



Good eHealth services across Europe - evidence on their economic benefits and lessons learned

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Summary: Citizens want, and ageing societies will need, more and better healthcare, but public funds are limited, and many citizens cannot afford, or do not want to pay, more for it. For healthcare providers in modern healthcare systems, this is a challenge. The right approach to developing, implementing and using effective eHealth can help address this challenge. Healthcare providers can use eHealth to improve quality and expand their capacity to meet this increasing demand within available resources.

This is derived from findings of the eHealth Impact study, which analysed in great detail the economic outcomes of ten sustained eHealth services across Europe. These show that across a wide spectrum of applications, 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, showing that eHealth can contribute increasingly to satisfying citizens' needs and wants for healthcare.

Several factors have to be right for eHealth to succeed. The eHealth applications must focus on solving particular problems, or have an impact on a particular clinical or operational process. Smart people and multi-disciplinary teams must be in place to drive the process of change needed to realise the benefits from eHealth. It is not enough to replicate the ICT component of a proven eHealth investment; the organisational component must be addressed too. eHealth applications should be part of an evolving series of investments to create a sustained eHealth dynamic.

Policy makers should ensure the effectiveness, and the right mix, of eHealth applications in order to achieve the goal of increasing benefits at broadly stable costs, as in our virtual health economy. To achieve this, they must support investment in eHealth, directly and indirectly, steer the mix of applications, and provide an appropriate legal and economic investment framework and environment that facilitates innovation.

Project background – eHealth IMPACT

The eHealth IMPACT (eHI) Study on the Economic and Productivity Impact of eHealth was initiated by the European Commission, DG Information Society and Media. In 2005 it developed a generic methodology for economic assessment and evaluation of eHealth applications. It was designed as a context-adaptive model to fit a wide diversity of applications, from clinical settings to supply chain solutions. The model relies on the concept of cost benefit analysis. Costs include initial, replacement and recurring eHealth investments, such as those in ICT and change management, as well as healthcare

operational costs. Special attention has been paid to identifying the benefits to, and impact on, citizens. At the same time, benefits to all potential stakeholders were analysed. The concept of cost avoidance is important in identifying benefits. This is the estimated cost for achieving the ICT-based performance without ICT, which is often prohibitive; the superior performance is hardly achievable without ICT.

Ten selected eHealth application sites across Europe were evaluated in detail to test and refine the eHI methodology. The results from each case show the, sometimes unexpectedly high, positive economic impact of eHealth systems and services. Aggregating them indicates a positive, sustainable economic impact in what we have named a 'virtual health economy' over fifteen years. The ten sites were selected from across the Union for their proven, sustained eHealth applications.

The project website, www.ehealth-impact.org, includes an eHealth good practice database with 90 cases from across the EU, the eHI methodology, the ten detailed cases studies, and a web-based appraisal tool.

Approach and methodology

Proven eHealth applications

Ten proven eHealth applications have been selected to analyse in detail their economic impact. They all show a positive economic impact on citizens and healthcare providers by providing information to support a direct healthcare activity, or for associated administrative and operational services. The overall economic costs and benefits, and the timing of realising positive net benefits, were not known until they were identified as part of the eHealth Impact evaluation.

Economic evaluation

Our focus was to identify costs and benefits, changes in productivity, and utilisation levels of the eHealth application. Costs included the design of the eHealth strategy and solution, the application development costs, implementation costs and the costs of operation. Benefits included the liberation of resources, notably time, cost avoidance in achieving an equivalent performance, gains from improved healthcare quality, and increased access to healthcare.

Some evaluations included a time period for services before and without eHealth, and the periods of development, implementation, and routine operation of the eHealth application. Thus, a before-and-after comparison was extracted, when meaningful, as part of the with-and-without analysis, which enabled the process of transformation to be observed.

Special attention was given to identifying benefits. All relevant stakeholders, and the benefits they have from eHealth, were identified. All benefits were given a monetary value. Proxies, such as willingness-to-pay, were used to estimate the value of intangible benefits. All estimates were made on the basis of conservative, if not pessimistic, assumptions, to help to achieve robust, trustworthy findings.

This approach required the eHI team to gain a detailed understanding of each of the services supported by eHealth, to reveal the factors contributing to the success of each site individually, and to collect comprehensive sets of data which had to be specified individually for each site. These were based on a generic framework developed by the eHI team. There were also some common features of eHealth services, such as process changes and change management activities.

The ten sites were analysed from several stakeholder perspectives to identify the costs and benefits for:

- Citizens, patients and carers, who are not part of the formal healthcare provision and administration system
- Healthcare provider organisations (HPOs), including healthcare professionals, such as those in private offices
- 3rd party payers of various types
- Others, if relevant.

Summary of findings

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 1. The ranges of the results are very wide, reflecting the material differences between each type of eHealth application.

TABLE 1: SUMMARY OF ECONOMIC FINDINGS ACROSS 10 SITES FROM 1994 TO 208

	average	min	max	range
Distribution of benefits				
Citizens	43%	1%	96%	95%
HPOs	52%	4%	99%	95%
eHealth providers	0%	0%	0%	0%
Third party payers	5%	53%	53%	0%
First year of annual net benefit	4	2	7	5
First Year of cumulative net benefit	5	2	8	6
Decrease in unit costs	48%	9%	97%	88%

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 running costs of the existing service without eHealth. Benefits can only be realised after the application has been implemented, or it is in routine operation. 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.

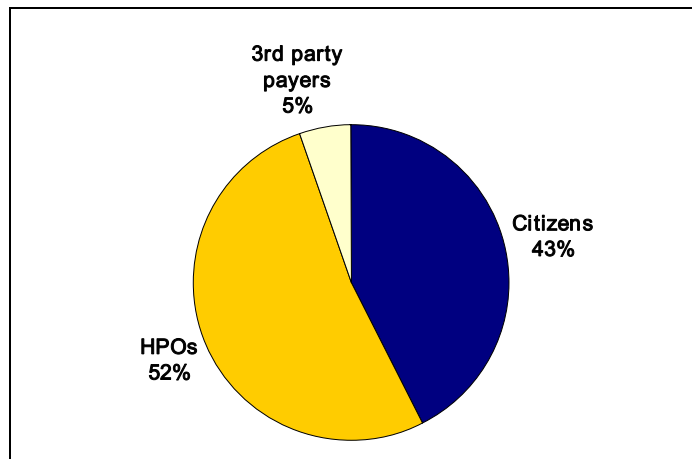
First year of cumulative net benefit: When the present values of annual costs and benefits are accumulated, the time needed for total benefits to exceed total costs associated with an eHealth application can be identified. For the ten cases, this is in year five, on average. The fastest achieved cumulative 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, IZIP and the Danish Health Data Network, 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 sustainable. This is the most distinctive, common feature of the economic impact of all ten proven eHealth applications.

Allocation 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 SUMMARY BENEFITS ACROSS 10 SITES FROM 1994 TO 2008



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

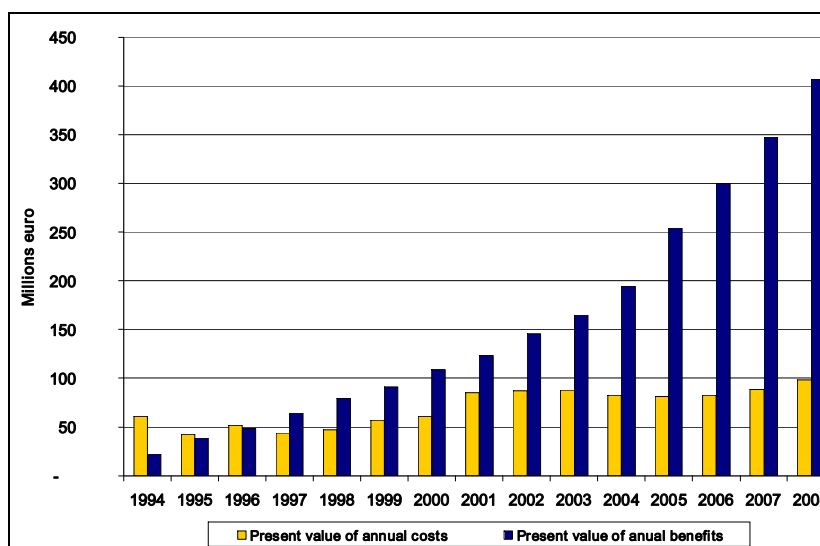
- Steady increase over a longer period of time, either gradual, or at an increasing rate
- Rapid surge in a short time period as implementation moves into operation.

A steady increase reflects the gradual roll out of an eHealth solution. These were found in NHS Direct Online, Danish Health Data Network, eReceipt, 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.

Economic impact on a virtual health economy

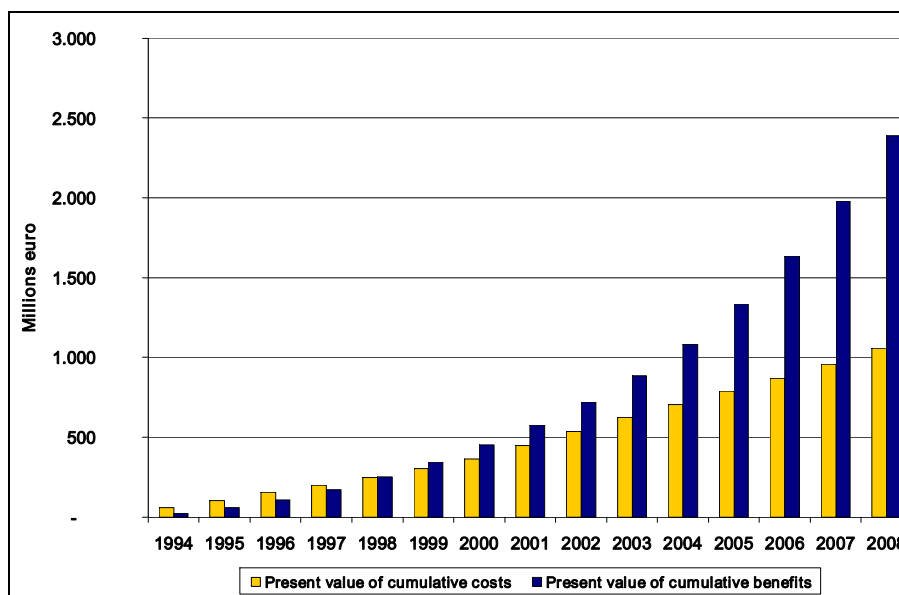
When all ten cases are, in summary, are regarded as part of an eHealth dynamic in the equivalent of a virtual health economy, the combined results illustrate very impressively the potential of the economic impact of eHealth, as shown in Chart 2. Over the period 1994 to 2008, the summarised annual present 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 ANNUAL DISCOUNTED COSTS AND BENEFITS OF EHEALTH FROM 1994 TO 2008



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, and at a faster rate than costs.

CHART 3: ESTIMATED CUMULATIVE DISCOUNTED COSTS AND BENEFITS OF EHEALTH FOR TEN SITES FROM 1994 TO 2008



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.

Benefits to the quality and capacity 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)¹. They are also consistent with the eHI specifications of quality, access and cost-effectiveness. Each of the seven categories contributes to improvements in healthcare quality: a goal of eHealth investment identified in each case.

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

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 around the patient: When healthcare professionals share and have access to 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 enables risk, potential injuries and possible harm to patients to be minimised.

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

¹ IOM Report (2001). Crossing the Quality Chasm: A New Health System for the 21st Century, Committee on Quality of Health Care in America, Institute of Medicine, 364 p., <http://books.nap.edu/catalog/10027.html>

can not; and healthcare professionals are enabled to work effectively in multi-disciplinary teams which share responsibility for the patient.

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

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

Fit to the benefits: For each of the ten eHealth applications, its fit to the benefit categories has been rated subjectively 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 2.

TABLE 2: THE BENEFITS FROM EHEALTH ACCORDING TO THE IDENTIFIED CATEGORIES

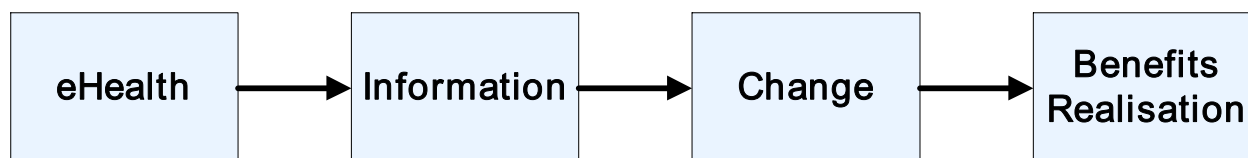
	Informed patients and carers	Information designed around the patient	Timeliness	Safety	Effectiveness	Efficiency	Access
AOK GCE	**	**	***		**	***	***
Apoteket – ePrescribing		**	***	***	***	***	
Bucharest ambulances		***	***	**	***	***	*
Institut Curie		***	***	**	***	***	
IZIP	***	***	**	**	***	***	*
Kind en Gezin	*	**	***	**	***	***	***
MedCom		**	***	**	***	***	
MOC			***	*	***	***	
NHSDO	***	*	***		**	***	*
Sjunet – radiology		**	***		***	***	**

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.

Core observations on some key success factors and process elements

Benefit realisation process needs the right people: Information is part of a process of benefits realisation as expressed and simplified in Figure 1.

FIGURE 1: THE PROCESS LEADING TO BENEFITS 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.

Each case was directed in navigating through this process by creating and sustaining multi-disciplinary teams of people with **the right mix of clinical, technical, managerial and organisational skills**. Sometimes engaging **marketing** experts and establishing a good service infrastructure to support eHealth services, e.g. to citizens, is also mandatory. For more complex eHealth investments, these multi-disciplinary teams included people who themselves, had a multi-disciplinary background. Having completed the process, their extensive knowledge and expertise in this field has been enhanced by the experience.

Adequate and sustained effort to support change was essential to achieving benefits from an effective eHealth application. This requires people with highly developed skills, who work in effective, stable, multi-disciplinary teams. For more complex applications, several members of the teams need multi-disciplinary skills in order to coordinate and drive the 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 the various process elements need to interact as a healthcare chain
- How specific ICT and eHealth applications can make a difference to various points of and interactions of the healthcare chain
- Clinical knowledge of healthcare practices
- Multi-disciplinary team-working
- How to achieve organisational change in complex settings.

This knowledge and experience, alone, was not enough. All teams, especially at Institut Curie, were integrated with the corporate vision for eHealth and the executive decision takers, who know and see eHealth benefits. It is seldom possible to find all these attributes in one person, but the team seems to perform as though it was. Successful multi-disciplinary 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.

Transferability of the sites: 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.

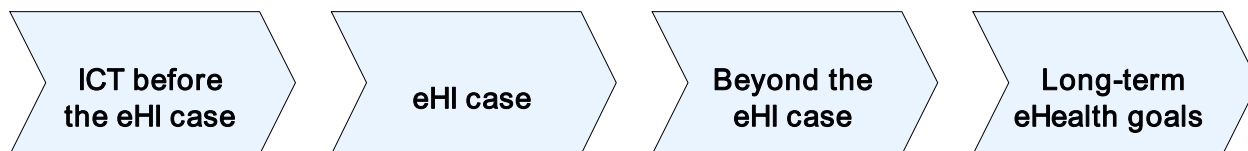
For the people who follow, and draw from the pioneers' experience, the learning curves may extend across a shorter time period till peak performance is reached, and so will be steeper. In all ten cases, the ICT component of eHealth can be transferred and adapted to other settings, albeit with some technical 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 alone will not be enough.

eHealth dynamic: 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 are reviewed 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 and realising a long-term vision. Exemplary here are Danish Health Data Network and IZIP, the Czech national patient record system, which were set up with the goal to facilitate communication.

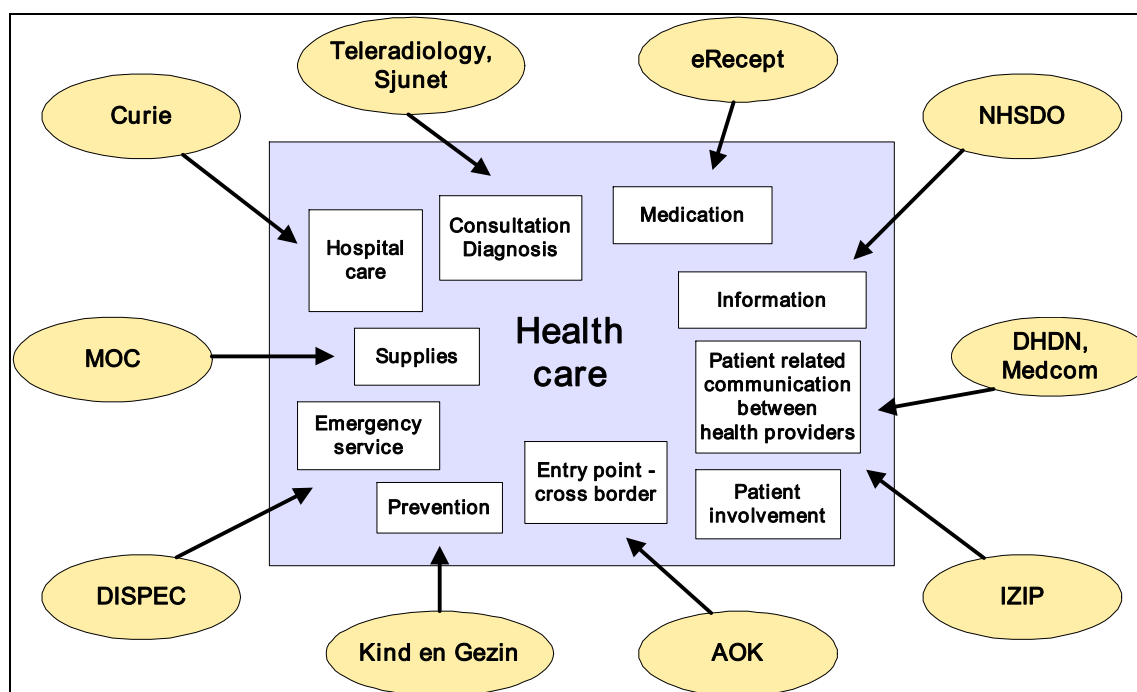
Each case included activities that preceded the eHealth application. These were essential to achieve a critical mass of expertise and experience needed to drive the dynamic into the direction of a longer-term goal. Continuous investment and development on a corporate level, not a single eHealth solution 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 eHealth dynamic, a continuous chain of ideas, developments and realisation of benefits from numerous individual eHealth investments, as shown in Figure 2.

FIGURE 2: SIMPLIFIED STRUCTURE OF AN EHEALTH DYNAMIC



Focus of each eHealth application: At each site, eHealth investment focuses on well-defined challenges and solutions to healthcare problems. It is not always the citizen that the eHealth application is aiming to benefit directly. Often, eHealth improves specific elements of the healthcare 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.

FIGURE 3: THE TEN EHEALTH APPLICATIONS FOCUS ON DIFFERENT PARTS OF HEALTHCARE



At NHSDO, and to a certain extent the AOK application, eHealth focuses directly on the citizen. The Medical Order Centre 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 supply chain. This in turn, benefits citizens by improving the efficiency of the healthcare provided. Curie's Elios and Prom  th  e tools, MedCom's national network, and the IZIP national health record system support the work of healthcare professionals and HPOs, and so facilitate better healthcare for citizens.

There are some important differences in the 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.

Correlations between rates of change in utilisation, benefits and costs are different across the sites. Correlations of changes in utilisation and benefits range from 1 to -0.83. A high, positive correlation indicates that utilisation itself can drive the benefits. Where it is low, or negative, then change management processes are a driver of benefits realisation. For some sites, especially HPOs with complex service and information structures, and 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 critical to benefits realisation.

Benefits from eHealth applications that are utilised directly by citizens tend to show a higher correlation. This reflects the greater role of the citizen as the direct beneficiary from the effective use of eHealth, and so a momentum, underpinning the benefits.

Similar complex 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.

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

Facing the challenges of modern healthcare

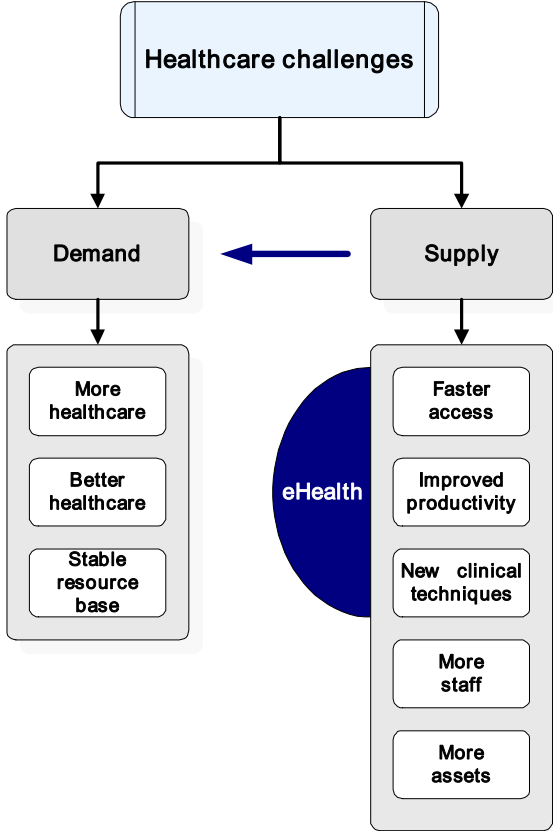
The economic performance of all ten cases confirms the, potentially, potent role of effective eHealth as an important strategic resource in helping to solve the problems of modern healthcare. Our results show that eHealth applications, taken together, as in our virtual health economy aggregation, can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

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

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 4:

FIGURE 4: SUPPLY AND DEMAND IN MODERN HEALTHCARE SYSTEMS



The demand for better quality is an inevitable consequence of the advances in medical science and technology and the expectations for future opportunities. The continuous expansion in demand is associated, among other things, with 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.

Policy recommendations

The eHI findings point to a few 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 *effective* eHealth in support to meeting citizens' healthcare demands can have substantial economic impacts and benefits, and is therefore worth encouraging. Key success factors to achieve such outcomes were identified above.

However, to pursue and accelerate the realisation of these benefits, health system policies as well as healthcare providers and third party payers must implement policies which foster such results.

Policy makers, health care providers and other actors must ensure the right mix of eHealth applications in order to achieve the goal of increasing benefits at stable costs. To achieve this, the following specific recommendations are made:

- Support investment in eHealth because of the high return on investment possible:
 - Provide incentives, such as tax breaks, regulatory and other advantages
 - Invest directly, with co-funding, or even full funding, by governments or third party payers for national and other eHealth applications benefiting society, but not benefiting an individual private investor
 - Integrate eHealth strategies into overall healthcare strategies.
 - Promote proven eHealth applications and effectively disseminate lessons learned
- Ensure the investment is appropriate:
 - Monitor the mix of existing applications and adjust efforts in order to achieve the virtual eHealth economy result. Otherwise, there is a risk of costs rising as well, which might not be affordable in the medium to long term
 - 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 problems that will be solved
 - 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
 - Invest in training and education to create stable multi-disciplinary teams with several multi-disciplinary individuals, 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, Continuing Professional Development, and a better understanding of the organisational change processes
 - Support the 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 for health care providers and cooperative health systems at the local and regional level
 - Ensure solutions are thought through, yet pragmatic, so implementation can start within a reasonable time period of some 3 to 5 years, depending on the application
 - Encourage, and actively organise working partnerships between suppliers of the ICT component, HPO and third party payers' managers, and most importantly users: healthcare professionals, citizens and administrative staff.
 - 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 validate and improve the method developed, and to compile more evidence about economic performance from other healthcare settings across the Union, and include financing implications, possibly with users and suppliers working in partnership.

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