 benefit functions created for the nine quantitative evaluations reflect the diversity of the impact indicators. Calculations involved some 1,300 time series variables, as well as about 600 estimates and assumptions that do not change over time.

The results of detailed sensitivity analyses undertaken for each case show that the conclusions drawn from the socio-economic analyses are robust, and do not depend on individual estimates or assumptions. The sensitivity analyses comprised 208 separate tests, focusing on all estimated variables or subsets of variables, to which the outcomes of the socio-economic analysis could be sensitive. The impact of manipulating assumptions is minimal, with highest impact involving a deferral of the onset of annual or cumulative net benefits by only one year, or, in rare occasions, by two years.

The tables below present the aggregated study results. The distributions refer to cumulative data over the EHR IMPACT horizons of the cases, starting between 1998 and 2002, and ending in 2010.

For all cases analysed, the socio-economic gains to society from interoperable EHR and ePrescribing systems eventually exceed the respective costs. From a health policy perspective, this justifies even the net financial boost needed. A successful development can reach a cumulative socio-economic return (SER) of close to 200%, with an average for the EHR IMPACT cases of almost 80%.

<b>EHR IMPACT: Socio-Economic Return (SER) - net benefit to cost ratio</b>				
	<b>min</b>	<b>max</b>	<b>average</b>	<b>range</b>
Annual ratio 2010	0.61	9.95	3.82	9.35
Annual ratio 2008	0.15	4.62	1.66	4.47
Cumulative ratio 2010	-0.20	1.92	0.78	2.12

Source: EHR IMPACT study (2009)

Comparing the SER with the other measure of performance, a proxy return on investment (ROI), shows substantial discrepancies between the two. The sub-analysis of financial, or cash, impacts underlines the extensive reliance on executives' and managers' capabilities, skills and expertise in organisational change and resource redeployment to realise financial returns. A general finding, inferred from the table below, is that EHRs and ePrescribing are beneficial socio-economic investments in better healthcare, but, except in very specific circumstances, need net cash injections. In only one case, financial returns were positive, whereas in all other cases overall net injections of new financial resources were required.

<b>EHR IMPACT: Types of costs and benefits</b>				
<b>Types of costs</b>	<b>min</b>	<b>max</b>	<b>average</b>	<b>range</b>
Financial extra	21%	83%	49%	63%
Financial redeployed	17%	79%	42%	63%
Non-financial	0%	19%	9%	19%
<b>Types of benefits</b>				
Financial extra	0%	58%	13%	58%
Financial redeployed	12%	82%	46%	70%
Non-financial	6%	88%	41%	83%

Source: EHR IMPACT study (2009)

From a systemic perspective, no single or small group of benefits comprise a sufficient reason for investment in EHR and ePrescribing systems, even if such expected benefits provide an initial policy or strategic start point. A wide range of benefits is usually the goal, and these depend on the functionalities and utilisation of systems. Many benefits occur in unexpected places. A key result of the EHR IMPACT study is that benefits from EHR and ePrescribing investments come under some broad, diverse categories, but in their concrete instantiation are very specific to the context of an investment.

A common feature among the case studies is that interoperability is a prime driver of benefits. Positive impact relies on access to information regardless of place and time. Local, closed ICT systems lacking interoperability would not release these substantial gains. Interoperable EHRs, whether as actual files or as virtual files in a network of data stored in several databases, are foundations of health information systems and support to other systems, such as ePrescribing, eBooking, management, administrative or logistics systems.

Without interoperability between EHR and other clinical and non-clinical systems, neither could realise their full potential. With this finding, the EHR IMPACT study identifies strong empirical evidence in support of the EC recommendation on cross-border interoperability of electronic health record systems, which claims that the “opportunities and positive benefits of achieving interoperability are ultimately significant”<sup>4</sup>.

Cost levels depend on the scope of the EHR and ePrescribing solution, the range of healthcare levels affected, the type of health system, and the economic environment of the investment. Reflecting these, the total value of invested financial and non-financial resources at the evaluated sites was extremely wide, ranging from €3 million to nearly €480 million, over between 9 and 13 years. An important finding, depicted in the table below, is that on average only some 42% of these are ICT expenditures. Within this, the annual financial investments never exceed 2% of the annual budgets of the main organisations, suggesting that affordability is not the primary barrier to deployment of interoperable EHR and ePrescribing systems.

<b>EHR IMPACT: The weight of ICT on costs</b>				
<b>ICT and organisational costs, cumulative</b>	<b>min</b>	<b>max</b>	<b>average</b>	<b>range</b>
ICT costs as share of total costs	14%	68%	42%	54%
Organisational costs as share of total costs	32%	86%	58%	54%
ICT as share of all costs to health provider organisation	18%	68%	48%	49%

Source: EHR IMPACT study (2009)

Healthcare provider organisations (HPO) bear most of the costs and are the main beneficiaries. The following table shows the distributions of costs and benefits among stakeholder groups. Third parties include government agencies, payers, and other case-specific stakeholders like ICT vendors. Long phases of engagement, planning and design lead to substantial net socio-economic costs for HPOs, followed by net benefits at later stages. Citizens, healthcare professionals and third parties tend to reach a net benefit quicker.

<b>EHR IMPACT: Distributions of costs and benefits by stakeholders</b>				
<b>Distribution of costs</b>	<b>min</b>	<b>max</b>	<b>average</b>	<b>range</b>
Citizens	0%	14%	2%	14%
Doctors, nurses, other staff	0%	45%	11%	45%
Health provider organisations	50%	94%	80%	44%
3rd parties	0%	40%	7%	40%
<b>Distribution of benefits</b>				
Citizens	2%	40%	17%	39%
Doctors, nurses, other staff	4%	38%	17%	34%
Health provider organisations	39%	94%	61%	56%
3rd parties	0%	21%	5%	21%

Source: EHR IMPACT study (2009)

Successful EHR and ePrescribing investments are not quick wins; they are sustainable wins. It takes at least four and, more typically, up to nine years before initiatives produce their first positive annual SER, and six to eleven years to realise a cumulative net benefit. Plans to invest in EHR and ePrescribing systems should have a clear focus on achieving changes over the right time period; neither too long, nor too short. It comes as a paradox that in the complex environment of EHR and ePrescribing systems, longer time scales are generally associated with lower risk of failure.

<b>EHR IMPACT: Time to net benefits</b>				
	<b>min</b>	<b>max</b>	<b>average</b>	<b>range</b>
First year of positive annual net benefits	4	9	7	5
First year of positive cumulative net benefits	6	11	9	5

*Source: EHR IMPACT study (2009)*

The results of the EHR IMPACT study provide the foundation for the following recommendations in support of future and ongoing eHealth initiatives in general, and interoperable EHR and ePrescribing systems in particular.

**1 FRAMEWORK AND CONTEXT: A CALL ON POLICYMAKERS**


Policies have to create the right climate and incentives for HPOs to pursue the required investments. A strong political commitment to improving the quality and increasing the efficiency of healthcare, and the removal of regulatory and other system barriers, is needed. This includes that policy makers allow investors, project teams and stakeholders time horizons beyond the traditional policy time scales in order to achieve sufficient benefits and realise the net socio-economic returns that are possible.

**2 COMPLETION? A NEVER-ENDING STORY**

Achieving strategic goals needs a consistent, continuous investment in people as well as technology over a long time-period. New projects should not set firm, unrealistic end points to their investments and development. Instead, they should ensure that financial support is sustainable into the long term and that projects are affordable within the finance available throughout this period. This will also allow initiatives to benefit from new opportunities that emerge as successful projects progress.

**3 THEY DID IT THEIR WAY: YOU HAVE TO DO IT YOURS**

The cases show that there is no single, 'right' strategy for implementing interoperable EHR and ePrescribing systems. Decisions to invest in such solutions must devise and adopt strategies that fit their local or regional setting, and be designed to succeed by meeting clearly identified, measurable needs. Transferability of some technology and tools to other contexts is more viable than transferring specific functionalities and organisational features. The specific roles and priorities of healthcare professionals and HPOs differ between jurisdictions and healthcare systems, limit-



ing transferability of success stories mainly to principles, tools and techniques rather than specific EHR and ePrescribing systems. The most transferable features are the experiences and capabilities gained, and requirements for success identified.

#### 4 THE RIGHT STRATEGIC GOALS: BETTER HEALTHCARE, NOT CASH

EHRs and ePrescribing bring about considerable strategic gains for healthcare and must be approached as clinical ventures, not as ICT projects. Using them as part of successful change in clinical and working practices is an essential component of improving health services delivery and performance. By taking the socio-economic perspective, the cases illustrate that initiatives can achieve returns of close to 200% on their total investment, and an average of about 80% over some nine years. These represent excellent returns from a wide range of benefits, but must be seen as longer-term investment to support a longer-term strategy for improving clinical performance.

The cases indicate that financial gains may be up to 60% of total socio-economic benefits, but with an average of only some 13%. Financial outlays, on the other hand, were between 20% and 85% of total socio-economic cost of investment, and reached an average of about 50%. Other costs were covered by redeploying available resources. The match of extra cash invested for the initiative and extra cash generated afterwards is usually a negative bottom line, with exceptions proving the rule. When opportunities to redeploy resources liberated by efficiency gains are included, the financial benefits increase to an average 60% of total benefits. Only then can they exceed the extra cash invested.

#### 5 NOT TO MISS: ENGAGEMENT AND INTEROPERABILITY

The EHR IMPACT study identified two key, not to miss opportunities for successfully implementing EHR and ePrescribing systems. One is to ensure engagement and a productive dialogue between clinical and administrative users and ICT experts, preceding and while spending large sums of money on actual solutions. Particularly, continuous leadership by and successful engagement of healthcare professionals from the outset is essential. This is time-consuming, so it must be resourced appropriately. Underestimating the importance of engagement results in bigger costs downstream, and a higher risk of failure.

The other opportunity is to use interoperability is a prime driver of benefits. It makes life easier for different users and provides gains that rely on access to information regardless of place and time, and from re-using information for multiple purposes. Without meaningful sharing and exchange of information, the gains would be marginal and not justify the cost of investments.

The results of the EHR IMPACT study give reason for optimism in the value of well designed and implemented interoperable EHR and ePrescribing systems across Europe. The strategic recommendations of the EHR IMPACT study should encourage and support future initiatives through learning from the successes achieved by the eleven cases.

# 1

## Unveiling the potential: why eHealth advances only slowly

A common challenge for all health systems is to use their limited resources to meet a demand with unlimited scope for increase. Ageing populations, rising expectations, and advances in life sciences all increase demand for more and better health services. Challenges lying ahead are to reconcile all the individuals' needs with the available healthcare resources and potential improvements in performance. Awareness of the potential of eHealth to help meet these challenges has been continuously rising across Europe and its Member States and other regions of the world. Simultaneously, awareness of the challenges in succeeding with eHealth has also increased.


For some time, the European Union (EU) has strongly supported the development of ICT applications in the health sector. Various national activities have gained in scope and relevance for healthcare professionals and citizens, and Member States have taken seriously the commitment in the European eHealth Action Plan<sup>5</sup> to develop national eHealth strategies<sup>6</sup>.

The promise of ICT in healthcare is that it facilitates networking, citizen-centred information sharing and exchange, and transparency and collaboration between different stakeholders. It can empower healthcare professionals



in providing healthcare, and electronic health records (EHR), in particular, are expected to facilitate seamless, continuous healthcare and teamwork involving various specialists at different locations.

Nevertheless, many past and current initiatives do not realise their full potential. This is evident from action points put down by the European eHealth Action Plan in 2004:

- 
- “By end 2006, Member States, in collaboration with the European Commission, should identify and outline interoperability standards for health data messages and electronic health records, taking into account best practices and relevant standardisation efforts.”<sup>7</sup>”
  - “By end 2008, the majority of all European health organisations and health regions (communities, counties, districts) should be able to provide online services such as tele-consultation (second medical opinion), e-prescription, e-referral, telemonitoring and tele-care.”<sup>8</sup>”

One reason for this situation is that clinical and healthcare workflows, care models, and business processes are significantly more complex than equivalents in other sectors of the economy and less amenable to standardisation and streamlining by conventional eBusiness systems. Another reason for the slow progress is the lack of awareness of, and sufficient empirical evidence on, the costs and benefits of existing interoperable EHR and ePrescribing systems and services<sup>9</sup>.

The European Commission (EC) EHR IMPACT study investigates the socio-economic impact of interoperable Electronic Health Record (EHR) and ePrescribing systems in Europe and beyond, and so helps to fill this information gap. It compiles and disseminates new knowledge about socio-economic impact and identifies the implications of success for all types of healthcare systems in Europe and other regions. Core to the project is a detailed qualitative analysis of eleven good practice cases. Nine of these underwent a quantitative evaluation of their socio-economic impacts. Each case study is a sustainable solution in routine operation.

The EHR IMPACT study takes a broad perspective of EHRs and ePrescribing. An EHR system can include parts of a comprehensive record, allows limited or extensive sharing of information, or may be part of a particular healthcare provider organisation (HPO) patient record. It usually does not contain all the health-related life-long data about people, often envisaged by grand strategies. ePrescribing is usually part of a wider health information system and often includes information on prescribing policies, clinical decision and dispensing support, advice to patients and carers, and tools to facilitate the processes and roles of each stakeholder needed to convert prescribing decisions into administered medications.

Interoperability is defined as the ability to exchange, understand and act on patient and other health information and knowledge among linguistically and culturally disparate clinicians, patients and other actors, within and across jurisdictions, in a collaborative manner. EHR IMPACT distinguishes between three levels of interoperability, which are potential interoperability, limited connectivity, and extended actual connectivity. Potential interoperability involves EHR and/or ePrescribing solutions and use of technology standards allowing information to be shared, but without actual exchange taking place. Limited connectivity refers to a situation in which not all features and levels of interoperability are achieved, yet some information exchange and sharing is practiced. Extended actual connectivity comes close to real interoperation by using interoperability to exchange and share information and knowledge with other actors in the health system. This facilitates collaboration and change in clinical and working practices and roles, as well as creating and expanding multi-disciplinary teams. Interoperability can support collaboration of people within a team, cooperation between teams, organisations, regions, and even between healthcare systems in different countries.



# 2

## The EHR IMPACT approach and methodology

The eHealth IMPACT study builds on the foundations for socio-economic evaluation of eHealth services laid by the European Commission eHealth IMPACT study (eHI). The eHI study provided empirical evidence on the benefits of eHealth systems and services. It demonstrated the potential of eHealth as an enabling tool to meet some of the big challenges of European health systems. For this study, the eHI approach, analysis and methodology were developed, refined and adapted to create the evaluation models needed for the specific setting of interoperable EHR and ePrescribing systems.

### 1 Study design – from specific to general

The goals of the EHR IMPACT study required an adaptive and inductive empirical approach. Two perspectives were used, the socio-economic, and the narrower, financial characteristics within the socio-economic. The case studies provide the empirical insights that underpin findings on the socio-economic impact of interoperable EHR and ePrescribing systems and the factors that need to be in place to accelerate their successful deployment.

The preparation phase involved a review of the literature and other sources, agreeing on key working definitions and the conceptual framework, and selecting case studies for evaluation. It included refining and adapting the eHI model to the setting of interoperable EHR and ePrescribing systems. An Advisory Board validated the methodology.


The second phase was evaluating the socio-economic impact. It overlapped with the preparation work, as refining the methodology was iterative and partly derived from the evaluation of the first two case studies. After the overlapping period, this phase continued with the quantitative evaluation of the seven remaining studies and the qualitative analysis of the two additional studies from outside Europe.

Phase three used the evidence-based outputs from the case studies to synthesise and aggregate the findings into general perspectives for policy makers, and find common themes. The Advisory Board and a wider expert community reviewed, discussed and validated the results.

### 2 Case study selection

For the EHR IMPACT study, **a good practice case is a proven, real-life operational EHR or ePrescribing system implemented several years before the evaluation and that enables a beneficial impact on health-care.** Beneficial impact includes improved clinical decisions and performance through interoperable data exchange and information sharing, and reorganising clinical and other workflows and processes. The impact can result in a combination of benefits from better quality, access and efficiency. With these characteristics, the case studies provide good examples of beneficial impacts and offer good learning experiences for other countries, regions, and organisations. The case studies are selected for the proven performance in their own healthcare contexts, they are not proposed as ideal or problem-free solutions to be copied.

Experimental or pilot EHR or ePrescribing solutions do not comply with the selection criterion of being operational for several years, so are excluded. Experience has shown that many such applications may not



be economically sustainable once the initial funding ends or the experimental characteristics and the support provided to such activities ceases.

The following guidelines were used to select the case studies:

- Some core clinical record components are implemented fully
- Functionalities have reached a level of maturity
- Connection to administrative and management components is available, or possible
- A level of interoperability reflected in at least limited connectivity
- Compliance with national and European legislation and data protection regulation
- A balance of coverage between:
  - Whole-country use
  - Solutions for regions
  - Solutions for a healthcare provider organisation
  - Use in specific healthcare sectors such as primary, secondary, tertiary
  - Scale indicated by ranges of functionalities
  - High current and potential deployment measured by the number of users
- Pragmatism:
  - Commitment of site teams and top management to work with the EHR IMPACT evaluation team
  - Availability of data and willingness to provide the information needed
  - No replication of, or addition to, socio-economic evaluations already completed.

The last guideline is not a criterion for good practice, but was essential in completing the evaluations. Cases included in eHealth IMPACT<sup>10</sup>, such as the national ePrescribing platform in Sweden, the internet-based EHR system IZIP in the Czech Republic, and the EHR and search engine developed and used by Institut Curie, Paris, France, were excluded from EHR IMPACT.

### ③ Socio-economic impact evaluation methodology

An EHR IMPACT evaluation relies on a bespoke analysis with two start points. One develops an understanding of the healthcare and organisational setting in which the EHR and ePrescribing systems operate. The other identifies relevant impacts over time from an initial hypothesis. It is this second part that builds the qualitative analysis into a quantitative evaluation of each indicator by assigning them monetary values.

#### ① Theoretical foundations of the EHR IMPACT methodology

The theoretical foundations of the EHR IMPACT methodology are value theory, and in particular, the concept of value added. Value added in economics is the additional value resulting from transformations of factors of production into a ready product. At its simplest, it is the difference between the value of a product and the aggregate value of its individual components. Over the last decade, value added has been a widely used approach supporting investment decision making.

For the EHR IMPACT study, socio-economic impact is the value added to society, either in part or as a whole, by using interoperable EHR and ePrescribing systems. This equals the total value of health services provided with the support of such systems less the total value of health services provided without this kind of support.

$$\text{value added from EHR and ePrescribing} = \text{value of health services with EHR and ePrescribing} - \text{value of health services without EHR and ePrescribing}$$

In an ideal model of perfect competition and complete markets, this can be derived from market prices for separate items of healthcare. Unfortunately, these seldom prevail in health services, so estimating value relies on change. Identifying the services affected by EHR and ePrescribing systems can reveal positive effects, or benefits, which create value, and negative effects, or costs, which reduce value. The total net value added is the sum of positive value added less the negative values. Total net value added is also referred to as net benefit.


Cost benefit analysis (CBA) is the foundation for turning theory into a pragmatic evaluation tool<sup>1</sup>. The UK Treasury's Green Book<sup>2</sup> and Germany's WiBe<sup>3</sup> specify CBA as an appropriate methodology and tool for analysing the impact of investments and activities in domains of public interest, including healthcare. All stakeholders can be included in a socio-economic evaluation based on CBA and that extends over long timescales. It also enables the narrower financial components within the costs and benefits to be identified and analysed separately.

## ② Empirical method

Gathering empirical evidence relied on desk research, organisations' existing data, specifically constructed statistics, and semi-structured interviews with stakeholders. A prerequisite for each model is a thorough understanding of the different settings of each case and identifying the relevant impact indicators through extensive exchanges with the site teams. Close cooperation included continuous email and telephone exchange, a total of more than 20 site visits, and approximately 100 face-to-face interviews with some 500 people across all sites.

Each EHR IMPACT model relies only partly on information gathered from existing data. Some costs and most benefits rely on expert estimates and assumptions. It was beyond the temporal and budgetary constraints of the study to perform detailed observational studies to establish precise changes in clinical practices, time allocations to tasks or quality of care. Therefore, interviews provided both, qualitative conclusions and some of the information needed to make the estimates, inferences and assumptions needed to quantify the socio-economic impacts.

Semi-structured interviews were preferred to distributing questionnaires that can be too rigid, leaving little room for elaboration to gain knowledge on the background, context, motivations, drivers, and the eventual impact of individual initiatives<sup>11</sup>. Questionnaires offer limited scope to capture spontaneous reactions or subtle affinities or reluctance from stakeholders. Qualitative methods using semi-structured group interviews offer scope to seek consistent information from each case study and to reflect differences in healthcare settings and associated changes to clinical and working practices. They are also fruitful and open enough to elu-



cidate stakeholders' perspectives, to cover a wide range of opinions and the strength of opinions held.<sup>12</sup> The approach revealed several unexpected insights from each case study, and helped to define features that users appreciate, as well as characteristics that they see as weaknesses or in need of further development.

Overcoming problems with data availability required additional secondary research by the EHR IMPACT team. When the first draft of each EHR IMPACT model was completed, additional interviews, reviews, data validation, data collection, and analyses of data items, inputs, costs, or benefits followed. Some responses from interviewees were adjusted for optimism bias to produce more robust estimates and assumptions that were consistent between all cases. Adjustments depended on the degree of reliance on expert opinion where actual hard data did not exist. Interviewing healthcare professionals in groups helped with this, by allowing them to challenge each others' estimates and assumptions, and so providing data for optimism bias adjustments.

### ③ Qualitative analysis

The essential perspective for an EHR IMPACT evaluation is to understand the healthcare and organisational settings, the development path of the project, the ICT functionality, its usability, the users and stakeholders that define the evaluation scope. The goals of eHealth policies and strategies in each healthcare system provide valuable information about each of these factors. Each healthcare system that uses EHRs or ePrescribing has specific, unique regional and local features. These must be understood to identify the investment motives and development path of each case study, and identify the EHR or ePrescribing users and stakeholders.

The stakeholder analysis identifies the actual people and organisations affected, and it helps to classify these into pre-defined stakeholder groups and sub-groups. The four main stakeholder groups are:

- Patients, carers, and other citizens
- Healthcare professionals and other healthcare workers as individuals
- Health service provider organisations (HPOs)
- Third parties, including health insurance companies as third party payers and government agencies.

The qualitative analysis identifies process changes, including different and new workflows, clinical practices, and working patterns. These lay the basis for revealing positive and negative effects by using interoperable EHR and ePrescribing systems. Users' reactions to using EHRs and ePrescribing are an important part of this analysis in identifying benefits and costs. The qualitative analysis also identifies the strategic implications and lessons for future equivalent initiatives, the potential transferability of the technology and organisational approach, the role of interoperability in realising the benefits, and specific management recommendations for policy makers, decision-takers and managers.

### ④ Quantitative analysis

The quantitative evaluation is built around four datasets: statistics, assumptions, costs and benefits. Each one extends across the whole timescale of the evaluation. The EHR IMPACT timescale was set at 1998 to 2010, with each case study having its own starting point in this period. The end year enables short timescales for

forecasts where significant and changing cost, benefit and net benefit curves may extend beyond the current year to reveal the direction of the investment. In some cases, estimates beyond 2010 were used to reflect the relatively long timescales needed for some cases to reach net benefits.

#### A Data sets and monetary values

Statistics include data about the population affected by EHRs or ePrescribing, the number of users, volumes of transactions, and changes in healthcare activity. Indicators were available from HPOs, but not always for the whole evaluation lifecycle, so some estimation was needed. These assumptions are held separately from data of actual activity, increasing transparency, helping to identify critical assumptions, and enabling structured sensitivity analyses.

Negative impacts are in the cost category. Positive impacts are benefits. Monetary values of costs and benefits are estimated at constant prices over the whole investment evaluation cycle of design and development, engagement, testing, implementation, operation and change. All values were at estimated constant 2008 prices for the country where the case study is located.

The monetary values assigned to each benefit and cost are classified in a separate financial analysis. Three categories are extra finance, redeployed finance and non-financial. This enables the socio-economic return (SER) from the CBA foundation to be set alongside a narrower proxy for return on investment (ROI). This dual perspective is essential to measure the impacts where EHRs and ePrescribing are pursued as investments in better healthcare rather than seeking net reductions in healthcare spending. In this setting, EHRs and ePrescribing can have a net financial cost justified by socio-economic gains.

#### B The evaluation model

The EHR IMPACT model has four levels, as shown in Figure 1:

**1/** Data input for populations, stakeholders, activity, staffing, unit costs, monetary values, and assumption schedules used for estimates where actual data is not available.

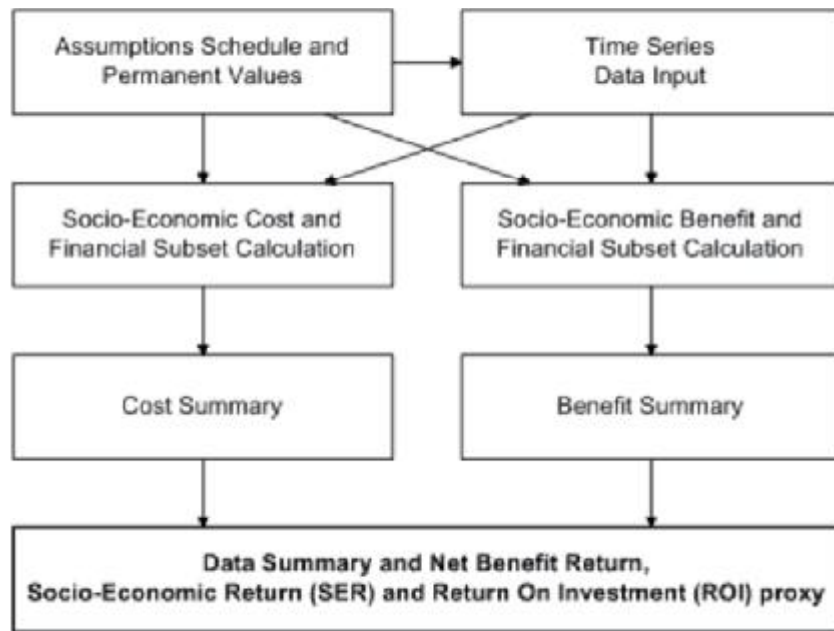
**2/** Cost Calculation and Benefits Calculation showing combinations of data from the data tables to produce estimates, adjustment for contingencies, discounting and classification of costs and benefits into three financial categories of extra financial, redeployed finance and non-financial.

**3/** Cost Summary and Benefits Summary, showing annual estimates, annual present values, and cumulative present values for each type of stakeholder, as well as further analysis results, such as distribution of costs and benefits and categorisation of impact items into the financial perspective.

**4/** Data Summary and Net Benefit Return, showing overviews of the overall socio-economic impact and narrower financial performances of each case study.

The sets of permanent values,  $p = (p^1, p^2, p^3, \dots)$ , and of time series values  $s_i = (s_i^1, s_i^2, s_i^3, \dots)$ , provide the basis for calculating the monetary value of each benefit indicator  $b_i$  and each cost indicator  $c_j$ . Permanent values are gathered in the assumptions schedule, while series values are held in the data input box on

Figure 1: Structure of the EHR IMPACT evaluation model



Source: © empirica/TanJent 2008

Figure 1. The monetary values are functions of the variables  $p$  and  $s$  for the relevant year of calculation ( $t$ ), and the contingency factor  $\sigma$ :

$$b_i(t) = f_i(s_t, p, \sigma_i)$$

$$c_j(t) = g_j(s_t, p, \sigma_j)$$

The EHR IMPACT evaluations use a consistent methodology, but each model needs constructing for each case to reflect their specific settings. Specific functions need to be created for each individual indicator, according to the setting and for each stakeholder group. This is at the level of cost and benefit calculations of the model.

The available techniques for estimating a particular benefit or cost indicator function are well known and widely used<sup>13,14</sup>. Measuring all stakeholders' involvement relied on estimations about the time they alloca-

ted 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 one of the main bases for the estimated ICT costs over whole evaluation cycles.

Time savings rely on estimates of the value of time. Savings in travel costs rely on available estimates of travel costs. Time savings of staff and saving in the 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<sup>1</sup>. 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 patients who enjoy new benefits that were not feasible without EHRs and ePrescribing. Valuing intangible negative impacts such as irritations and inconvenience relies on the same techniques.

Intangible benefits for HPOs, such as reductions in their 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 impacts realise cash benefits, such as identifying increased billing from comprehensive data capture of activity. Estimates of extra activity multiplied by prices provide the monetary value.

The following examples serve as an illustration for the process of assigning monetary values to identified positive and negative impact. Additional information is available on request, in agreement with the specific site team management.

For the cost side, the illustration is the costs to citizens for providing consent, a cost that can occur in many countries. Citizens who wish their data to be shared across healthcare providers have to give their explicit informed consent at registration. This is a purely non-financial effort facing every registered patient once. A proxy for the value of this effort is the time it takes to collect information and provide the consent. The time is either precisely measured, or estimated by healthcare staff providing the detailed information and answering any questions. For this illustration, an average time estimate was 5 minutes per patient. This applies to all new registrations in the relevant year, since we focus on the registration consent, provided only once. Let us assume that 200,000 patients have registered with the system for a given year. In reality, this number is from the internal statistics of each site team. The final variable is the monetary value of time. Given that the target population is the average citizen, an appropriate proxy for the monetary value of time is average income. A reasonable value is €20 per hour. Each evaluation researched incomes to reflect the actual levels. In order to complete the cost function in its clearest form, we have to assign a contingency factor. Taking an adjustment of 10% means a factor of 1.1. This gives the following cost function for the effort by citizens to provide up-front, one-off, informed consent for registration, for year  $t$ , in which 200,000 new patients are registered:

$$c_{\text{patient consent}}(t) = (\text{time for consent in hours}) \times (\text{number of patients in year } t) \times (\text{average hourly income}) \times (\text{contingency factor}) = (5/60) \times 200,000 \times 20 \times 1.1 = \text{€}366,667$$

The assignment of costs and benefits according to the three categories of extra finance, redeployed finance and non-financial follows immediately after the creation of each cost or benefit function. The number 366,667 in this case is just a monetary representation of the estimated value of the required effort, not a financial outlay for patients. As already stressed, the value is a proxy, and as such only an estimate.

Other functions can be much simpler and precise. A striking example is given by the radiology department at University Hospital Geneva (HUG), where the introduction of the radiology information system within the clinical information system improved billing by CHF 0.5 million of previously forgone income a year. This benefit factor, reported by internal studies within the organisation, is a tangible, financial impact. The corresponding benefit function for a particular year is the annual extra income multiplied by the respective contingency factor. Examples of benefits are in table 2, section 3.1.

The aggregation of the individual cost and benefit functions over time, and discounted to present values, yields the cumulative net benefit, or the Net Present Value (NPV) of the initiative. Year  $k$  is the end of the horizon,  $\alpha$  denotes the years to 2008, and  $r$  is the discount factor. For the specific study,  $k = \alpha + 2$ .

$$NPV = \sum_{t=0}^k \left[ (1+r)^{(\alpha-t)} \left( \sum_{i=1}^n b_i(t) - \sum_{j=1}^m c_j(t) \right) \right]$$

The socio-economic return (SER) of the investment is the ratio of discounted cumulative net benefits and cumulative costs:

$$SER = \frac{\sum_{t=0}^k \left[ (1+r)^{(\alpha-t)} \left( \sum_{i=1}^n b_i(t) - \sum_{j=1}^m c_j(t) \right) \right]}{\sum_{t=0}^k \left[ (1+r)^{(\alpha-t)} \left( \sum_{j=1}^m c_j(t) \right) \right]}$$

Details on the impact indicators and the quantification methods involved are in an appendix to each particular case study report<sup>15</sup>. The EHR IMPACT study created 304 cost functions ( $c_j$ ), and 423 benefit functions ( $b_i$ ) for the nine quantitative evaluations. This involved some 1,300 time series variables ( $s_i$ ) and about 600 estimates and assumptions that do not change over time ( $p$ ).

The contingency factor  $\sigma$  was set 81 times. Each block of cost and benefit functions has an individual contingency rate. There are four blocks on the benefits side, one for each stakeholder group. On the cost side, HPOs have two separate blocks to distinguish between ICT and organisational costs. The latter usually require a higher contingency adjustments, since ICT costs are often only available from vendor contracts and exclude some of the management and project costs of the healthcare organisation.



### C Outcomes of the quantitative evaluation

The net benefit to cost ratios over time, the SER rates, provide comparisons of the net present value of the socio-economic impact of the evaluated systems to the costs, including any intangible negative impacts. The ratios are rates of socio-economic, not purely financial, return over the given periods. Positive ratios indicate worthwhile socio-economic endeavours. Ratios of zero are at break-even points where the net socio-economic impacts are zero. Ratios of less than zero show net costs.

The estimated monetary values of annual and cumulative benefits and costs show the time taken to realise net benefits and their scale. The cumulative estimates reveal the distribution of the costs and benefits between stakeholders and the distributions of extra finance, redeployed finance and non-financial costs and benefits. Correlations of utilisation to benefits and to net benefits indicate whether the socio-economic impact is substantially achieved by increasing utilisation.

An important feature of the net benefit estimates needs stressing. The net socio-economic benefit, or SER, is a monetary measure of the net value of all positive and negative impacts, not a measure of financial returns and is not the same as return on investment. The separate, three different financial categories provide a proxy for ROI, but from the perspective of all stakeholders, not from the view of the investing organisations. Several questions can be answered from this analysis. One relates to how much extra cash is needed, and generated, by EHRs and ePrescribing over time. Another, essential question, is whether EHR and ePrescribing systems are investments in better healthcare and need a net investment of cash, similar to classical infrastructure investments in new medical techniques, science, expanded skills, and numbers of healthcare professionals.

### D Rigour and sensitivity

The evaluation techniques provided baseline estimated costs and estimated benefits. Contingency adjustments 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 were discounted to net present values with a discount factor set at 3.5%, with a base year 2008. The chosen discount rate





reflects an average factor when considering official rates found across Europe<sup>16</sup>.

The sensitivity analysis comprised 208 separate tests, focusing on all possible estimated variables to which the outcomes of the socio-economic analysis could be sensitive. Such variables include a number of probabilities based on secondary literature, as well as estimates of willingness to pay values inferred from behaviour, and estimated time changes for which no scientific proof was available. The tests involved changing the values of blocks of variables included in the calculation of monetary values towards a pessimistic scenario. Values were lowered or increased by between 25% and 500%, depending on the variable, in a direction that reduces net benefits over time, so testing the effect of estimates and assumptions on the findings.

Interpreting the outcomes of the EHR IMPACT evaluations relies on their order of magnitude, not their absolute values. In this context, the sensitivity analyses show that the evaluations provide a sufficient level of rigour to rely on the analyses and the conclusions on the overall impact and performance of the evaluated sites. The impact of manipulating assumptions is minimal, with highest impact involving a deferral of annual or cumulative net benefits by one year; in rare occasions by two years. The overall socio-economic return for the EHR IMPACT evaluation timeline, measured by the cumulative net benefit to cost ratio in 2010, worsens within a range of up to 70%, still leaving a comfortable positive result in each of the case studies.

# 3

## Results and analysis

Table 1 shows the summarised results from an aggregated perspective. The distributions provide cumulative positions over the EHR IMPACT horizon starting between 1998 and 2002, and ending in 2010. The two measures of performance, SER and a proxy ROI, show different results, as described below. A general finding is that EHRs and ePrescribing are beneficial investments in better healthcare and, except in very specific circumstances, need net cash injections.

Table 1: EHR IMPACT results

<b>EHR IMPACT: Summary of results</b>				
	min	max	average	range
<b>Time to net benefits</b>				
First year of positive annual net benefits	4	9	7	5
First year of positive cumulative net benefits	6	11	9	5
<b>Socio-economic return: net benefit to cost ratio</b>				
Annual ratio 2010	0.61	9.95	3.82	9.35
Annual ratio 2008	0.15	4.62	1.66	4.47
Cumulative ratio 2010	-0.20	192	0.78	2.12
<b>Distribution of costs</b>				
Citizens	0%	14%	2%	14%
Doctors, nurses, other staff	0%	45%	11%	45%
Health provider organisations	50%	94%	80%	44%
3rd parties	0%	40%	7%	40%
<b>Distribution of benefits</b>				
Citizens	2%	40%	17%	39%
Doctors, nurses, other staff	4%	38%	17%	34%
Health provider organisations	39%	94%	61%	56%
3rd parties	0%	21%	5%	21%
<b>Types of costs</b>				
Financial extra	21%	83%	49%	63%
Financial redeployed	17%	79%	42%	63%
Non-financial	0%	19%	9%	19%
<b>Types of benefits</b>				
Financial extra	0%	58%	13%	58%
Financial redeployed	12%	82%	46%	70%
Non-financial	6%	88%	41%	83%
<b>Correlations</b>				
Utilisation to benefit	+0.912	+0.995	+0.978	+0.083
Utilisation to net benefit	+0.659	+0.970	+0.909	+0.311
<b>ICT and organisational costs, cumulative</b>				
ICT costs as share of total costs	14%	68%	42%	54%
Organisational costs as share of total costs	32%	86%	58%	54%
ICT as share of all health provider organisation costs	18%	68%	48%	49%

Source: EHR IMPACT study (2009)

The EHR IMPACT case studies have a lot in common, mainly that they are successful. However, the route to success was different. There are many clichés about successful eHealth initiatives, some of which are true. A look under the surface opens up new perspectives and gives valuable insights into the causes of success and failure. Even when decision-makers meet all their requirements, **success does not follow as a matter of course**. Their checklists may not be good enough. The following sections address the main topics that comprise decision-makers' checklists. The real value, however, lies in the combination of high-level insights and the specific features that have to be taken into account when designing new initiatives.

## ① Reasons for investing in interoperable EHR and ePrescribing systems

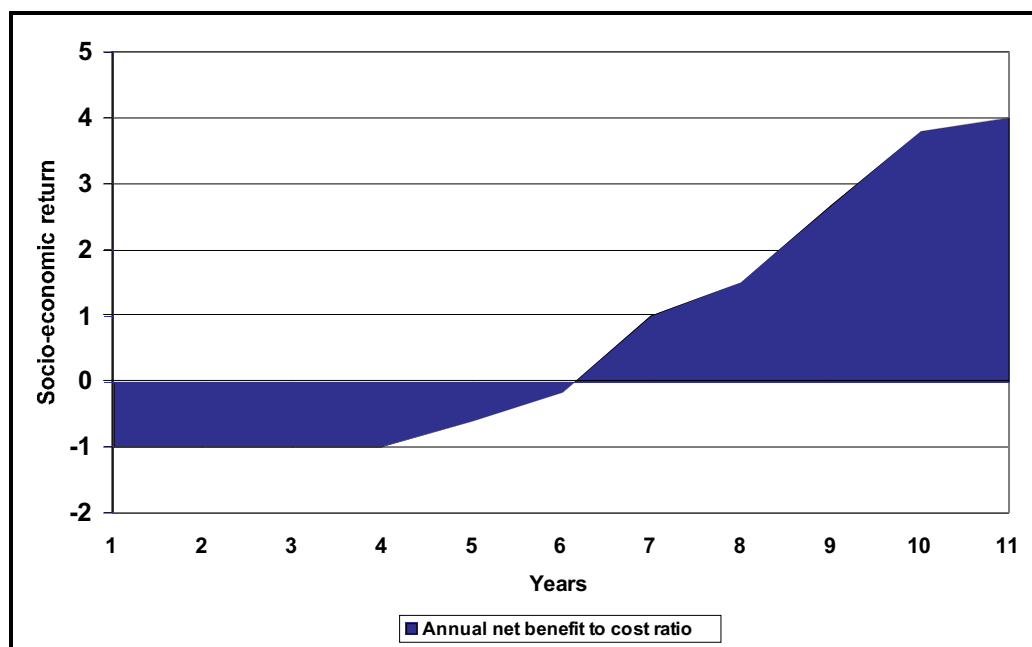
There are many different types of benefits from EHRs and ePrescribing, and they combine to confirm the main reason to invest in interoperable information systems for clinical purposes: to facilitate a wide range of improvements in the quality of healthcare. ICT can serve as an enabler to change clinical and working practices, which in turn, directly improve quality and efficiency. **The socio-economic gains to society from successful interoperable EHR and ePrescribing systems will eventually exceed the costs.** This is why investment in EHRs and ePrescribing are worthwhile, and justify their net financial boost.



### ① Scale of socio-economic returns (SER)

**The average cumulative SER, but not financial return, is 78% over the evaluation timescales of between 9 and 13 years.** This confirms that **investments in interoperable EHR and ePrescribing systems, if pursued with the necessary rigour, are worthwhile.** Once the value of benefits begins to cover costs, the net benefit expands and becomes substantial. Annual net benefit in 2010 reaches between €1.2 million for the smaller-scale sites and over €170 million for Diraya, which serves more than 8 million people. The annual SER increases considerably towards the end of the time scale. Chart 1 shows a typical development, with an initial period of investment without any benefits, but reaching annual SERs of up to 400%. The average annual SER for the EHR IMPACT sites in 2010 was about 380%.

Chart 1: Illustrative annual SER over time



Source: EHR IMPACT study (2009)

## ② Evidence on benefits from interoperable EHR and ePrescribing systems

Looking at the cases in aggregate reveals a large number of different types of benefits across four main stakeholder groups: citizens, healthcare professionals, HPOs, and third parties, which includes payers. EHRs and ePrescribing are part of strategies for investment in better healthcare. Except in very special circumstances, such investments do not generate net extra cash. They usually need extra cash as an investment in better healthcare. Examples of information-intensive strategic goals facilitated by interoperable EHR and ePrescribing systems include:

- Continuity of care in Rhône-Alpes, Lombardy, Kronoberg, Andalucía, and Israel
- Epidemiology and other public health statistics in Andalucía, Sofia, Geneva, and Israel
- Waiting time and general management in Andalucía, Scotland, Sofia, Kolin, Geneva, Kronoberg, Israel, and Lombardy
- Out of hours and A&E healthcare provision in Scotland, Kronoberg, and Andalucía.

**No single or small group of benefits comprise a reason for investment in EHRs and ePrescribing, even if this is an initial policy or strategic start point.** A wide range of many benefits is the goal, and these depend

on the functionalities and utilisation of EHRs and ePrescribing, and may occur in unexpected places. A result of the EHR IMPACT study is that benefits from EHR and ePrescribing systems fall under similar broad categories, but are very individual and specific to the context of an investment. Table 2 below provides an overview of the benefit items found across the EHR IMPACT case studies. The list is not comprehensive, but rather points out to the main positive impacts reported by the nine detailed case studies. The last column indicates the case studies in which the benefit is found.

EHR IMPACT evaluations do not include second order effects on general labour productivity, population health status, employment, and economic growth. These are notoriously difficult to assess reliably because of the limited proven causal links between EHRs and ePrescribing and second order factors. Thus, table 2 includes only direct, first order effects on different stakeholders.

**Table 2: Selected benefits from EHR IMPACT case studies**

<b>Benefit</b>	<b>Comment</b>	<b>Case studies</b>
<b>Healthcare provider organisations</b>		
Patient safety and reduced clinical risks	Fewer technical mistakes with associated avoided effort, due to information availability	Diraya, ECS, HUG, Kronoberg, NHHS, Receta XXI
Reduced risks by fewer repeated diagnostic tests	Avoided unnecessary complaints and suits related to pain and discomfort	Diraya, DPPR-SISRA, HUG, Kolin-Cáslav, Kronoberg, NHHS, SISS
More effective healthcare	Quality and efficiency from better-informed decisions	Diraya, DPPR-SISRA, ECS, HUG, Kolin-Cáslav, Kronoberg, NHHS, Receta XXI, SISS
Integrating human resources more effectively	Facilitated seamless care pathways by multi-disciplinary teams	Diraya, DPPR-SISRA, ECS, HUG, Kolin-Cáslav, Kronoberg, NHHS, Receta XXI, SISS
Reducing patients' waiting times	Avoiding complaints	Diraya, ECS, HUG, SISS
Better compliance with clinical guidelines	Avoiding potential penalties	Diraya, DPPR-SISRA, HUG, Kronoberg, NHHS, Receta XXI
Improved prescribing practices	Taking more factors into account during the process of prescribing	Diraya, HUG, Kolin-Cáslav, Kronoberg, NHHS, Receta XXI, SISS

Reducing stockholding, especially drugs	Stocks are tied-up resources with opportunity costs; too large stocks also produce waste in form of gone-off medications	NHHS
Reduced drug costs	Mainly from prescribing by active ingredient rather than brand	Diraya, Kronoberg, Receta XXI
More accurate billing	Direct link between clinical procedures and billing leads to less procedures being accidentally omitted from bills	HUG, Kolin-Cáslav, NHHS
Better efficiency and productivity	Mainly time redeployed to other activities	Diraya, DPPR-SISRA, ECS, HUG, Kolin-Cáslav, Kronoberg, NHHS, Receta XXI, SISS
Evidence-based management	Near-time reports and statistics support better management decisions	Diraya, HUG, Kolin-Cáslav, Kronoberg, NHHS, Receta XXI, SISS
<b>Citizens</b>		
Reducing the risks of technical mistakes at the point of care	Avoided unnecessary pain and discomfort	Diraya, DPPR-SISRA, ECS, HUG, Kolin-Cáslav, Kronoberg, NHHS, Receta XXI, SISS
Reduced risks by fewer repeated diagnostic tests	Avoided unnecessary pain and discomfort	Diraya, DPPR-SISRA, HUG, Kolin-Cáslav, Kronoberg, NHHS, SISS
Enhanced continuity and a smoother transfer between different points of care	Supporting timeliness of care	Diraya, DPPR-SISRA, ECS, HUG, Kolin-Cáslav, Kronoberg, NHHS, Receta XXI, SISS
Time savings for appointments and repeat prescriptions	Particularly where booking systems are interoperable with EHR and ePrescribing systems	Diraya, Receta XXI, SISS
Saved time from avoiding unnecessary or duplicate procedures	More pronounced for patients with long-term conditions and those who may move locations	Diraya, ECS, HUG, Kolin-Cáslav, Kronoberg, NHHS, Receta XXI, SISS
Saved time from avoiding unnecessary or duplicate journeys	More pronounced for patients with long-term conditions and those who may move locations	Diraya, Kolin-Cáslav, Kronoberg, SISS
Saved cost from avoiding unnecessary or duplicate journeys	Cash saving	Diraya, Kolin-Cáslav, SISS
Saved co-payments from avoiding unnecessary or duplicate procedures	Cash saving	Kolin-Cáslav, Kronoberg, NHHS

<b>Healthcare teams</b>		
Provide services that are more consistent with their high personal and professional standards and goals	Having the clinical and patient information they need is seen as an enormous advantage; decisions made on the basis of more information are seen as reducing risks	Diraya, DPPR-SISRA, ECS, HUG, Kolin-Cáslav, Kronoberg, NHHS, Receta XXI, SISS
Work more effectively as multi-disciplinary teams	Facilitated teamwork and communication	Diraya, DPPR-SISRA, ECS, HUG, Kolin-Cáslav, Kronoberg, NHHS, Receta XXI, SISS
Save time	Mainly from avoiding unpaid extra-hours by not searching for information and fewer repeated diagnostic tests	Diraya, DPPR-SISRA, ECS, HUG, Kolin-Cáslav, Kronoberg, NHHS, Receta XXI, SISS
Provide more effective and efficient healthcare	Unwillingness to return to pre-eHealth working environments, as it would be too burdensome, clumsy, and prone to mistakes	Diraya, DPPR-SISRA, ECS, HUG, Kolin-Cáslav, Kronoberg, NHHS, Receta XXI, SISS
<b>Payers and other third parties</b>		
Lower administrative costs	Due to integration of clinical and admin systems and re-use of information. Applies to payers, as well as authorities and judicial clerks	Diraya, HUG, Kronoberg, NHHS
Saved procedures	Cost reductions to payers	Diraya, HUG, Kronoberg, NHHS
Better statistics, which help meet health policy goals	Benefit for authorities. Examples include promulgating clinical standards, reducing clinical risks, and contributing to health gains for communities	Diraya, DPPR-SISRA, ECS, HUG, Kronoberg, NHHS, Receta XXI, SISS
Saved cost from avoiding unnecessary or duplicate journeys	In systems where these are covered by payers	Kronoberg

Source: EHR IMPACT study (2009)

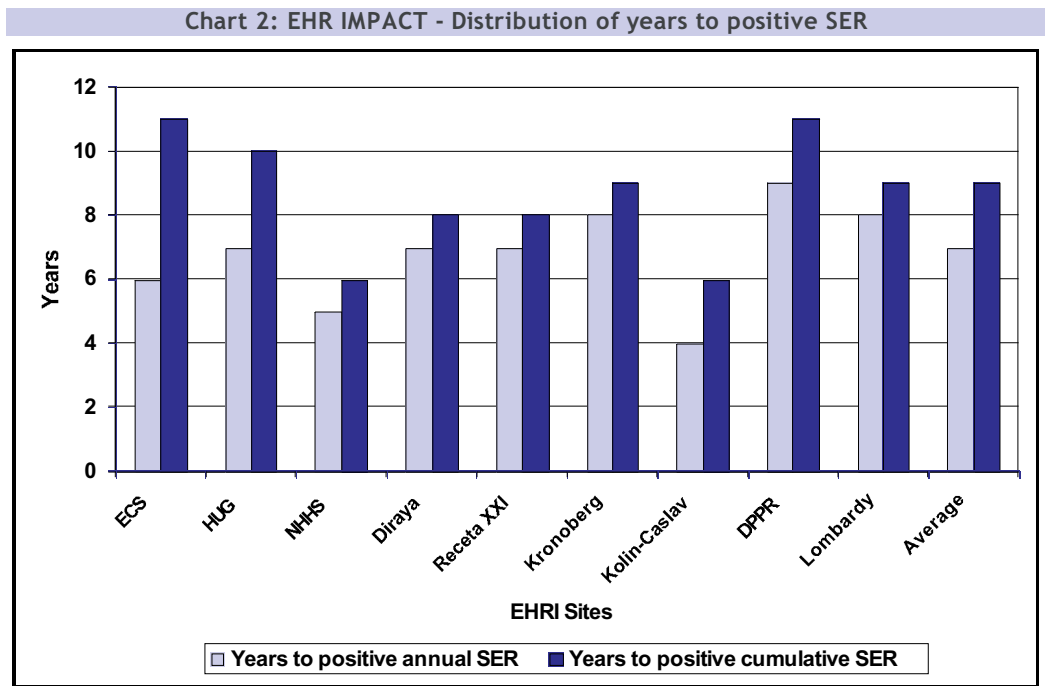


2 Times horizons

The positive SER justifies the wider deployment of interoperable EHR and ePrescribing systems. A critical issue, however, is planning, realising and managing the timing of returns.

1 Time to net benefits

Successful EHRs and ePrescribing are not quick wins; they are sustainable wins. **It takes at least four, and more typically, up to nine years before the case studies produced annual SER.** Average time to annual net benefit of the nine sites is seven years. These long timescales reflect the complexity and scope of successful EHR and ePrescribing systems. Chart 2 depicts the positions of all nine EHR IMPACT sites, showing reasonably good clusters for years to net benefits, both annual and cumulative. The EHR IMPACT study is not ranking performance, but rather revealing features of successful investments. Differences in timing between sites are due to differences in the scope and context of the initiatives.

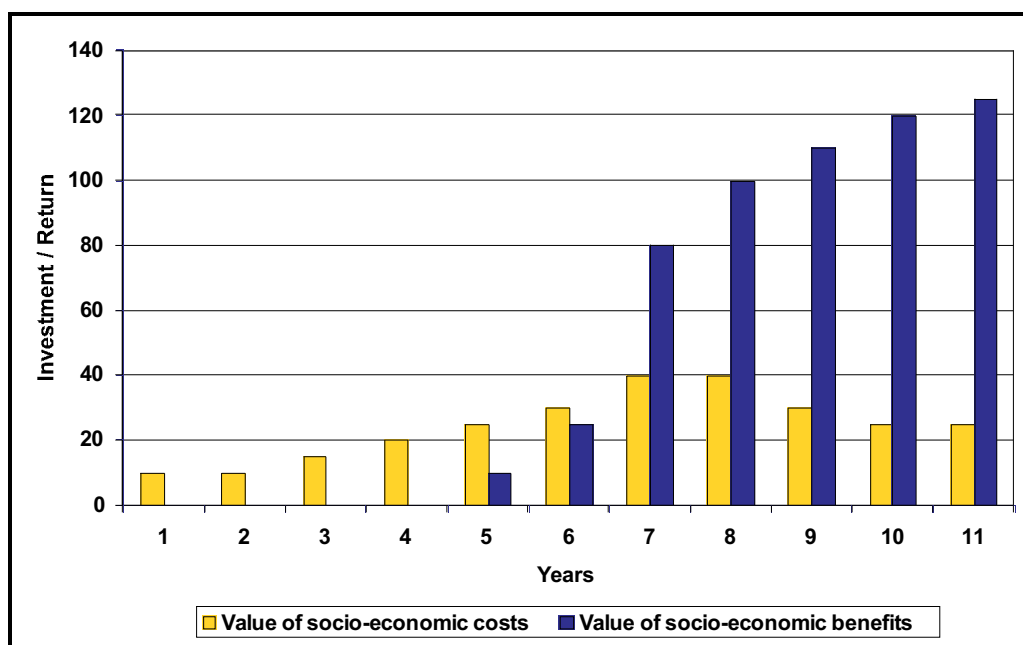


Source: EHR IMPACT study (2009)

Once the value of benefits starts rising, performance of successful investments is sustainable. The outline of annual costs and benefits in Chart 3 illustrates the point.



Chart 3: Generic annual value of socio-economic impact



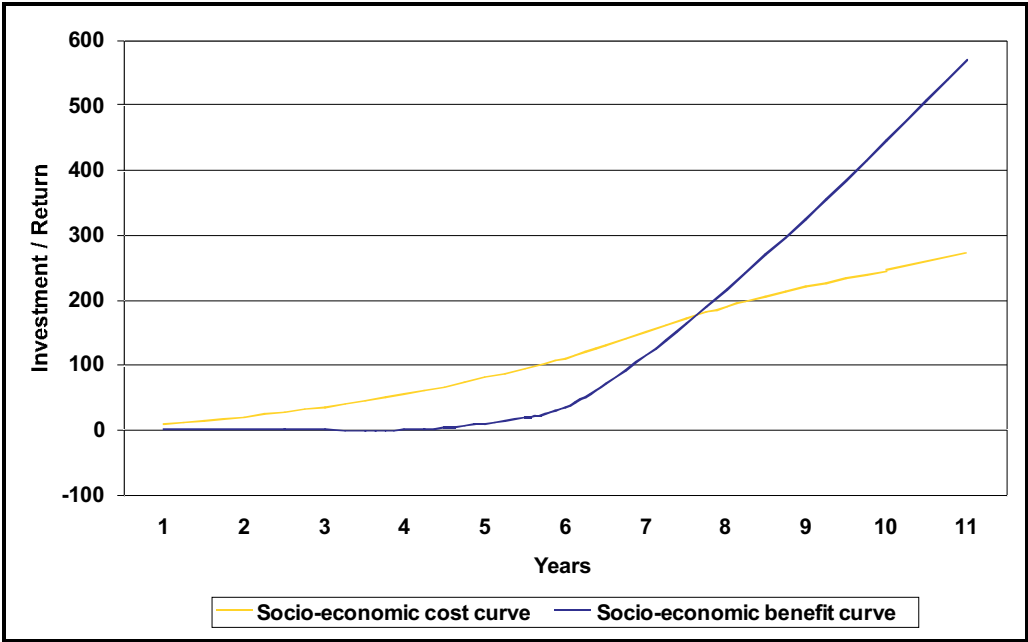
Source: EHR IMPACT study (2009)

During the first two years, the annual investments look relatively small. The timescale's first year is when the decision to invest in EHRs and ePrescribing is taken. After that, resources are needed for engagement with key stakeholders, especially healthcare professionals. These can be extensive and time-consuming and can culminate in agreements about scope, standards, interoperability, design and initial requirements. Costs rise steadily after this stage as EHRs and ePrescribing systems are developed, procured, designed, tested and implemented. After this investment hump, costs begin to decline. After implementation, benefits rise rapidly over about three years, and the shape and steep slope of this part of the curve is crucial to their sustainability.

Cost levels depend on the scope of the EHRs and ePrescribing, the range of healthcare affected, and the economic environment of the investment. Reflecting this, the total value of invested financial and non-financial resources at the evaluated sites was extremely wide, ranging from €3 million to nearly €480 million. Although considerable at first sight, these are investments in complex systems and changes and stretch over long timescales. This challenges a widespread belief that financing hurdles are barriers to progress. They are not.

**EHRs and ePrescribing need a lot of patience** before they provide cumulative SER. It takes six to eleven years to realise a cumulative net benefit, and nine on average. Chart 4 shows an example from of all nine sites, illustrating a potential shape of the curves for a future investment. It shows that common time horizons of strategies, often reaching no more than five years, are too short for this type of investment decision. They include mainly the costs, but do not reach out long enough to include the activities needed to realise benefits.

Chart 4: Generic cumulative value of socio-economic impact



Source: EHR IMPACT study (2009)

The slopes of the cumulative cost and benefit curves change between years seven and nine. The result is a sustained growth rate of benefits at a significantly higher level than the growth rate of costs. This relationship, observed in each individual case, is an essential sign of long-term sustainability.

If the slopes do not change sufficiently over this period, it becomes extremely difficult, and possibly unlikely, that an SER will arise from the investment. The activity may be stuck in a rut, equalling failure, needing radical decisions and modification. Plans for EHRs and ePrescribing should have a clear focus on achieving changes at the right time; neither too late, nor too early.

The EHR IMPACT time horizon cuts off artificially at 2010 to avoid uncertainties about future developments that may bias the outcome of the evaluations. Some of the impacts identified have not yet unveiled their whole scale, and will continue to grow beyond this period. This applies particularly to ESC Scotland, SISRA in Rhône-Alpes, SISS in Lombardy, and the EHR system in Kronoberg. Compared to other cases, they are still in the relatively early stages of routine operation.

## ② The risk paradox

Conventionally, long time scales for projects increase risks, as the opportunities for unplanned developments and uncertainty increases, and the wait for results over a longer time reduces momentum and motivation. However, the experience of the EHR IMPACT sites contradicts the theory. It comes as a paradox **that in the complex environment of EHR and ePrescribing systems, longer time scales are associated with lower risk of failure.** Timescales that are too short are unrealistic and unachievable from the outset, and so increase the risk of wasting effort and resources. As was explicitly pointed out in Kronoberg, a health information network is much more than an ICT project. It is inseparable from fundamental changes in the organisations and the way healthcare is delivered. These changes need careful preparation and take time to complete. Not allowing enough time for change increases the risk of resistance, underutilisation, and ultimately of failure. However, appropriate, longer timescales that reduce risk must not be confused with longer timescales due to indecision and bad decisions that lead to failure.

Findings from SISRA show how unhurried timescales mitigate risk and lead to a strong sustainable impact. With explicit, informed consent required from eventually more than 6 million people, overhasty roll-

out can require significant, unrealistic investments of time on behalf of citizens and healthcare staff, which may result in resistance and a return to negative net impact on outcomes and net values. The strategy of gradual and effective rollout used by the SISRA team eases the cost and management of providing consent. NorthShore in the USA followed a similar pattern. The initial decisions were taken some 13 years ago.

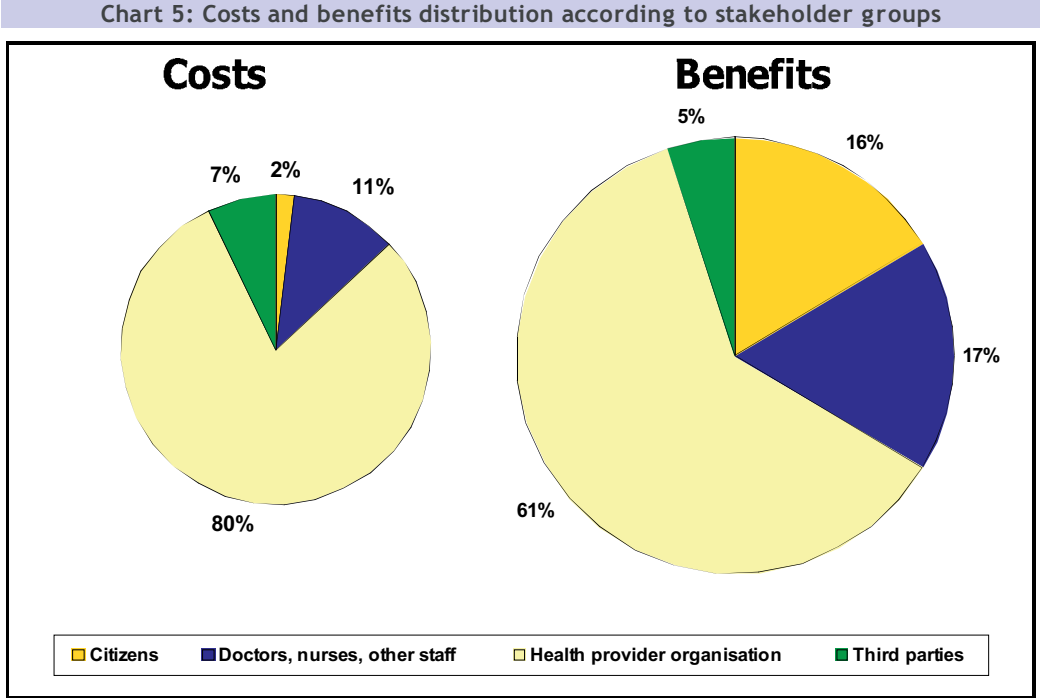


### 3 Impact on different stakeholders

Investments in interoperable EHR and ePrescribing systems impact on more than one stakeholder. The distribution of costs and benefits is important for planning future investments. A decisive factor is the eventual net impact on stakeholders who have the power to fail an investment.


#### 1 Distribution and nature of costs and benefits

Chart 5 provides an overview of the average distribution of costs and benefits between the main stakeholder groups defined by the EHR IMPACT study. **HPOs bear most of the costs and are the main beneficiaries.** This is consistent with the eHealth IMPACT findings<sup>17</sup>.



Source: EHR IMPACT study (2009)

Just less than half of the costs borne by **HPOs** are direct investment in ICT. This makes some 42% of the value of all costs. Another considerable cost item is the cost of large-scale engagement of users in the development and implementation phases of the investments. Most of this is resource redeployed from other activities.



Most benefits to HPOs, mainly quality and efficiency from better-informed decisions, occur at the point of care. As the main investors in interoperable EHRs and ePrescribing, HPOs can realise an extensive range of benefits for citizens, their patients, their healthcare professionals and teams and themselves if they adopt recognised good practices identified by the evaluations. Table 2 above provides more detail.

**Citizens** and patients are subject to many positive impacts, yet sometimes their involvement is also called for. Citizens' investments in EHRs are modest, which is in line with the European social care model of services financed by the state or other third parties. The most significant input on behalf of patients is providing explicit, informed consent, which needs time and can drive citizens' costs to some 14% of an investment, especially when a large number of people is affected.

The gains for this group of stakeholders arise from improved healthcare achieved with the help of EHRs and ePrescribing. The share of benefits to patients, informal carers, and other people can reach up to 40% of all gains, with an average of about 17%.

A key feature of interoperable EHR and ePrescribing systems is that the impact on **healthcare professionals and other team members** is significant. In some cases, they have over 40% of the value of positive and negative impacts. On the negative side, this includes personal commitment in building up the system, investing free time, and inconveniences and irritations during implementation phases. The latter last anything between a couple of weeks and six months to a year, depending on the system in question and the personal affinity to technology of the healthcare team member. Longer lasting negative effects are less common. It is also observed that younger professionals adapt and endorse new technology faster than older professionals.

Individuals in the healthcare delivery system invest part of their time in helping to develop EHRs and ePrescribing to improve the information they need, and see a direct benefit to their professional life. It could be that a critical motivator is that their benefits exceed the costs of their engagement.

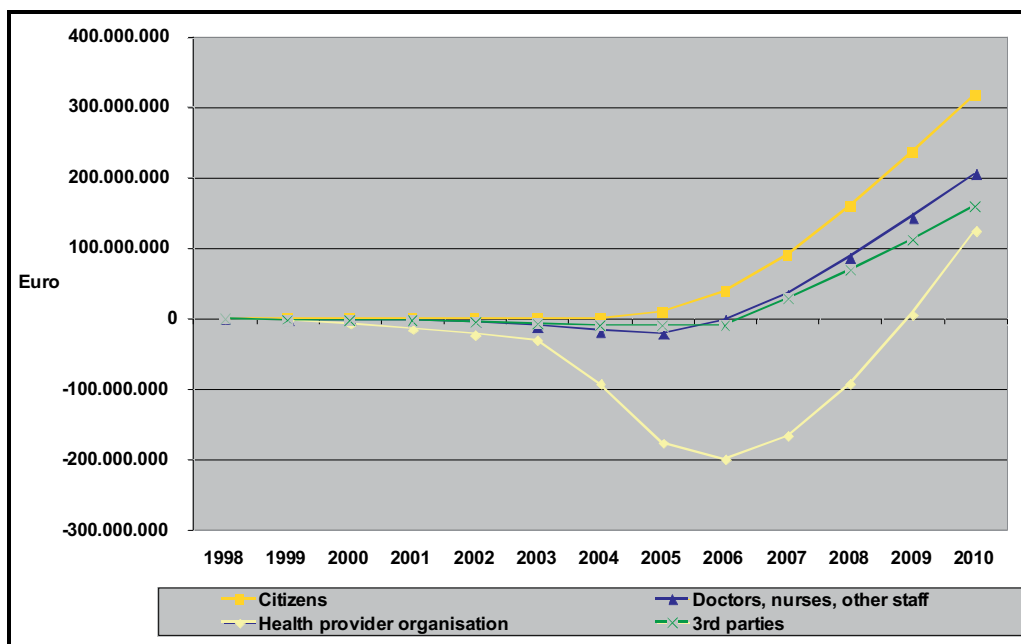
Interview partners insisted on not wanting to return to a pre-eHealth working environment, as it would be too burdensome, clumsy, and prone to mistakes. This result is consistent with the findings of a recent study in the US, which claims that "physicians who receive training in a technology-rich environment but go on to work in a less modern facility feel they can't provide safe, efficient care as they could have with information technology"<sup>18</sup>. Leaving the job, or requiring a multiple of their current income, were often stated by healthcare professionals during EHR IMPACT interviews as the price for going back to paper or even to earlier, less comprehensive and usually not interoperable systems.

**Third parties** can be highly involved in investments in interoperable EHR and ePrescribing systems, or not affected at all. Being mainly authorities and payers, third parties bear on average 7% of the costs and reap some 5% of the benefits. The extent of impact on third parties depends primarily on the healthcare system and the scope of the EHR and ePrescribing investment. In a context where state budgets are the only allowed source of investment finance for providers, authorities face a relatively high share of costs. Payers face extra bills from previously unaccounted-for activity, but this is only the case in fee for service environments. On the positive side, reducing duplicative tests and procedures lowers the bill from providers.

② Cost and benefit timings, distribution and sustainability

A critical characteristic of successful initiatives is that in the long term, healthcare professionals, HPOs and third party stakeholders receive positive net benefits for themselves. Across the individual cases, HPOs sometimes are still on the way to realising the full value of net benefits towards the EHR IMPACT horizon to 2010. The trends, however, are constructive. Long phases of engagement, planning and design lead to net costs followed by net benefits. HPOs carry the highest net costs, but their benefits grow fastest. Chart 6 shows the aggregate positions of the four EHR IMPACT stakeholder groups across the nine sites.

Chart 6: Value of cumulative net benefits per stakeholder group\*



\*Aggregate from all nine EHR IMPACT case studies

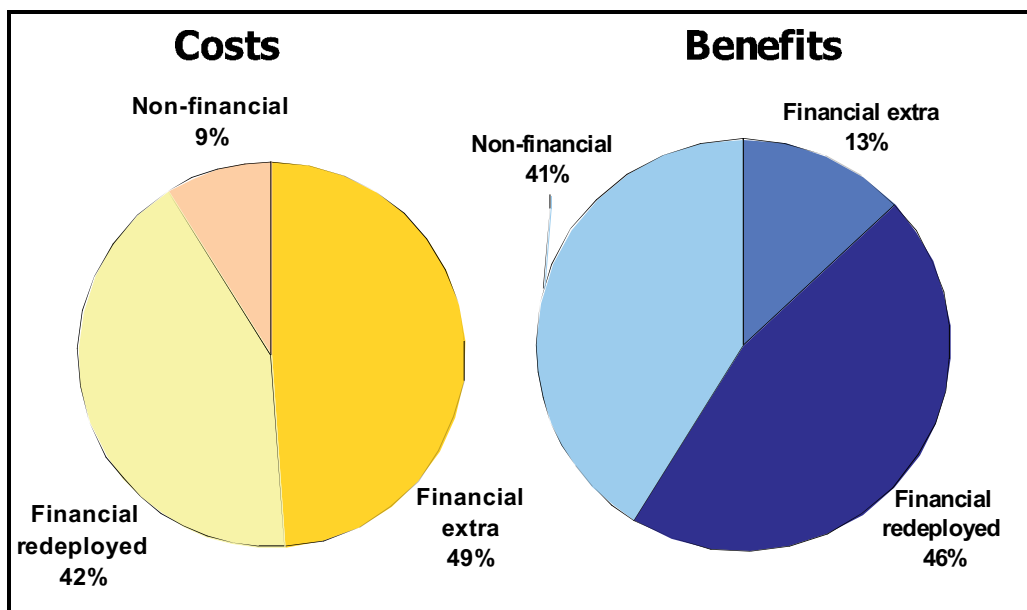
Source: EHR IMPACT study (2009)

The general shape of the curves are benchmarks and aims when deciding on, engaging, designing, implementing and using interoperable EHR and ePrescribing systems in the future.

### 3 Financial impact

Experts in the field<sup>13</sup> have identified that eHealth, and so **interoperable EHRs and ePrescribing, are not about cash benefits**. The evaluations confirm this. The financial positions of the EHR IMPACT sites are different to their SERs, as Chart 7 indicates. Only one case study, the National Heart Hospital Sofia, Bulgaria, showed a positive cumulative financial impact. This was due to its specific circumstances mainly of switching from paper-based administration and care to interoperable EHRs and its high level of stockholding at its start point.

Chart 7: Types of costs and benefits



Source: EHR IMPACT study (2009)

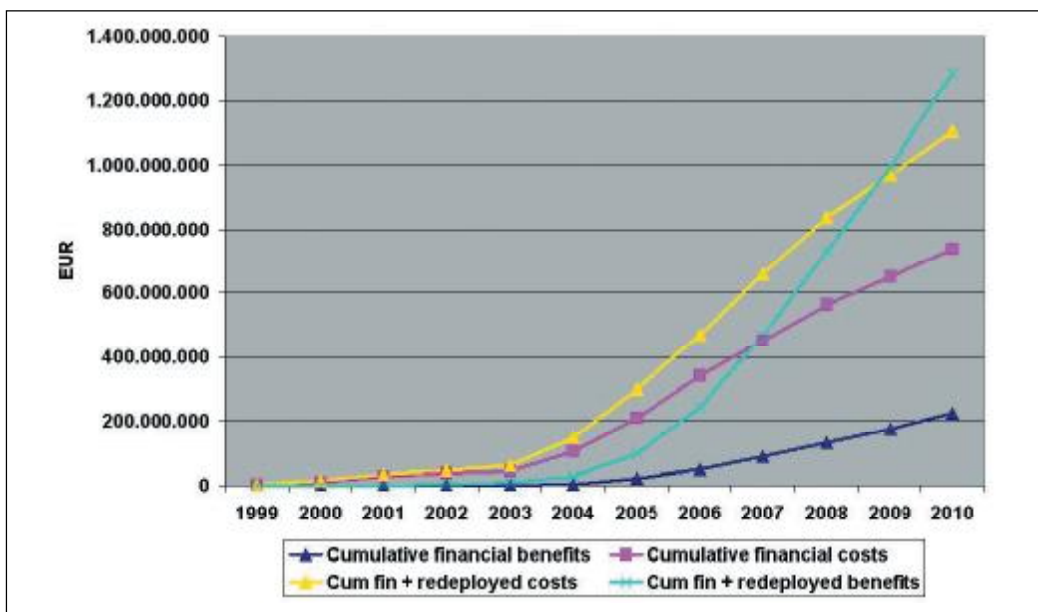
About half of the cost of interoperable EHRs and ePrescribing need extra finance over time. This generates 13% extra cash as benefits, plus improved allocation from redeployed resources of some 46%. From a financial view, the main positive impact of interoperable EHRs and ePrescribing is the opportunity to redeploy resources to improve performance and so healthcare, rather than generate extra cash. Nevertheless, the released extra finance of an average of more than €24 million is far from insignificant and reduces the size of the long-term financial requirement.




**Most cases needed additional financial investment to realise non-financial returns.** These annual financial investments never exceed 2% of the annual budgets of the main organisations, suggesting that **affordability is not the primary barrier to deployment of interoperable EHR and ePrescribing systems.**

Extra cash as benefits are from improved data capture for billing, better stock control releasing tied up money, and staff savings when regulations require certain procedures that would need additional staff without the support of ICT. In the case of the National Heart Hospital Sofia, these were an estimated 15 Full Time Equivalents (FTEs) for manual coding of clinical procedures for reimbursement and statistical reporting to public health agencies. NHHS also achieved significant reductions in its stockholdings. In Andalucía, reliance on technical support staff reduced by replacing databases in each health centre with a single, shared database for GPs. Kronoberg’s healthcare support staff budget was reduced by introducing a health information network across the whole county.

Chart 8: Illustrative financial impact based on aggregated results of nine sites



Source: EHR IMPACT study (2009)



The shape of the curves in Chart 8 provides a good overview of a commonly found position where eHealth investments require recurring financing over the long-term. Reliance on one-off financial injections was not found in the EHR IMPACT sites. **Financing limited in time does not lead to sustainable deployments of interoperable EHR and ePrescribing systems.** The financial curves illustrate the extensive reliance on executives' and managers' skill and expertise in organisational change and resource redeployment to realise the financial returns. These are layered on the changes achieved by healthcare professionals that realise the SERs.

An important part of both costs and benefits are the resources redeployed from, or to, other activities. Redeployed resources that support EHR and ePrescribing represent about 42% of the total costs. The opportunities to redeploy resources, mainly from increased efficiency, represent about 46% of benefits. Redeployed resources comprise mainly of time reallocated between activities. There is an important difference between this and time not employed at all, which can lead to savings in staff. This distinction matches the critiques and recommendations of the US Congressional Budget Office (CBO) report on costs and benefits of health information technology, which acknowledges that “[b]y itself, the adoption of more health ICT is generally not sufficient to produce significant cost savings”<sup>19</sup>.

On the cost side, **decisions to invest in EHR and ePrescribing should include the need for redeployed resources** in order not to underestimate the real cost, the total resources for the projects and the considerable challenge of investment. On the benefit side, these gains are in many small pockets and are not easy for executives and managers to redeploy between activities. This is a standard eHealth challenge for management. However, if redeployable resources are turned into productive activity, the proxy ROI can turn positive. This position is shown by the aggregate financial and redeployed cost and benefit curves in Chart 8.

In one EHR IMPACT case study, the National Heart Hospital Sofia in Bulgaria, the evaluation showed a positive net financial impact of some €3.6 million over 10 years. The evaluation revealed that the hospital leapfrogged in digitalising a number of administrative processes and gained from better stockholding, especially for drugs, as referred to earlier. Such gains have been realised in the past in other environments. At the National Heart Hospital Sofia, finance released from changing administrative processes with the support of ICT financed the clinical applications that return better quality and efficiency of healthcare services. Another example is NorthShore, which estimates incremental operational savings of some \$10m a year in excess of ICT costs.

## 5 Requirements of healthcare strategies

**Improving healthcare quality, increasing efficiency and supporting national and regional health initiatives are the predominant triggers** for EHRs and ePrescribing. The different initiatives in each EHR IMPACT case are driven by numerous and different factors that derive from each healthcare context. Therefore, scope and scale of the EHR or ePrescribing system and their potential depends on their environment.

NorthShore's interoperable EHR has its origins in the organisation's strategic plan to be the "best integrated healthcare delivery system in its region". The five-year plan was for the period 1996 to 2001, and the EHR was part of it.

The Rhône-Alpes Region team recognised that paper-based information management does not meet the needs of modern healthcare. Creating multi-disciplinary teamwork, and the failure of a previous network for oncology, made the provision of access to electronic patient data any time, from any place indispensable for high quality care.

Efficiency issues form the background of the Swedish initiative in the Kronoberg County, where paper-based information was failing to cope with the information load in healthcare. The same holds for the Italian region of Lombardy. Interoperable EHRs and ePrescribing offer solutions to create the capacity needed to meet increasing healthcare demand and healthcare activity. Lombardy faces constantly growing healthcare costs, rising from € 10 billion to € 13.7 billion a year between 1999 and 2004. In Kronoberg, integrated EHR and ePrescribing addressed the problem of an increasing number of paper records that hampered the exchange of information needed to improve patient safety. Lack of transparency and co-operation bring about inefficiency in the form of unnecessary double tests and treatments.

Some sites addressed organisational issues before they decided to implement their EHR or ePrescribing system. An example is Andalucía's initiative. It started with Diraya's predecessor, Tarjeta de Afiliado a la Seguridad Social (TASS) to meet the national Ministry of Labour and Social Security's requirement to improve the authorisation and control of absence from work due to illness. As TASS provided external communication only for sick leave notifications, it was not available to hospitals, and made it impossible to align national and regional interests on issues such as restrictions for reimbursement of some medications. The Andalucía health service decided to develop Diraya and its ePrescribing module, Receta XXI, to meet the requirements of regional health initiatives, such as waiting time guarantees and the rational use of drugs, especially generic drugs. In Scotland, the ECS improved the performance of the new arrangements for GPs contracts.





## 6 Future goals and potential

The potential of each initiative is directly affected by its background, its context, and its progress to date. **Objectives envisaged for the future are mainly to increase the number of users, extend functionalities, expand interoperability, and utilise more current system functions.** Hospital-based EHR systems put their focus on extended functionalities. Tapping the full potential of successful EHRs and ePrescribing often needs extending functionalities for ePrescribing, introducing decision support tools, facilitating both prescribing and diagnostics, and integrating computerised physician order-entry (CPOE) and picture archiving and communication system (PACS). Expanding interoperability is a critical condition to achieve these goals.

For regional initiatives, integrating healthcare services and connecting healthcare professionals is a priority. Boosting benefits by data sharing, is a common feature among all regional EHR and ePrescribing systems in the EHR IMPACT study. Andalucía and Lombardy intend to grant patients access to their EHRs, or part of them. Patients are envisaged as active participants in their healthcare and key to realising the full potential of citizen-centred care.

Secondary use of health data also plays a dominant role in future developments. Comparing public health data, and gaining more knowledge from anonymised analyses of EHRs and ePrescribing data, helps to monitor outcomes and set clinical guidelines. It fosters document standardisation and clinical practices and processes which support evidence-based medicine.

In Sofia, the HIS helped to improve compliance with existing clinical guidelines and to expand their coverage. The Kolín-Čáslav exchange network facilitated networking and co-operation between healthcare facilities. In Andalucía, the regional ePrescribing system developed the role of pharmacists, supporting their interaction with patients.

## 7 Interoperability: role and approaches

The EHR IMPACT cases show that **interoperability is a prime driver of benefits from EHR and ePrescribing systems.** Benefits rely on access to information regardless of place and time. With this finding, the EHR IMPACT study identifies strong empirical evidence in support of the EC recommendation on cross-border interoperability of electronic health record systems, which claims that the “opportunities and positive benefits of achieving interoperability are ultimately significant”<sup>4</sup>. Local, closed ICT systems lacking interoperability would not release these substantial gains. As an example, benefits in Kronoberg could have been even larger if more nursing home information systems were interoperable with the healthcare infor-

mation system COSMIC. The absence of interoperability requires more time-consuming manual data re-entry, increasing the costs and limiting the gains from EHRs and ePrescribing, so impeding the overall net benefit of the initiative.


In Andalucía, many people change residence temporarily in the summer months and many patients change their family carers frequently. The first solution, TASS, operated within each health centre, and the inability to share data could hamper timely and effective healthcare for these mobile patients. With Diraya and Receta XXI's interoperability and shared database, seamless data sharing and availability across the region are routine. Interoperability with pharmacists in Andalucía allows them access to prescriptions and the possibility to cancel prescriptions that need reviewing by GPs, improving patient safety. Interoperability to local administration, stock control, and billing systems improves efficiency at pharmacies.

In Rhône-Alpes, interoperability allows for multi-disciplinary teamwork. It started for cancer care, and is being extended to other healthcare sectors.

**The importance of interoperability is commonly recognised, but achieving it relies on different approaches.** The regional EHR and ePrescribing systems in Kronoberg and Andalucía and the hospital-focused sites in Sofia and Kolín-Časlav are single, integrated systems. Data is stored centrally, regardless of the place of entry. This facilitates integration, connection, and sharing of information, compared to the use of different local ICT systems. The main system interfaces to a limited set of external systems in order to enable data exchange with supporting applications. This approach is more realistic in a model of healthcare provision and management with central policy and decision-making bodies that engage with key stakeholders to select single solutions for all users.

Networks and integration platforms allow for a variety of different systems to be interoperable under a common umbrella. Scotland, Rhône-Alpes, Lombardy, Geneva, and Israel have opted for this approach. In these cases, interoperability is in a multi-system environment. Here, issues such as the quality of data provided, the possibility to integrate with the different systems, both from a technical and organisational perspective, are core. Even though organisational issues hamper cross-system integration and interoperability, developing comprehensive, region-wide health information networks sets the technical context in which stakeholders' issues and requirements are addressed. Lombardy facilitated the technical development for providing high quality data by offering a variety of products directly, and certifying vendors from which hospitals and GPs can choose.





Among the EHR and ePrescribing case studies, **there is a trend towards virtual EHRs**. In Geneva, HUG has excelled through its implementation of a service-oriented architecture. The EHR is displayed on request by using data from the supporting systems. The virtual EHR disappears after use, leaving a record of access. Similar facilities are used in Israel. In Kronoberg, the volume of medical information created by integrating several healthcare services creates a risk of information overload. User-based log-in sessions determine each user's interface and data are processed in a way that allows prompt identification of vital information to avoid log jams.

Interoperable EHRs, whether as actual files or as virtual files in a network of data stored in several databases, are foundations of health information systems and support to other systems, such as ePrescribing and eBooking. **Without interoperability between EHRs and other clinical and non-clinical systems, neither could realise their full potential.** Examples are Sofia and Kronoberg, where healthcare professionals switch constantly between their appointments agenda and the clinical records of the patients. In Andalucia and Geneva, patients' medication records are integral parts of their EHRs, allowing automatic medication data availability from the time of prescribing. This facilitates several decision support features on contraindications and other risks, including negative interferences of medications with patients' health parameters.

## ⑧ Performance, utilisation, and implementation strategies

Utilisation of EHRs and ePrescribing largely drives benefits and net benefits, and the main contributors to utilisation include engagement, requirements meeting real, concrete needs, matching functionalities, ease of use, and direct benefits for users. The logical causality of using systems being a requirement for their positive, or in fact any, impact, is confirmed by high correlations between utilisation and the value of socio-economic impact. **Achieving high levels of utilisation during the implementation and operational phases is essential to achieve positive performance.**

### ① Correlations of utilisation and impact

Utilisation is the number of times records are accessed, or prescriptions made and dispensed, depending on the case. Utilisation and benefits show a positive correlation. The average correlation of utilisation to benefits for the EHR IMPACT case studies is +0.98. Utilisation and net benefits correlation is +0.91. This confirms the expectation that **unused information systems cannot bring any gains, but can create some costs.**

The relationship between utilisation and performance confirms a cliché appeal of ICT vendors about functionality, usability and usefulness of their systems. Vendors alone cannot take responsibility for these. **Each environment implementing an information system is different, has different start points, different requirements, different priorities for interoperability, and needs different functionalities and nuances. The only people who can help identify the requirements and modifications needed to an ICT system are the users themselves.**

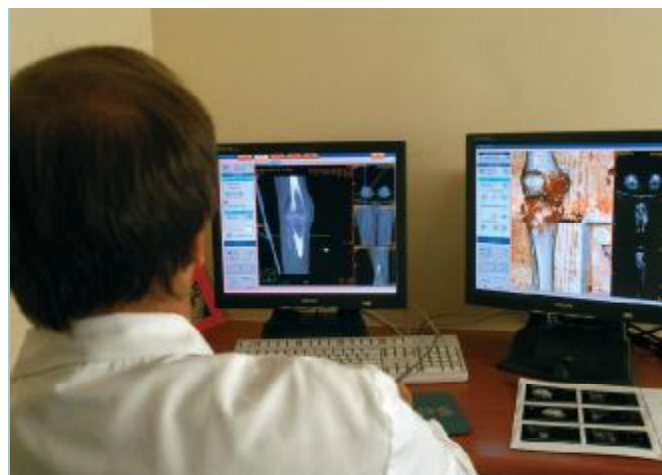
### ② Successful approaches to engagement, user buy-in and change

All EHR IMPACT case studies match a finding of the *Financing eHealth* study<sup>20</sup> fully: engagement from the outset is essential. "Engagement is working with users and stakeholders so they can participate in the

design, development, requirements and constraints of eHealth.” This can, and should, be a large-scale activity to ensure that the outcome fits the working requirements and environment of all users. In Kronoberg, 460 healthcare and ICT professionals in 51 implementation teams are responsible for the right configuration of the ICT systems. Andalucía included some 500 healthcare professionals in the review of specifications for the primary care EHR system. The support team during transitions included up to another 150 people. These resources are substantial, and need planning from the outset. Where a top-down approach to adaptation was chosen, at the National Heart Hospital Sofia in Bulgaria and in the hospitals Kolín and Čáslav in the Czech Republic, the design and development of the ICT tools were driven by groups of users. **Continuous engagement is essential for success.**



**“Dealing with positions, propositions, concerns and requirements distinguishes engagement from consultation.** Executives and managers can ignore advice and views provided through consultation. In engagement, dealing with advice and views is essential in order to gain subsequent commitment to changes in clinical and working practices that realise the benefits from eHealth.”<sup>20</sup> Effective engagement also enables users to adapt to changes at their own pace, with the ICT following suit. Good examples are HUG, the Scottish Emergency Care Summary, the health information network in Rhône-Alpes SISRA, as well as the EHR system in Kronoberg. In all these cases, the first steps of introducing ICT involved only moderate changes, such as replacing paper with digital alternatives of the same forms and documents. In Rhône-Alpes, some connected hospitals that do not have local ICT for clinical records, still participate at that level. The move towards more complex and more beneficial ICT follows the pace of readiness to change working and clinical processes.



In Geneva and Andalucía, people’s previous familiarity with computerised applications enabled a faster pace of development and user acceptance. The continuous expansion, starting with Diogenes in HUG, and



with TASS in Andalucía, enabled experience, learning and knowledge to accumulate over time, improving the skills and capabilities of the human resource so that it succeeds with complex solutions. The process was also supported with a relatively stable workforce so that the learning remained in the organisations.

All the cases included initiatives that changed clinical and working practices. Most of these were relatively modest, but scale up to realise high-value benefits. Changes were led by healthcare professionals working closely with informatics, ICT, and information teams. They adopted models that are broadly consistent with a recent report from the UK parliament, which claims that “leaders need to be role models, setting a positive example, and lending their full support to others”<sup>21</sup>.



# 4 Strategic recommendations for interoperable EHR and ePrescribing initiatives

The results of the EHR IMPACT study give grounds for optimism in the success, value and deployment of interoperable EHR and ePrescribing systems across Europe. The synthesis analysis and the individual case study reports contribute to the pool of evidence on the socio-economic impact and the supporting financial profiles and requirements, and provide insights on challenges and opportunities of investing in such changes. This new knowledge yields a set of recommendations, encouragements, and warnings for decision-makers and initiators who are starting now with EHRs and ePrescribing. Usually HPOs drive the investment and have to manage the costs and the realisation of benefits to themselves and other stakeholders. Before HPO managers and leaders can succeed, regional, national, and EU-level policy makers have to create a constructive environment.


## 1 Framework and context: a call on policymakers

The scope and scale of EHR and ePrescribing systems and their potential depends on their environment. **Policies have to create the right climate and incentives for HPOs to pursue the required investments.** Improving the quality of care, increasing the efficiency of healthcare and complying with regional health initiatives are the predominant triggers. Targeting expenditure cuts is counterproductive. Policy makers also have the responsibility to identify and remove potential regulatory and other system barriers. A specific example is that the healthcare system must allow for the prime investor, as well as for all other affected actors, to reap gains that cover their costs in value, if not always financially.

**The second plea to policy makers is to allow investors, project teams and stakeholders enough time to achieve net returns.** HPOs should create strategies and plans that look far enough ahead to include the changes needed to realise the benefits. It usually extends beyond the timescales needed for the initial investments and includes the measures that HPOs will adopt to achieve successful engagement with stakeholders and the changes needed to develop clinical and working practices that are supported by interoperable EHRs and ePrescribing. Where policy makers are unable to do this, they will increase the risks for HPOs.

## 2 Completion? A never-ending story

HPOs' strategies and plans for EHRs and ePrescribing should have realistic timescales. Adjusting ICT to the organisational setting and the organisation to the ICT-enabled processes and practices is anything but trivial and requires its own pace. Those who have gone through such projects and indulge in retrospection, such as the EHR IMPACT case study site teams, know that very clearly. Those about to start can learn from these experiences and so can know it too.



**Achieving strategic goals needs a consistent, continuous investment in people as well as technology over a long time.** Whilst the case studies have implemented proven solutions and achieved strategic benefits up to 2010, their interoperable EHRs and ePrescribing continue to expand in scope and functionality beyond this period as part of an eHealth dynamic for sustainable investment in improvements to healthcare for all stakeholders. **New projects should refrain from setting a firm end point to their investments and development,** but ensure that financial support is sustainable into the long term and that projects are affordable within the finance available throughout this period.

### ③ They did it their way: you have to do it yours

The evaluations revealed that each case study developed and applied their own approaches to achieving interoperable EHRs and ePrescribing. Some began in primary healthcare and extended into hospital services. Others developed in the opposite direction. Some achieved interoperability as part of a large scale, integrated solution. Others adopted a more modest set of interoperable building blocks. These different approaches resulted in successful socio-economic performance over time. It seems that **there is no single, theoretically right strategy for interoperable EHRs and ePrescribing.** Future EHR and ePrescribing systems should devise and adopt strategies that fit their own setting and are designed to succeed.

This is reinforced by a recent study<sup>22</sup> in Norway that has commissioned two digital hospitals. Successful integrated hospital networks in new facilities in Olav's Hospital in Trondheim and Ahus Hospital in Oslo replaced old facilities with digital hospitals. They used different methods to implement the digital hospital vision, and there was no single solution, no single starting point, and no definite endpoint.

**Transferability of some technology and tools to other contexts is more viable than transferring specific functionalities and organisational features** of EHRs and ePrescribing. There is some convergence of the requirements, functionalities and usability of EHRs and ePrescribing between different healthcare systems at the points of care between patients and healthcare professionals. However, **the specific roles and priorities of healthcare professionals and HPOs differ between healthcare systems, limiting transferability of success stories mainly to principles, tools and techniques rather than specific EHR and ePrescribing systems.**

**The most transferable features are the experiences, capabilities and requirements for success.** Decision-makers from other regions, countries, or organisations can benefit from the lessons of each site. They can use these lessons to design the organisational changes, functional requirements, and the appropriate technology architecture that fits their setting.

### ④ The right strategic goals: better healthcare, not cash

EHRs and ePrescribing bring about considerable strategic gains for healthcare and should be approached in this way, not as an ICT project. Using EHRs and ePrescribing as part of successful change in clinical

and working practices is an essential component of improving healthcare delivery and performance. This is a core strategic goal for investments.

By taking the socio-economic perspective, initiatives can achieve an SER, or ratio of net benefits to cost, of close to 200% on their total investment, and **an average of nearly 80% over some nine years. These represent good returns from a wide range of benefits, but must be seen as longer-term investment to support a longer-term strategy.**

Financial gains can be up to 60% of the total returns, with an average of some 13%. Financial outlay can be between 20% and 85% of the total cost of investment, and an average of about 50%. Other costs are redeployed from existing resources. The match of extra cash for the initiative and extra cash generated is usually a negative bottom line, with exceptions proving the rule. When opportunities to redeploy resources liberated by efficiency gains are included, the financial gains increase to about 60% of total benefits, exceeding the extra cash invested. Some administrative systems can deliver actual financial gains, but clinical systems, including EHR and ePrescribing applications, support healthcare quality and efficiency.

The precise value of strategic gains for future projects depend on the performance of the healthcare system before interoperable EHRs and ePrescribing and the scope and functionality of the new interoperable information.

### 5 Not to miss: interoperability and engagement

The EHR IMPACT study identified two not to miss opportunities for all EHR and ePrescribing systems. One is to **organise engagement and a productive dialogue between users and ICT experts**. All EHR IMPACT cases invested in engagement with key stakeholders, usually healthcare professionals, before designing and developing solutions. The nature and timescale of the engagement depended on the context and scope of the EHR IMPACT solution, but preceded spending large sums of money on actual solutions. Continuous engagement with healthcare professionals from the outset is essential and time-consuming, but cannot be avoided. If it is, it has bigger costs downstream.

The other opportunity is to **use interoperability is a prime driver of benefits**. It makes life easier for users and provides gains that rely on access to information regardless of place and time, and from re-using information for multiple purposes. Without the meaningful sharing and exchange of information, the gains would be marginal and probably not justify the cost of investments.

These two not to miss items are also integrated. Engagement provides one of the contexts for setting priorities, requirements and benefits for interoperability.



# 5

## The EHR IMPACT case studies

### 1 Emergency Care Summary of NHS Scotland, UK

Scotland's Emergency Care Summary (ECS) provides up to date information about allergies and GP prescribed medications for authorised health-care professionals at the Scottish national health call centre NHS24, Out of Hours (OOH) services, and accident and emergency (A&E) departments. Other services have already expressed their wish to receive access to the ECS to improve their contribution and patient safety. Ambulance services are next to gain access, with other user groups considered for the future.

The ECS project discussions and consultations started in 2002 and initial pilots were launched in 2004. Implementation into routine use followed incrementally across Scotland. OOH services were the first users, with NHS24 and A&E departments joining in 2006. Full rollout was completed in 2007. NHS24 is the biggest user, with about 70% of all ECS accesses. Some 1,000 GP practices contribute records to ECS, more than 98% of the total, and it is used by health-care professionals in all 14 Health Boards across Scotland.

The ECS does not create or capture new information about patients. It copies items of data that already exist in the four different EPR systems used by GP practices and makes the information available to users who need it as 'read only'. Updating this twice a day every day relies on interoperability between the four EPR system types holding source data in GP practices and a central store with access by NHS24, OOH and A&E departments in hospitals throughout Scotland.

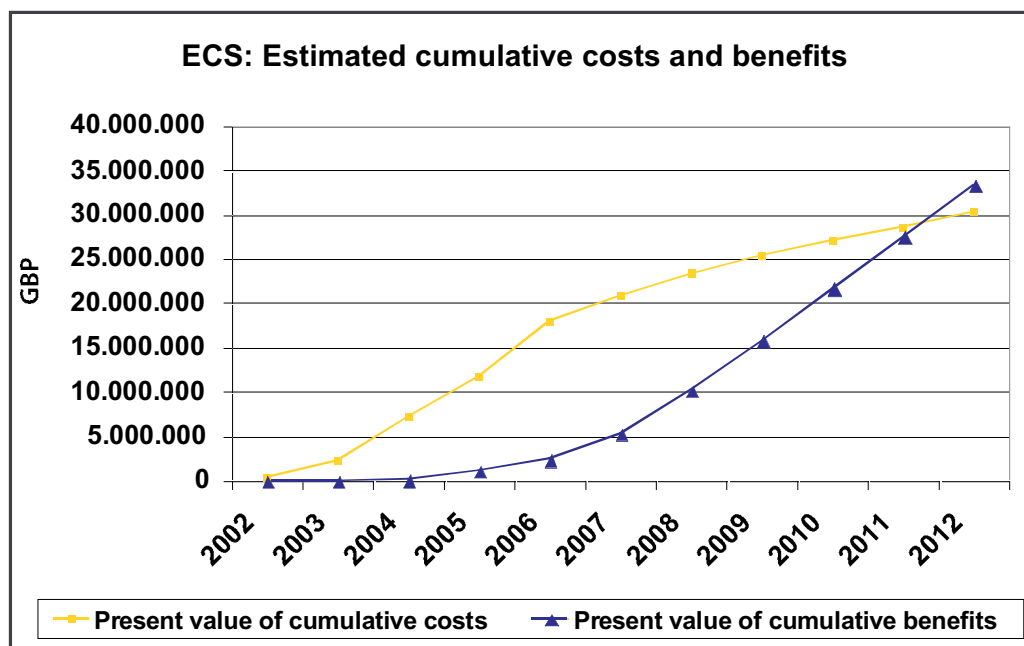
In 2008, over 1,000 GP practices, or 98% of all, participate fully in ECS. More than 5 million peo-

#### ECS: Socio-economic analysis results

<b>Time to net benefits</b>	
First year of positive annual net benefits	6
First year of positive cumulative net benefits	11
<b>Socio-economic return: net benefit to cost ratio</b>	
Annual return 2010	260%
Cumulative return 2010	-20%
Cumulative return 2012	10%
<b>Distribution of costs</b>	
Citizens	
Doctors, nurses, other staff	45%
Health provider organisations	50%
3rd parties	5%
<b>Distribution of benefits</b>	
Citizens	37%
Doctors, nurses, other staff	25%
Health provider organisations	39%
3rd parties	0%
<b>Types of costs</b>	
Financial extra	21%
Financial redeployed	79%
Non-financial	0%
<b>Types of benefits</b>	
Financial extra	0%
Financial redeployed	23%
Non-financial	77%
<b>Correlations</b>	
Utilisation to benefit	+0.99
Utilisation to net benefit	+0.97
<b>ICT and organisational costs, cumulative</b>	
ICT costs as share of total costs	14%
Organisational costs as share of total costs	86%
ICT as share of all health provider organisation costs	26%

Source: EHR IMPACT study (2009)

ple, 99% of the population in Scotland have an ECS record. Total utilisation by healthcare professionals in all 14 health boards across Scotland in 2008 was about 121,000 accesses a month.



Source: EHR IMPACT study (2009)

### ► Core impact

- Patients benefit from higher patient safety through a reduced risk of medication errors.
- GPs benefit as they can opt out of OOH services with reduced concerns about their patients' continuing care.
- Clinicians at NHS24 and OOH services benefit as they have access to valid, current and reliable patient information from GP practices.
- GP practices benefit by better integration in a healthcare chain that enables services for patients to continue in OOH, NHS24 and A&E with minimal disruption to practice workflow.
- Health boards see improved quality of healthcare, reduced risk exposure and time savings accumulate to an overall improved performance.
- Typical eHealth costs include engagement, design, implementation, project management, procurement, training and change as part of the ECS investment.

- The Scottish Executive Health Department, as third party, incurred the cost of the national leaflet and local communication campaigns.
- The EHR IMPACT analyses show that extra cash of some £5.5 million was invested over nine years to realise non-financial benefits and redeployed finance of over £21.6 million.

### ► Case features

The ECS case illustrates two themes exceptionally clearly. First, the focus in planning, development, and implementation of the ECS was on delivering benefits, not ICT systems. Part of this was defining the benefits appropriately as quality, risk reduction, and efficiency, not cash.

Second, the engagement and roll-out approaches allowed over ten years of sustained investment before net benefits are realised. No attempts were made to short-cut engagement. It was recognised that such short-cuts could lead to disruptions and increased investment with even longer timescales to net benefit.

### ► Lessons learnt

- Effective engagement with all stakeholders before design is complete and implementation begins ensures user buy-in.
- Implied consent with an opt-out option for storage, and explicit consent to access patient data can be an effective and efficient solution.
- Step-by-step progress may take longer, but is more effective in realising a net benefit and in managing risk.
- Interoperability should be as simple as possible in order to make it work.

## 2 Computerised Patient Record Systems at the University Hospitals of the Canton of Geneva, Switzerland

### HUG: Socio-economic analysis results

<b>Time to net benefits</b>	
First year of positive annual net benefits	7
First year of positive cumulative net benefits	10
<b>Socio-economic return: net benefit to cost ratio</b>	
Annual return 2010	179%
Cumulative return 2010	65%
<b>Distribution of costs</b>	
Citizens	0%
Doctors, nurses, other staff	0%
Health provider organisations	59%
3rd parties	40%
<b>Distribution of benefits</b>	
Citizens	3%
Doctors, nurses, other staff	5%
Health provider organisations	91%
3rd parties	1%
<b>Types of costs</b>	
Financial extra	83%
Financial redeployed	17%
Non-financial	0%
<b>Types of benefits</b>	
Financial extra	3%
Financial redeployed	82%
Non-financial	15%
<b>Correlations</b>	
Utilisation to benefit	+0.99
Utilisation to net benefit	+0.97
<b>ICT and organisational costs, cumulative</b>	
ICT costs as share of total costs	68%
Organisational costs as share of total costs	32%
ICT as share of all health provider organisation costs	68%

Source: EHR IMPACT study (2009)

Organised as a consortium of hospitals, HUG is the major public healthcare facility in the Geneva region and adjacent France. Offering a complementary service portfolio, HUG covers the whole spectrum of outpatients, and secondary and tertiary inpatients care, including long-term rehabilitation and psychiatry. With an annual budget of CHF 1.4 billion, HUG manages over 48,000 admissions and 800,000 outpatient visits each year, with more than 2,000 beds, over 7,000 care professionals and 10,000 employees.

Building on more than 30 years of experience, the current Computerised Patient Record (CPR) systems integrate clinical and non-clinical processes into a patient-centred care service. It covers CPOE for all orders including laboratory tests, drugs, radiology, and care; unified clinical documentation; administrative information; access management; imaging; and pathology information. Each real-time query of all relevant databases in the system creates a CPR, so it is entirely interoperable.

Planning started in 1998. The system was developed and implemented gradually from 2000, allowing sufficient time for effective user involvement and individualisation to meet the specific needs of different departments. Supported by an infrastructure covering over 7,000 computers, the CPR has reached a high usage level among care providers across HUG, with over 25,000 records per day accessed in 2007.

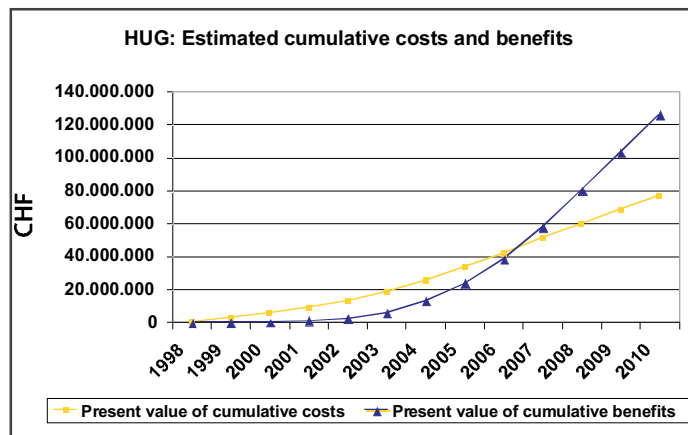
The strong, sustainable positive impact was preceded by a relatively slow build-up of benefits in the first three to four years, which is consistent with the approach towards ensuring acceptance before changing working practices. The gradual build-up helped to reduce risk of rejection and failure.

### ► Core impact

- Patients benefit from increased patient safety, time savings through avoided unnecessary admissions, better care due to enhanced continuity of care, improved drug interaction control, and better informed clinical decisions.



- Healthcare professionals benefit from better employed time, better work satisfaction because of the improved availability of information in real time, and lower exposure to risks.
- The largest share both in costs and benefits accrues to the hospitals. Primary gains are time savings, cost avoidance in providing better quality care, and capturing more services for billing. Negative impact to HUG includes the extra time and cognitive effort to use the CPR system, temporary disruptions in the implementation stage, in which processes take more time rather than less, as well as extra time for ward rounds and forgone income for unnecessary procedures.
- As third parties, health insurances enjoy a small benefit from avoided costs of admissions, yet face a higher bill because of better data capture for billing at HUG.
- The financial analysis shows that extra cash of more than CHF 63 million invested over thirteen years realised CHF 4.3 million of financial benefits. However, the investment has already been worthwhile from the socio-economic perspective. A cumulative benefit worth some CHF 125 million more than justifies the investment.



Source: EHR IMPACT study (2009)

► Case features

The Geneva canton plays an important role in the CPR investment at HUG. Regulations on large scale public investments lead to a financial contribution by the canton of about a third of the costs. The benefit to the political level, however, is only indirect in the form of improved quality of healthcare services to its citizens. This matches the social responsibility carried by politicians and is an example for recognising the need for direct financial investments for less tangible, yet highly valuable benefits to society.

► Lessons learnt

- Investors need deep pockets and a lot of patience. Up to ten years and 63 million CHF total economic costs for the CPR systems at HUG needed financing to realise the net benefits.
- Investors need to know what they get. The benefits are mainly in quality of care and potential liberation of scattered resources, and relatively small amounts of extra cash.
- Investors need to know what can go wrong. Realistic risk management is essential for the realisation of net benefits. At HUG, major risks were associated with technology failure and user acceptance. The identification of risks is the first step towards their mitigation, but is not sufficient.

### 3 Hospital Information System at the National Heart Hospital Sofia, Bulgaria

#### NHHS: Socio-economic analysis results

<b>Time to net benefits</b>	
First year of positive annual net benefits	5
First year of positive cumulative net benefits	6
<b>Socio-economic return: net benefit to cost ratio</b>	
Annual return 2010	550%
Cumulative return 2010	192%
<b>Distribution of costs</b>	
Citizens	0%
Doctors, nurses, other staff	9%
Health provider organisations	81%
3rd parties	10%
<b>Distribution of benefits</b>	
Citizens	2%
Doctors, nurses, other staff	4%
Health provider organisations	94%
3rd parties	0%
<b>Types of costs</b>	
Financial extra	45%
Financial redeployed	37%
Non-financial	19%
<b>Types of benefits</b>	
Financial extra	58%
Financial redeployed	36%
Non-financial	6%
<b>Correlations</b>	
Utilisation to benefit	+0.98
Utilisation to net benefit	+0.96
<b>ICT and organisational costs, cumulative</b>	
ICT costs as share of total costs	40%
Organisational costs as share of total costs	60%
ICT as share of all health provider organisation costs	50%

Source: EHR IMPACT study (2009)

The National Heart Hospital Sofia (NHHS) is the biggest hospital specialising in cardiology and paediatric cardiac surgery in Bulgaria. It is a tertiary care facility providing all necessary services for cardio-vascular diseases and neurology for children and adults, including inpatient and outpatient care. NHHS' rehabilitation unit is at a separate site in Bankia, some 25 km from Sofia. The state-owned hospital has some 320 beds and employs about 900 employees who served approximately 48,000 inpatients and 15,000 outpatients in 2007.

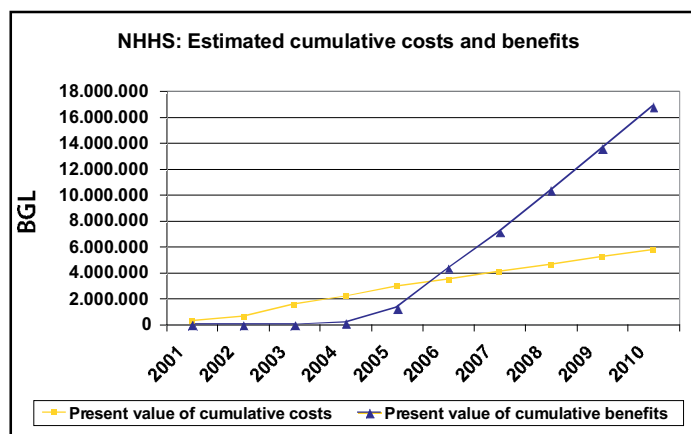
The hospital-wide information system (HIS) project started in 2001. Implementation of the outpatient modules was in 2003, followed by inpatients in 2004. The HIS helps healthcare teams in their work along entire patient journeys. The backbone of the system is the electronic patient record (EPR) which facilitates patient-centred care services. The EPR comprises information on health status, chronology of diagnosis, therapy at the hospital, examinations and diagnostic tests and results, and alert information, such as allergies. The system also supports diagnosis and procedure coding, stock management, billing and the calculation of patient's healthcare costs. Each of these connects to the EPR. Increasing steadily, the number of accesses to HIS records has reached over 30,000 a year.

#### ► Core impact

- Patients benefit from the improved timeliness and quality of care, including reduced risk of errors.
- Healthcare professionals mostly benefit by being better informed, investing their time in activities more closely related to their job, and better work satisfaction.
- The lion's share of costs and benefits accrues to NHHS, with about 81% and 94%, respectively. Efficiency gains include improved productivity for coping with increased demand, avoided labour costs, and reduced operating costs.
- Negative effects include temporary irritation to staff during the phase of change and increased time requirements for some

procedures due to regulations requiring duplication of recording practices.

- Large reductions in stock holdings, especially drugs, achieved shortly after implementation, were a significant non-recurring financial benefit.
- The annual net socio-economic benefit from the system is stable. It will continue to improve the cumulative position. The socio-economic return, albeit not purely financial, from the HIS and NHHS is estimated at about 190% over a life-cycle of 10 years. Even more potential, however, lies in the immediate and planned future developments of the system that are already underway.



Source: EHR IMPACT study (2009)

► Case features

An unusual feature of NHHS is the realised positive overall net financial benefit. Unlike most comparable sites, the financial classification of benefits shows that 58% of the benefit, over BGL 9.7 million, is extra released finance. This is compared to 45%, or just over BGL 2.5 million, of extra financial costs related to the investment. This means a net financial return from a social planner’s point of view of BGL 7.2 million over a period of 10 years. The hospital’s relative modest starting position for the investment and a rare example of bundling administrative and clinical information system investments explains this. The NHHS case shows how the combination of systems for clinical and supportive processes can lead not only to a positive socio-economic impact, but also to a net financial return.

A secondary effect from the introduction of HIS at NHHS was an increase in general computer literacy, which led to a noticeable increase in private PC purchases and use among hospital staff.

Another uncommon finding is the lack of fewer laboratory tests. This is a consequence of the reimbursement system, which requires a set of diagnostic and treatment procedures to be performed for a given clinical pathway. The health insurance agency rejects bills where tests are omitted even if this is reasonable clinically.

► Lessons learnt

- It is critical to see the eHealth investment imbedded in the overall development strategy of the hospital, not an add-on project for pioneers.
- Effective engagement of healthcare professionals in the development process ensures usability and usefulness of the system.
- An implementation approach of gradual extension of the system in scope and scale and continuous, interactive training can create an information culture in which users ask for more.
- Bundling investment in clinical and non-clinical applications can release finance from within the organisation and provide some finance for new clinical systems. This requires the integration of different systems into a comprehensive, EPR-centred HIS and securing inter-system interoperability.

### 3 Regional EHR and ePrescribing system Diraya in Andalucía, Spain

#### Diraya: Socio-economic analysis results

<b>Time to net benefits</b>	
First year of positive annual net benefits	8
First year of positive cumulative net benefits	9
<b>Socio-economic return: net benefit to cost ratio</b>	
Annual return 2010	959%
Cumulative return 2010	177%
<b>Distribution of costs</b>	
Citizens	0%
Doctors, nurses, other staff	7%
Health provider organisations	93%
3rd parties	0%
<b>Distribution of benefits</b>	
Citizens	28%
Doctors, nurses, other staff	17%
Health provider organisations	51%
3rd parties	4%
<b>Types of costs</b>	
Financial extra	61%
Financial redeployed	32%
Non-financial	7%
<b>Types of benefits</b>	
Financial extra	18%
Financial redeployed	42%
Non-financial	40%
<b>Correlations</b>	
Utilisation to benefit	+0.99
Utilisation to net benefit	+0.97
<b>ICT and organisational costs, cumulative</b>	
ICT costs as share of total costs	51%
Organisational costs as share of total costs	49%
ICT as share of all health provider organisation costs	55%

Source: EHR IMPACT study (2009)

Diraya is the regional health information system for primary, out-patient specialised, and emergency care across the Autonomous Community of Andalucía in Spain. It is a patient EHR and ePrescribing system, which combines and holds information about patients' chronic diseases, allergies, diagnostic and test histories, therapeutic data, consultations, visits to hospital outpatient specialised care and emergency services, medications prescribed and dispensed.

The Andalusian Health Service (SAS) is responsible for public health-care in the region and designed and implemented Diraya. SAS has 1,500 primary healthcare centres (PHC) and 28 hospitals. About 94% of all primary healthcare professionals use Diraya and 17% of consultations in specialised care as well as 75% of A&E episodes rely on it. There are nearly 3,600 private pharmacies connected to Receta XXI, Diraya's ePrescribing module.

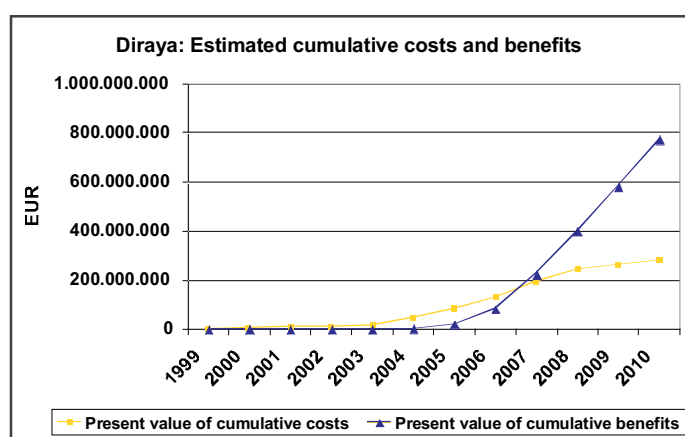
More than 8 million people live in Andalucía, representing about 18% of the Spanish population. Citizens receive a unique health record number (NUHSA) on their first contact with SAS. In 2009, there were more than 6.8 million EHRs containing clinical as well as administrative data.

Diraya supports the regional government's strategy for health, and integrates with other strategic initiatives. These include minimum waiting times guarantees, extending the period of prescriptions to up to one year, rational use of drugs, and converting research into practice by disseminating evidence-based medicine through decision support tools. The resulting improvements in quality and efficiency of care create opportunities to redeploy existing resources to meet increasing demand.

Development of Diraya began in 2000. It replaced TASS, the local health information system previously used in PHCs. Many PHCs received the first release of Diraya in 2003 with a mixed architecture of data stored in central and local databases. The centralised version was available from 2004 and replaced the local databases, increasing the scope to share data. In 2006, Diraya expanded to emergency and outpatient specialised care in hospitals. Receta XXI was introduced in primary care in 2003.

## ► Core impact

- Patients, carers and citizens benefit from enhanced continuity of care across the region, reducing the risk of missing or overlooked information. This is especially beneficial for the many relocating patients in Andalucía who experience improved timeliness of care by avoiding unnecessary reassessments.
- Healthcare teams recognise the negative impact of shifting some of their direct attention during consultation from patients to their information on Diraya's screens, but the overall response is positive. Many healthcare professionals say it is unimaginable working without Diraya. Better continuity of care and improved provision are highly valued, with a strong feeling of pride, professionalism and satisfaction.
- HPOs experience selective reduction in productivity, such as from increase in administrative work leading to a 25% increase in time per PHC consultation.
- The number of GP visits for patients who have their first prescription using Receta XXI for an episode of care is more than 15% lower.
- Generic prescribing triggers sustained cumulative cash savings of some € 37 million.
- Non-attendances in outpatient specialised care has dropped by 10%.
- Healthcare protocols and standards apply quickly throughout the region.
- Health professionals are more efficient along all healthcare services.
- ICT support cost reduced by replacing many local databases with a centralised database.
- Appointments with Salud Responde, the regional call centre, became more efficient.
- An investment of extra finance of some €170 million in the seven years from 2004 stands against some €135 million of released cash, and around €635 million of non-financial benefits and redeployed sources.



Source: EHR IMPACT study (2009)

## ► Case features

The comparatively long period to realisation of annual net benefits reflects the time needed for engagement, planning and development. The scope and complexity of connecting the healthcare services of a region of the size of Andalucía required this elapsed time. During the period, the SAS team successfully seized opportunities emerging from changing regulations and political initiatives. An important part of the process was identifying and addressing specific needs in the short term, which led to short-term achievements, without losing the connection to the wider concepts and visions.



### ► Lessons learnt

- A good practice is to integrate projects needed for each module into a single project that delivers interoperable clinical and health information. The project lifecycle must be long enough so there is enough time to engage stakeholders and to adapt the system to their different needs.
- EHR and ePrescribing development should support the health strategy, such as contributing to continuity of care, consistent healthcare provision, meeting increasing demand, introducing generic prescribing, and improving quality of care.
- Benefits accrue from integrating clinical and health information across several healthcare services and providing healthcare professionals with the tools to increase the scope of the gains and mitigate the risk of the project's failure.
- Benefits must be realised in a timeframe in which healthcare professionals can succeed and performance becomes sustainable. Overhasty implementation must be avoided and different modules should be implemented gradually after rigorous testing.

### 5 Regional ePrescribing system Receta XXI in Andalucía, Spain

The Andalusian ePrescribing system, Receta XXI, is a module of Diraya, the region’s EHR and general health information system. Receta XXI was developed by SAS, the Andalusian Health Service, which is responsible for public healthcare in Andalucía. SAS has 1,500 PHCs and 28 hospitals. The vast majority of the nearly 3,600 community pharmacies use Receta XXI.

Receta XXI facilitates prescribing, dispensing, control of drugs and, through its connection with Diraya, supports the compilation of medical histories in patients’ EHRs. Since 2004, it has enabled sharing of patients’ medication information between doctors in primary care and doctors in hospital specialised outpatient and emergency care. Integrated prescribing decision support (DSS) tools enable the application of regional standards and facilitate prescribing practices and procedures.

Pharmacies use Receta XXI to access centrally stored electronic prescriptions directly, and share information on patients’ current and long-term medications with doctors. GPs can prescribe for periods of up to one year, and pharmacists’ can cancel prescriptions and send them back to the relevant GP for revision.

Receta XXI’s functionalities are available for all physicians who have access to Diraya. In November 2008, 46% of all prescriptions used Receta XXI, with more than 1.9 million patients benefiting from ePrescriptions.

Functionalities such as printing prescriptions and electronically storing medication data locally were already part of TASS, Diraya’s predecessor. TASS was a local health information system for each PHC, and operational from 1999 until its ePrescribing functionality was replaced by Receta XXI in 2004.

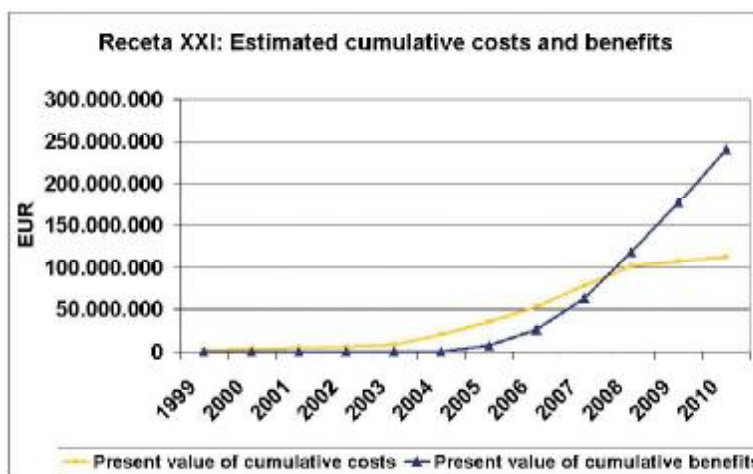
**Receta XXI: Socio-economic analysis results**

<b>Time to net benefits</b>	
First year of positive annual net benefits	8
First year of positive cumulative net benefits	10
<b>Socio-economic return: net benefit to cost ratio</b>	
Annual return 2010	995%
Cumulative return 2010	112%
<b>Distribution of costs</b>	
Citizens	0%
Doctors, nurses, other staff	9%
Health provider organisations	91%
3rd parties	0%
<b>Distribution of benefits</b>	
Citizens	23%
Doctors, nurses, other staff	16%
Health provider organisations	59%
3rd parties	3%
<b>Types of costs</b>	
Financial extra	55%
Financial redeployed	36%
Non-financial	9%
<b>Types of benefits</b>	
Financial extra	19%
Financial redeployed	49%
Non-financial	31%
<b>Correlations</b>	
Utilisation to benefit	+0.99
Utilisation to net benefit	+0.97
<b>ICT and organisational costs, cumulative</b>	
ICT costs as share of total costs	55%
Organisational costs as share of total costs	45%
ICT as share of all health provider organisation costs	60%

Source: EHR IMPACT study (2009)

### ► Core impact

- Patients, carers and citizens benefit significantly from increased patient safety from prescribing decision support tools, sharing medication data between doctors and reviews by pharmacists.
- Health service teams value Receta XXI's positive impact on their provision of healthcare as they have the information they need for making well-informed prescribing and dispensing decisions.
- Pharmacists value their more participative and constructive role in the prescribing process.
- SAS provided extra resources for implementation and these worked alongside healthcare professionals who allocated their time away from direct healthcare to work with project teams to review and develop clinical and working practices.
- The Ministry of Health prepares and releases evidence-based clinical standards and protocols. Receta XXI is an effective facility to disseminate this information rapidly and comprehensively across the region.
- The number of GP visits for patients who have their first prescription using Receta XXI dropped by more than 15%, resulting in savings in time and travel cost for patients and time saving for healthcare professionals and provider organisations.
- Cumulative cash savings from generic prescribing total some € 17 million over the lifecycle.
- The financial classification of cumulative costs shows that Receta XXI needed over €62 million of extra finance over the twelve-year period. Receta XXI generated estimated cash savings of more than € 46 million for healthcare providers, mainly from generic prescribing. Other benefits are some € 118 million of redeployed finance and some € 75 million worth of non-financial benefits.



Source: EHR IMPACT study (2009)

### ► Case features

Receta XXI's integration with Diraya, Andalucía's comprehensive EHR system, and its scope of employment, affect the scale of benefits and costs to the different stakeholders involved. Receta XXI is available to all physicians connected to Diraya, but their utilisation differs. GPs use the opportunity to prescribe for up to one year to different degrees. Some do not use Diraya for single interventions, but for patients with chronic conditions only. SAS leaves these types of decisions and choices to each GP.



As one of the few routinely operating ePrescribing systems of such a scale and scope, Receta XXI offers extremely valuable knowledge and insights for planned ePrescribing developments in other health services and countries.

### ► Lessons learnt

- ePrescribing must be pursued as a contribution to the overall and long-term health and healthcare strategy of a region or country.
- Changes needed for ePrescribing should be within realistic, unhurried timescales that allow sufficient time to engage stakeholders and develop complex, interoperable, usable and tested solutions.
- Changes to prescribing rules can increase the benefits from ePrescribing by saving patients time and travel costs with fewer visits, saving GPs time, and enhancing the role of pharmacists.
- ePrescribing can be developed as an integrated, interoperable module of EHR systems rather than an stand-alone CPOE project, and take advantage of interoperable common databases, such as citizen registries, DSS and transfer of data into patients' EHRs.
- Doctors should use ePrescribing when and how they choose, instead of imposing its use for all patients. For some patients, there are no or few benefits compared to printed prescriptions.

## 5 Regional integrated EHR and ePrescribing across the Kronoberg County, Sweden

### Kronoberg: Socio-economic analysis results

<b>Time to net benefits</b>	
First year of positive annual net benefits	8
First year of positive cumulative net benefits	9
<b>Socio-economic return: net benefit to cost ratio</b>	
Annual return 2010	146%
Cumulative return 2010	52%
<b>Distribution of costs</b>	
Citizens	1%
Doctors, nurses, other staff	11%
Health provider organisations	87%
3rd parties	0%
<b>Distribution of benefits</b>	
Citizens	7%
Doctors, nurses, other staff	38%
Health provider organisations	54%
3rd parties	1%
<b>Types of costs</b>	
Financial extra	47%
Financial redeployed	40%
Non-financial	13%
<b>Types of benefits</b>	
Financial extra	15%
Financial redeployed	43%
Non-financial	41%
<b>Correlations</b>	
Utilisation to benefit	+0.91
Utilisation to net benefit	+0.66
<b>ICT and organisational costs, cumulative</b>	
ICT costs as share of total costs	42%
Organisational costs as share of total costs	58%
ICT as share of all health provider organisation costs	48%

Source: EHR IMPACT study (2009)

Kronoberg County in Southern Sweden spans eight municipalities and 182,000 inhabitants. It has two hospitals, 31 health-care centres, three mental health units and 25 dental care centres. These facilities have 5,700 staff and provide annually 413,000 consultant visits and 504,000 visits to other healthcare professionals each year.

The EHR system is operational in all the county's healthcare facilities and impacts on services across the entire healthcare system. These include primary, secondary and long-term care. It enables a seamless patient journey through HPOs and between different levels of care.

Plans for a county-wide EHR solution started in 1999, followed by the introduction of a patient administration system in 2000. Implementation of the clinical EHR system started in 2003. Gradually, a standard shared EHR replaced paper medical records. New EHR components either replaced or complemented stand-alone ICT systems. Today, about 98 % of the population have an EHR. All healthcare professionals are users.

The regional integrated EHR and ePrescribing system in Kronoberg presents a valuable benchmark for other European regions. Although still being developed, the system already achieves impressive results in many areas. The socio-economic performance is robust. The EHR system spreads across all levels of healthcare in routine operation. The high value to users, made clear in numerous interviews, proves sustainable acceptance levels and a positive impact on healthcare services.

### ► Core impact

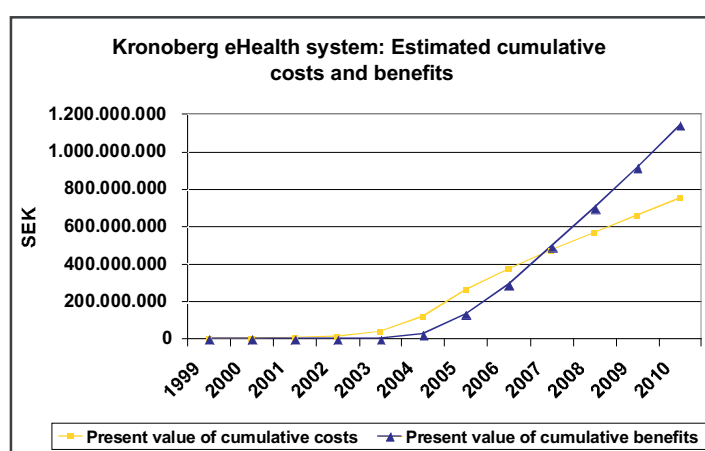
- Quality gains include improved patient safety, better continuity of care, better-informed decisions and more effective health services.
- Efficiency gains result from time-savings, avoided waste and some modest financial savings.

- Some psychiatry patients benefit from discharge where the region-wide EHR ensures that their condition will be recognised correctly by health professionals if the need arises.
- Healthcare professionals, whose working practices and roles have changed significantly, consider the county-wide EHR system indispensable.
- In many cases, the instant availability of information from the EHR enables HPOs to solve problems quicker and avoid unnecessary consultations, particularly for patients seeking advice over the phone and healthcare professionals seeking a second opinion during a consultation.
- Psychiatrists identified information overload as a negative impact because prompt and comprehensive information requires fast decision-making, which they consider sometimes ill-placed in their speciality.
- The value of time needed for new tasks, especially by hospital doctors who need to record more information themselves and by secretaries in primary healthcare centres who now have a new role in ICT support, amount to more than half the estimated organisational costs to HPOs.
- As a third party, the Swedish Social Insurance Agency benefits from avoided unnecessary double and triple prescriptions as doctors can view medications already prescribed.
- Similar to other sites, cash gains are relatively modest at 15% of the benefits, while 47% of the costs are of a financial nature.

### ► Case features

A distinct feature of the Kronoberg case study is the comprehensive scope and scale of the health information network. Few regions can show an operational system covering not only the whole population, but also all aspects of healthcare, including mental healthcare, and crossing the boundary to social care.

The long period of continuous costs without benefits prior to implementation reflects the time of careful planning and searching for an ICT solution that matches Kronoberg's health system requirements. Implementation was deferred because the ICT available had not yet reached the required maturity. The advantage was a better focus on robustness and reliability of all features of the system, and thus mitigation of risk. The early realisation of net benefits validates the approach.



Source: EHR IMPACT study (2009)



### ► Lessons learnt

- Management commitment at all levels is essential to cope with the fundamental changes in processes and practices needed to connect different healthcare activities.
- The hybrid of bottom-up and top-down system development and implementation approach ensures engagement leading to useful ICT solutions in seeing the implementation through to routine service.
- Implementing the least disruptive parts of the eHealth application quickly, aiming at fast returns for users, with a subsequent long-term commitment to changing processes and standardising clinical and working practices, is a powerful approach.
- A substantial amount of pressure on technology arises because it is complicated and it is clinically risky to work with parallel routines over long periods.
- Organisational risks, often stemming from hidden processes and the automatic increase in transparency brought about by the implementation of a comprehensive EHR system, are a bigger challenge than technology risks, because they are less predictable.

## 7 The Kolín-Čáslav health data and exchange network, Czech Republic

The Kolín-Čáslav health data and exchange network in the Czech Republic comprises the regional hospital Kolín, the municipal hospital Čáslav, and 29 GP and specialist practices in and around Kolín. Hospital Kolín is a secondary care facility with twelve specialties and about 600 doctors and nurses, treating some 20,000 inpatients and 300,000 outpatients every year. Hospital Čáslav is a smaller secondary facility with a staff of 300 and five specialties: internal medicine, gynaecology, surgery, paediatrics, and geriatrics. Ten GPs, six paediatricians, and 13 specialists run the private practices in the network.

The EHR IMPACT analysis covered the HIS in the Kolín and Čáslav hospitals and the exchange of patient data between them and between Hospital Kolín and doctors in private practice. The HIS stores comprehensive EPRs which also form the basis for the exchange of patient data. The EPR-centred HIS supports both clinical activities and administrative functionalities such as billing. HIS implementation at Hospital Čáslav started in 2001, followed by Hospital Kolín in 2004. In early 2007, Hospital Kolín and private practices in and around Kolín started exchanging medical data electronically. Hospital Čáslav joined the network in 2008, by exchanging data with Hospital Kolín. The use of HIS and the data exchange has been increasing steadily.

The Kolín-Čáslav health data and information network illustrates what interoperable electronic health record systems can do for healthcare provision in a hospital environment and how data exchange between healthcare facilities can evolve from existing eHealth infrastructure.

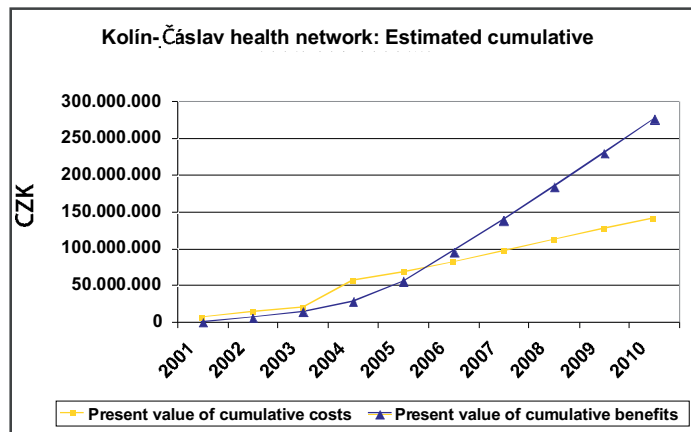
### Kolín-Čáslav: Socio-economic analysis

<b>Time to net benefits</b>	
First year of positive annual net benefits	4
First year of positive cumulative net benefits	6
<b>Socio-economic return: net benefit to cost ratio</b>	
Annual return 2010	204%
Cumulative return 2010	95%
<b>Distribution of costs</b>	
Citizens	0%
Doctors, nurses, other staff	11%
Health provider organisations	89%
3rd parties	1%
<b>Distribution of benefits</b>	
Citizens	5%
Doctors, nurses, other staff	36%
Health provider organisations	59%
3rd parties	0%
<b>Types of costs</b>	
Financial extra	22%
Financial redeployed	67%
Non-financial	11%
<b>Types of benefits</b>	
Financial extra	2%
Financial redeployed	57%
Non-financial	41%
<b>Correlations</b>	
Utilisation to benefit	+0.995
Utilisation to net benefit	+0.90
<b>ICT and organisational costs, cumulative</b>	
ICT costs as share of total costs	16%
Organisational costs as share of total costs	84%
ICT as share of all health provider organisation costs	18%

Source: EHR IMPACT study (2009)

### ► Core impact

- Data exchange enables patients to benefit from better-informed consultations, examinations and care decisions at hospitals and time savings from faster treatment and avoided unnecessary consultations.
- Healthcare professionals' experience an overall alleviation of work, stemming from better-informed decision-taking and avoiding time-consuming administrative work such as manual coding and typing reports.
- Organisational cost include increased time requirements to digitalise external paper records, disruption of work due to capacity overload at workstations, and a temporary reduction in productivity during the period of adaptation.
- HPOs' main benefit from the HIS and exchanging patient data is provision of more efficient services, which includes time savings in documentation, coding and reporting for reimbursement purposes, as well as less search for past records.
- Similar to other sites, the financial classification of benefits shows that only 2% of the benefits, about CZK 4.8 million, is extra released finance. This compares to 22%, or some CZK 31 million, of extra financial costs related to the investment. The financial investments are more than offset by the redeployed and non-financial benefits amounting to a value of some CZK 270 million.



Source: EHR IMPACT study (2009)

### ► Case features

HIS at the Kolín and Čáslav Hospitals adopted a radical approach. The timescale of replacing the semi-paper-based systems was exceptionally short. Strong leadership minimised costs from parallel processes and prevented a prolonged period of possible confusion. This succeeded because it was consistent with the prevailing organisational culture. The HIS functionalities supported this implementation strategy. Working with the ready-to-use system was simple and intuitive, and suited users' needs. As the logic of clinical events paralleled the logic of paper documentation, healthcare professionals could quickly adapt to the system. Continuous training and the minimal, but effective, user involvement by engaging doctors as permanent HIS representatives contributes to the positive performance.

Healthcare providers as individuals bear approximately 11% of the entire costs and reap 36% of the benefits. This unusually large share of the benefits reflects the extremely positive feedback by users of the system.

### ► Lessons learnt

- A radical, rapid implementation strategy can work if it is consistent with the system functionalities and the organisational culture, and if the usefulness and usability of the system is identified and tested in advance.
- Continuous user involvement helps the enhancement of functionalities and mitigation of problems, thus improving acceptance and usefulness.
- Building health networks in decentralised contexts on existing eHealth infrastructure lowers the costs and risk of failure.
- Strategic goals can and should go beyond short-term benefit realisation and aim at long-term competitiveness.

## 8 Dossier Patient Partagé Réparti (DPPR) – Shared and Distributed Patient Record platform in the Rhone-Alpes Region, France

### SISRA: Socio-economic analysis results

<b>Time to net benefits</b>	
First year of positive annual net benefits	9
First year of positive cumulative net benefits	11
<b>Socio-economic return: net benefit to cost ratio</b>	
Annual return 2010	61%
Cumulative return 2010	7%
<b>Distribution of costs</b>	
Citizens	14%
Doctors, nurses, other staff	3%
Health provider organisations	73%
3rd parties	9%
<b>Distribution of benefits</b>	
Citizens	40%
Doctors, nurses, other staff	6%
Health provider organisations	39%
3rd parties	15%
<b>Types of costs</b>	
Financial extra	38%
Financial redeployed	45%
Non-financial	18%
<b>Types of benefits</b>	
Financial extra	0%
Financial redeployed	12%
Non-financial	88%
<b>Correlations</b>	
Utilisation to benefit	+0.99
Utilisation to net benefit	+0.89
<b>ICT and organisational costs, cumulative</b>	
ICT costs as share of total costs	32%
Organisational costs as share of total costs	68%
ICT as share of all health provider organisation costs	43%

Source: EHR IMPACT study (2009)

The Rhône-Alpes health information system (SISRA) is the infrastructure supporting a shared, distributed patient record (DPPR). The DPPR acts as a broker for finding health data related to a specific patient. Data is stored at the point of creation, or in a central data store (PEPS). PEPS is used where local storage or access cannot be guaranteed at all times.

In 2009, the system was interoperable with 19 separate hospital information systems and six different systems in primary care, connecting over 50 healthcare facilities across the region. It provides healthcare professionals with access to a wide range of clinical and health information about patients. SISRA is being implemented across the region, so the EHR IMPACT evaluation deals with the status and position at early 2009, when registration in DPPR was just below 20% of the region's population.

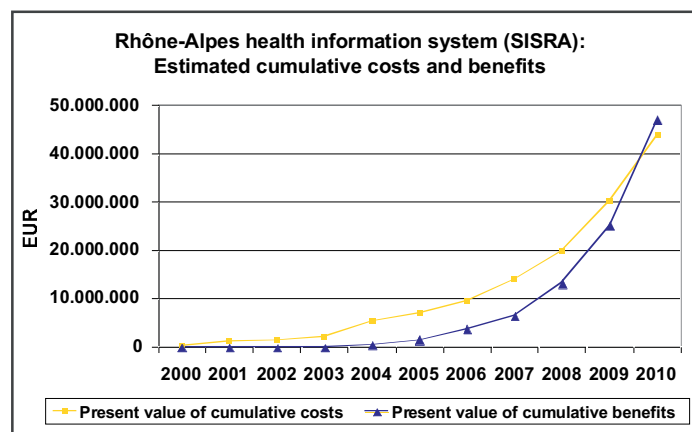
The central data store (PEPS) was operational in 2004 and in 2005 the DPPR was available. Since then, the number of healthcare professionals as users has increased steadily to about a thousand in 2009, forecast to rise to about 1,500 in 2010. The main users are healthcare professionals in hospitals across Rhône-Alpes, with GPs already taking the system up rapidly to accessing available clinical information. Development and implementation is continuing beyond 2010, and excluded from the EHR IMPACT evaluation.

University hospitals in Lyon, Grenoble and St-Etienne are the main development sites for SISRA. From these centres, SISRA solutions extend gradually into to other hospitals in the region, primary care services, nursing homes and social services. Each advance builds from proven, successful solutions. Several other regions of France have taken Trajectoire, one of SISRA's components to support the planned transfer of patients between different services for follow-up care.



## ► Core impact

- Patients treated for severe conditions in large specialised hospitals, who are then referred to local facilities for post-intervention treatment, have their real-time health information available at all locations.
- Patients bear the time commitment involved in informing themselves about SISRA in order to give their subsequent informed and explicit consent for registration with Serveur Télématique d'Identité Communautaire (STIC), SISRA's identity management and access authorisation component.
- Doctors as members of spatially separated multi-disciplinary healthcare teams benefit from safer and better-informed decision taking for patients referred from other care providers.
- Better-informed decisions by carers help HPOs to cope better with increasing demand, including physicians dealing with unscheduled second opinions and patient consultations, and participating in multi-disciplinary teams and reviews.
- Hospitals have to bear the indirect costs of their healthcare staff's additional time commitment and allocation away from healthcare to assemble patients' medical data on SISRA.
- Benefits to the Region's political authorities, affected as third parties, are in SISRA paving the way towards a more sustainable healthcare provision.
- Costs include providing information on DPPR to patients and the political engagement of all stakeholder organisations.
- The EHR IMPACT analyses show a financial position where extra cash of some €16.6 million invested over ten years from 2001 realise non-financial benefits and redeployed finance of over €47 million. These are equivalent to gross returns on financial outlays of some 183% for society as a whole. The investment is justified by better quality of care, including improved patient safety, and improved efficiency.




Source: EHR IMPACT study (2009)

## ► Case features

The technical interoperability of SISRA is extraordinary, as even paper-based HPOs are connected to the network. This case study illustrates the importance of a needs-driven approach, which reflects the reality and adjusts the ICT to it.

Another specific feature is the explicit political support from all relevant stakeholder groups, including the regional representative of the Health Ministry in charge of coordinating all hospitals in the region Agence Régionale d'Hospitalisation (ARH), the social security body responsible for care outside of hospitals Union Régionale des Caisses d'Assurance Maladie (URCAM), the regional unions of self-employed doc-



tors Union Régionale des Médecins Libéraux (URML), the Regional Council responsible for prevention, and the umbrella-organisation of patients' associations in France.

#### ► Lessons learnt

- Organisations representing critical stakeholders should be part of the strategic direction and steps of EHR development and implementation.
- Guiding strategic and operational goals must be set for healthcare first.
- Interoperable solutions developed in several steps can rely on data already in other systems, and offer a wide range of functionalities that supplement narrow EHR specifications. Such solutions are often modular and can be implemented in different locations in different sequences.
- Additional, affordable cash needed to finance the project must not go with a requirement to generate cash savings as a pay-off, because the net benefits are mainly non-financial for all types of stakeholder, and emphasising financial returns will distort priorities and increase risk.
- Long timescales to success are realistic and a better alternative to failing fast.

## 9 The health information platform Sistema SISS in the region of Lombardy, Italy

Regione Lombardia recognises the need to change the provision of healthcare. The local HIS in each hospital and the regional network are seen as part of these changes.

After the project requirements were defined and feasibility analysed in 1999, the pilot of the health information platform of Regione Lombardia (SISS) was completed from 2000 to 2002. SISS's expansion to all districts in the region started in 2002. In 2005, the entire region was connected, comprising all 34 public hospitals, of which five are public medical research institutes; 7,700 GPs; all 2,600 pharmacies, and around 9,500,000 citizens. From 2008, Regione Lombardia has been expanding the network to the private sector.

The connected healthcare providers can access a variety of reports, complementing information in their local patient record systems with information from other HPOs. Reports through SISS include laboratory test results, examination reports, referrals, discharge letters, and ePrescriptions. The eSignature functionality is critical for exchanging medical information. All documents available in SISS must be digitally signed before they are available to other healthcare providers. eBooking adds to the overall positive performance of SISS.

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.

### ► Core impact

- Data sharing renders safer healthcare provision, especially in cases where patients do not bring

### SISS: Socio-economic analysis results

<b>Time to net benefits</b>	
First year of positive annual net benefits	7
First year of positive cumulative net benefits	9
<b>Socio-economic return: net benefit to cost ratio</b>	
Annual return 2010	86%
Cumulative return 2010	24%
<b>Distribution of costs</b>	
Citizens	2%
Doctors, nurses, other staff	4%
Health provider organisations	94%
3rd parties	0%
<b>Distribution of benefits</b>	
Citizens	10%
Doctors, nurses, other staff	5%
Health provider organisations	65%
3rd parties	21%
<b>Types of costs</b>	
Financial extra	68%
Financial redeployed	26%
Non-financial	6%
<b>Types of benefits</b>	
Financial extra	3%
Financial redeployed	66%
Non-financial	31%
<b>Correlations</b>	
Utilisation to benefit	+0.96
Utilisation to net benefit	+0.90
<b>ICT and organisational costs, cumulative</b>	
ICT costs as share of total costs	63%
Organisational costs as share of total costs	37%
ICT as share of all health provider organisation costs	67%

Source: EHR IMPACT study (2009)

their referrals or discharge letters. It allows for data validation and counter-checking of test results, preparation of consultations in advance, creating new healthcare models, 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.

- ICT costs present about 63% of the overall costs and 67% of HPOs' total costs.

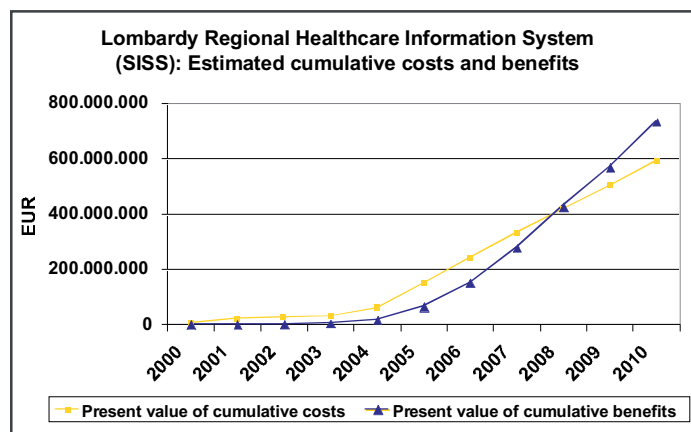
Disruptions, inconveniences to, and engagement of HPOs and end-users of the ICT applications account for about one-third of overall costs and are distributed among Regione Lombardia, pharmacies and GPs and paediatricians.

- The financial position includes extra finance released of less than 10% of benefits, attributed to financial incentives for GPs and pharmacists, and financial savings from avoided travel costs for patients. It compares to 68% of extra financial investment in the overall costs.
- Around two-thirds of benefits are 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.
- About 31% of all benefits are non-financial benefits. All stakeholder groups benefit from 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; improved clinical governance and the region's capability to meet increasing demand by providing more effective and more efficient services.

### ► Case features

The long-term strategic plan to change the healthcare model is significant. Implementing an ICT network is not seen as a pure ICT project, but as a necessity to achieve a healthcare strategy designed to make Regione Lombardia's healthcare system fit for future challenges.

Healthcare has been faster than other public services in developing an ICT infrastructure across the region. This is unusual when matched against the consensus that the healthcare sector is slow in adopting ICT.



Source: EHR IMPACT study (2009)

### ► Lessons learnt

- A successful decision was allowing users to familiarise themselves with the application and gradually integrate it into their daily working routines, and simultaneously stressing the importance of the initiative by making training compulsory and making connection to SISS mandatory for each public health-care organisation.
- Implementation can start with administrative functionalities as their employment is easier for users, and the benefits are easier to realise at a much faster pace than clinical features.
- Effective user support for ICT is essential. HPOs needed help to develop, implement and maintain the central data repository, and integrate their local databases with central and individual data. Support included provision of guidelines, consultancy, ICT products, and certification of vendors and their products.



## 10 Nation-wide health information network, Israel (qualitative report)

The EHR and Health Information Network (HIN) in Israel are well developed and implemented beyond the Israeli context. The HIN function is to share all medical information existing in a wide array of disparate informational systems between authorised healthcare professionals and make it accessible at every point of care with an interoperable solution specifically created for health information exchange (HIE).

Israel's healthcare reforms in the mid-nineties introduced competition into the market for healthcare. The new healthcare model motivated health maintenance organisations (HMOs) to change their strategies and seek new ways of providing and managing healthcare. The HIN has been identified as one of the tools supporting this.

The network was rolled out in 2001 across Israel's largest HMO. In 2003, the government-owned Sheba Medical Centre in Tel Aviv, the largest medical centre in Israel, adopted the system for its internal use and joined the HIN in 2004. Rambam Medical Centre in Haifa, which provides medical services to the majority of Israel's northern population and serves as a military hospital, joined the network a few months later. The HIN now spreads across the whole of Israel, supporting healthcare provision for more than 5 million people, nearly 70% of Israel's population. A wide range of healthcare is covered, including primary and dental care and secondary and tertiary hospitals. Its users number in the tens of thousands including physicians, nurses, pharmacists, paramedics, laboratory and imaging technicians and administrators.

The main HIN goal is to provide healthcare professionals with the clinical and health information they need to treat and care for their patients. This includes information about each patient's hospitalisation history, diagnosis test requests and results, visits, prescriptions and dispensings, laboratories, imaging, pathology, procedures, surgery, medical treatments, Accident & Emergency encounters, outpatients, nursing care, sensitivities and allergies, main complaints, problem list, GP encounters, and vital signs.

When a healthcare professional asks the network for data about a specific patient, it checks the treatment relationship for the user's permission for access to a patient's file. The HIN then creates a Virtual Patient Record (VPR) out of information from all relevant data storage sites in hospitals, community clinics and pharmacies. The presented screen resembles an ordinary EHR. After the VPR is closed, it disappears, leaving only a record of the access.

### ► Core impact

- Patients receive safer care, especially where there are language barriers. For example, in the catchment area of Soroka Hospital, where 27% of the population are Bedouin, HIN reduces patients' risk of adverse events from ill-informed decisions as it provides vital information on patients who cannot report on their medical history themselves.
- Many healthcare professionals have adopted the HIN willingly, and say they cannot imagine working without it, especially young doctors who have no experience of traditional ways of working.

- There is no delay in either starting or extending treatment, or deciding that there is no need for action.
- Doctors can avoid over-prescribing.
- Nurses in primary care integrate with the work of hospital nurses, avoiding the need for them to reassess transferred patients.
- Transfer from hospital to primary and community care is much smoother and better prepared and organised.
- Doctors can check patients' medications dispensed by pharmacies, and use the information to indicate a potential failure to conform to the medication regime.
- GPs can monitor patients' compliance with referrals to hospital services.
- Hospital teams gain from time savings and efficiency. Typically, about 20% of a person's time was dedicated to record retrieval. Overall improvements in discharge procedures have achieved savings of 10 to 15 minutes per patient where existing hospital notes have replaced full retyping of notes. Using the HIN for admissions can save up to a day a week on clerking. The time saved increases the time available for patients.
- Epidemiology and infection control services have improved with faster access to patient data.
- Improvements have been achieved in handover procedures between nursing shifts in hospitals, and bed management, which is especially critical because many wards in Israel operate at or near 100% occupancy.
- Third parties benefit from facilitated research, and the availability of reliable information on the performance and workloads of their HPOs and can be used to develop policies, strategies, plans and projects for service development and improvement.

### ► Case features

The HIN makes locally available information accessible for qualified caregivers within the network. It plays an important role at the interface between primary and hospital care by enabling prompt, simple and rapid communication across health service boundaries to support direct and continuous patient care. This scale and scope of the network are rare.

Future benefits are expected from upgrades using semantic interoperability to support advanced aggregation and clinical logic. The foundation for this semantic interoperability functionality is dbMotion's Unified Medical Schema (UMS) based on HL7 V3 and the Reference Information Model and its vocabulary domain, which leverages information architectures that do not share common terminologies, vocabularies, or code structures.

### ► Lessons learnt

- Development of HIN should start from a clear understanding of the needs of all types of users, especially medical knowledge and medical needs, and clarity on what was possible and acceptable within organisations.
- Project teams should include all important stakeholders and people with the authority and peer standing to bring the project out of the committee stages and to fruition.
- HIN began with a minimal data set that was clearly defined and subsequently expanded, showing how to avoid a model trying to create a complete, sophisticated solution at one attempt.
- ICT teams must allow people working in healthcare and business activities to lead, acting as technology enablers and facilitators, and iterating potential solutions with leaders and users.
- Existing ICT infrastructure and investment can be leveraged by integrating the HIN with functions employing existing data, confidentiality, security and authentication standards.



## 11 The EHR system at NorthShore University HealthSystem, USA (qualitative report)

Among the roughly 6,000 USA hospitals, NorthShore University HealthSystem in Evanston, IL (North of Chicago), formerly known as Evanston Northwestern Healthcare (ENH), is one of the few organisations using a fully integrated health record and hospital information system that is built around the patient. The key feature of the system is its ability to function as a comprehensive, state-of-the-art suite of software products that work together in a unified fashion. With this, NorthShore has three of 15 USA hospitals reaching Stage 7 at the top of the HIMSS Analytics “EMR [Electronic Medical Record] Adoption Model” scale in 2008.

This case study illustrates a probably world-wide leading example of good practice in planning, implementing and running a comprehensive, integrated information system allowing four hospitals and about 80 regional GP offices and primary care facilities to cooperate closely, with access to the same information on all their patients. The experience, lessons learnt and identified success factors at NorthShore are of more or less universal relevance.

Adoption of information technology solutions began in the late 1970s, far ahead of most other hospitals or regional systems. The initiative to implement a comprehensive, interoperable EHR and hospital information system at NorthShore derived from their 1996-2001 strategic plan, which stated as its primary goal to become the “best integrated healthcare delivery system in its region.”<sup>23</sup> The overall objective was to facilitate a seamless movement of patients between physician offices, hospital inpatient and ambulatory services by providing physicians, nurses and other staff with access to complete, accurate and current patient data.

After many years of experience with various stand-alone health IT systems, in 2001 NorthShore decided to purchase an Epic Systems EMR. The system started going live in early 2003, a phase mostly completed that year for their then three hospitals in Evanston, Glenbrook and Highland Park.

The information system at NorthShore is operational throughout the whole organisation and consequently is used in a wide variety of different healthcare settings. Each of the following services is supported by a modified module of the core commercial system, which was adapted to and extended by additional functionalities to fit the special needs of each service. Services are EpicCare inpatient medical record; Ambulatory Care; Intensive Care Unit (ICU); Care Plans and Critical Pathways; Nursing Flowsheet Documentation; Decision Support; Emergency Department (ED); Computerised Physician Order Entry (CPOE); Pharmacy; Medication Administration Record (MAR); Patient Education and Support for Care Decisions.

The Prelude Registration, Cadence Scheduling and Resolute Billing modules complement EpicCare’s clinical and healthcare modules. Together with a NorthShore connect module, they provide a fully integrated, interoperable IT infrastructure across all the organisation’s services, healthcare facilities and locations.

As NorthShore is using a commercial system, technological transferability of this case should be possible. Of course, as each hospital and each environment will differ somewhat, an adaptation to local contexts will



be mandatory. But the component-based architecture should allow such adaptations to be made with relatively low effort. The organisational transferability depends as much on the system to be transferred, as on the setting in which it is to be transferred. Here, quite independent from technical details, the planning and implementation approach characterised by strong leadership and commitment by management, by facilitating full involvement of professionals, securing their acceptance and charging them with changing working practices is surely transferable.

These enabling conditions point to a relatively high level of transferability of this case to other contexts. The risks associated with an actual transfer seem to be associated more with the receiving side rather than with the flexibility of the overall change approach and system observed at NorthShore. It took a combination of high-level, visionary people at the clinical, the technical and the operational level, supported by people who excel in health informatics, to succeed. This combination of people and circumstances is difficult to achieve on purpose.

### ► Core impact


NorthShore's capital and operational IT costs from 2001 through 2004 were about \$35m. In addition, operational expenses for training were \$7.5m during the first three years, involving staff time of about 150,000 hours. When other costs like reduced productivity during change-over are factored in, the overall cost is likely to have exceeded \$50m.

Most obvious benefits from the new system are quality and safety improvements for patients, while providing ease of use and greater efficiency among physicians, nurses, administrators and managers. On the financial side, realised cost reductions and financial benefits were estimated at about \$12.5m overall per year. NorthShore estimates that it realises ongoing incremental savings of \$10m per year over incremental IT expenses. And it believes that after factoring in the cost of capital, the system has proven its worth. They see a small but positive financial return from the HIS.

But even being at the leading edge of eHealth developments still implies that many documents received from outside the NorthShore system need to be scanned so that they can be viewed electronically, but scans are nothing more than images, not computable data. The same applies to dictations or typed notes by its professionals. To fully realise the eHealth vision, it is still needed to transfer this and other unstructured information into discrete data, i.e. in a structured format rather than as free text. And that comes back to better structured workflows. It seems that NorthShore has the potential to fully realise these visions in the medium term.

### ► Case features

A key aspect to note is that this was not designed as a technology project, but rather as “a clinical project, and ENH launched the project with a full-scale analysis and redesign of all clinical processes. [...] Early on, the steering committee knew that to succeed, most if not all workflow processes would need to be examined and redesigned. Existing processes were too inconsistent and convoluted to have an electronic



system dropped on top of them.”<sup>24</sup> It is this clear focus, which dominated strategic planning for three years with no other objectives acknowledged, which is rather unique to this case.

### ► Lessons learnt

The following factors and change management aspects were identified as key to success:

- Strong executive and professional staff leadership right from the beginning of the planning process through to full implementation.
- Well-designed, communicated and implemented overall project governance and clearly defined core objectives.
- Clearly articulated expectations of behaviour with respect to both training involvement and usage of the new system by physicians.
- Physicians, who had the trust of the operations staff, as champions and team leaders of clinical pathway redesign and standardisation.
- Comprehensive training programme of 55 different courses for all staff with full support by super-users; only physicians that passed the competency test allowed to access the system. For two weeks from the start of each go-live phase in each hospital, a command centre was staffed 24/7.
- Open, organisation-wide and intensive communication processes to engage and commit all leaders, managers and users.
- Recognition and rewards to motivate people.
- Strong support from technology and IS staff, highly reliable and fail-save system.

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# Abbreviations

A&E	Accident and Emergency
AB	Annual Benefit
AC	Annual Costs
CBA	Cost-Benefit Analysis
CIS	Clinical Information System
CPOE	Computerised Physician Order Entry
DPPR	Dossier Patient Partagé Réparti
ECS	Emergency Care Summary
ED	Emergency Department
eHI	eHealth IMPACT Study
EHR	Electronic Health Record
EHR IMPACT	EHR IMPACT study
EMR	Electronic Medical Record
ENH	Evanston Northwestern Healthcare
EPR	Electronic Patient Record
FTE	Full Time Equivalent
GP	General Practitioner
HIS	Hospital Information System
HPO	Health Service Provider Organisation
HUG	Hôpitaux Universitaires de Genève
ICT	Information and Communication Technologies
ICU	Intensive Care Unit
MAR	Medication Administration Record
NB	Net Benefit
NHHS	National Heart Hospital Sofia, Bulgaria
NHS	National Health Service
NPV	Net Present Value
OOH	Out of Hours
PACS	Picture Archiving & Communication System
PV	Present Value
ROI	Return on Investment
SISRA	Système d'Information de Santé Rhône Alpes
SISS	Sistema Informativo Socio Sanitario
SER	Socio-Economic Return
TASS	Tarjeta de Afiliado a la Seguridad Social

# References

- [1] 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) (1-4-2010)
- [2] HM Treasury (2003): The Green Book, Appraisal and Evaluation in Central Government. Treasury Guidance. London. Available at: [http://www.hm-treasury.gov.uk/d/green\\_book\\_complete.pdf](http://www.hm-treasury.gov.uk/d/green_book_complete.pdf) (1-04-2010).
- [3] 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.epractice.eu/en/library/281229> (1-4-2010)
- [4] Commission of the European Communities - C(2008) 3282: Commission recommendation on cross-border interoperability of electronic health record systems. Brussels.
- [5] Commission of the European Communities - COM (2004) 356: Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions: e-Health - making health care better for European citizens: An action plan for a European e-Health Area. Brussels.
- [6] European Commission (2007): eHealth priorities and strategies in European countries. Luxembourg: Office for Official Publications of the European Communities. ISBN 92-79-02957-6.
- [7] Commission of the European Communities - COM (2004) 356: Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions: e-Health - making health care better for European citizens: An action plan for a European e-Health Area. Brussels. Page 17.
- [8] Commission of the European Communities - COM (2004) 356: Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions: e-Health - making health care better for European citizens: An action plan for a European e-Health Area. Brussels. Page 20.
- [9] Financing eHealth (2008): Sources of financing and policy recommendations to Member States and the European Commission on boosting eHealth investment. Final study report. Bonn, empirica. Available at: [http://www.financing-ehealth.eu/downloads/documents/FeH\\_D5\\_3\\_final\\_study\\_report.pdf](http://www.financing-ehealth.eu/downloads/documents/FeH_D5_3_final_study_report.pdf) (1-04-2010).
- [10] eHealth IMPACT (2006): Study on economic and productivity impact of eHealth - developing a context-adaptive method of evaluation for eHealth, including validation at 10 sites - covering the whole spectrum of eHealth applications and services. [www.ehealth-impact.eu](http://www.ehealth-impact.eu) (1-4-2010)
- [11] Yin, Robert K. (2003): Case Study Research. Design and Methods. Applied Social Research Methods Series Volume 5. Southand Oaks: Sage Oublications.

[12] Kuckartz, Z., Dresing, T., Rädiker, S., Stefer, C., (2008): Qualitative Evaluation. Der Einstieg in die Praxis. Wiesbaden: VS Verlag für Sozialwissenschaften.

[13] Ministry of Health and Social Affairs in Sweden (2009): eHealth for a Healthier Europe. Opportunities for a better use of healthcare resources.

[14] Canada Health Infoway (2008): Diagnostic Imaging Benefits Evaluation. Final report

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

[16] World Health Organization (2008): Ensuring value for money in health care: The role of health technology assessment in the European Union, ISBN 978 92 890 7183 3

[17] Stroetmann, Karl A., Jones, T., Dobrev, A., 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> (1-4-2010)

[18] Johnson, KM., Chark, DM., Chen, QP., Broussard, A., Rosenbloom, STM, (2008): Performing Without a Net: Transitioning Away From a Health Information Technology-Rich Training Environment In: Academic Medicine. Vol. 83, 12: 1179-1186.

[19] Congress of the United States (2008): Evidence on the Costs and Benefits of Health Information Technology. Paper by the Congressional Budget Office. p.3

[20] Financing eHealth (2008): Sources of financing and policy recommendations to Member States and the European Commission on boosting eHealth investment. Final study report. Bonn, empirica. Pages 72-74. Available at: [http://www.financing-ehealth.eu/downloads/documents/FeH\\_D5\\_3\\_final\\_study\\_report.pdf](http://www.financing-ehealth.eu/downloads/documents/FeH_D5_3_final_study_report.pdf) (1-4-2010)

[21] House of Commons Public Accounts Committee UK HC 562 (September 2009): Learning and Innovation in Government Forty-third report of Session 2008-09.

[22] Duffy, J., Piai, S. C.(2009): Best Practices: Norway's Hospital Evolution - a tale of two cities. Health Industry Insights, an IDC Company. <http://www.idc.com/HII/getdoc.jsp?containerId=HIOH03R9> (1-4-2010)

[23] Tom Smith et al. (2004): Transforming Healthcare with a Patient-Centric Health Record System. Submission to the Nicholas E. Davies Award of Excellence. Evanston, IL, Dec. 2004, p. 4

[24] Tom Smith et al. (2004): Transforming Healthcare with a Patient-Centric Health Record System. Submission to the Nicholas E. Davies Award of Excellence. Evanston, IL, Dec. 2004, p. 8

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