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eHealth is Worth it

The economic benefits of implemented eHealth solutions at ten European sites

Karl A. Stroetmann, Tom Jones, Alexander Dobrev, Veli N. Stroetmann

eHEALTH IMPACT

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- TanJent Consultancy, UK
- Kadris, France
- Jagellonian University, Poland
- ESYS Consulting, UK

Disclaimer

Foreword

Healthcare is one of the most information-intensive sectors of European economies and can greatly profit from recent advances in information and communications technology. Given that the health sector currently lags behind other sectors in the use of this technology - eHealth - there is great potential for rapid, sustained growth.

The eHealth market is currently some 2% of total healthcare expenditure in Europe, but has the potential to more than double in size, almost reaching the volume of the market for medical devices or half the size of the pharmaceuticals market. However, unlike the products from these two other healthcare industries, eHealth applications are not yet routinely assessed for their impact, benefits and safety.

This study shows across a wide range of eHealth applications that clear evidence can be provided of the benefits of information and communication technology in routine healthcare settings. The benefits range from improvements in quality and better access of all citizens to care, to avoidance of unnecessary cost to the public purse. The methods used point the way to more formal certification of eHealth in future, and can support current efforts on both sides of the Atlantic to establish official certification mechanisms for electronic health record systems.

The European Commission Directorate General Information Society and Media supported this important contribution to methods for advanced evaluation and the collection of reliable evidence. The information gathered from 10 sites across Europe clearly shows that eHealth does matter, that it is well worth the investment, and can lead to very substantial benefits. An important lesson is that deployment of eHealth must be combined with appropriate changes in processes and organisation, and must be guided by appropriately skilled people.

I hope that this document will prove useful to all those with responsibility for health in Europe and will give courage to those who hesitate to invest in eHealth. The advice is simple: do not postpone innovation, but equally, do not take a leap into the dark; take small steps, carefully, and be guided by evidence now available of the successes and failures of others.

Brussels, September 2006

Viviane Reding
European Commissioner
Information Society and Media

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Executive Summary

The health systems of the European Union are a "fundamental part of Europe's social infrastructure". eHealth, defined in a holistic fashion as encompassing information and communication technology (ICT)-enabled solutions providing benefits to health, be it at the individual or at the societal level, is expected to contribute significantly to the further development of health systems. A key barrier to the more widespread diffusion of such solutions has been that little reliable evidence is available on the economic impact of using ICT in delivering high quality healthcare. The impact is potentially enormous, but has been difficult to measure, especially some of the benefits. Evaluations often have only one perspective, such as financial, or the view of a single stakeholder.

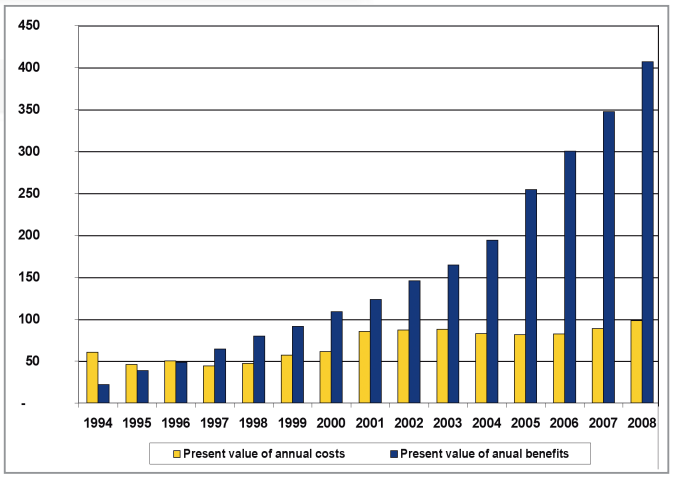
The European eHealth IMPACT study, responding to the EU *eHealth Action Plan* (2004) target "to assess the quantitative, including economic, and qualitative impacts of eHealth"addressed these shortcomings by:

- Developing a generic, adaptable assessment and evaluation framework and method for eHealth applications and services, focusing on economic performance and measurement tools for quantitative indicators
- Identifying good practice examples of eHealth applications across European Union Member States and across the whole eHealth domain, integrating the experience and lessons learned from these examples into the method
- Applying the method and measurement tools at ten sites, each with proven eHealth applications and reflecting diversity of the regional and healthcare systems of the Union.

An online database of good practice examples in eHealth across Member States was also created as part of the project and is available at http://www.ehealth-impact.org

This report presents a synthesis of the outcomes of the study: Chapter 2 summarises the approach and methodology of economic evaluation and assessment developed by eHealth IMPACT. Next, the results from the economic evaluations performed are summarised, demonstrating the potential of eHealth to impact health services – both in economic and in qualitative terms. The third part, chapters 4 to 6, provides an analytical treatment of the results, including lessons learned and policy recommendations. Chapter 7 presents short summaries of the ten case studies and the results of each evaluation.

eHealth IMPACT developed a generic methodology for the economic evaluation of eHealth applications. It is a context adaptive model, so it fits a wide diversity of applications, from clinical settings to supply chain solutions. The model relies on the concept of cost-benefit analysis. Costs include the initial and continuous eHealth investments, such as those in ICT and change management, as well as the running costs of healthcare. Special attention has been paid to identifying the benefits to, and impact on, citizens. At the same time, benefits to all potential stakeholders can be analysed. The concept of cost-avoidance is important in identifying benefits. This is the cost for achieving the ICT-based performance without ICT, which is often prohibitive.



The results of the study show that given the right approach, context and implementation process, benefits from effective eHealth investment are indeed better quality and improved productivity, which in turn liberate capacity and enable greater access. Once development and implementation stages have been successfully realised, the value of these benefits, for what we have called a 'virtual health economy' consisting of the 10 evaluated cases, rises each year and exceeds the costs, usually very significantly. Annual costs are broadly stable once implementation has been completed, whereas net benefits tend to grow each year with expanding usage, showing that eHealth can contribute increasingly to satisfying citizens' needs and wants for healthcare.

The eHealth IMPACT study provides empirical evidence on the benefits of eHealth systems and services. It demonstrates the potential of eHealth as enabling tool for meeting the 'grand challenges' of European health delivery systems. Policy makers, industry, and healthcare providers alike must be aware that the realisation of this potential depends on six key factors:

1) **Commitment and involvement of all stakeholders:** All phases of eHealth development, implementation and deployment have to be supported by citizens/patients, health providers, industry, authorities, and third party payers.

2) **Strong health policy and clinical leadership that guides a flexible and regularly reviewed eHealth strategy:** While the strategy should be directed by a long term vision of a citizen-centred health delivery system, it must address concrete needs of actors in the system. The strategy should include achievable, shorter term goals that create an eHealth investment dynamic. A big-bang approach with ambitious goals to be achieved over a short period of time is not recommended.

3) **Regular assessment of costs, incentives and benefits for all stakeholders:** Considering purely financial return on investment at an institutional level, or potential benefits for only one of the stakeholders, may lead to suboptimal decisions. Particular attention should be paid to include all users, some of whom are often neglected in such assessments.

4) **Organisational changes in clinical and working practices:** This is indispensable in order to optimise the use of ICT-enabled solutions and realise the benefits. Such changes should be facilitated by greater legal certainty in using eHealth solutions.

5) **Strong clinical leadership, good organisational change management, multi-disciplinary teams with a well-grounded experience in ICT and clear incentives:** The combination of skills of the people involved will make the difference between success and failure, not the specific eHealth solution. Skills development through continuous education and training is essential.

6) **Long term perspective, endurance and patience:** Beneficial eHealth investment is like a good wine. It takes a considerable amount of time (about 5 years) to mature and develop its potential fully.

1. eHealth - an enabler for better health across Europe?

The health systems of the European Union are a "fundamental part of Europe's social infrastructure." [1] Information and communications technologies (ICT) are expected to contribute significantly to the further development of our health systems. [2] However, "to date, HIT [health information technology] has been mostly the realm of enthusiasts." [3] "For over thirty years, there have been predictions that the widespread clinical use of computers was imminent. Yet the wave has never broken." [4] But the results of the European eHealth IMPACT study show that - given the right approach, context and implementation process – ICT-based solutions can indeed improve the quality, access and efficiency of healthcare provision.

Here we define in a holistic fashion **eHealth as encompassing ICT-enabled solutions providing benefits to health** – be it at the individual or at the societal level. A key barrier to the more widespread diffusion of such solutions has been that very little reliable evidence is available on the economic impact of using ICT in delivering high quality healthcare. The impact is potentially enormous, but has been difficult to measure, especially some of the benefits. Evaluations often have only one perspective, such as financial, or the view of a single stakeholder.

The eHealth IMPACT (eHI) study, responding to the EU *eHealth Action Plan* [5] target "to assess the quantitative, including economic, and qualitative impacts of eHealth" addressed these shortcomings by:

- developing a generic, adaptable assessment and evaluation framework and method for eHealth applications and services, focusing on economic performance and measurement tools for quantitative indicators
- identifying good practice examples of eHealth applications across European Union Member States and across the whole eHealth domain, integrating the experience and lessons learned from these examples into the method
- applying the method and measurement tools at ten sites, each with proven eHealth applications and reflecting the regional and health system diversity of the Union.

Recently the OECD observed that "the growing importance of economic considerations in hospital purchasing and clinical adoption decisions explicitly rewards cost reducing technologies or at least technologies with a reasonable cost-effectiveness ratio." [6] As the cases to be reported upon show, eHealth solutions applied in a wide variety of contexts can indeed meet this challenge and even show considerably improved economic efficiency (benefit/cost) ratios.

2. Approach and methodology of economic assessment

2.1 Overview

2.1.1 General concepts

Several perspectives had to be linked to evaluate the economic impact of eHealth applications. They are the impact on:

- Citizens
- Health provider organisations (HPO)s; including physicians in private offices, and other professionals
- Third party payers, including insurance funds
- Other parties, if relevant.

Each of these perspectives was analysed over three time periods of the eHealth investment: (1) planning and development, (2) implementation, and (3) routine operation.

Benefits were defined initially as improvements in quality, access, or cost-effectiveness. As the sites to be analysed were all proven eHealth applications, it was expected that the performance of most, or all, of them would improve after the eHealth investment had been successfully implemented. Identifying these improvements is a core goal of the eHI methodology.

For an economic analysis, data to measure the benefits and costs for each stakeholder are needed. Monetary values have to be assigned to enable the economic and productivity performance to be evaluated. This enables, in the aggregate, potential common patterns, trends and relationships to be identified. The economic method that enables these data to be linked is cost benefit analysis (CBA). It allows different outcomes to be evaluated by common measures and can reflect a different allocation of resources before and after an eHealth investment. The decision to base the eHI methodology on CBA principles was derived from a focused state-of-the-art review. A key merit of CBA lies in that it allows for comparative, as well as single-option evaluation.

The sites that were selected all have proven eHealth investments. They all have been recognised as effective eHealth applications and judged, informally, to achieve good economic performance. They were not selected at random. This must be taken into account when transferring the findings from the eHI study to other settings.

An important principle applied in developing and using the eHI model for economic evaluations is that the methodology adapts to the healthcare and eHealth setting of each site. The data from each site need not adapt to the eHI model.

Another central feature of the eHI methodology is that the conclusions from the economic evaluations should be used at a relatively high level. It provides a robust estimate of the economic performance over time, but is not an incisive tool that produces precise, undisputable numbers. This means that the focus is on showing whether a particular eHealth application has a positive or a negative economic impact, measured mainly in net benefits and productivity improvements, rather than on the exact amount of the achieved benefits. The same principles apply to the other eHI measures; for example, a 70% share of benefits to citizens should be interpreted as a considerable majority of benefits, rather than exactly 70%.

2.1.2 State-of-the-art review

The methodology needed for the eHI study was identified from of a focused review of the state-of-the-art of economic evaluation techniques and assessments of ICT applications, particularly in healthcare. The review aimed at:

- Selecting an appropriate economic concept
- Seeking a methodology that applied the concept.

CBA became the preferred economic concept because it enables the impact on all stakeholders to be included in the evaluation. Also, CBA allows for an assessment of a new, stand-alone application, as well as for an estimation of outcomes from a range of options. Cost-effectiveness (CEA) and cost minimisation analyses (CMA) were not selected because they do not enable the evaluation of a range of outcomes. CBA has been reflected in the methodology of the economic case in the Green Book, Appraisal and Evaluation in Central Government, HM Treasury, UK. [7]

The insights of the Green Book provide effective analytical frameworks, guidance on methodologies and insights to estimating monetary values for tangible and intangible benefits. They do not, however,

provide a model that can be used for economic evaluation of specific eHealth sites. Enhancements are needed to adapt the methodology to the respective context. These are provided as a complementary approach of designing bespoke methodologies and features for evaluations and analyses by the eHI team to fit the specific needs of each site, and to support the eHI study goal to seek economic findings that can be used to guide future eHealth investment decisions.

2.1.3 The structure of an eHealth Impact evaluation

The core elements and time frame of the eHI evaluation can be summarised as follows:

- CBA - costs and benefits for all stakeholders: citizens, HPOs including professionals, 3rd party payers, others when of considerable relevance – i.e. taking an economic perspective
- eHealth utilisation
- Productivity measures – unit costs
- Three eHealth investment periods:
  - Planning and development
  - Implementation
  - Routine operation.

The eHI approach focuses on identifying costs and benefits, changes in productivity, and utilisation levels of a comprehensive, but clearly identifiable eHealth application or a clearly delimited system. Costs are divided into two main categories: investment costs and costs of running the healthcare related service. They include costs for citizens, application development, software and hardware costs, and costs of eHealth operation and service provision for HPOs and eHealth investors. Benefits include benefits to all stakeholders. Citizens often benefit from better quality of care, better access to care and time savings. The impact on HPOs is mainly improved healthcare quality outcomes, better performance, time savings, resource liberation, and cost avoidance.

eHealth utilisation is a measure of the use of the new service supported by the eHealth investment, derived from data such as the growth in the number of users or transactions. It is important in setting a context for estimated benefits. In particular, investments often lead to benefits that arise only after a reasonable level of utilisation has been achieved, not always immediately after implementation. Productivity is measured by changes in unit costs.

Time is an important feature of economic evaluations. The three time periods used in the eHI model are:

- Years for planning and development, from conception up to the year of implementation
- Years from implementation start to the year of full operation
- Years of full, routine operation.

For the 10 sites evaluated, the years of full operation have been extended by a three-year forecast of the utilisation, costs and benefits to be expected up to and including 2008. This reflects changes in these three factors, and so enables a forecast of economic performance to be included in the evaluation. This is valuable extra information for the sites with a:

- Relatively short history of a proven eHealth solution
- Steeply rising curve of utilisation with an equivalent impact on the value of benefits
- A flattening curve of utilisation, where the main net benefits were achieved on, or before, 2004, to see whether the net benefits were diminishing towards negative.

The three time periods defined are not always consecutive periods. Overlaps are usually found with eHealth development, which is a continuous process at most sites. Planning and implementation of new elements or modules can be continuous, and this is reflected in the estimates used for each site.

2.1.4 Measuring the impact of eHealth

2.1.4.1 Approach to data collection and structuring

The eHI methodology is adaptive to the context and data availability of each eHealth application. Detailed schedules of cost and benefit factors must be created anew for each site to reflect its respective specific characteristics. Nevertheless, there are some common themes examined in each evaluation. These ensure completeness of the evaluation so that no major, relevant costs or benefits are ignored. The structure of data collection is:

- Identify the scope and borders of the service using the eHealth application
- Define the relevant eHealth service, and corresponding utilisation

- **Estimate costs**
  - › *eHealth investment*
    - · Direct investment and re-investment in ICT: hardware, software, licences
    - · Changes to process and organisation: procurement, project management and change management
  - › *Operational costs of healthcare supported by ICT*
    - · Healthcare professionals
    - · Support staff
    - · Cost of healthcare process
    - · ICT staff
    - · Other recurrent costs
- **Estimate benefits – quality, access, efficiency**
  - · Citizens
  - · HPOs
  - · Third party payers
  - · Others.

2.1.4.2 Defining units of utilisation

Utilisation levels are often drivers of benefits. It is thus important to define the relevant units of ICT and eHealth utilisation. ICT utilisation is the use of the technological component of an eHealth application alone. This, however, is not necessarily the relevant unit when trying to assess the impact of the application. The service that is supported by ICT is usually more relevant as a driver of benefits and indicator of productivity. Use of this service is defined as eHealth utilisation. This can be significant for identifying and estimating costs and benefits, and in particular, ensuring that the costs for, and benefits from eHealth, refer to the same entity.

2.1.4.3 Estimating costs

Estimated costs and timing of eHealth investment include recurring and non-recurring costs. Examples of non-recurring costs for ICT are hardware, and process and organisational change costs, including procurement, project management, change management for new practices and processes and extra training costs around the time of implementation. Some of these are included in other costs. For example, procurement and project management can be part of a person's job, rather than a complete, intact, additional resource. In cases like this, estimated costs must be apportioned.

Annual running costs of healthcare supported by the eHealth investment are estimated in a timeframe ranging from the planning and development stage, through to the routine operation phase ending in 2008. This allows for the actual impact to be clearly illustrated. Operational costs include mainly staff costs, for professionals and support staff, as well as non-employment costs associated with the healthcare, such as costs of surgical operations, equipment and medical consumables, and overhead.

2.1.4.4 Estimating benefits – quality, access, efficiency

Benefits for each year covered by the assessment are identified according to the stakeholders: citizens, HPOs, third party payers, and others when relevant. In this way, all beneficiaries are included, and the full impact of eHealth is revealed. Three main types of benefits arising from the eHealth investment are

sought for each stakeholder. These are quality, access and efficiency. The impact on quality and access can be direct for citizens, or indirect, by enabling health-care professionals to improve the quality and efficiency of healthcare that they provide.

Five factors facilitating benefits to **quality** are investigated:

- › Informed citizens and carers
- › Information designed to streamline healthcare processes
- › Timeliness of care
- › Safety
- › Effectiveness.

Informed citizens and carers refers to citizens and carers having direct access to data, information and knowledge about their conditions, diagnoses, treatment options and healthcare facilities, to enable them to take effective decisions about their health and lifestyles.

Information designed to streamline healthcare processes allows healthcare professionals to have access to more complete and focused information. As a result, they can be more citizen-focused and more effective in their work.

Timeliness of care refers to appropriate timing of healthcare. This is not necessarily fast treatment. Information is used to enable all types of healthcare to be scheduled and provided at the right time, to meet citizens' needs.

Safety can be improved where information contributes to reducing the risk of potential injuries and to minimising the possible harm to patients.

Effectiveness provides an improved positive impact to resource ratio. This refers to the related service and its outcomes, not the eHealth application itself. Making the best decision on the most appropriate healthcare depends on information about the possible service options and their outcomes, and these can be influenced by eHealth.

Benefits to **access** can have different forms. Equity of access is the same quality healthcare and health related services available to all those in need, when they need it and where they need it. A gain to access can be achieved by the provision of a service to more citizens for a given time period. Better information flows, supported by ICT, can lead to increase in capacity that can provide greater access, also at more locations.

Efficiency benefits are reflected in improved productivity, avoided waste, and optimisation of resource utilisation. Two common signs of increased efficiency are time savings and cost avoidance. Cost avoidance conceptualises the estimated virtual cost of providing the standard of performance as achieved by eHealth, but by conventional methods in use before the eHealth investment. This requires estimates of the staff and other resources needed to provide the same level of service without the eHealth solution. In practice, the eHealth performance cannot be attained easily, if at all, by these means, but the estimated additional cost avoided is a proxy for the enhanced performance of eHealth.

2.1.5 Measuring tools

2.1.5.1 Estimates, optimism bias and contingencies

Collecting and compiling data for the wide range of variables and three time periods covering usually 10 and more years as specified in the methodology rely to some extent on estimation. This is needed to overcome information shortfalls, due to factors such as the historical perspective of a site, sometimes starting in 1994, and the general lack of actual, accurate accounting information about some cost items, not to mention benefits, particularly those accruing to citizens. Even data about some of the more recent factors cannot always be analysed in the required detail, because the local financial and cost systems do not hold the data in the way that it is needed. For future costs and benefits up to 2008, estimation is inevitable. Data were estimated jointly by the local team at each site and the eHI team, and were compared, where appropriate, with data from other sites, and sometimes data known from published sources, to establish their plausibility. This ensures consistency in principles and practices across all sites, and improves the overall reliability of results.

This extensive use of estimated values, indispensable for a pragmatic approach to measuring the impact of eHealth, requires adjustments for optimism bias and contingencies. Estimates of costs and benefits tend to understate costs and overstate benefits. This bias is greater where the basis of estimates relies

more on judgement than facts, and where the person making the judgements is too close to the subject of the evaluation. Some costs are impossible to extract precisely from the total cost of a larger service. Some benefits that are the result of factors indirectly linked to the eHealth application cannot be allocated or apportioned reliably. In order to account for these drawbacks of using estimated data, the eHI methodology uses a contingency adjustment that increases costs and reduces benefits. Contingency adjustments are applied before conclusions about net economic impact are drawn and sensitivity analysis is applied. The size of the adjustment depends on the availability and quality of the actual data and the degree of estimation used at each site. When reliance on estimates is material, the percentage for contingencies is high. For the ten sites evaluated, it ranged between 5% and 40%; however, this range is not restrictive for future evaluations. Differential percentages are applied to costs and benefits in some sites.

2.1.5.2 Monetary values

To use CBA fully and aggregate data, all benefits must be assigned a monetary value. Most data was gathered from internal sources at each site. However, in some cases concrete numbers were not available and proxies from relevant studies were used.

Assigning value to time and other resources saved, or the use of which is avoided because of eHealth, is most common. Time as a healthcare resource is valued in full time equivalent employment costs. Time for individual citizens is valued on the basis of net earnings. The value of other resources is assigned according to market prices. The latter technique is also used for measuring travel costs and time, either as costs to a service, or for measuring the benefit of reduced travel.

Willingness to pay (WTP) is the main estimation method used in eHI evaluations for the monetary value of intangible benefits without a market price or another useful proxy. These are usually benefits to citizens, such as improved quality, convenience, less stress, and more attention from medical staff. The aim is to simulate a market by estimating how much users or beneficiaries will be willing to spend if they could receive the benefit, but only against payment. Where impacts cannot be readily measured and quantified, or prices determined from market data, the WTP can be determined by inferring a price from observations of consumer behaviour. [8] This is a recognised approach used in CBA. Conservative assumptions are made for all estimates to avoid overvaluing benefits.

The merit of the WTP method is that it is a measure that can be used for attributing monetary values to benefits from eHealth applications regardless of the kind of benefit. The only condition is that an improved service is provided, and that someone, a citizen, a professional, administrative staff, is using it. As long

as this is the case, a value can be attributed to the provision of that service. The economic good can be in the from of benefits from services that may range from feeling more comfortable with the knowledge of a complete health insurance cover when travelling to avoiding death through a more effective emergency service control and allocation system.

Quality adjusted life years (QALY), as a summary measure of benefits from a new medical intervention or a new medical device may be used in particular cases, according to data availability and the appropriateness of such a measure. [9] Where eHealth applications improve citizens' experience of healthcare, but do not change the clinical outcome, it cannot be used as a measure for eHI. Similarly, QALYs are not helpful measures for time saving and improved productivity from eHI. The same holds, for example, for ICT in support of administrative processes, such as insurance cover validation. Measuring the impact of eHealth in terms of QALY is thus not appropriate in such settings. QALY have not been found to be an appropriate measure for any of the ten evaluations conducted as part of the study.

2.1.5.3 Present values – discounted cash flow

All monetary values are converted onto a comparable time base by presenting them in present values, using the discounted cash flow technique. For each case study, a discount rate of 3.5% is used to reflect the social time preference rate, opportunity costs and differences in the time value of money.

The present value concept reduces nominal monetary values in the future by the discount rate to show their value at present, thus reflecting an opportunity cost of time. The base year is different for each evaluation. It is the first year of the planning and development phase. For eHI purposes, the actual base year can be different between sites, as the aim is to show costs and benefits over time for each site.

2.1.5.4 Sensitivity analysis

The results of the evaluation are always tested for robustness by a sensitivity analysis. This consists of:

› Increasing the costs in every year by 50%
› Decreasing the benefits in every year by 50%
› Increasing the discount rate by 50%
› Decreasing the discount rate by 50%.

It is observed whether the findings of the evaluation, like net benefits and time to achieving those, change materially as a result of any of the above four manipulations. Possible reasons for such changes can be identified, such as the nature of assumptions, or expected small difference between costs and benefits up to the last year of forecast.

2.1.6 Technical tools for calculations, analysis and reporting

A mathematical spreadsheet tool is an adequate means for applying the eHI methodology. It comprises several sheets:

- Activity data
- Cost data
- Benefits data
- Data summary
- Calculations
- Values and information on non-generic themes as appropriate, such as the impact on a group of citizens or a part of a service, according to the specific case.

Table 1 provides an example of a data summary sheet.

The cases are described according to a common template in a well-structured text format. It has six main headings:

› Executive summary
› Policy background and context
› The subject of the case study
› Case analysis
› Technical characteristics of the eHealth application
› Conclusions.

Every case analysis includes several standard eHI charts that show:

- Changes in utilisation levels
- Present values of estimated ***annual*** *benefits and costs*, identifying the first year where the present value of estimated annual benefits exceeds annual costs
- Present values of estimated ***cumulative*** *benefits and costs*, identifying the first year where the estimated present value of cumulative benefits exceeds cumulative costs
- Changes in productivity, measured as unit costs
- Distribution of benefits between main stakeholder groups.

Name of site	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008
	€000	€000	€000	€000	€000	€000	€000	€000	€000	€000
Estimated COSTS										
eHEALTH INVESTMENT										
ICT application	0	0	0	250	562	936	1,560	2,496	4,056	6,240
Organisational activities										
ANNUAL OPERATING COSTS of service	130	260	520	1,073	2,646	4,801	8,640	14,585	25,030	40,901
Total estimated costs	**130**	**260**	**520**	**1,323**	**3,207**	**5,737**	**10,200**	**17,081**	**29,086**	**47,141**
PV of total costs	**130**	**251**	**520**	**1,193**	**2,795**	**4,830**	**8,298**	**13,425**	**22,088**	**34,589**
PV of cumulative costs	**130**	**381**	**901**	**2,095**	**4,890**	**9,720**	**18,018**	**31,443**	**53,531**	**88,120**
Estimated BENEFITS										
Citizens	0	0	0	30	285	840	1,860	3,698	6,783	11,773
HPOs	0	0	0	-	731	1,624	4,548	10,409	23,869	49,716
3rd party payers	0	0	0	-	1,052	2,338	6,545	14,981	34,354	71,554
eHealth provider (if not 1 of the above)										
Total Estimated Benefits	**0**	**0**	**0**	**30**	**2,068**	**4,802**	**12,953**	**29,088**	**65,006**	**133,043**
PV of benefits	**0**	**0**	**0**	**27**	**1,802**	**4,043**	**10,537**	**22,863**	**49,366**	**97,618**
PV of cumulative benefits	**0**	**0**	**0**	**27**	**1,829**	**5,872**	**16,409**	**39,272**	**88,638**	**186,256**
NET BENEFITS										
Net benefits not discounted	**-130**	**-260**	**-520**	**-1,293**	**-1,140**	**-935**	**2,752**	**12,007**	**35,920**	**85,902**
PV of net benefits	**-130**	**-251**	**-520**	**-1,166**	**-993**	**-787**	**2,239**	**9,437**	**27,278**	**63,029**
PV of cumulative net benefits	**-130**	**-381**	**-901**	**-2,067**	**-3,061**	**-3,848**	**-1,609**	**7,829**	**35,106**	**98,136**
Unit costs - cost per download					10.87	9.72	6.43	4.91	3.64	2.88
Service utilisation - Nr. of downloads	0	0	0	0	450,000	1,000,000	2,800,000	6,409,000	14,696,500	30,610,710

TABLE 1: EXAMPLE OF A DATA SUMMARY SHEET

2.2 Sites for developing and validating the methodology

2.2.1 Proven eHealth solutions

The eHI methodology was not created in isolation. Rather, through an iterative, stepwise approach it has been developed by the study team, applied, tested, adapted and improved based on concrete experience and lessons learned together with the many colleagues and professionals involved at the local level at each site. Across the European Union, ten sites with proven eHealth applications were selected to demonstrate the economic impact of eHealth services.

Each of these sites was selected to cover a well-bounded, comprehensive eHealth solution. As is known from systems analysis, to look at just one small, single element may render wrong conclusions because a significant improvement there may lead to even worse bottlenecks at several other locations with an overall negative impact.

2.2.2 First two sites

A sequence was applied to site selection. Two sites, the NHS Direct Online (NHSDO) service in England, UK, and Kind & Gezin (K&G) vaccination service in Flanders, Belgium, were selected early in the project, and the initial eHI methodology was tested with them. As a result, some changes and improvements were made. These included an increased significance of cost-avoidance factors in benefits, and improved precision in their estimation and inclusion in the eHI

analysis. Another change was the practice of identifying the critical factors in the evaluation. For example, some costs and benefits could be the same for both types of settings, with and without eHealth. These rendered them less critical, or neutral to the analysis, and enabled equivalent factors to be identified in the other eight sites. A third factor was the scope to draw data from the findings from other studies, and apply these at each site. An example is the use of data from the eUser [10] study as a proxy for estimating some of the NSHDO benefits.

The two sites also revealed the need to rely more extensively on estimates. Comprehensive actual data, even from a few years ago, is seldom available. Reliance on estimates was inevitable. As a result, the need for the contingency adjustments for optimism bias gained more importance.

At K&G, the need was revealed for additional analysis to reflect the impact of eHealth on specific events that would not be generic. In this case, they were cessations of vaccination supplies. A specific analysis was needed to show the beneficial eHealth impact in this unusual setting.

With two sites that were so different, the initial eHI model was applied with different emphases. This confirmed the initial concept that whilst the eHI methodology can be generic, the eHI model must adapt to the sites, not the data of the sites adapt to the eHI model.

2.2.3 Next eight sites

The further eight sites offered a wide range of different eHealth and healthcare settings, including electronic patient records, a nation-wide medical record system, ePrescribing, dispatch service for ambulances, or supply chain management. The methodology continued to be refined within the eHI evaluation principles. In particular, the eHI model was adapted to fit each sites' eHealth solution. This ensures that the findings are not distorted by methodological factors, and also retains the consistency needed for the virtual health economy analysis.

2.3 Outlook

Development of the eHealth Impact methodology and translating it into a practical and pragmatic tool adaptable to a wide variety of eHealth investments was complex. Confronting theory with reality and the data availability in the healthcare environment, dealing with administrative structures and professional colleagues who are not used to such a terminology and whose foremost responsibility is to care for citizens and patients, and not to support an economic evaluation, turned out to be a task not as fast accomplished as we assumed when embarking on this exercise.

But, the results achieved have been worth it. The initial assessment of the performance of all ten sites shows that eHealth was, and can be expected to be, a significant factor in the improved economic performance of healthcare. The data on economic performance reflect the often very positive, and sometimes multi € m economic impact that eHealth applications and services have already achieved. It can be expected at an even larger scale in future. Benefits can also be expected from many applications already implemented, or about to become reality. However, our empirical results should be transferred directly to other sites only where the context and the effectiveness of the eHealth application, and the associated changes in organisation and process, are equivalent. The selection of the ten sites evaluated by eHI was not random, and the results are to be seen as an indication of the potential of eHealth, not of average performance.

3. Summary of findings from the ten eHealth case studies

3.1 Economic impact

All ten cases show a positive economic impact, measured as a net benefit at present values. High-level measures are listed in Table 2. The ranges of the results are very wide, reflecting the material differences between each type of eHealth application analysed.

TABLE 2: SUMMARY OF ECONOMIC FINDINGS ACROSS 10 SITES UP TO 2008

	average	min	max	range
Distribution of benefits				
Citizens	43%	1%	96%	95%
HPOs	52%	4%	99%	95%
Third party payers	5%	53%	53%	0%
First year of annual net benefit	4	2	7	5
First Year of cummulative net benefit	5	2	8	6
Decrease in unit costs	51%	9%	97%	88%

running costs of the existing service without eHealth. For the ten cases, benefits were realised very shortly after implementation was completed and utilisation was underway.

With respect to utilisation, different patterns have been observed: sometimes the service reaches a high to very high usage rate within a short period of time, particularly when supporting or expanding an already existing service. In cases where a new service is introduced, it may take quite some time to gain ground, and only after a critical mass has been achieved and effects of network economics start to work.

3.1.1 First year of net annual benefit

For the ten cases together, the present value of annual benefits exceeds annual costs, also in present value terms, for the first time in year four, on average. The earliest achieved annual net benefit is in year two, and was achieved by three of the ten cases: the teleradiology consultation service between Sweden and Spain supported by Sjunet, the electronic Gesundheits [Health] Card Europe (GCE) service of AOK Rhineland and the storage and supply chain support system delivered by Medical Order Centre (MOC). Cases with the longest timescales to the first year of net benefit are Institut Curie's Elios and Prométhée, its electronic patient record and search meta-engine, and IZIP's Internet-based, nation-wide citizens' health record systems. These took seven years for the benefits to exceed costs for the first time. Longer time scales are largely due to the complexity of the eHealth settings and the lack of experience to draw from when addressing the complex challenges in such a new and innovative way, during the 1990s. In cases where the eHealth application is upgrading or modifying an already existing service, expenditure on eHealth investment is usually needed during the development stage, in addition to the

3.1.2 First year of cumulative net benefit

When the present values of annual costs and benefits are accumulated, the time needed for total benefits to exceed total costs associated with an eHealth application can be identified. For the ten cases, this is in year five, on average. The fastest achieved cumulative net benefit is Sjunet teleradiology application, in year two. This is due to pre-existing ICT applications, which allowed teleradiology between Sweden and Spain to be implemented without substantive investments. Institut Curie and IZIP needed eight years to realise a cumulative net benefit. Differences are mainly due to the nature of the eHealth investment, its healthcare setting, the time taken to reach high utilisation volumes, or the duration of development.

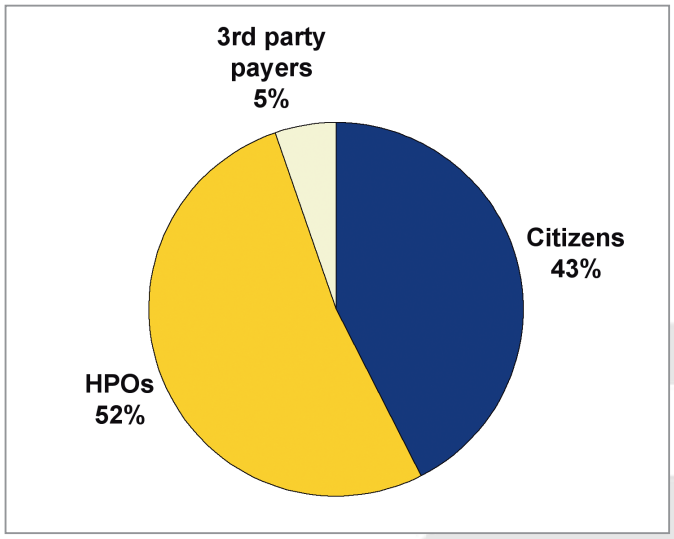
Once the cumulative benefits exceed the costs, the gap between them is sustained. This is the most distinctive, common feature of the economic impact of all ten proven eHealth applications.

3.1.3 Distribution of benefits

Citizens and HPOs are the two main beneficiaries, as shown in Chart 1. There is a wide range of benefit distribution. On average, citizens receive about 43% of the eHealth benefits directly. HPOs receive about 52%, which supports an economic case for the role of HPOs in investing in eHealth.

Direct benefits in terms of positive gains or cost avoidance to insurance companies and other third party payers occur at a substantial level in one of the ten cases only, IZIP, which explains the low proportion of summary benefits credited to these stakeholders. Third party payers sometimes experience direct expenditure savings and indirect, second order, effects, which show up on the cost side of the evaluation. These are not included in the distribution of benefits shown in Chart 1.

CHART 1: AVERAGE DISTRIBUTION OF BENEFITS ACROSS 10 SITES FROM 1994 TO 2008



3.1.4 Utilisation

Utilisation is a core determinant of benefits. The cases revealed two types of utilisation curves:

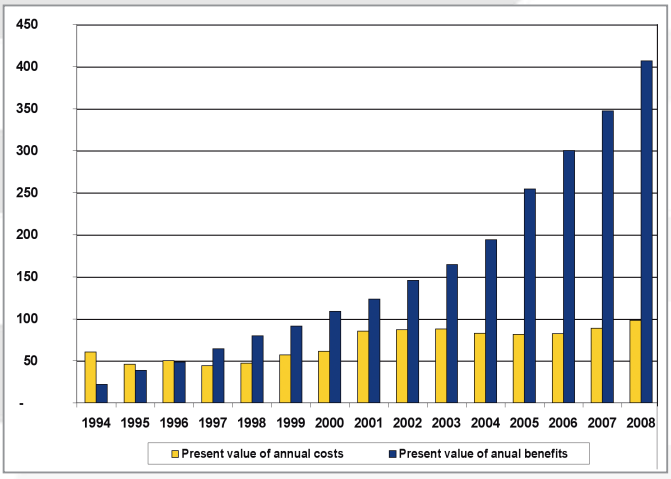
- Steady increase over a longer period of time, either gradual, or at an increasing rate
- Rapid surge in a short time period as implementation moves into operation.

A steady increase reflects the gradual roll-out of an eHealth solution. These were found in NHS Direct Online, Danish Health Data Network, eRecept, Elios and Prométhée, and IZIP. Rapid surges tend to reflect a comprehensive, swift change in some central process. DISPEC is a good example, as the electronic ambulance dispatching system replaced the old paper-slip based procedures within days.

3.2 Economic impact on a virtual health economy

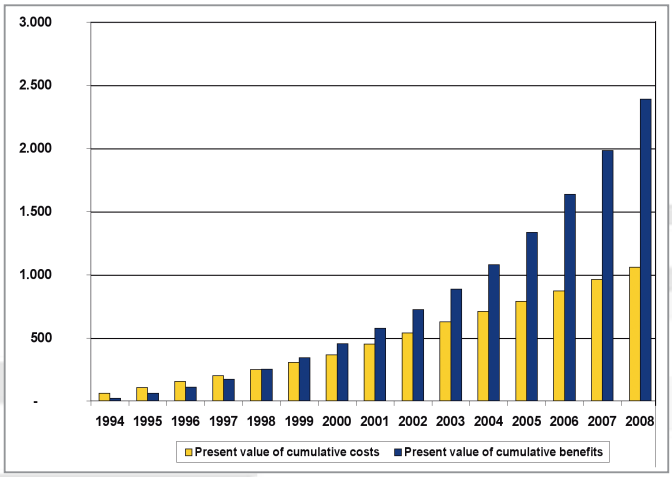
When all ten cases are, in summary, regarded as part of an eHealth dynamic in the equivalent of a virtual health economy, the combined results illustrate very impressively the potential of the economic impact of eHealth, as shown in Chart 2. Over the period 1994 to 2008, the summarised annual present value of benefits grows continuously from below € 20m in 1994 to about € 200m in 2004 and estimated € 400m in 2008. Conversely, the associated costs stay broadly stable after the initial planning and implementation phases, and do not reach beyond € 100m per year, as can also be seen in Chart 2.

CHART 2: ESTIMATED PRESENT VALUES OF ANNUAL COSTS AND BENEFITS OF EHEALTH FOR A VIRTUAL HEALTH ECONOMY OF 10 SITES FROM 1994 TO 2008, in € mill.



This surge in net benefits is also reflected in the cumulative present values of costs and benefits in Chart 3. Cumulative costs rise in a linear curve, despite the different individual investments having different peak years of investment expenditure. In contrast, the cumulative benefits increase exponentially during this time period.

CHART 3: ESTIMATED PRESENT VALUES OF CUMULATIVE COSTS AND BENEFITS OF EHEALTH FOR A VIRTUAL HEALTH ECONOMY OF 10 SITES FROM 1994 TO 2008, in € mill.



These findings are drawn from ten successful, proven eHealth applications and are therefore exemplary. None of the ten applications on its own shows such an impressive performance, but these results may be taken as an indication of the potential overall benefits to be expected from a wide diffusion of successful eHealth applications across the European Union.

These virtual health economy findings cannot be used to infer that all proposed eHealth investments would follow the same economic pattern because the sites were not selected at random; they were all proven eHealth investments. Furthermore, as was observed also by the OECD, "technological improvements that enhance efficiency are not necessarily accompanied by cost savings in health budgets or society." [11]

3.3 Benefits to the quality and performance of healthcare

Information on its own seldom provides direct benefits. It is when it is used in decision taking, new actions and new processes that benefits can be realised. The benefit categories below emerged from the synthesis of the evaluation of the ten sites.

They are similar to, but not the same as the quality aims for a 21st century healthcare system defined by the USA Institute of Medicine (IOM). [12] They are also consistent with the eHI specifications of quality, access and efficiency. Each of the first five categories contributes to improvements in healthcare quality: a goal of eHealth investment identified in each case. Access and efficiency can also have an impact on the quality of healthcare provision, yet they can be affected without a necessary change in quality as well.

In the following, the benefit categories are defined briefly, followed by a summary qualitative evaluation across all sites.

Quality:

Informed patients and carers

Patients and carers have direct access to data, information and knowledge about health issues and the impact of life styles and behaviour on health and wellness, prevention, their conditions and vital parameters, diagnoses, treatment options and healthcare facilities, to enable them to take effective decisions about their health and lifestyles.

Information designed to streamline healthcare processes

When healthcare professionals share this type of information, they can be more patient focused and so add to the benefits for patients.

Timeliness

Information is used to enable all types of healthcare to be scheduled and provided at the right time, to meet patients' needs.

Safety

Information contributes to reducing the risk of potential injuries and to minimising the possible harm to patients.

Effectiveness

Information enables healthcare to be developed, planned, scheduled and derived from evidence and provided consistently to patients who can, or may, benefit, and not provided to those who can not; healthcare professionals are enabled to work effectively in multi-disciplinary teams which share responsibility for the patient.

Access:

Information ensures that healthcare is available and accessible at the same standard to all those in need.

Efficiency:

Information enables productivity to be improved, waste to be avoided, resource utilisation optimised and costs contained to budgets.

For each of the ten eHealth applications, its fit to the benefit categories has been rated subjectively by the eHI team, using a three star method. No stars is no fit; one star is some, but not a good fit; two stars is a good, but not comprehensive fit; three stars is a good, comprehensive fit. The ratings reflect the performance of each individual application against the benefit category. As the applications are quite different, the ratings cannot be used to compare the scope of the impact, as shown in Table 3 below.

Three benefits categories are prevalent across all ten eHI cases. They all contribute extensively to improved timeliness, effectiveness and efficiency. Two benefit categories, informed patients and carers and access, are not prevalent at all eHI sites. Where they are, they are specific functions of the eHealth application.

TABLE 3: THE BENEFITS FROM EHEALTH ACCORDING TO THE IDENTIFIERS CATHEGORIES

	Informed patients and carers	Information designed around the patient	Timeli-ness	Safety	Effective-ness	Efficiency	Access
AOK GCE	**	**	***		**	***	***
eRecept		**	***	***	***	***	
DISPEC		***	***	**	***	***	*
Institut Curie		***	***	**	***	***	
IZIP	***	***	**	**	***	***	*
Kind en Gezin	*	**	***	**	***	***	***
MedCom		**	***	**	***	***	
MOC			***	*	***	***	
NHSDO	***	*	***		**	***	*
Sjunet – radiology		**	***		***	***	**

4. The potential of eHealth – facing the challenges of modern healthcare

The economic performance of all ten cases confirms the, potentially, potent role of effective eHealth as an important strategic resource in helping to solve the problems of modern healthcare. Our results show that eHealth applications, taken together, as in our virtual health economy aggregation, can help to meet growing demand, improve quality and expand capacity. This is at an increasing rate, as was shown in Chart 2 above.

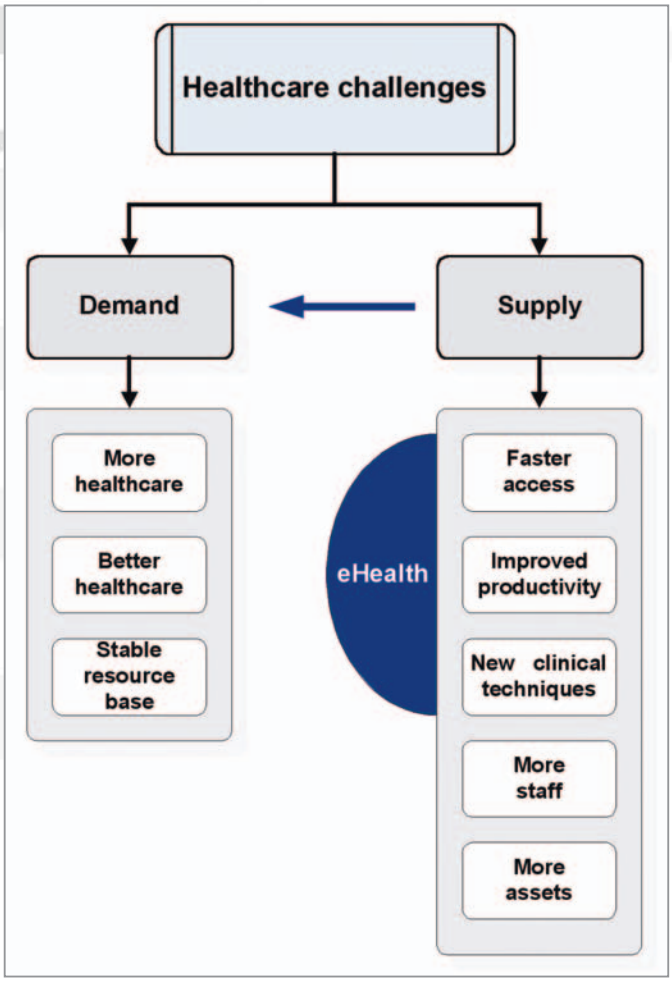
It takes about four years, on average, to reach a level of benefits that exceed the costs.

This means that spending on eHealth must be dealt with as an investment in healthcare resources alongside, or perhaps as an alternative to, other investments in staff and assets, over a medium to long-term strategic horizon.

eHealth supports the supply side in meeting the increasing demand for healthcare. The interaction of supply and demand in healthcare can be summarised as illustrated in Figure 1.

Healthcare providers can use eHealth to effectively expand their capacity and performance to meet increasing demand by using their resources to better effect.

FIGURE 1: SUPPLY AND DEMAND IN MODERN HEALTHCARE SYSTEMS



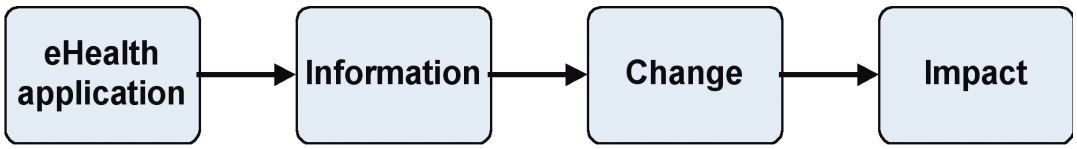
The demand for better quality is an almost inevitable consequence of the advances in medical science and technology and the desire to extend life years. The continuous expansion in demand is associated, among other things, with the spread of chronic diseases and the ageing population in developed countries. The growth in benefits from eHealth can contribute to meeting this increase in demand. On the other side, eHealth can also help cope with resource limitations by adding capacity to the supply side, at a broadly stable cost.

5. Success factors and lessons learned

5.1 Process change and benefit realisation

Information is part of a process of benefits realisation as expressed and simplified in Figure 2.

FIGURE 2: THE PROCESS TO BENEFIT REALISATION



Neither ICT applications, nor information by itself bring benefits. The gains in all ten sites come from changes in processes or working practices that are more substantial than replacing paper with an electronic document, which may have been the trigger to benefit realisation.

The implementation of ICT leads some sort of changed information. This can be, for example, a different information flow; more appropriate information; less, better focused information; faster access to information; different form and structure of presentation of information.

This gives an impetus to some more substantial changes in, for example, clinical processes, working practices and workflow in healthcare, administrative or support services. The change can also be in the form of faster or otherwise improved execution of familiar procedures.

It is this change that brings about the impact seen at the end. The impact for the 10 eHI sites was the realisation of a great variety of different types of benefits. This was the expected outcome for these eHealth application sites. It must be stressed, however, that the impact can also be negative. [13] Not every eHealth application will lead to realisation of substantial benefits, let alone sustainable net benefits. The process summarised in Figure 2 applies just as well to application of ICT with a negative impact.

5.2 The importance of multi-disciplinary teams

A critical success factor is the *multi-disciplinary* nature of the teams involved in the planning, development, implementation, and operation of eHealth applications.

This is because they

- Facilitate in a more balanced way change in clinical and working practices
- Improve communication with all stakeholders impacted and well-reasoned decision taking
- Can more effectively deal with integrating key issues of healthcare, ICT, procurement, project management, change management, training
- More easily obtain the backing from the top to drive the process of change.

Adequate and continuous effort to initiate, support and sustain change was essential to achieving benefits from an eHealth application. For more complex applications, several members of the teams need multi-disciplinary skills in order to coordinate and drive other team members with specific expertise. For larger eHealth applications, each person may be a member of several such teams. Team profiles may include both a breadth and depth of knowledge and experience of:

- The potential of ICT for applications in health-service related contexts
- When to use external and when internal skills and resources
- How to procure and manage services from ICT suppliers and in-house teams

- How healthcare functions, and how the various process elements need to interact as a healthcare chain or value system
- Clinical knowledge of healthcare practices
- How to achieve organisational change in complex settings.

This knowledge and experience, alone, is often not enough. All teams, especially at Institut Curie, were integrated with the corporate vision for delivering safer, higher quality healthcare supported by eHealth and with the executive decision makers, who know and see eHealth benefits. It is seldom possible to find all these attributes in one person, but a successful team seems to perform as though it was. Successful multidisciplinary teams also have considerable personal credibility with stakeholders through one or more of the team members, and so can engage users, especially doctors, from the initial eHealth stages through to securing their commitment and acceptance for routine use.

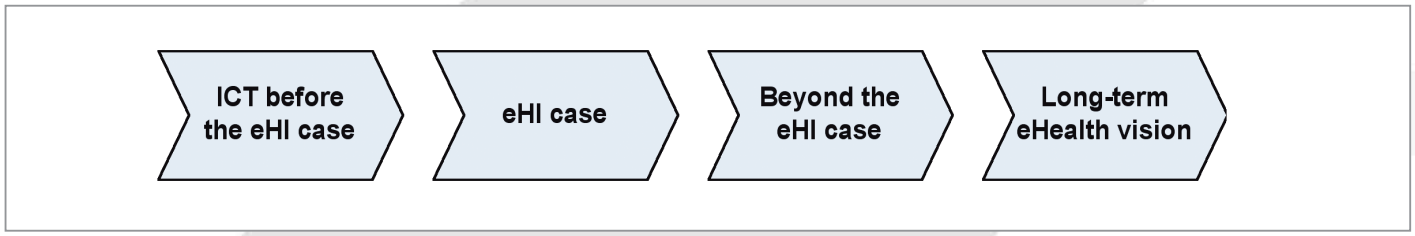
5.3 eHealth dynamic

Each case included activities by team members in their present organisation that preceded the eHealth application. These were essential to achieve a critical mass of expertise and experience needed to drive the dynamic into the direction of a longer-term goal. Continuous investment and development at a corporate level, not a single eHealth solution on its own, is the norm at all ten sites. The subject of each case study was not a final goal. These processes, together, represent the respective organisation's eHealth dynamic, a continuous chain of ideas, developments and realisation of benefits from numerous individual eHealth investments, as shown in Figure 3.

A series of planning and development steps before, during and after the point in time of the eHI evaluation of 2005, were identified in all studies. In many of the cases, progress was reviewed by stakeholders and new short-term goals and directions were set that meet stakeholders' needs. At Institut Curie, a regular comprehensive review of progress and the planned next steps is undertaken every two years. In the Czech Republic, representatives of IZIP's stakeholders meet twice a year to discuss and review achievements and further steps. These performance reviews enable the eHealth focus and goals to be updated and reset to reflect the need for new solutions, new opportunities and changes in relative priorities, and also to adapt to a changing regulatory environment and new priorities of national health systems. In this way, the eHealth dynamic is responsive to changing information needs and drives the continuous realisation of benefits. Another feature of all ten cases is that the goals set reflected pragmatic considerations rather than a drive towards perfectionism from the very start to realise a fixed, long-term strategy. Exemplary here are the Danish Health Data Network and IZIP, the Czech national patient record system, which were set up with the goal to facilitate communication among healthcare providers and citizens.

The conclusion is that the successful approach to implementing effective eHealth applications is a pragmatic series of steps and developments. Future investors should not expect miracles and big-bang-type faultless and complete applications, especially in more complex cases where large amounts of data and organisational effort are required. At the ten eHI sites, there is a clear vision of long-term goals, but usually not a fixed long-term strategy towards those goals.

FIGURE 3: SIMPLIFIED STRUCTURE OF AN EHEALTH DYNAMIC BASED ON AN EHI EVALUATION



To have concrete short-term assignments, in combination with flexible long-term strategies, is an important practical lesson to be learnt.

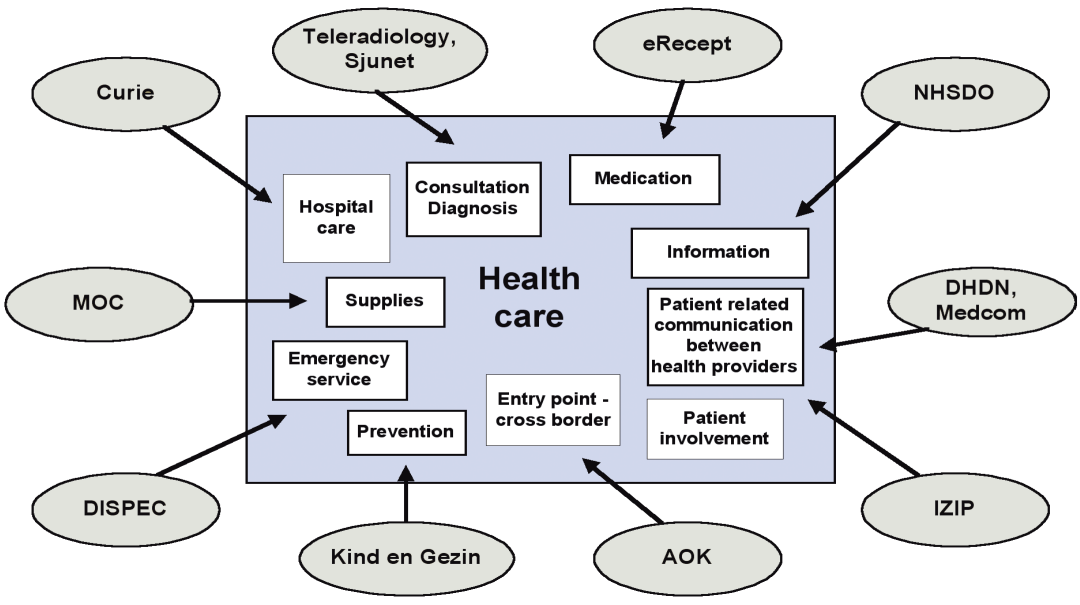
5.4 Meeting concrete needs

At each site, the eHealth investment focuses on addressing well-defined needs, either of citizens, or related to the process of health and healthcare provision. This can be in the form of solutions to problems, as well as process optimisation addressing the need for more timely, more accurate, or easily available healthcare, information about health and lifestyle, or any other health related service.

It is not always the citizen that the eHealth application is aiming to benefit directly. Often, eHealth improves specific, but comprehensive elements of the health-care process, which in turn benefit citizens indirectly. The type of eHealth investment that focuses on changing processes that benefit citizens is as appropriate as aiming at a direct impact on patients. The important point is that the use of ICT is not technology driven and imposed on processes not requiring significant changes. Rather it addresses a concrete optimisation, or other, need or problem.

FIGURE 4: EACH OF THE TEN EHEALTH SITES FOCUSES ON SATISFYING NEEDS AT DIFFERENT PARTS OF HEALTH AND HEALTHCARE PROVISION

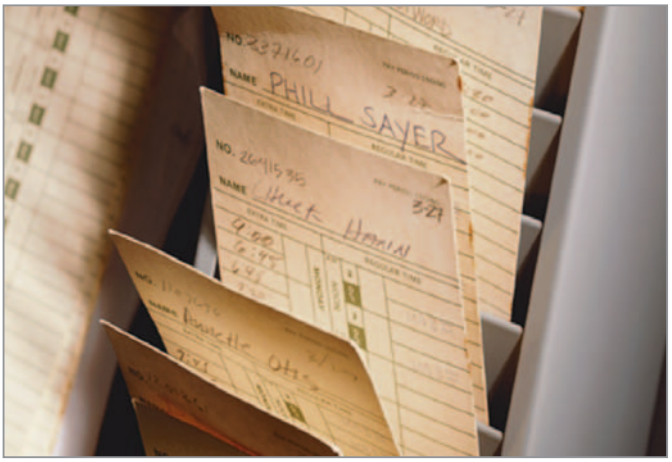
Figure 4, without claiming to present a comprehensive depiction of the health and healthcare value system, illustrates the areas in this system that the ten eHI sites focus on. At NHS Direct Online (NHSDO), and to a certain extent the AOK health insurance cross border application, eHealth focuses directly on the citizen. The Medical Order Centre (MOC) supply chain solution is a clear example of the patient not being directly addressed; here, the eHealth application provides a direct benefit to the hospital by optimising the procurement of supplies. This, in turn, benefits citizens by improving the efficiency of the healthcare provided. Curie's Elios and Prométhée electronic health record and meta-search tools, MedCom's national message exchange network, and the IZIP national health record system support the work of health-care professionals and HPOs, and so facilitate better healthcare for citizens. Similar considerations apply to the eRecept solution in the county of Stockholm, and the teleradiology service between Sweden and Barcelona, Spain. Kind en Gezin is a public health application with great benefits to children, and the DISPEC emergency service in Bucharest, Romania, benefits all persons living or travelling in this metropolitan area.



5.5 Project and change management

There are some important differences in the characteristics of eHealth investments across the ten sites. Some have a rapid impact on users, others take several years of development time before utilisation and benefits can be realised. For each type of site, the nature of the eHealth application, and the healthcare setting, determine the change management goals.

For some sites, especially at HPOs with complex service and information structures, and applications with long development periods, benefits realisation includes complex changes to switch from clinical and working processes without eHealth to new ones that use eHealth. In these settings, effective change management resources are particularly critical to benefits realisation.



Benefits form eHealth applications that are utilised directly by citizens tend to show a high correlation between rates of change in utilisation and benefits realised. This reflects the greater role of the citizen as the direct beneficiary from the effective use of eHealth, and so a strong momentum, underpinning the benefits. For these solutions, change management is normally less complex.

Similar relationships can be found in managing eHealth costs. Resources are often deployed over long time periods, and not always with a firm relationship with eHealth utilisation. In these settings, strict project management is essential to control spending so that it does not erode, or defer, the onset of net benefits from the eHealth investment. On the other hand, some solutions of considerable direct benefit to citizens show low marginal costs as utilisation increases strongly.

These factors emphasise the need for effective project and change management. Leaders in the core eHealth team must have these skills at well-developed levels to achieve the clinical commitment needed to realise the net benefits from eHealth.

5.6 Transferability of applications

Most of the ten sites can be regarded as pioneers when they started planning their eHealth investment. Then, they had few concrete reference points and comparators to draw from, especially in the 1990s. They had to rely on their own grasp of ICT's potential to change healthcare, and to learn on the job during their period of innovation. In this setting, learning curves have relatively flat slopes. If these pioneers were starting now, but with the knowledge that they have gained, it is feasible that the time needed to reach a positive net benefit would be shorter.

For the people who follow, and draw from the pioneers' experience, the learning curves may extend across a shorter time period till peak performance is reached, and so will be steeper. In all ten cases, the ICT component of eHealth can be transferred and adapted to other settings, albeit with some technical effort and modifications. However, the organisational component of eHealth, such as changing work processes and creating and sustaining multi-disciplinary team working, cannot be transferred so easily.

The implications are that subsequent eHealth investment has the potential to shorten the time needed to achieving a net benefit, but this will depend on the pace at which the organisation can learn and adapt. Replicating the ICT solution alone will not be enough.

6. Policy recommendations

The eHI findings point to some important recommendations to policy makers at all levels: local, national, and EU. In strategic terms, the overarching conclusion from the ten detailed site analyses is that eHealth in support of meeting citizens' healthcare demands can have - given the 'right' approach, context and implementation process - substantial economic impacts and benefits, and is therefore worth encouraging. Key success factors to achieve such outcomes where identified above.

However, to pursue and accelerate the realisation of these benefits, health system decision makers as well as healthcare providers and third party payers must implement polices which foster such results. They must ensure the right mix of eHealth applications in order to achieve the goal of increasing benefits at stable costs. The following specific recommendations towards this goal are made:

- **Support successful investment in eHealth because of the significant and sustained positive economic impact possible:**
  - › Integrate eHealth strategies into overall health system and healthcare strategies
  - › Provide incentives, such as tax breaks, regulatory or other advantages like adequate reimbursement
  - › Invest directly, with co-funding, or even full funding, by governments or third party payers in national and other infrastructure eHealth applications benefiting society, but not sufficiently benefiting an individual healthcare provider or private investor

- **Ensure the investment is appropriate:**
  - › Monitor the mix of existing applications and adjust efforts in order to optimise benefits achieved. Focus on changes in processes and working practices
  - › Analyse and treat eHealth alongside other investments in healthcare systems and provision, both as complementary and substitutive
  - › Base eHealth investment decisions on clear business cases that focus on the benefits to be gained and the needs that will be addressed
  - › Reflect eHI findings in eHealth strategies and investment decisions, especially realism in time periods allocated for achieving net benefits, setting realistic goals to be realised in progressive stages, and committing the resources needed for essential enablers
  - › Ensure strong support for change management and organisational adaptation
  - › Invest in training and education to create stable multi-disciplinary teams, and extend this to structured training to expand the personnel available.

- **Ensure meaningful investment is allowed to work by providing the appropriate framework and environment:**
  - › Invest in relevant RTD and innovation research, education and curriculum development
  - › Support research to better understand organisational change processes, including analyses of failures
  - › Support continuing professional development and retention of eHealth ICT expertise in health systems and provider organisations
  - › Disseminate case studies and develop application models of successful eHealth dynamics
  - › Develop a business case framework in support of eHealth investment decisions
  - › Use the eHealth Impact methodology to monitor performance of investments and identify corrective actions
  - › Continue to analyse more applications and services in diverse settings to compile more evidence about economic performance from other healthcare settings across Europe.

The next most important step towards guidance, encouragement, and support toward investment in effective eHealth is to adapt and use the methodology developed in the eHealth Impact study for ex ante appraisal of investment opportunities. Further, and in parallel to that, a methodology for investigating affordability and financing options complementing the eHI analysis should be developed. This would be particularly relevant for healthcare providers, which across all our cases gained more than 50% of the benefits, with an estimated monetary value that exceeds their eHealth investment expenditure materially. They seem not to be adequately aware of the benefits they can gain from eHealth, partly because benefits are far too often associated with cash, not cost, savings, which are indeed much lower and may even be negative.

The challenge is for providers to use the eHI cost benefit approach to identify, realise and secure the benefits from eHealth, and finance the required investment. It has been argued that traditional models for return on investment (ROI) are not appropriate for this creative role. "We are running out of time to figure out the return on investment". [14] It is believed that in five years Electronic Medical Records and Electronic Health Records will be a cost of doing business for hospitals wanting to survive in the healthcare marketplace. Instead of looking at ROI, hospital leaders will have to focus on cost and benefits. The eHealth Impact assessment methodology is an excellent base for research, but perhaps more importantly for an investment decision support methodology embracing this approach not only for hospitals, but eHealth applications affecting any part of the health and healthcare value system.

7. The ten eHealth IMPACT evaluation sites

7.1 AOK Rheinland, Germany – GesundheitsCard Europa (GCE), access to healthcare abroad D/NL/B

Until 2004, the administrative procedures for acute treatment of citizens from EU member states when abroad were dominated by various 'E' paper forms. The most common is the E111 form for short period visits, such as holiday travel. On average, about 200,000 citizens insured by AOK Rheinland, a large public insurance fund, were issued an E111 for travel to the Dutch or Belgian coastal regions every year. In 2004, the European Health Insurance Card (EHIC) was introduced in 13 EU member states, including Germany and Belgium. It is a longer-lasting version of the original E-forms. The EHIC is meant to speed up the reimbursement system, by avoiding problems with incomplete or illegible forms and reducing administrative costs. However, the payment settlement process is very bureaucratic and still takes up to two years. Also, introduction of the EHIC has not resolved the serious problem of low acceptance levels, about 50%, of the E-forms. Preliminary data indicates that EHIC performs even worse. Neither has it reduced significantly the risk of fraud. Most EHICs are issued for a specific short journey, yet they are valid for a longer period of time.

Physically, the GesundheitsCard Europa (GCE) is the national health insurance card issued by AOK Rheinland since 2003. The German Techniker Krankenkasse (TK) joined the project in 2004, so the TK insurance card is also a GCE. The GCE was developed and implemented unusually quickly, because AOK Rheinland had previous experience and a good partner network in the field of cross-border healthcare between Germany, the Netherlands, and Belgium. It has been involved in crossborder co-operation activities for 15 years, including the development of the GesundheitsCard International, an insurance card issued jointly by AOK Rheinland and Dutch insurance CZ Actief in Gezondheid to citizens in the Limburg/Aachen border regions, which is being replaced by the GCE in 2006.

The ICT application that makes the GCE service a good practice case of eHealth is the multilingual website http://europa.aok-tk.de. Through this web service, staff in 14 hospitals on the Dutch and Belgium coast regions can instantaneously confirm the insurance status of patients presenting a GCE. Also, reimbursement is processed and completed within 3 months using the web-portal in cooperation with partner insurances in the Netherlands and Belgium.

The advantages of the GCE solution can be seen in light of current practice among non-participating healthcare provider organisations. The low acceptance levels can be explained to a great extent by sheer ignorance and additional administrative costs involved for the healthcare provider organisation. For example, paper copies of the EHIC and valid identification are required, increasing paperwork, staff effort and administration time. The procedure with GCE is paperless and instantaneous. This gives the citizen access to acute healthcare whenever in need of treatment.

The insurance fund has the benefits of providing a better service package and the associated gain in competitive advantage, as well as a reduction in the administrative costs of issuing tens of thousands of insurance certificates every year.

In addition, because insurance status confirmation is instantaneous, the GCE secures payment guarantees for the healthcare provider organisation and reduces the risk of fraud and error.

Core impact:

- Acceptance rate of patients' insurance certificates or EHIC by HPOs increased from 50% to 100%
- No advance payments by citizens, no need for AOK to reimburse them later
- No additional insurance certificate required for travel abroad
- Instant insurance validation at the point of care
- Reduced bureaucratic effort at Healthcare Provider Organisation
- Reduced payment settlement time from up to 2 years to 3 months
- Reduced risk of fraud and error.

Main beneficiaries:

- Some 200 000 citizens travelling to the Dutch and Belgium coast receive healthcare in case of need as conveniently as at home in Germany
- AOK Rheinland benefits from
  - › Gain in competitive advantage
  - › Drastically reduced costs for insurance confirmation abroad
  - › Reduced risk of fraud and error
- Participating hospitals benefit from
  - › Faster payments and
  - › Time savings in administration procedures.

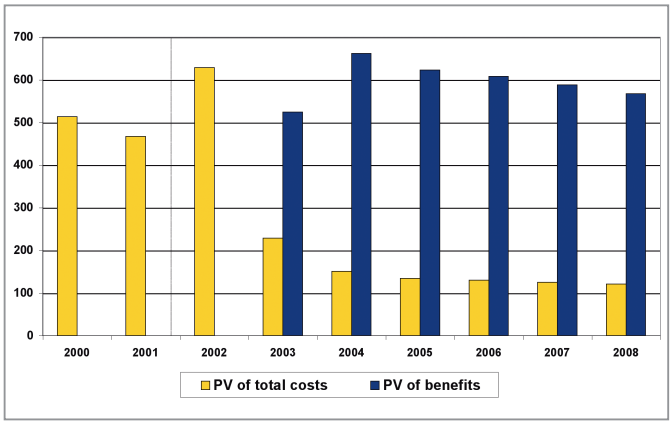
Lessons learned:

- Clear, pragmatic goal for eHealth project, which addresses specific needs, is essential
- User-driven solution has a high probability for high acceptance rates: the application was developed for the benefit of citizens and hospital staff
- eHealth can help overcome constraints of national borders
- A successful eHealth project is a series of continuous investments over time – an eHealth dynamic
- A successful eHealth project is part of a chain of activities.

Economic Results:

- First year of annual net benefit, i.e. when annual benefits exceed annual costs: 2003, year 2
- Estimated annual net benefit for the year 2008: approximately € 450 000
- First year of cumulative net benefit: 2004, year 3
- Estimated cumulative benefit by 2008: approximately € 3.5 million
- Cumulative investment costs, including operating expenditure, by 2008: approximately € 1.5 million
- Estimated productivity gain, measured in decrease in unit costs of providing an insured with a valid and accepted insurance validation certificate for travel abroad: 65%
- Distribution of benefits (direct positive gains) to 2008: Citizens – 96%; Hospitals – 4%

Chart: Present values of estimated annual costs and benefits - 2000 to 2008, in € 000s



Note: The development of the application started in 2002. The costs of providing insurees with valid and accepted insurance certificates for 2000 and 2001 are shown for comparison purposes only.

FIGURE: HOSPITALS ON THE DUTCH AND BELGIAN COAST WITH AOK CONTRACTS

- www.aok-rheinland.de
- http://europa.aok.de
- www.ehealth-impact.org/case_studies/index_en.htm

7.2 Apoteket and Stockholm County Council, Sweden – eRecept, an ePrescribing application

The delivery of ePrescriptions is a joint effort between each county council in Sweden and Apoteket, Sweden's national pharmacy. Currently 42% of all prescriptions in Sweden are transferred from the doctor to the pharmacy electronically via Sjunet, the Swedish ICT network for healthcare, or by using web based prescribing.

There are two ways for an eRecept (electronic prescription) to be transmitted from the doctor to the pharmacy using the electronic Sjunet network. The first is from a primary care electronic record system, which has been supplemented by a new software module to permit sending an eRecept. The other route is by using secure web-based prescribing, which means that the doctor only needs a computer with Internet access although this is not used often. The prescription form is available only to registered clinicians and, when complete, is securely dispatched through Sjunet.

The `e´ part of the service is that prescriptions are being transmitted directly to the pharmacy from the GP's surgery, and from all hospital facilities for inpatients, outpatients, ambulatory care and A&E departments. All hospital pharmacies are also owned by Apoteket.

Conventional prescribing has the patient at the centre of the process. This involves considerable time and effort on the patient's behalf. The patient visits the GP surgery or a hospital from which a paper prescription is generated. The patient then physically takes the prescription to an Apoteket pharmacy where the appropriate medication is dispensed.

eRecepts are transmitted electronically from a GP surgery or hospital ICT system to the pharmacies through the extranet provided by Sjunet. When the eRecept is produced, it can either be sent to a specific pharmacy or to the National Mailbox. The mailbox allows all 900 pharmacies in Sweden to pick up an eRecept so that patients do not have to specify the pharmacist they use for their medicine - they simply choose the most convenient at the time. The mailbox was introduced in June 2004 and has been a success with all the users, especially patients who enjoy greater flexibility and a wider range of services, such as a 24 hour call centre offering advice and home delivery.

If patients know which pharmacy they will use, doctors can simply state this on the eRecept so that the specific pharmacist can expect a visit and a collection. Pharmacists can then check stocks and prepare the prescription for dispensing in advance.

The concrete service evaluated, ePrescribing in the Stockholm County, generates an estimated annual net economic benefit of over € 95m in 2008. In 2005, five years after the beginning of planning and development, there was already a net benefit of approximately € 27m. This is an impressive performance, given the relatively low spending on ICT of less than 4m for the whole period 2001-2008. Healthcare provider organisations obtain 80% of the benefits, mainly from time savings and avoided costs of providing the same timeliness, convenience and reduction in errors without eHealth. The safety aspect of correctly issued and read prescriptions is the main item in the 20% of total benefits reaped by the citizens.

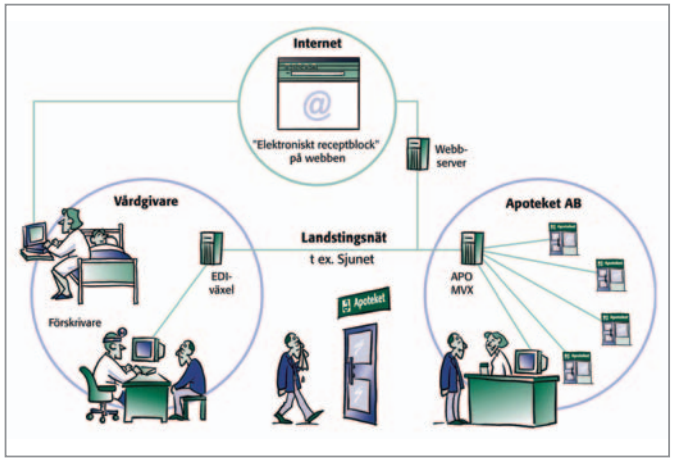
Core impact:

- eRecept increases security and quality of prescriptions because the chain of information between the GP's surgery or hospital and the pharmacy (Apoteket) is unbroken.
- The prescription the doctor writes into the medical record of patients has exactly the same information that the pharmacist uses to dispense the drugs, which has led to a reduction in prescription error both of drugs delivered and suggested dosage by 15%
- There are considerable savings of time for health provider organisations (HPOs). The time saved by HPOs can be used more effectively for patient diagnosis and treatment.

Main beneficiaries:

- Citizens benefit from:
  - › Advice through a dedicated drug information helpline, improving patient knowledge on taking the appropriate medication at the correct times
  - › Overall, a considerable increase in patient safety
  - › Flexibility, in that they can obtain the prescribed drugs from any one of the 900 pharmacies in Sweden

FIGURE: JOURNEY OF THE EPRESCRIPTION



- The health provider organisations, hospitals, GP surgeries, pharmacies, benefit from:
  - › Avoidance of illegible prescriptions, i.e. the pharmacist does not have to call the GP or hospital to verify what is on the prescription
  - › The time saved by doctors and nurses using electronic prescribing is considerable, which allows them to devote more time for patient diagnoses and treatment
  - › Reduced risk of fraud and prescription falsification which previously was problematic
  - › Improved patient drug information for the HPOs as they are able to see what has been prescribed to the patient using the electronic record
  - › Avoidance of duplicate prescriptions which were necessary to replace lost or misplaced prescriptions.

Lessons learned:

- Key driver for eRecept acceptance in Stockholm has been the awareness campaign initiated and sustained by the County Council and Apoteket
- In Stockholm, the main success factor for eEecept is considered to be the high level of cooperation between all, the healthcare providers, the pharmacies and the County Council, who are involved in providing the service, especially the cooperation between the senders and receivers of eRecepts
- A good and clear implementation strategy connected to a national strategy for electronic prescribing and a process of continual review has led to faster up-take of electronic prescribing in the County Council. This clear strategy has resulted in reduced delays and good use of available resources during the implementation phase
- The success of eRecept is also attributable to professional project managers in the HPOs and Apoteket.

Economic results:

- First year of annual net benefit, i.e. when annual benefits exceed annual costs: 2005, year 5
- Estimated annual net benefit for the year 2008: approximately € 97 million
- First year of cumulative net benefit: 2006, year 6
- Estimated cumulative benefit by 2008: approximately € 330 million
- Cumulative investment costs, including operating expenditure, by 2008: approximately € 155 million
- Estimated productivity gain, measured in decrease in costs per prescription: 58%
- Distribution of benefits to 2008: Citizens – 20%; Hospitals – 80%

- www.e-receptstockholm.se
- www.apoteket.se
- www.carelink.se
- www.ehealth-impact.org/case_studies/index_en.htm

7.3 City of Bucharest Ambulance Service, Romania – DISPEC tele triage and dispatch system

DISPEC is a sophisticated, complex emergency ambulance tele triage and dispatch system, developed for and used by the City of Bucharest Ambulance Service (SAMB). SAMB is a strategic medical unit registered as a legal entity. It is a 24 hours available medical emergency service and it provides for the people of Bucharest:

- Pre-hospital emergency medical assistance
- Emergency medical assistance in case of disaster
- Home medical assistance for less acute emergencies
- Preventive medical assistance for large events
- Medical and non-medical transportation
- Transportation of medicines and biological products, such as blood and organs
- Issuance of death certificates on weekends and legal holidays.

During the political and economic crises of the early 1990s, but also nowadays, SAMB has been facing rising costs and limited budgets. Only a significant increase in productivity could ensure the existence and effectiveness of emergency services in the Romanian capital. Thereupon, SAMB decided to develop DISPEC. The system was introduced in 1996. SAMB defined the contents to support internal work processes and the Bucharest software company ROMSYS developed the server-client application. Up to 1996 a paper-based system was in use. Untrained phone operators received emergency calls and filled paper slips with data of the emergency call. A paper slip was carried physically to a co-ordinating doctor, who then tried to identify adequate resources with the aid of radio operators.

Working with DISPEC means that trained phone operators enter the information from incoming emergency calls into the system. In communication with the person reporting the incidence, the operator identifies the nature and severity of the emergency, and gives first advice. Then he or she attributes a presumed diagnosis to one of the four severity levels for emergencies. Next, DISPEC automatically generates the best match with the available rescue teams, which are scattered all over the city area. The radio operators allocate an ambulance equipped with the appropriate facilities and staff and then direct the teams to the emergency sites. In routine care, the match is controlled by a coordinating physician. Time savings occur from a location reporting system based on GPS, allowing operators to identify free ambulances nearest to the location of the emergency.

The system is designed mainly for support in process optimisation, the main beneficiaries of which are the citizens in need. They gain over 80% of the benefits. Despite decreasing resource availability during the 1990s, the ambulance service was able to cope with increasing demand due to the implementation of the DISPEC system. This is reflected in a peak in benefits in the late 1990. After 2003, estimated net economic benefits stabilise at a sustainable level of just over € 1.4m per year.

Core impact:

- SAMB has been able to handle an increasing number of high level emergency calls with the same resources
- Waste of high level resources on low level emergency calls was reduced
- The internal response times dropped dramatically
- The time till arrival at the emergency sites dropped dramatically
- Taking into account the general loss of purchasing power of the Romanian Lei since 1991, SAMB has increased not only productivity, but also maintained the cost-effectiveness of the service.

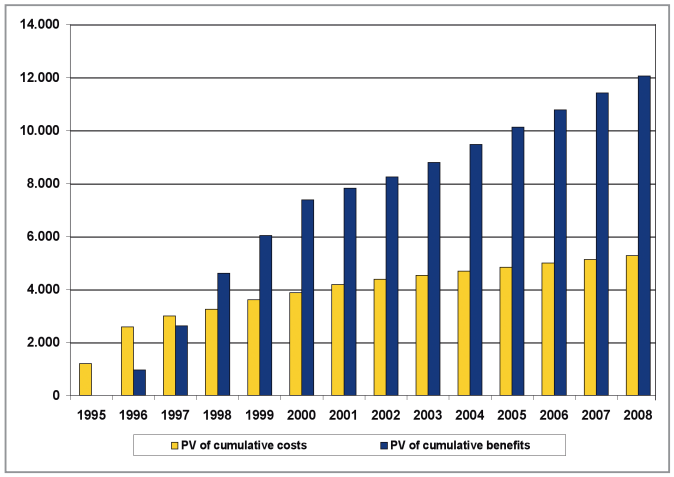
Main beneficiaries:

- Citizens in need can expect to receive timely and high quality help. All citizens in Bucharest, some 2.5m people, benefit from the knowledge that in case of emergency they will be provided with timely access to appropriate care
- SAMB benefits from time and other resource savings. The main benefit to the emergency service provider is the cost avoided in order to provide the same level of service without DISPEC.

Lessons learned:

- A success factor was the focus on a concrete problem, i.e. to counteract the impact from a constantly deteriorating resource base. DISPEC helped improve performance in spite of fewer resources being available (in real terms)
- Continuous development and investment in ICT, an eHealth dynamic, is essential for the sustainability of benefits in view of constantly changing framework conditions
- DISPEC illustrates the importance of effective resource management, rather than following a blind cost-minimisation strategy.

CHART: ESTIMATED PRESENT VALUE OF CUMULATIVE COSTS AND BENEFITS, IN REAL TERMS, in € LEI 100,000s



Economic results:

- First year of annual net benefit, i.e. when annual benefits exceed annual costs: 1997, year 3
- Estimated annual net benefit for the year 2008: approximately € 1.4; peak in 1998 with nearly € 5m net benefit
- First year of cumulative net benefit: 1998, year 4
- Estimated cumulative benefit by 2008: approximately € 35 million
- Cumulative investment costs, including operating expenditure, by 2008: approximately € 15 million
- Estimated productivity gain, measured in decrease in DISPEC cost per call: 38%
- Distribution of benefits to 2008: Citizens – 90%; SAMB – 10%

- www.romsys.ro
- www.ambulanta.ro/
- www.ehealth-impact.org/case_studies/index_en.htm

7.4 Institut Curie, Paris, France – Elios, a comprehensive EPR system, and Prométhée, a sophisticated search meta-engine

Institut Curie, a combined research and treatment hospital in Paris, France, specialises in oncology. Elios is their comprehensive Electronic Patient Record (EPR) system, allowing for access to patient data by all members of the healthcare team involved in the treatment, including external partners such as other hospitals or GPs. Related to this is Prométhée, a sophisticated, yet very user-friendly search meta-engine tool that enables healthcare professionals not only easy access to Elios but also to ask, at the same time, medical questions across a large number of Curie's other hospital (patient and administrative) and clinical research databases. This enables fast data compilation and analysis, particularly for research and quality assurance, as well as statistical and administrative evaluation purposes.

Elios and Prométhée together fundamentally transformed healthcare processes, improved the quality of care, supported the change towards a paperless hospital, and led to considerable economic gains. The tools were designed to improve Institut Curie's medical as well as research and administrative performance. This explains why Curie reaps about 92%, and citizens 8% of the annual benefits, estimated at between € 4 and 5 million. Elios is a large-scale, ongoing project, conducted with external support by 4 IT companies, and includes a fully integrated electronic patient record (EPR), which allowed the transition from a paper records system to a paperless hospital. In comparison, Prométhée is a small-scale project, funded by resources internal to Curie, and which has still to reach its full potential. This is reflected in the shares of costs and benefits allocated to the two ICT tools. Most of the estimated overall benefits, 91%, come from Elios, with Prométhée contributing 9%. For a large institution the initial, i.e. to the point in time when it started to pay off, investment sum of around € 3m over 7 years was relatively modest, especially in comparison with the annual net benefits, estimated at a sizeable € 3m to 4m since 2002. The whole eHealth application took 7 years to achieve an annual net benefit and 8 years for a net benefit on a cumulative basis. The estimated productivity gain, measured in eHealth cost per patient, was found to be 17%.

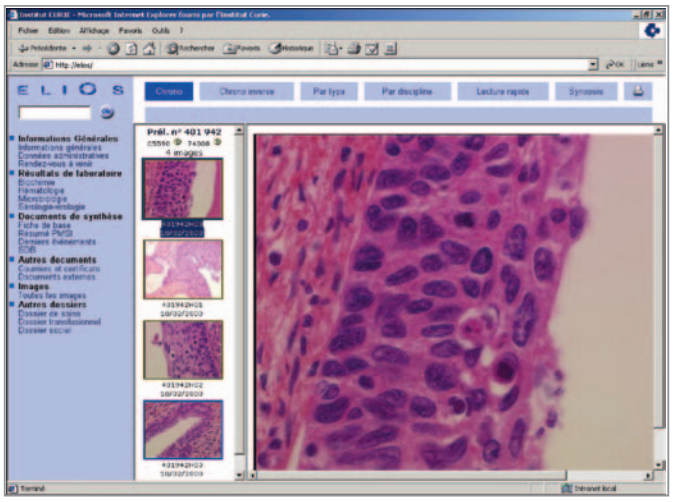
Core impact:

- Improved quality of care due to comprehensive, yet focused instant access to high quality clinical data and information
- Considerable time-savings for doctors supported by medical secretaries trained to use Elios
- Improved productivity for doctors, medical secretaries and archivists
- Improved access to clinical and research knowledge at anytime and anywhere
- Improved information sharing, also with external physicians
- Better support for sophisticated multi-disciplinary teamwork
- Real-time clinical audit studies to measure outcomes and control quality
- Real-time organisational audit studies to streamline workflow
- Faster compliance with new clinical guidelines and organisational protocols.

Main beneficiaries:

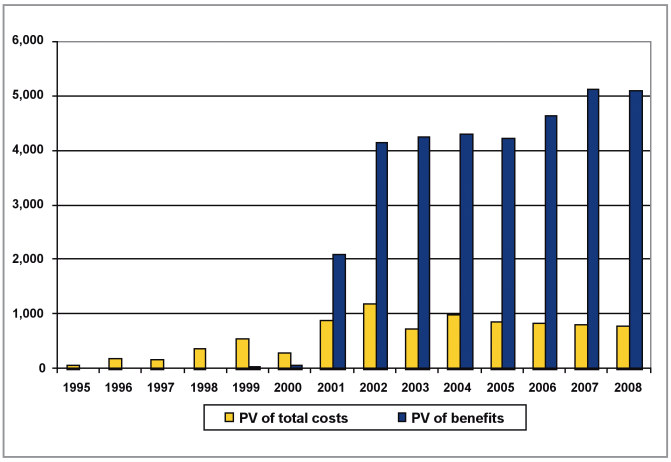
- Citizens benefit mainly from the improvement in quality of care – better informed carers, both about the particular patient and about the best-practice opportunities for further treatment

FIGURE: AN ELIOS SCREENSHOT



- Doctors save time and, at the same time, can collaborate better in the care of a specific patient
- Simultaneously, doctors are better informed, facilitating better decision making about treatment
- Medical secretaries and archivists at the institute can make better use of their time because they need to invest less effort in compiling and retrieving comprehensive patient records
- For the HPO, reduction of the number of archivists and of costs for additional storage of paper documents.

CHART: PRESENT VALUES OF ANNUAL COSTS AND BENEFITS - 2000 TO 2008, in € 000s



Lessons learned:

- To successfully involve and convince medical professionals, one has to meet their needs for information and adequate process support
- Pragmatic steps should nevertheless be strongly linked to the overall goal and strategy
- Regular, comprehensive strategic reviews ensure that the objectives are still valid, but adapted to new requirements
- Excellent clinical leadership is needed for success, especially when health professionals are the direct users of the specific eHealth solution
- Create and operate stable, effective multi-disciplinary teams, including several members with multi-disciplinary expertise, in order to effectively combine health services, ICT, and the important organisational aspect to effective eHealth solutions
- Assure real-time clinical and organisational information to create a flexible, adaptable work environment.

Economic results:

- First year of annual net benefit, i.e. when annual benefits exceed annual costs: 2001, year 7
- Estimated annual net benefit for the year 2008: approximately € 4.3 million
- First year of cumulative net benefit: 2002, year 8
- Estimated cumulative benefit by 2008: approximately € 30 million
- Cumulative investment costs, including operating expenditure, by 2008: approximately € 7.6 million
- Estimated productivity gain, measured as decrease in eHealth cost per patient: 17%
- Distribution of benefits to 2008: Citizens – 8%; Institute Curie – 92%

- www.curie.fr
- www.ehealth-impact.org/case_studies/index_en.htm

7.5 IZIP, Czech Republic – web based electronic health record

IZIP is an electronic health record (EHR) system with Internet access, currently in operation in the Czech Republic. The EHR includes relevant information about all contacts of the citizen with healthcare services, compiled from regular GP visits, dental treatments, laboratory and imaging tests, and healthcare provided by hospital services. Through software modules within the electronic systems of these diverse healthcare providers, interoperability with the IZIP system is assured, and during each visit with a single "click" new data can be uploaded to the central system. With the consent of the patient, the IZIP system allows doctors to access the central EHR at the time and point of care, so that each doctor can resume treatment where the previous doctors have stopped.

The principal role of IZIP is to provide both the technical and the service infrastructure for this comprehensive record integrating medical data from individual healthcare professionals and healthcare provider organisations (HPOs), and assuring full control by the insured citizen. They have the right to access and read their own EHR, but they cannot change them. They can authorise healthcare professionals to view and update their data, converting citizens to an active participant in the healthcare system. They are thus better placed to make responsible decisions about their health, cooperate better with healthcare providers and gain a picture of the technical, resource and financial possibilities and limitations of the proposed or available services and procedures. This is a basic change compared to the conventional system of health record administration, where the HPO, not the citizen, had the power to disclose information.

The internet health files comprise structured parts of the medical documentation. Only healthcare professionals are authorised to insert data into the IZIP system. Records in the IZIP system contain:

- Anamnesis
- Results of examinations performed by a GP or specialist, in chronological order
- Results of laboratory tests and examinations
- A list of prescribed and issued medicines and drugs
- X-rays, scans and other images
- Reports on hospitalisations
- Vaccination history
- Information on other treatments, including type and location.

Modules to be introduced in the near future include ePresribing, emergency service support, and messaging among healthcare providers and with the patient. Plans for further development beyond these include smart cards and digital signatures and improved structuring of the data in the health records, enabling expanded statistical and clinical analyses.

Data security is currently guaranteed by a password and PIN system. Healthcare professionals have to register with the system and can log in using their own password and PIN, identifying them as professionals. Various security enhancement measures have been developed and are in the implementation stage.

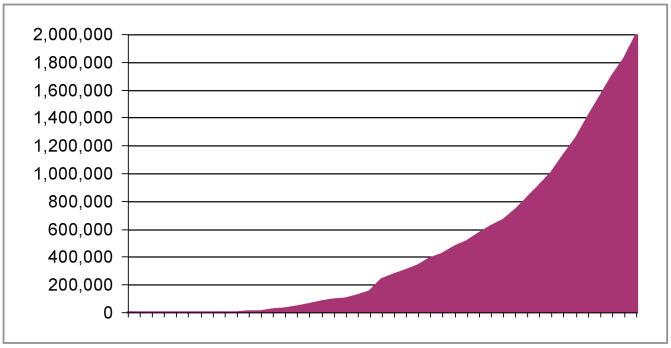
The system was developed by a private company, IZIP Ltd., in cooperation with the General Health Insurance Company of the Czech Republic (GHIC CR) which insures about 2/3 of all Czech citizens. It has spread over the whole of the Czech Republic since the beginning of 2003. Discussions with healthcare authorities in other countries are under way to expand similar services to their jurisdictions.

It took 7 years to achieve an annual net benefit and 8 years for a net benefit on a cumulative basis. The estimated net annual benefit in 2008 exceeds € 60 million. The estimated productivity gain, measured as the decrease in the cost of using a record, was found to be 74%. Citizens, having control over the information on their health history and access to it, as well as avoiding unnecessary interventions, are estimated to receive about 10% of total gains. Doctors and other healthcare providers have access to the full medical account of the patient at the point and time of care. This leads to better care and time savings, amounting to 37% of the direct benefits estimated. The biggest partner of IZIP, the General Health Insurance Company of the Czech Republic benefits from avoided duplicative tests, treatments and other interventions, estimated at 53% of the economic benefits.

Core impact:

- Empowering citizens – they are the gatekeepers to information about their own health
- Instant access to comprehensive patient information independent of the location of the citizen at the time of care, even abroad
- Full interoperability of core patient data and information among all healthcare providers
- Improved communication between healthcare providers and support for continuity of care
- Significant reduction in duplicative examinations and tests
- Positive net economic benefit to society.

CHART: IZIP - DEVELOPMENT OF INDIVIDUAL RECORDS 2002 TO 2007



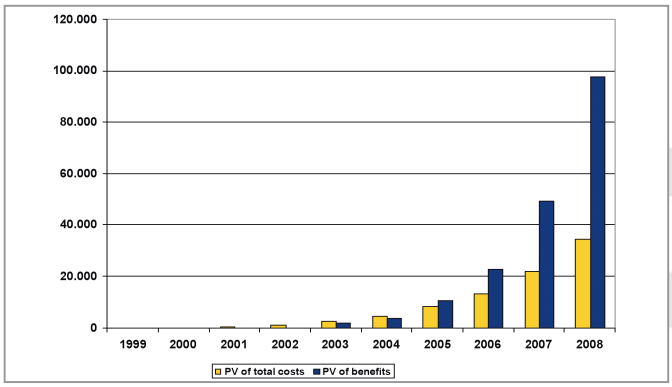
Main beneficiaries:

- Citizens have control over the information on their health history and access to it at the point of need
- Doctors and other healthcare providers have access to the full medical account of the patient, including examination results and full list of medications at the point and time of care. This leads to better quality care and time savings
- Insurance companies and the healthcare system as a whole benefit from the costs avoided by avoiding duplicative tests and unnecessary treatment.

Lessons learned:

- Voluntary, but structured and well organised involvement of a wide range of stakeholders facilitates engagement and support by all health system actors
- Attention to, and addressing the needs of citizens is essential for success
- A pragmatic approach to flexibly develop and adapt a nationwide system creates an eHealth dynamic
- Step-by-step advancement, ensuring agreement among stakeholders, secures engagement and continuous support
- Setting achievable goals at every stage of the eHealth dynamic drives progress
- Emphasis on the first stage of the application being in routine operation early, with clear benefits to major supporters, and with frequent, comprehensive reviews of the fit with the long-term goals is helpful – no big-bang strategy
- Recognition of the importance of training for users, be they professionals or patients
- Patience in achieving complex change in a complex national setting is a necessary requirement for success.
- Once a critical mass of records and users has been achieved, usage will grow exponentially.

CHART: PRESENT VALUES OF ESTIMATED ANNUAL COSTS AND BENEFITS - 1999 TO 2008, in € 000s



Economic results:

- First year of annual net benefit, i.e. when annual benefits exceed annual costs: 2005, year 7
- Estimated annual net benefit for the year 2008: approximately € 60 million
- First year of cumulative net benefit: 2006, year 8
- Estimated cumulative benefit by 2008: approximately € 180 million
- Cumulative investment costs, including operating expenditure, by 2008: approximately € 90 million
- Estimated productivity gain, measured in decrease eHealth cost per patient: 74%
- Distribution of benefits to 2008: Citizens – 10%; HPOs – 37%; Insurance company – 53%

- www.izip.cz
- www.ehealth-impact.org/case_studies/index_en.htm

7.6 Kind en Gezin, Flanders, Belgium – Flemish vaccination database (FVD) and Vaccinnet, facilitating vaccination programmes for children

Kind en Gezin (K&G) has developed and used the Flemish Vaccination Database (FVD), later complemented by the Vaccinnet vaccination programme, to increase and sustain child vaccination rates across Flanders, Belgium, from about 77% to around 95% in about six years.

The FVD and Vaccinnet are web-based applications that contain the vaccination requirements and record of all children born in Flanders as well as comprehensive information on stocks and shipping. Healthcare professionals working for K&G have been able to access the FVD effectively to achieve a rapid and sustainable growth in the numbers of vaccinations, and so achieve the public strategy of eliminating and controlling some infectious diseases.

The applications provide an electronic vaccination record for each child; an effective means of vaccination stock control and supply; a rapid, reliable channel of communication to healthcare professionals about changes to vaccination policies, practices and vaccines; a source of data for performance monitoring, and policy and strategy development. In addition, it initiated an eHealth dynamic that will be continuously developed to support the further improvement of the quality of the service and to cater to the data needs of other K&G tasks.

Vaccination policy is not constant overtime. Changes to vaccination regimes have been introduced, and the Flemish Vaccination Database has been used to communicate with healthcare professionals about the implementation of the new policy.

Occasionally, vaccine supplies can be disrupted. This usually results in a reduction of the vaccination rate below the required target. The FVD enabled K&G to effectively manage these situations and to return to the target vaccination levels within short time periods after vaccination supplies returning to normal.

After the database was implemented in 1999, K&G developed a complementary application to support the automated supply, ordering and stock management of vaccines - Vaccinnet. Continuous developments of the FVD have several dimensions.

Data about registration of births will be downloaded in the FVD automatically. As electronic identity cards are introduced, citizens will be able to access their own vaccination records. Also, the scale of utilisation has been expanded since 2005 when private doctors and school nurses were able to use the FVD.

Besides substantial increases in coverage and protection, other impressive benefits were realised. Some four years after the start of the project, substantial increases in productivity were achieved, including a fall in unit cost per vaccination of about 15%. This, among other things, led to a positive net economic benefit on the eHealth investment. A sustained cumulative positive return, with break even point in 2001, was reached in year six of the project. Financial benefits achieved, and forecast for coming years, imply a rate of return of about 8% of costs incurred over the period. Critical features of the success of the FVD

include its steady expansion in functionality and the reliance on a small internal team to complete the web-based applications.

Estimated benefits to children and families from increased vaccination account for about 95% of the total benefits. The cost gain to K&G is mainly from improved productivity that enables K&G to avoid the estimated cost of additional staffing that would be needed to achieve and sustain the increased vaccination rate by relying on the previous, manual records. Over the period 1996 to 2008, the application generates an estimated net economic benefit of over € 17m.

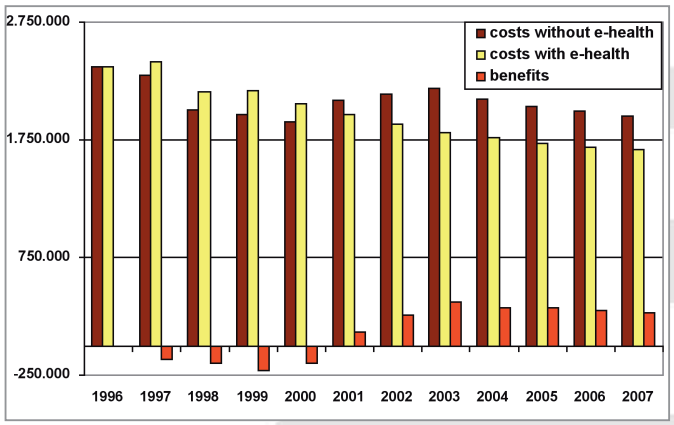
Core impact:

- Vaccination rate of young children increased within 4 years from 77% to almost 95%
- Recovery from disrupted vaccine supplies is rapid due to transparent information and stock control
- Communication to healthcare professionals and nurses on changes in vaccination regimes and procedures is fast, comprehensive and effective
- The automated online vaccine ordering and stock control system substantially contributed to overall benefits
- The system serves as a catalyst for services beyond K&G to achieve the required vaccination rates.

Main beneficiaries:

- Substantially more children are now vaccinated against infectious diseases
- Parents have improved transparency of vaccination cover for their families
- Citizens are less exposed to infectious diseases (with concomitant savings to be expected in coming years)
- Health professionals have instant access to data to support higher quality services
- Considerable efficiency gains for Kind en Gezin.

CHART: KIND EN GEZIN ANNUAL COSTS AND BENEFITS WITH AND WITHOUT E-HEALTH SYSTEM, in £



Lessons learned:

- Clear, highly focused goals for the eHealth project facilitated successful implementation
- eHealth can be a proven means to overcome resource constraints
- A sustainable eHealth solution consists of a series of continuous investments over time
- In-house expertise is a critical resource.

Economic results:

- First year of annual net benefit, i.e. when annual benefits exceed annual costs: 2001, year 5
- First year of cumulative net benefit: 2003, year 7
- Estimated cumulative benefit by 2008: approximately € 43 million
- Cumulative investment costs, including operating expenditure, by 2008: approximately € 25.5 million
- Estimated productivity gain, measured in decrease in cost per vaccination: 41%
- Distribution of benefits to 2008: Citizens – 96%; K&G – 4%.

- www.kindengezin.be
- www.ehealth-impact.org/case_studies/index_en.htm

7.7 MedCom, Denmark – Danish Health Data Network

The history of MedCom - the Danish Healthcare Data Network (DHDN) - goes back to the late 1980s, when interest in electronic communication among healthcare providers grew. It is a long-term project that enables effective data transfer between several actors of the health service, including stake-holders of the community-based social care system. This national network allows fast information flow in form of reliable data exchange of EDIFACT or XML-based messages among the respective software systems of the participating healthcare providers.

Agreements on interface specifications as well as certification of software compliance with agreed-upon standards and syntax allow for optimal inter-operability. Data transfer begins at the point of care for patients and General Practitioners (GPs). From there, services that citizens may need access to include pharmacists, diagnostic services and specialist consultation at hospitals, referral to and discharge from a hospital, and transfer to home care and residential care services. Effective access to these by citizens depends on efficient exchange of messages between health and social care providers and other actors.

The Danish Centre for Health Telematics plays a core role in achieving and expanding these communications through a process which has been implemented as a set of projects that develop national data standards and take advantage of new information and communications technology in healthcare. It started formally in 1994 and so far has had five main phases:

- MedCom I — pioneer spirit and professionalism — 1995 - 1996
- MedCom II — implementation and consolidation — 1997 - 1999
- MedCom III — quality services and diffusion — 2000 - 2001
- MedCom IV — adopt Internet and web based technologies — 2002 - 2005
- MedCom V — realisation of "Good Web Service"— 2006 - 2007

Electronic data interchange (EDI) is used for the messaging process, including:

- GP referrals to hospitals
- GP prescriptions
- GP requests for diagnostic tests
- Test reports
- Discharge letters to GPs
- Notifications of discharges to community and home care services
- Reimbursements.

The focus of the economic assessment of this unique nationwide eHealth system has been on the direct impacts from improved message exchange. Benefits for citizens are derived from faster, more reliable and more efficient communication between healthcare and social care professionals. GPs' benefits include costs savings on secretarial and clerical services in preparing and sending information to other healthcare services. Pharmacists can receive prescriptions directly and electronically from GPs, a faster and more reliable process than paper prescriptions transferred by hand.

By receiving prompt notification of transfers to their domain, social services benefit from earlier preparation and information about patients discharged from hospital, and so earlier, and more effective, care provision. This is a rare example of active efforts to improve cooperation between the healthcare and community and social care systems.

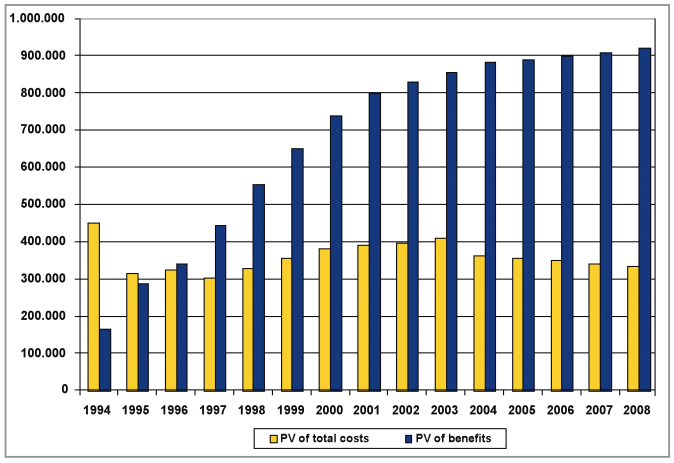
Hospitals and diagnostic services receive and send information that is more consistent, and so can be more efficient and responsive. They can also be more confident about the reliable data standards included in their eHealth applications.

Due to interoperability assured by certified software, sender and receiver can upload respectively download the messages into their own electronic record systems.

All this has started to operate already in 1994 using mainly electronic data interchange (EDI) and its associated tools. The system generates considerable net economic benefits estimated to exceed € 75m on an annual basis by 2008. About 80% of the total annual costs, estimated to be in the order of € 50m,

are investment in ICT and organisational change. The main impact of the application is effective and efficient communication between health- and social care professionals. This translates to over 95% of the direct gains going to care providers.

CHART: PRESENT VALUES OF ESTIMATED ANNUAL COSTS AND BENEFITS - 1994 TO 2008, in € 000s



Core impact:

- Enables healthcare partners to communicate more effectively and reliably for improved quality of services
- Offers significant efficiencies in communication processes and record keeping, thus reducing administrative overhead
- Improves communication between healthcare, community care and social care systems.

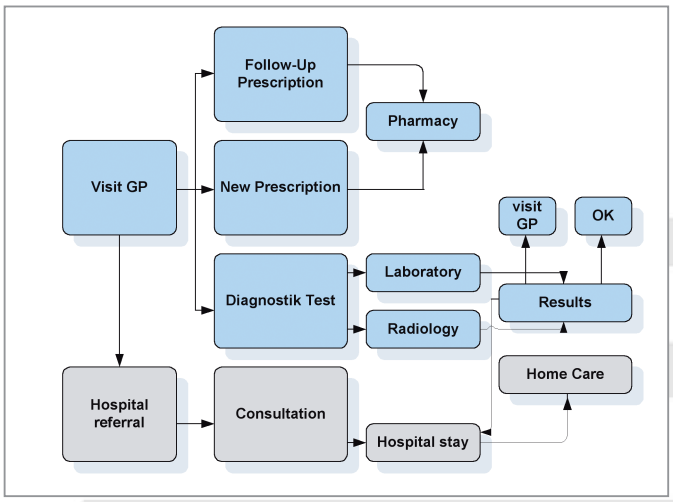
Main beneficiaries:

- Healthcare providers, especially general practitioners, benefit from effective and efficient data transfer and reduced administration costs
- Social services benefit from earlier communication by being better prepared to receive patients transferred to them from hospital
- Citizens benefit from more efficient and better quality health and social services that can be provided with faster and more reliable communications between healthcare professionals.

Lessons learned:

- Long term goals should be defined from the outset, but need to be regularly reviewed and adapted as user needs and technology change
- A step-wise process allows for inevitable mistakes and failures to be corrected faster and at lower costs
- Setting data standards and specifications is a prerequisite for successful nationwide eHealth services
- Effective consensus, teamwork and collaboration with stakeholders is essential for success
- Regular involvement and exchange with software industry, including certification of software, is a key factor for assuring interoperability of electronic systems
- Sustainable eHealth is a series of continuous investments over time
- A permanent infrastructure organisation (national centre of competence) with sufficient in-house expertise is a critical resource for such a national system.

FIGURE: AN ILLUSTRATION OF THE HEALTHCARE PROCESS SUPPORTED BY THE DHDN



Economic results:

- First year of annual net benefit, i.e. when annual benefits exceed annual costs: 1997, year 3
- Estimated annual net benefit for the year 2008: approximately € 80 million
- First year of cumulative net benefit: 1999, year 5
- Estimated cumulative benefit by 2008: approximately € 1.4 billion
- Cumulative investment costs, including operating expenditure, by 2008: approximately € 725 million
- Estimated productivity gain, measured in decrease in cost per message transaction: 97%
- Distribution of benefits to 2008: Citizens – 2%; HPOs – 98%

- www.MedCom.dk
- www.ehealth-impact.org/case_studies/index_en.htm

7.8 MedicalORDER®center Ahlen (MOC) and St. Franziskus Hospial Münster – supply chain optimisation, Germany

Supplies are a key cost factor for hospitals and may account for up to 1/3 of annual expenditures. This designates this area as a key application field for cost-saving eHealth solutions. The St. Franziskus Stiftung Münster established, together with the logistics focused Fiege Group, the medicalORDER®center (MOC) in Ahlen, Germany. medicalORDER®center provides hospitals and other healthcare institutions in the vicinity of 300 kilometres with logistic services. The centre offers a variety of services supporting logistic processes in hospitals, thereby supporting supply chain optimisation. These additional services are the supply with pharmacological products from a centralised pharmacy, supply with medical and office products from a centralised warehouse, and the supply with sterilised goods from a centralised sterilisation unit.

Each service is offered by a separate division:

- medicalORDER®pharma serves as the hospitals' pharmacy and is to 100% owned by St. Franziskus Hospital.
- medicalORDER®services GmbH is responsible for medical goods and other commodities
- medicalORDER®instruments GmbH provides surgical instruments especially for the operating theatre and takes them back again for sterilisation.

In short, MOC offers a standardised, ICT-supported storage and supply system. About 90% of articles used at a hospital ward, including most drugs, can be barcoded and stored according to a standardised system. This standardisation of supplies for a large number of hospitals leads to more efficiently manageable and cheaper logistics, as well as lower product prices as a result of the possibility of bulk purchasing. At the wards and hospitals, the system leads to demand based ordering rather than expensive storage of larger quantities. Demand is analysed continuously by MOC and stock levels are adjusted accordingly. This results in a smaller stock of supplies, compared to the without eHealth situation, less waste of materials (especially medications) not being used by their expiration date, and up to 75% reduced incidents of medication and other supply shortages.

The system was implemented among others in the intensive care unit (ICU) of the St. Franziskus Hospital Münster in 2005. This ICU has 13 beds and about 650 patients a year.

The ordering process between the ICU and MOC is fully electronically integrated. The orders are processed by the MOC. The orders between MOC and suppliers are gathered and forwarded using an eProcurement platform provided by the company Medicforma.

The suppliers physically deliver ordered goods to the MOC, which then repackages them according to the ward's order and delivers them pre-sorted to the hospital. In the hospital, in-house logistic is organised using a company called FACT, the facility management company of St. Franziskus foundation.

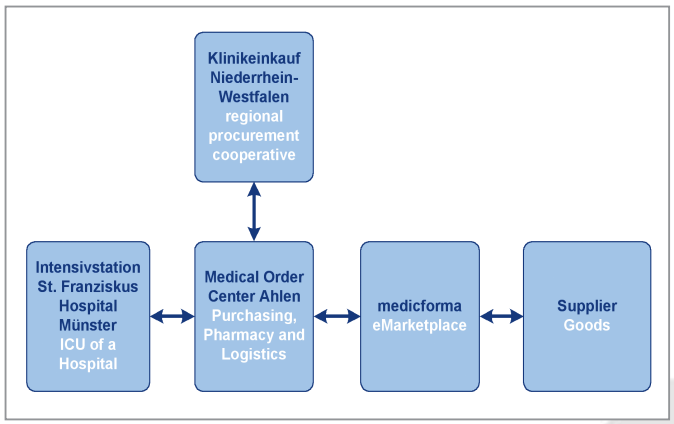
The actual eHealth application is an electronic ordering system that makes the supply chain in electronic form complete and involved re-engineering of the whole purchasing process. This included a profound change in the organisation of institutions and also in physical buildings like storage rooms. Institutions specialise on certain parts of the purchasing process. The hospital and its nurses respectively concentrate on medicine and care, instead of administrative burdens. Within the MOC, purchasing and logistics can be rationalised due to economies of scale and based on improved demand notices from the ICU. FACT specialises in in-house technical services like in-house logistics.

Cost reduction, which is the main benefit in eOrdering, generates its savings in first instance from the decrease in process costs which results in lower product prices. This is the result of product

standardisation and reduction of logistics costs at the intersection between the suppliers and MOC. However, these savings would not materialise if there were not an efficient way of handling messages. Standardisation, process re-engineering and electronic message exchange are intrinsically tied together and only so unfold their full potential.

The initial investment in 2005 for the ICU at the St. Franziskus Hospital Münster was just over € 100 000. Including the annual running costs of the MOC service, the economic benefits from the application are expected to exceed total costs already one year later in 2006. The annual net benefit from the application at the intensive care unit in the years to 2008 is expected to surpass 40 000 per year . The impact on the whole hospital is a multiple of this. Even though the system is designed for supply chain optimisation, patients receive a benefit as well. The time saved by nurses is spent with the patients in need, which gives citizens a 3% share of total direct gains. The rest goes to the hospital unit.

FIGURE: ORGANISATIONAL STRUCTURE OF PROCUREMENT AT ST. FRANZISKUS HOSPITAL MUENSTER



Core impact:

- Major decrease in cost of supplies
- More efficient logistic processes
- Standardisation and transparency of supply chain processes
- Reduction in stock levels: on average, the stock had to last for 11 days, which is now reduced to seven.

Main beneficiaries:

- St. Franziskus Hospital benefits from reduced supply costs – resources redeployed to delivering healthcare
- St. Franziskus Hospital benefits from fewer instances of material and medicine shortages, and thus lower risk for patients
- Patients of the hospital benefit from increased time at patients' site.

Lessons learned:

- Consequent process re-engineering and continuous process improvement is important for benefits realisation
- Such complex change processes should be implemented step-by-step to learn from experience – the ICU was the last ward in the hospital that introduced the supply chain system
- To cope with unforeseen instances, a contact person is needed despite automated processes
- Interdisciplinary competences from logistics and healthcare are required for successful implementation.

Economic results:

- First year of annual net benefit, i.e. when annual benefits exceed annual costs: 2006, year 2
- Estimated annual net benefit for the year 2008: approximately € 40 000
- First year of cumulative net benefit: 2007, year 3
- Estimated cumulative benefit by 2008: approximately € 470 000
- Cumulative investment costs, including operating expenditure, by 2008: approximately € 390 000
- Estimated productivity gain, measured in decrease in cost of logistics per item supplied: 9%
- Distribution of benefits to 2008: Citizens – 3%; Hospital – 97%

- www.medicalorder.de
- www.sfh-muenster.de
- www.f-log.de
- www.ehealth-impact.org/case_studies/index_en.htm

7.9 NHS Direct, UK – NHS Direct Online (NHSDO) information service

NHS Direct is a special health authority within the UK National Health Services (NHS), and has two divisions. NHS Direct Call Centres focus on symptomatic response to users and only to a certain extent on delivering health and healthcare information services. The NHS Direct Online (NHSDO) division has other priorities – it provides mainly information services, and a limited symptomatic service. NHSDO relies on part of the call centres resources to support its web site activities. This can be seen as similar to a modern business setting, where web sites offer visitors an option to telephone a call centre if they need additional support.

NHSDO was developed in 1998 to provide citizens and healthcare professionals with access to information about health and healthcare via the Internet. It is a web portal offering citizens information to help them to understand health and healthcare issues relevant to them, and to indicate the potential benefits they may gain from change. As for the call centres, NHSDO also enables citizens to make better choices about their use of the NHS healthcare services.

It is a service in addition, and complementary to, the NHS Direct call centres. Both NHSDO and the NHS Direct call centres are 24 hour services that provide healthcare information to users. Some NHSDO users may not find all they want or need on NHSDO's web pages, and may want further help or clarification after using NHSDO, and so may rely on the NHS Direct call centre service. The subject of this case study is this wider range of the NHSDO service and its estimated share of call centre resources.

With NHS Direct, citizens can phone the NHS Direct number and their enquiries are answered by an operator. The operators are aided by a decision support programme. With NHSDO, citizens go online and look themselves for the information they need. There are no phone calls, waiting time for a free operator, or the trouble of finding a GP on duty at out-of-office hours. These options are still available if citizens need them. This process may not apply to emergencies, but rather to more routine enquiries like advice in case of stomach-ache or minor household injuries.

Visitors to NHSDO enter either through the general NHS website (www.nhs.uk), or directly via www.nhsdirect.nhs.uk. The address www.nhsdirect.co.uk also provides access. By following the relevant links and inserting required information, users are guided to the information they are seeking. The NHSDO web portal enables users to improve their knowledge and choices about life styles, nutrition, health, healthcare, self-treatment, healthcare services in their region etc. Information is provided by access to a range of facilities, including a health information enquiry service; a health encyclopaedia; a best treatments website, self-help guide; details of local NHS services, common health questions, interactive tools and an interactive health space.

The number of visitors to NHSDO has risen dramatically from about 1.5 million in 2000 to the forecast of some 24 million for 2008. The number of repeat visitors has risen too, from about one-third of visits to about half.

The continuous investment totals approximately € 22m in the period 2000-2008. Annual running costs increase over the period to some € 12m in 2008. Yet these are exceeded by the benefits already in the third year of operation. Net economic benefits rise to approximately € 112m in 2008. Although the obvious tangible impact is the service to the citizens, the main benefit is the avoided costs of providing the same level of access to the same quantity and quality of information. This explains why over 85% of the benefits are observed to be for NHS Direct, leaving about 13% of direct gain for the citizens.

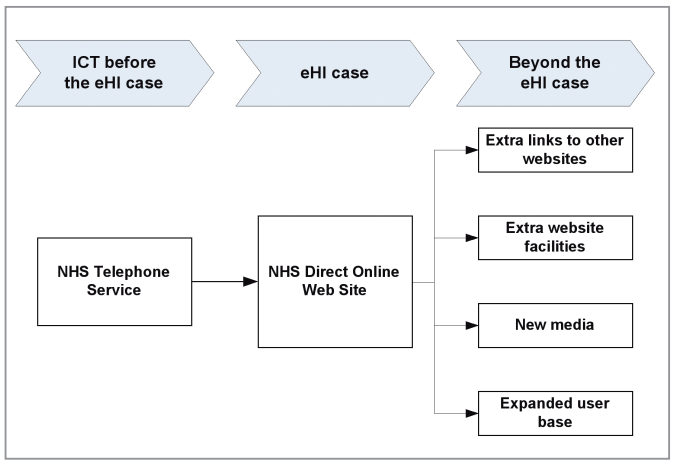
Core impact:

- Citizens are enabled to use health and healthcare information to make choices about lifestyles
- Citizens are empowered to rely more on self help and avoid some visits to GPs for information
- Costs of the workforce needed for an alternative technology with call centres are avoided
- Reduced number of visits to healthcare professionals triggered by need for health information.

Main beneficiaries:

- Citizens through improved health and healthcare information
- NHS Direct with a lower-cost option.

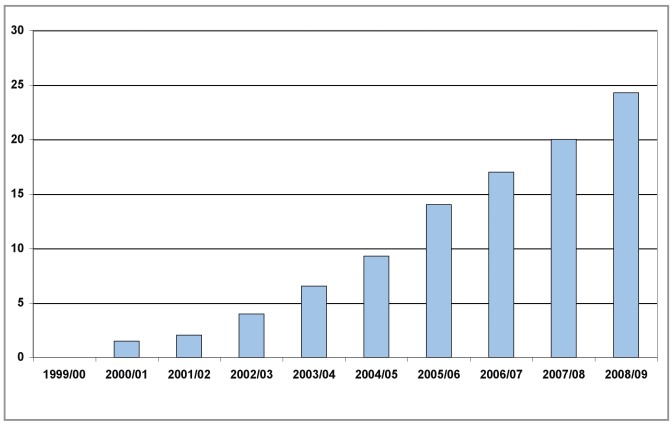
FIGURE: THE EHEALTH DYNAMIC OF NHS DIRECT ONLINE



Lessons learned:

- When providing a new service to citizens, use the technology that citizens are increasingly using
- Focusing on citizens and providing them with health and healthcare information empowers them to take more informed decisions and choices
- Obtain external support in the earlier years, but for the running service rely on an internal team
- The eHealth dynamic of such a service is a continuous chain of developments to add more functions
- Do not use patient empowerment as an aim to reduce spending on healthcare, but to improve quality of services.

CHART: NUMBER OF NHS DIRECT ONLINE VISITS PER YEAR



Economic results:

- First year of annual net benefit, i.e. when annual benefits exceed annual costs: 2001, year 3
- Estimated annual net benefit for the year 2008: approximately 110 million
- First year of cumulative net benefit: 2002, year 4
- Estimated cumulative benefit by 2008: approximately 550 million
- Cumulative investment costs, including operating expenditure, by 2008: approximately 100 million
- Estimated productivity gain, measured in decrease in cost per online visit: 85%
- Distribution of benefits to 2008: Citizens – 13%; NHS Direct – 87%

- www.nhsdirect.nhs.uk
- www.ehealth-impact.org/case_studies/index_en.htm

7.10 Sollefteå and Borås hospitals; Sjunet, Sweden – radiology consultations between Sweden and Spain

Teleradiology enables radiology departments in hospitals to connect with, and expand, the performance of their radiology services without having to employ extra locum or additional permanent radiologists. Reacting to a shortage of radiologists in Sweden, the involved hospitals implemented the analysed eHealth application, allowing regular teleconsultations for Swedish patients given by specialists in Spain. This case study evaluates the economic impact of such services at two Swedish hospitals. Radiology nurses at Sollefteå and Borås hospitals conduct magnetic resonance imaging (MRI) examinations, and for less urgent cases the images are sent to the Telemedicine Clinic in Barcelona for analysis via the Swedish secure ICT network for healthcare, Sjunet. Borås also regularly sends a number of computed tomography (CT) images. This lowers the pressure on the radiologists in Sollefteå and Borås, and shortens the patient waiting lists. The hospitals not only can better cope with the shortage of specialists in Sweden, but also are more flexible in coping with short term peaks in demand.

With over 85% of the total economic benefits, estimated at over 800 000 per year fr om 2006 onwards, citizens gain significantly from the reduced waiting times. The cost per scan analysis for the two hospitals has already decreased by about 35%. Net economic benefits were achieved in the second year of operation and are sustainable at over € 700 000 per year beyond 2007.

Sollefteå Hospital

When the radiology department at Sollefteå Hospital failed to recruit a specialist in magnetic resonance imaging (MRI), it resolved the problem by seeking a different solution. Employing locums for short time periods would have been demanding because of recruitment difficulties in a geographically remote area. It would also incur a high cost of employment, approximately up to four times more costly than a permanent specialist.

The solution was to rely on teleradiology to link the radiology department with specialists in other locations. Skilled radiology nurses conduct MRI examinations, some of which are transmitted to the Telemedicine Clinic (TMC) in Barcelona for analysis, advice and opinions. The response arrives back in Sollefteå between 24 to 48 hours later. This model is used for some of the non-emergency examinations, transferring some of the increasing workload to other, extra specialists, and reducing the need for an extra radiologist in Sollefteå. This increased resource also contributed to reducing waiting lists and times. Since the beginning of the service in March 2003, the waiting time for non-emergency MRI scans has been reduced by 50%. The success of the initial pilot project was converted into a successful fully operational service. Links with the TMC also provides a source of new medical information. These factors combine to give a considerable return in value on the original MRI investment.

Borås Hospital

At Borås Hospital, sustaining radiology recruitment has been demanding. Reliance on TMC services enables the hospital to continue to meet rising demand during periods when vacancies cannot be filled. Simultaneously, the goal was to reduce waiting times significantly from 52 weeks for MRI scans, and about 12 weeks for CT scans. Using TMC for these has enabled MRI waiting times to be reduced to 22 weeks, down by about 58%, and CT waiting times to be reduced to about six weeks, a 50% drop. Without these performance improvements, MRI and CT scans would have become a bottleneck for other hospital services, leading to deterioration in their performance.

A team of radiologist and specialist nurses complete most of the MRI and CT scans. Appointing locums to fill vacancies temporarily would have been more costly than using TMC's service. It would also be disruptive for the team, having to spend time to seek locum replacements and integrate new people into the team for short periods of time.

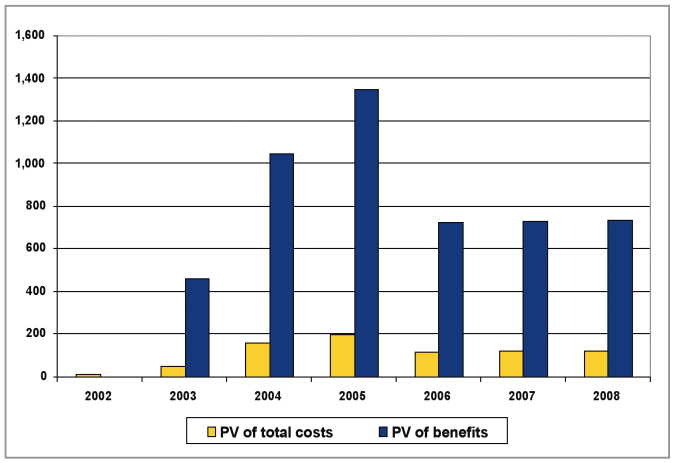
Barcelona TMC

TMC is a telecare service based in Barcelona. Its resources include a service centre that receives and despatches information, including images, and a network of radiologists who review and analyse images, and produce diagnostic reports for the originating sites. These connect to create a network of expertise. Over 60 radiologists provide diagnostic services through the TMC service centre. There were two when the service started in 2003.

Sjunet

Carrying the information from the sites to the TMC service centre relies on Sjunet, a secure ICT network for healthcare in Sweden. Data from MRIs and CTs is held in a Picture Archiving and Communication System (PACS), and so can be readily transmitted to and from TMC. Sjunet sets the data standard and infrastructure architecture. Sjunet was started as a project in 1998 and has been fully operational with all Swedish hospitals connected since 2001. TMC has been connected since 2002 and their teleradiology service started in March 2003.

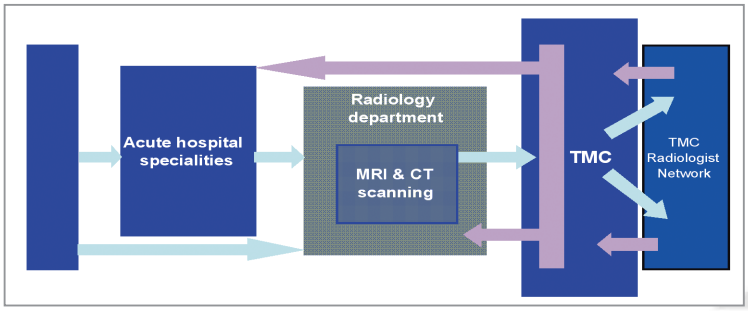
CHART: ESTIMATED PRESENT VALUES OF ANNUAL COSTS AND BENEFITS - 2002 TO 2008, in € 000s



Core impact:

- Reduction in waiting times for patients by up to 50%
- Improvement of a key bottleneck and more flexibility in coping with peak requirements
- Example for the development of a truly pan-European healthcare services market
- Improved service quality at a considerably lower cost

FIGURE: THE PROCESS OF IMAGE REVIEW AND DIAGNOSIS AT TMC



Main beneficiaries:

- Citizens gain due to reduction in waiting times for MRI and CT image analysis and consultation
- Swedish hospitals benefit from cost savings; no extra local resources are required
- The Spanish Telemedicine Clinic benefits from more sustained business.

Lessons learned:

- Identifying use of ICT as a tool, not a goal in itself, is a key to realising benefits in health
- Application development was driven by citizen's needs, greatly facilitated by existing infrastructures in Sweden (Sjunet) and Spain (Barcelona Telemedicine Clinic)
- Given the right framework, telemedicine can stimulate the development of a single European healthcare market
- A successful telemedicine project is only one element in a process chain of related healthcare activities.

Economic results:

- First year of annual net benefit, i.e. when annual benefits exceed annual costs: 2003, year 2
- Estimated annual net benefit for the year 2008: approximately € 600 000
- First year of cumulative net benefit: 2003, year 2
- Estimated cumulative benefit by 2008: approximately € 5 million
- Cumulative investment costs, including operating expenditure, by 2008: approximately € 800 000
- Estimated productivity gain, measured in decrease in cost per scan: 34%
- Distribution of benefits to 2008: Citizens – 86%; Hospitals – 14%

- www.midsweden.se
- www.lvn.se
- www.carelink.se
- www.telemedicineclinic.com
- www.ehealth-impact.org/case_studies/index_en.htm

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Notes:

Notes:

European Commission

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Alexander Dobrev, Veli N. Stroetmann

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