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ICE-Health

An Integrated Collaborative Environment for Health Care in Iceland

Situation Analysis, Vision, and Action Plan for Change 2005-2007

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Chapter 1

Introduction

This report is written by ParX Business Consulting in Iceland, an IBM Business Partner, in close co-operation with IBM Business Consulting Services in Denmark.

The work was commissioned by the Icelandic Ministry of Health (MoH) in March 2004 and had a twofold objective. One was to provide an objective situation analysis of the current status of electronic patient records (EPR) in Iceland. The purpose was to assist the MoH and other stakeholders in obtaining objective data to facilitate decision-making regarding future EPR investment. The other objective was to provide a detailed technical and financial outline of the architecture scenario selected and estimate the likely benefits of such a program and how it should be managed. The benefit and program management sections were to be based on recent experience in Europe and the Nordic countries.

The criteria for a feasible architecture scenario were that it would have to ensure that earlier investments could be preserved as much as possible and preferably have the tactical support of the main stakeholders.

This report provides answers to the following main questions:

- What is the current situation of EPR proliferation in the Icelandic health care system; how much has been invested and has the investment been effective?
- Which aspects of EPR are necessary for Icelandic health institutions?
- What is the value of present systems and what opportunities do they hold?
- What IT infrastructure updates are necessary during the investment period?
- What is the benefit of switching to a new system, rather than keeping the present systems and engaging in the necessary integration and development work?
- When will the EPR become operational and what are the most important steps?
- What systems and tasks should the MoH focus on in 2004-2006?

The opportunities of electronic processes have been recognised by the health care services as in other areas of society. Several benefits accompany electronic opportunities. These have been realised in the Nordic Countries, Europe and the United States where experience and knowledge of implementing electronic work processes and electronic health records are well established.

Chapter 2

Executive Summary

The vision and architecture scenario recommended in this report is based on an extensive situation analysis of the current status of electronic patient records (EPR) in Iceland and the views of a sample of the main stakeholders in the area. This is believed to be the best way to preserve earlier investments and the nature of the consultation is considered likely to ensure the tactical support of the main stakeholders.

The proposed benefits are only a part of the supporting evidence for the ICE-Health project, which is estimated to be an investment of approximately ISK 1,979 million. On the other hand, the estimated investment in health care information technology[1] since 1998 is estimated at ISK 6,136 million. Net Return on Investment (ROI) of the ICE-Health project could be considered to be approaching 40% with potential monetary savings of around ISK 850 million annually. The proposed recommendation will be effective in raising health care IT to the next level and helping the government to realise earlier investment. It is necessary, however, to be aware that the main success factor lies within the change management aspect of the implementation of the ICE-Health project, involving not only technology but, even more so, processes and people. Furthermore, experience shows that proper funding of a project of this magnitude and complexity is paramount.

Benefits

The estimated investment in health care information technology (IT) to date, of ISK 9,150 million, has created a solid IT infrastructure with high user acceptance of EPR methodology. The proposals set forth by the ICE-Health project build on and take full advantage of this foundation.

The single most visible monetary benefit of the ICE-Health project will probably be realised in a reduction of medication errors.

A Committee, commissioned by the Minister of Health, that has been working on the Redefinition of Division of Work between LSH and FSA, states in its preliminary conclusions that in order to ensure continuity of service and patient safety and to increase the efficiency of operations, information must be safely shared between all health care providers.

The report *Revolutionizing Health Care Through Information Technology*, by the [United States] President's Information Technology Advisory Committee (June 2004) states that: "Nationwide implementation of health information technology is the only demonstrated method of controlling costs in

[1] The definition of investment in IT in this report includes purchase of hardware and software, user training and annual operations of such systems within the Icelandic health care system.

the long term without decreasing the quality of health care delivered." The report proposes an IT infrastructure and EPR system very similar to what is proposed by the ICE-Health project. The AS-IS analysis supports the opinion that the Icelandic health care system is very well suited to the implementation of such a project, while the US health care system seems to have some way to go until such a system can be implemented.

However, the US Veterans Administration hospitals have pioneered the use of this type of EPR infrastructure, testing the effects against critical benchmarks. Results show a reduced rate of incorrectly administered medication, from 1 in 20 ambulatory care prescriptions to less than 1 in 100,000, reduced hospitalisation, marked improvement of all critical benchmarks and a simultaneous cut in the annual cost of care per eligible veteran by nearly half. The president has set the goal of achieving EPR access for a majority of the US population within 10 years, but currently 13% percent of hospitals and 14-28% of doctors use electronic EPR.

According to a project plan for EPR in hospitals in Copenhagen (Köbenhavns Amt) in Denmark, such a system will increase quality, efficiency and patient safety. Better data access will reduce length of hospital stay (LOS.) It is estimated that LOS will be reduced by one day in 25% of medium-length stays and by one day in 50% of longer stays. Denmark has achieved 87% EPR usage amongst GPs and 50% usage at specialty clinics, but has set ambitious objectives: All hospitals shall have implemented an EPR system by the end of 2005; all GPs are to have an EPR by January 2005; all specialty clinics by 2007 and patient information shall be accessible from all points-of-care by 2007.

In Norway, 75% of hospitals use EPR; 92% of GPs in Sweden use EPR and Finland will have a national EPR in use by 2007.

The main success factor lies within the change management aspect of the implementation of the ICE-Health project, involving not only technology but, even more so, processes and people.

Benefits – overview

- Reduced risk of medication errors and adverse drug effects
- Reduction of admissions and reduced cost due to fewer medication errors
- Shorter hospital stay due to better data access
- Better information for administrative decisions, planning and prioritising, along with improved reporting for administrative agencies
- Improved response times for lab results
- Reduced waiting times and faster patient service
- Increased availability of health records due to multi-user access
- Increased opportunities for preventive measures
- Less time spent on paperwork
- Improved working conditions and increased job satisfaction

Budget Highlights

The proposed budget includes start-up investments and estimated annual operation expenses, itemised where applicable.

Total Budget	*ISK 1,979 million*
Collaborative Environment	*ISK 412 million*
Hospital EPR	*ISK 1,208 million*
Primary Care EPR	*ISK 264 million*
Program Management	*ISK 96 million*

The budget tables in chapter 10 include short explanations for each budget item that sometimes include strategic suggestions relevant to the item. It is suggested that the reader familiarise himself with the content of the explanations.

The second table provides an overview of the estimated operating costs for the different components of the project. It should be stated that the operating costs are “estimates based on an estimate” and are only provided for the purposes of this report; some items which will certainly have some annual cost associated with their operations have no estimated cost due to a lack of information or material on which to base estimates. The actual operating costs will be calculated based on actual cost and operational considerations regarding each item; please note that these operating costs will be IN ADDITION to current operating costs of IT systems

Total Annual Operating Cost	*ISK 101 million*
Collaborative Environment	*ISK 14.3 million*
Hospital EPR	*ISK 82.6 million*
Primary Care EPR	*ISK 4.3 million*

Situation and Challenges

For many years IT awareness has been high in Icelandic health care. This has spurred visionary national initiatives such as HealthNet and the Health Sector Database legislation, and is also reflected in the government’s information society policy for 2004-2007. Actual implementation, however, of electronic patient record systems (EPR) remains fragmented throughout the health care sector, due to lack of resources and other limitations.

The AS-IS analysis is based on a desk research of published and unpublished material, interviews with key stakeholders, surveys and comparison with other Nordic countries. The AS-IS analysis indicates that implementing EPR in the Icelandic health care sector currently faces a number of challenges:

- **Integration between health care institutions:** Electronic data interchange is very limited, restricting efficient patient flow and causing excessive communication costs and delays.
- **Integration within health care institutions:** The needs of specialised hospitals such as LSH and FSA cannot be met by a single system, but will require an extensive internal integration effort
- **Implementation of EPR within hospitals:** Implementation of EPR in hospitals is non-existent or very limited. Some hospitals are negotiating licenses for the Saga system, but adaptation of this to the requirements of specialised hospitals will require a major development effort. In addition, the effort needed for organisational change management (involvement, training, process optimisation) may be underestimated.

- **Involvement of key stakeholders:** Health care professionals, seeking to improve their own work environment, expect more influence on future IT development in health care services.
- **Harvesting benefits:** Impressive benefits identified in local pilots (e.g. HealthNet pilots) are not yet harvested on a nationwide scale. Redirecting resources that are freed up through electronic data interchange will require local management initiative.
- **Credibility of national initiatives:** Waiting for the Health Sector Database and for results from HealthNet to become widely visible has created a certain disillusion, which calls for a new vision and rapid, visible action.

Vision and Architecture

In meeting the challenges presented above, a **common EPR vision** must be projected by the entire health care sector for:

Patients, to experience a modern, secure, IT-enabled and collaborative health care system, which has memory across institutions and individual health care professionals; information about individual patients is placed in his or her patient journal at their regular point of care, e.g. with their GP, independent of place of origin of the data.

Professionals, to experience that relevant clinical patient information is available electronically where and when it is needed, regardless of its source and place of origin.

Managers, researchers and other professionals not involved in direct patient care, to experience that they have ready access to reliable and current information (suitably aggregated and anonymous) to support research, planning and management of care services. High quality information shall support the implementation of clinical governance and improvement of public health.

The foundation for bringing this vision to life is a national EPR architecture defining:

- **Standardised interfaces** for data interchange between institutions to allow patient data to flow in the interest of the patient.
- **A common integration strategy** for internal integration of EPR and other patient-related systems in the larger, specialised hospitals.
- **National core data sets** for selected key patient data such as medications, vaccinations and medical warnings (CAVE)

As a whole this architecture will facilitate an **integrated collaborative environment** for health care. The national EPR architecture does not imply a single EPR system to fit all needs. On the contrary, it facilitates competition by requiring developers to adopt and open-standard policy, thus allowing other software houses than the original developer to create modules for the single EPR system.

Actions and Management

The challenges listed above call for rapid action at the national level. The overall role of the national action plan will be to establish the national EPR architecture while leaving local implementation to local management. While maintaining this general objective, it must also be considered that the Icelandic market is hardly large enough to sustain a single health care software development house, let alone a number of developers that would create any form of open competition.

The actions necessary are grouped into 3 action streams reflecting the organisational structure of the health care sector:

- ***Collaborative environment stream*** will identify and prioritise interface standards, leveraging national as well as Nordic and other international experience, and facilitate nationwide implementation of these through operational pilot implementations. This stream will also define and implement national core data sets for sharing of key data.
- ***Hospital EPR stream*** will define the common integration strategy for hospital EPR (based on analyses already performed by the larger hospitals) and provide an adaptation of this suitable for the local hospitals.
- ***Primary care EPR stream*** will prioritise investments in the current primary care EPR (Saga) and prepare an opening of standards for Saga, thus creating opportunity for competition in the primary care EPR market.

The collaborative environment stream will build upon the successful results of the HealthNet project. To ensure full value from the HealthNet efforts, it is recommended to realign these with the national EPR architecture and integrate the project activities in the ICE-Health action plan.

Due to the number of stakeholders and the importance of an integrated architecture, efficient program management is a key success factor. To ensure undivided focus on the program, it is recommended that a dedicated task force be established, led by an overall program manager reporting to an executive management board comprising representatives of the MoH, the Directorate of Health, the hospitals and primary care providers.

Chapter 3

AS-IS Analysis

The AS-IS analysis was carried out to provide an overview of the current status of the use of information systems and technology, data exchange and storage within the Icelandic health care system[2]. The AS-IS analysis, along with other criteria (e.g. international benchmarking and experience), provides the basis for the suggested future scenarios for EPR in Iceland, which is the purpose of the ICE-Health project.

AS-IS Summary

The current EPR system is sufficient for the primary health care service, which was designed with its needs in mind. It is, however, evident that the system's users need more training and better knowledge of how to utilise its potential. It's not certain that the current EPR system will prove sufficient in the hospital environment as the system is mainly designed to transfer paper forms into electronic forms, with the addition of storing the patient records.

IT Expenditure in 2003 and Project Budgets

	IT Expenditure	Project EPR Spending	HealthNet Budget
Ministry of Health	68,000,000	-	585,000,000
Landspítali	800,000,000	70,000,000	Not applicable
FSA	55,000,000	25,000,000	Not applicable
Reykjavík Health Care Services	108,000,000	Not available	Not applicable
Other Health Care Institutions	39,000,000	Not available	Not applicable
Primary Care	16,900,000	Not available	Not applicable
Total	1,086,900,000	95,000,000	585,000,000

The licenses for the current EPR system amount to an annual figure of ISK 23,000,000, which includes 756 licences of Saga EPR. The annual accumulated IT expenditure for the hospitals and primary health care centres is currently estimated at over ISK 1 billion, which relates to software licenses and hardware purchases as well as IT services. This figure includes licenses and IT department overhead, except for other health care institutions and primary care.

[2] A part of the Icelandic health care system is privately run albeit publicly funded. In the year 2002 the total social expenditure to private specialists was ISK 2,290 million. The total amount for clinical doctors was ISK 1,628 million, and the total for medical research was ISK 661 million. This part of the health care system is not a part of the analysis in this report due to their variable needs and the limited access to information.

The EPR implementation has not been centrally administrated or coordinated, as individual institutions have been responsible for implementing and financing the EPR system with grants from the MoH, amounting to ISK 68 million in 2003. The MoH could assume a more central role by providing project management, IT knowledge pertaining to EPR systems and utilising the purchasing knowledge and leverage of central administration and service contracts to efficiently align the implementation process on a national level.

The main national health care initiatives relating to electronic patient records are the Health Sector Database (HSD) and the Icelandic HealthNet. The HSD is currently not being pursued by deCode as the firm's focus has been redirected from being a genomic firm to drug development (see p. 18. for further discussion of HSD and deCode). In addition, the Supreme Court of Iceland has ruled that legislation on the HSD needs to be addressed again by parliament. The HealthNet is under development, with the security requirement analysis for EDI and XML being completed, and assessment of network connections, security definitions and a pilot on electronic prescriptions being completed as well. Compared to the Swedish Sjunet and the Danish MedCom, the HealthNet is in a stage of preparation.

Data Gathering

Data gathering for the AS-IS overview was carried out via interviews with key stakeholders regarding EPR and information technology for the health care system. More than 30 individuals representing the health care sector were interviewed, including representatives from hospitals and the MoH. The second method of fact gathering was through written reports and studies from health care policy makers, i.e. from the MoH. Thirdly, data gathering took place by researching current work on IT in the health care sector to provide an overview of initiatives already undertaken regarding EPR and electronic data interchange. Fourthly, a questionnaire was sent to a sample of health care institutions and hospitals to provide an overview of the following:

- Existing and planned applications
- IT organisation (staffing)
- IT budget
- IT infrastructure

Finally, a questionnaire was sent to all providers of primary health care in Iceland asking for feedback on IT expenditure and executive assessment of the current IT usability. The questionnaire was sent to 33 health care institutions and primary health care centres of which 12 provided feedback. The survey was sent to 17 health care institutions and hospitals and 16 primary health care centres.

The Ministry of Health – Strategic Themes

During the years 1996 and 1997 the MoH developed its strategy regarding information within the health service. The main projects in this area were determined to be the following:

- HealthNet
- Electronic Patient Records (EPR)
- Telemedicine
- Integration of information systems
- Online public Healthsite
- Information services for health care employees3

Icelandic Health Care – Size and Shape

In Iceland there are approximately 80 health care institutions, which can be categorised as follows:

- Two high-tech hospitals, LSH and FSA. LSH serves the Greater Reykjavik area and FSA the northern region of the country.
- Six hospitals outside Reykjavik performing various surgical operations, maternity functions and providing emergency services.
- 23 smaller hospitals and health care centres providing limited services.
- Approximately 50 nursing/residential homes for the elderly situated at various locations in Iceland.4

The total number of hospital beds in Iceland is approximately 6,000, whereof 2,500 are hospital beds, 2,000 beds in nursing homes and around 1,500 beds in other health institutes (disability, mental care etc.). There are around 8,500 employees in hospitals, nursing/residential homes and health clinics in Iceland.[5] Table 1 shows an overview of health care providers, with the number of full-time positions and operating cost for each health care institution. The total cost, including hospitals and primary health care centres, is around ISK 40 billion.

[3] *Rafræn sjúkraskrá – Rafræn heilbrigðisþjónusta*. Ávarp Jóns Kristjánssonar. Málþing á Hótel Nordica 1.4.2004. Pg. 1.
[4] Meeting minutes: ParX and the Ministry of Health, 22 September, 2003. STB.
[5] Meeting minutes: ParX and the Ministry of Health, 22 September, 2003. STB.

Table 1. Health care providers in figures (*in ISK*).

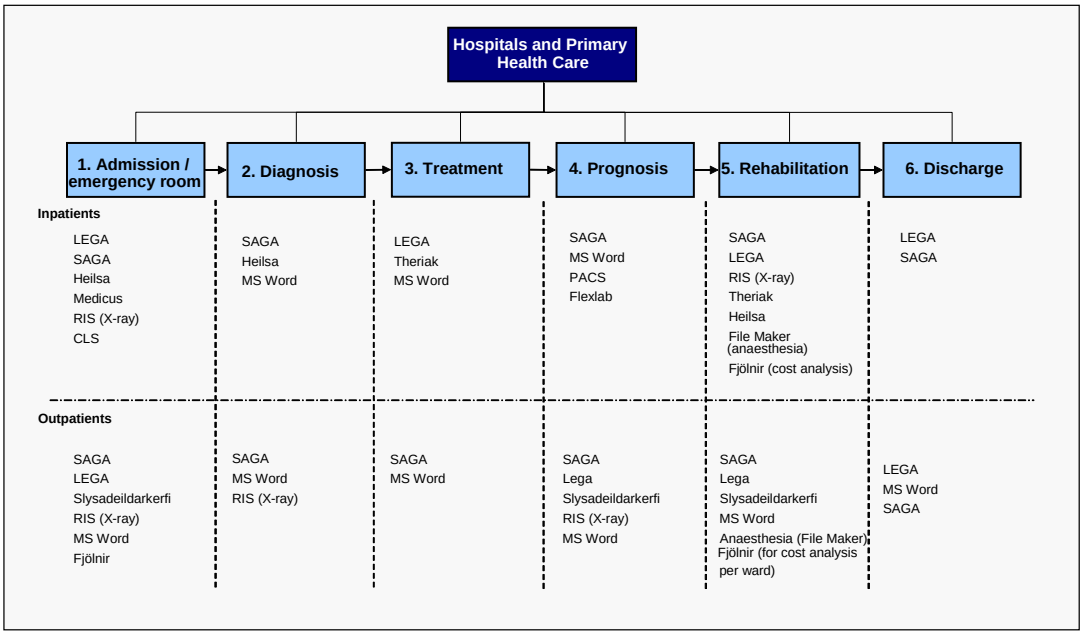
Health Care Providers in Figures				
Location	**FT Employees**	**Operating Cost**	**No. of Locations**	**Field of Operation**
Landspitali	5,000	27,491,767,000	27	Hospital. Provides all medical specialities and most sub-specialities
FSA	461.5	2,827,955,701	7	Hospital. Provides all general and special health care services
Reykjavik Health Care Services			10	Primary health care.
Heilbrigðisstofnun Þingeyinga	106	669,000,000		Hospital and primary health care
Heilbrigðisstofnun Austurlands	223	1.237,000,000		Hospital and primary health care
Heilbrigðisstofnunin Akranesi	176	1.127,000,000	1	Hospital and primary health care
Heilsugæslustöðin á Akureyri		374,000,000	1	Primary health care
Heilbrigðisstofnunin Selfossi	152	761,000,000	1	Hospital and primary health care
Heilbrigðisstofnunin Ísafjarðarbæ	109	645,000,000	1	Hospital and primary health care
Heilsugæslustöðin Sólvangi	60	317,000,000	1	Primary health care
Heilbrigðisstofnunin Sauðárkróki	128	627,000,000	1	Hospital and primary health care
St. Jósefsspítali	129	588,000,000	1	Hospital
Heilbrigðisstofnunin Blönduósi	98	299,000,000	1	Hospital and primary health care
St. Franciskusspítalinn, Stykkishólmi	48	288,000,000	1	Hospital
Heilbrigðisstofnunin Vestmannaeyjum	76	491,000,000	1	Hospital and primary health care
Heilsugæslustöðin Garðabæ	18	125,000,000	1	Primary health care
Heilbrigðisstofnun Suðausturlands			1	Hospital and primary health care
Heilbrigðisstofnunin Siglufirði	58	301,000,000	1	Hospital and primary health care
Heilbrigðisstofnunin Hvammstanga		207,000,000	1	Hospital and primary health care
Heilbrigðisstofnunin Patreksfirði	33	185,000,000	1	Hospital and primary health care
Heilbrigðisstofnunin Hólmavík		98,000,000	1	Hospital and primary health care
Heilbrigðisstofnunin Suðurnesjum	175	1.047,000,000	1	Hospital and primary health care
Heilbrigðisstofnunin Bolungarvík	20	112,000,000	1	Hospital and primary health care
Borgarnes	12	99,000,000	1	Primary health care
Ólafsvík	8	74,000,000	1	Primary health care
Grundarfjörður	4	41,000,000	1	Primary health care
Búðardalur	6	66,000,000	1	Primary health care
Ólafsfjörður		40,000,000	1	Primary health care
Dalvík	10	67,000,000	1	Primary health care
Höfn		85,000,000	1	Primary health care
Kirkjubæjarklaustur	3	38,000,000	1	Primary health care
Vík	4	41,000,000	1	Primary health care
Rangárþings	11	96,000,000	1	Primary health care
Laugarás	8	74,000,000	1	Primary health care
Hveragerði	6	65,000,000	1	Primary health care
Þorlákshöfn	4	38,000,000	1	Primary health care
Total	7146.5	40,641,722,701	75	

Sources: Ársskýrsla 2002, FSA. Clinical application domain at Landspitali, Baldur Johnsen. Office of engineering and information technology. Ministry of Health. Ársskýrsla 2003, Landspitali – háskólasjúkrahús, maí 2004.

Systems Overview

Systems in use can be categorised according to their function, i.e. how the individual (patient) interacts with the health care system. The main touching points between the patient and the health care system have been determined to be admission, diagnosis, treatment, prognosis, rehabilitation and discharge.[6] Figure 1 shows the location of IT systems from the process viewpoint as the patient progresses or interacts with the health care services.

Figure 1: Systems categorised according to the interaction between patient and health care.



Saga – the Saga EPR system is the system most commonly used by primary health care centres. The system was designed to accommodate the needs of primary health care in the early 1990s. Although not originally designed for hospital environment, the two largest hospitals, LSH and FSA, have recently contracted the Saga vendor to start implementing the system.[7]

The Saga system comprises a number of modules, including patient records, nursing records, waiting lists and reception and billing. The Saga EPR system is intended to store all medical data from a patient receiving treatment at a health care institution. The EPR system stores basic personal information, the reasons for each visit, and information on the diagnosis, the treatment and the results of the treatment. Additionally, the system stores all formal communication between health care employees regarding each patient, e.g. letters, work orders and outcomes.[8] Data collected through the EPR system is not shared between institutions.

[6] See further *Almenn kröfulýsing fyrir sjúkraskrárkerfi: Lágmarkskröfur*. MoH, Reykjavík, 2001.
[7] *Rafræn sjúkraskrá – Rafræn heilbrigðisþjónusta*. Ávarp Jóns Kristjánssonar. Málþing á Hótel Nordica. 1.4.2004. Pg. 2-3.
[8] *Rafræn sjúkraskrá – Rafræn heilbrigðisþjónusta*. Ávarp Jóns Kristjánssonar. Málþing á Hótel Nordica. 1.4.2004. Pg. 3.

The Saga nursing module is included in the EPR system but is uniquely designed for inpatients, with the use being restricted to one ward at LSH.[9]

The Saga waiting list records patients waiting, operation list and list of admitted patients.

The Saga reception and billing module keeps record of scheduling, patient visits and payments from outpatients and inpatients.[10]

Lega – this system is used for the patient's process through the hospital from admission to discharge. The system contains information on licence registration, operations and diagnoses. In 1996, implementation of the Lega system started at Sjúkrahús Reykjavíkur, which later became part of LSH, and it is now in use at LSH. The system is in development and the current version was issued in 2001.[11]

FlexLab – a system in use at research laboratories for haemopathology and pathochemistry, where samples and lab results are registered. The system can be connected to research tools and measuring equipment.[12]

Kodak Radiology Information System (RIS) – the RIS system dates to the year 1996. It was developed in Iceland for requests, reporting, scheduling and radiology data collection.[13]

Theriak – a system developed by Theriak Ltd, is divided into three main components, the pharmacy inventory system, online order system and Theriak therapy, which is a system supporting the drug dispensing process focusing on the principle of unit dosage dispensing. The Theriak system supports doctors' orders, clinical medication guidelines and interfaces with an automated unit dosage packaging machine.[14]

Notes ePR – the system was introduced in 1996 as a support for clinical assistants.

ProSang – is the blood bank information system, connected to the administration of LSH. The system is Swedish, from the vendor Databyran, and holds information on blood donors, donations and supplies.

WM DATA Orbit – is a system for surgical planning processes and resource allocation and supports pre- and post-operation tasks. The surgical planning system collects data automatically from the anaesthesia equipment.[15]

DRG – a management decision support system for productivity and cost-per-production-unit analysis, where production is defined as the number of inpatient admissions and routine tasks at out- or inpatient wards. The system is in use at LSH.[16]

Ískrá – the system was designed and programmed by the Reykjavik Health Care Services for health care in schools within the Reykjavik Health Care Services area.[17]

Medicus – is an old EPR system and will gradually fade out. The number of users is minimal.

[9] *UT innviðir og þjónusta Landspítala, útg. 2.1*. Heiðar Jón Hannesson, May 2004. Pg. 37
[10] *UT innviðir og þjónusta Landspítala, útg. 2.1*. Heiðar Jón Hannesson, May 2004. Pg. 37
[11] *UT innviðir og þjónusta Landspítala, útg. 2.1*. Heiðar Jón Hannesson, May 2004. Pg. 40
[12] *UT innviðir og þjónusta Landspítala, útg. 2.1*. Heiðar Jón Hannesson, May 2004. Pg. 41
[13] *Clinical Application Domain at Landspitali*, Baldur Johnsen. Office of engineering and information technology.
[14] *Clinical Application Domain at Landspitali*, Baldur Johnsen. Office of engineering and information technology.
[15] *Clinical Application Domain at Landspitali*, Baldur Johnsen. Office of engineering and information technology.
[16] *UT innviðir og þjónusta Landspítala, útg. 2.1*. Heiðar Jón Hannesson, May 2004. Pg. 47
[17] AS-IS Questionnaire: Reykjavik Health Care Services.

Primary Health Care and Health Care Institutions: Systems and Infrastructure

The total number of primary health care facilities is 35, with 19 primary health care centres situated outside the Reykjavik area.[18]

Systems

Systems used by the primary health care service for EPR are primarily the Saga system, versions 2.6 and 3.1. Most primary health care organisations now use the Saga system for patient records, reasons for patient visit, diagnosis, treatment and result of the treatment.[19] Other systems in health care relate to systems for lab results and diagnoses, e.g. radiology information systems, laboratory systems and emergency room systems.[20] Lab results are not integrated into the Saga system and results must therefore be entered manually as produced.[21]

A survey performed among the health care institutions in Iceland indicates that they require more training in using the EPR system.[22]

Infrastructure

Network connections for the health care system can be divided into two categories. First, the local area network within an institution and its subunits – most of the institutions have their facilities connected by a local area network. Second, external connections to the internet and between institutions. The bandwidth varies from high-speed connections to dial-in connections and accordingly the availability of workstations and internet connections varies between the different locations. The difference lies mainly in that the nursing homes have the lowest availability of workstations and internet connections.

The most common connections to the internet utilised by the institutions are fixed-line (leased lines and frame relays) and ADSL. Some institutions utilise ISDN and low-speed ADSL and a few institutions, located outside the reach of the ADSL service, utilise ISDN connections.[23]

Reykjavik Health Care Services infrastructure upgrades

Current IT infrastructure is composed of MS Windows NT 4.0 workstations and MS Windows NT 4.0 servers. These operating systems have been tested and proven for the Reykjavik Health Care Services usage and only minor changes have been made since day one. Due to this, no additional investment has been needed and the original investment has served well. It has, however, become necessary to update to the Windows XP operating system and servers operating Windows 2003.

Reykjavik Health Care Services central filing and user support

The first step would be to implement Windows 2003 servers for filing and user support. Basically there are two servers for all user support and two servers for filing services.

[18] Heilbrigðisráðuneytið. Heilsugæslustöðvar sbr. http://www.heilbrigdisraduneyti.is/stofnanir//nr/1243.
[19] Rafræn sjúkraskrá – Rafræn heilbrigðisþjónusta. Ávarp Jóns Kristjánssonar. Málþing á Hótel Nordica 1.4.2004. Pg. 3.
[20] AS-IS Questionnaire: SHA.
[21] AS-IS Questionnaire Survey within the Health Care Services.
[22] AS-IS Questionnaire Survey within the Health Care Services.
[23] *Fjartengingar heilbrigðisstofnana*. Stiki. Stefán Orri Stefánsson, October 2003. pg. 7.

Electronic data exchange between LSH and Reykjavik Health Care Services is expected to be up and running within the next two years. Backup lines for Reykjavik Health Care Services are preferred.[24] At Reykjavik Health Care Services the coverage of LAN and WLAN is 95%.[25]

Hospitals: Systems and Infrastructure

The current EPR system in place was originally written for the primary health care service and the systems have therefore needed to be adapted to the needs of the hospital environment. Other systems have been developed to support the treatment processes, as described in the *Systems Overview* section above. The EPR system has not been fully implemented as the process has only recently begun at LSH and FSA with implementation in some wards. Smaller hospitals use the Saga EPR system, versions 2.6 and 3.1.

At LSH there are 73 information systems in operation, divided into three main categories: hospital systems, human resource systems and other management support systems.[26] The general picture is of a number of specialised processes being well supported by IT, but these are mainly isolated systems. The core clinical processes currently have very limited IT support.

Systems

The Saga EPR system has been initiated at LSH and FSA and the latest version, version 3.1, has been installed. At LSH it is anticipated that implementing the Saga will, in the short term, change the current work processes and the culture of handling, storing and retrieving data. The implementation of the Saga system is partly caused by the legal imperative to implement electronic health records. The Saga is seen as an intermediate system, not yet based on the principle of organizing around processes and with the present benefits mainly pertaining to the electronic storage of data, but which will later lead to an integrated solution of data entry, storage and retrieval.[27] As the culture change progresses the process analysis can be carried out and the main benefit of the Saga will be the central data collection by doctors and nurses. The Saga system is believed to be one of few systems that can be implemented quickly and off the shelf, although it is mainly a documentation system for processes via forms for data storage. The process mindset is a newly applied method of analysing the IT needs at LSH but the current EPR system is not designed for processes or the value chain.[28]

[24] AS-IS Questionnaire: Reykjavik Health Care Services.
[25] AS-IS Questionnaire: Reykjavik Health Care Services.
[26] *UT innviðir og þjónusta Landspítala, útg. 2.1*. Heiðar Jón Hannesson, May 2004.
[27] AS-IS Questionnaire: LSH.
[28] AS-IS Questionnaire: LSH.

Infrastructure

According to a recent study, the bandwidth for LSH is sufficient and is projected to suffice for some time. The LAN and WLAN is 100%.[29] The technical operations environment at LSH is comprised of:

- 5 IBM AIX computers
- 7 HP-UX computers
- 5 Linux computers
- 2 SUN computers
- 8 Netware servers
- 43 Windows servers

Dataflow from the internet is 700 gigabytes per month, accumulating to 8.2 terabytes annually.[30] The new financial system is hosted centrally for government institutions and all communication with the financial system is therefore via the internet.

Data storage at LSH is as follows:

- IBM FasTrack 900 SAN – will be fully used this year, with 5,773 gigabytes.
- LotusNotes groupware – 350 gigabytes and projected to expand to 800 in 2004.
- PACS RIS system currently stores 600 gigabytes, projected to expand to 1,630 gigabytes in 2004..[31]

National Initiatives

Currently, by law, health information on patients cannot be sent by e-mail between hospitals or health care centres. The Icelandic HealthNet is an ongoing project which was begun in the year 2000, with the purpose of sharing health information electronically between hospitals and health care centres. The HealthNet is intended to allow electronic exchange of individual EPR, discharge letters, prescriptions, lab results, billing, financial information, logistics etc. Recently, a revised project plan for the HealthNet was approved for the years 2004-2007.[32]

Icelandic HealthNet

The tasks of the project for the next four years, according to the project budget, will be concerned with security issues (i.e. consulting) technical operations (i.e. network, mail system, system operation, technical services) operations (i.e. employees, facilities) and subtasks (i.e. experimental projects). The HealthNet budget for the years 2004-2007 is shown in table 2.

[29] AS-IS Questionnaire: LSH.
[30] *UT innviðir og þjónusta Landspítala, útg. 2.1*. Heiðar Jón Hannesson, May 2004. Pg. 6.
[31] *UT innviðir og þjónusta Landspítala, útg. 2.1*. Heiðar Jón Hannesson, May 2004. Pg. 6.
[32] *Rafræn sjúkraskrá – Rafræn heilbrigðisþjónusta*. Ávarp Jóns Kristjánssonar. Málþing á Hótel Nordica 1.4.2004. Pg. 2.

Table 2. HealthNet proposed budget for 2004-2007 (*figures in ISK*).

Icelandic HealthNet: Budget 2004-2007				
	2004	**2005**	**2006**	**2007**
Security	12,000,000	10,000,000	8,000,000	6,000,000
Technical operation	3,000,000	21,000,000	29,000,000	39,000,000
Operations	26,250,000	62,000,000	86,500,000	103,500,000
Tasks	30,000,000	40,000,000	40,000,000	40,000,000
Unforeseen 5%	4,000,000	7,000,000	8,000,000	9,000,000
Total	75,250,000	140,000,000	171,500,000	197,500,000

Source: *Íslenska heilbrigðisnetið*, financial plan, 11.2.2004.

The Health Sector Database (HSD)

The Act on the HSD stipulates that health care institutions and GPs can allow individual health records to be transferred and stored in the HSD. An individual or patient can, at any time, instruct that his health records are not to be transferred into the central database and the health care service is obliged to comply. It is further stipulated that no personal identification can be made from the data as the data is coded by one-way encryption. The practical use of the database, according to the Act on the HSD, is for planning, health care reports, strategic decisions, to improve health, diagnosis and treatment and to increase efficiency in the operation of health care information systems and data retrieval for reports.[33] The idea of a centralised database has been planned since the 1990s but it has yet to be realised. The database has not yet been built and, according to a ruling from the Supreme Court of Iceland, the Act on the HSD does not comply with the Icelandic constitution (Article 71, Paragraph 1) by adequately protecting data from being traced back to relevant individuals[34] as further described below in an excerpt from the ruling by Supreme Court of Iceland:

> An Act that provides for the establishment of a database system can comply with Article 71, Paragraph 1, of the Icelandic constitution, even though it is made without the patients' consent and even though it provides for a private party, which is neither a health institution nor a self-employed health worker, to build it, *if the legislature, when writing a statute such as that Act, does its utmost to ensure that the data cannot be traced back to the data subjects.*
>
> The Act stipulates repeatedly that data in the HSD must not be personally identifiable (linkable to individuals), but it does not contain precise provisions on how to achieve this goal as it should due to the above mentioned responsibilities, which the constitution charges the legislature with, for the purpose of protecting the citizens' personal privacy.
>
> This can not be substituted with provisions on various surveillance measures to be taken by governmental agencies, without these agencies being furnished with clear and lawful parameters on which to base their evaluations. Neither can this be substituted by referring to the Minister of Health for him to put relevant provisions into the operating license; nor to entrust any other governmental bodies with coming up with codes of practice, since such

[33] *Lög um gagnagrunn á heilbrigðissviði. 1998 nr. 139 22. desember*. See further: http://www.althingi.is.
[34] Data Protection Authority. Excerpt from a judgement by the Supreme Court of Iceland, of November 27, 2003, concerning The Health Sector Database (HSD). See further: http://www.personuvernd.is.

codes could be subject to a variety of changes, given the very vague boundaries set by the Act on a Health Sector Database.

In the year 2000 the firm deCode Genetics was granted a 12-year exclusive license to make, fund and manage an HSD. The firm was to hand the property back to the Icelandic state in 2012. For the exclusivity the firm was supposed to develop and be the main financial source for an EPR for all public sector health care organisations in Iceland. The firm is currently not working on a general EPR system for the Icelandic health care sector. This has been the de facto status for some time, at least since 2002.[35]

IT Expenditure

The following summary of IT spending and budgets within the Icelandic health care sector is not exhaustive and is only intended to provide an indication of the scale of the IT environment. The number of systems varies according to the size of each organisation; LSH supports 73 systems for its IT budget, FSA supports 12 and the Reykjavik Health Care Services support three systems. Table 3 shows the IT budgets for the larger health care services.

Table 3. IT expenditure in 2003: Larger health institutions.

Organisation	**IT Expenditure**			(Figures in ISK)
Hospital and Primary Health Care Centres	**Hardware**	**Software**	**IT services**	**Sum**
80 workstations and above				
Landspitali				800,000,000
FSA				55,000,000
Reykjavik Health Care Services				108,000,000
Heilbrigðisstofnun Þingeyinga				-
Heilbrigðisstofnun Austurlands	3,216,346	3,508,810	89,601	6,814,757
Heilbrigðisstofnunin Akranesi				-
30 to 80 workstations				
Akureyri	2,500,000	2,800,000	3,000,000	8,300,000
Heilbrigðisstofnunin Selfossi	2,476,473	2,501,337	4,808,631	9,786,441
Heilbrigðisstofnunin Ísafjarðarbæ				-
Heilsugæslustöðin Sólvangi				-
Heilbrigðisstofnunin Sauðárkróki				-
St. Jósefsspítali Hafnarfirði	1,414,193	2,160,260	2,191,302	5,765,755
Heilbrigðisstofnunin Blönduósi	900,000	3,500,000	-	4,400,000
Total	*10,507,012*	*14,470,407*	*10,089,534*	*993,666,953*

Sources: Fjartengingar heilbrigðisstofnana, AS-IS questionnaires: Reykjavik Health Care Services, AS-IS questionnaire: LSH, AS-IS questionnaire to institutions

As seen in table 4, there is considerable difference in IT needs between smaller health institutions and the larger institutions, where the high-tech hospitals are in a category of their own regarding IT needs. The data from the hospitals, the health care institutions and the MoH indicates an IT budget of over ISK

[35] Meeting Minutes: ParX and deCode, June 15. 2004. AJ.

1 billion for the year 2003, as seen in tables 2 and 5. The proposed budget for the HealthNet is ISK 585 million for the years 2004-2007. The services contract for the Saga EPR system amounts to an annual cost of ISK 23,000,000 for 756 licences.[36]

Table 4. IT Expenditure 2003: Smaller health institutions.

Organisation	IT Expenditure			(Figures in ISK)
Hospital and Primary Health Care Centres	**Hardware**	**Software**	**IT-Services**	**Sum**
Less than 30 workstations				
St. Franciskusspítalinn, Stykkishólmi	3,286,626	2,698,712	-	5,985,338
Heilbrigðisstofnunin Vestmannaeyjum	1,530,000	3,470,000	-	5,000,000
Garðabær				-
Heilbrigðisstofnun Suðausturlands				
Heilbrigðisstofnunin Siglufirði		600,000	650,000	1,250,000
Heilbrigðisstofnunin Hvammstanga				-
Heilbrigðisstofnunin Patreksfirði				-
Heilbrigðisstofnunin Hólmavík				-
Heilbrigðisstofnunin Suðurnesjum				-
Heilbrigðisstofnunin Bolungarvík				-
Smaller Primary Health Care Centres	**Hardware**	**Software**	**IT services**	**Sum**
Borgarnes	1,189,802	676,352	442,330	2,308,484
Ólafsvík	576,000	400,000	300,000	1,276,000
Grundarfjörður	600,000	400,000	200,000	1,200,000
Búðardalur				-
Ólafsfjörður				-
Dalvík				-
Höfn				-
Kirkjubæjarklaustur				-
Vík				-
Rangárþings	1,000,000	1,500,000	1,300,000	3,800,000
Laugarás				-
Hverageröi				-
Þorlákshöfn				-
Sum	*8,182,428*	*9,745,064*	*2,892,330*	*20,819,822*

Sources: Fjartengingar heilbrigðisstofnana, AS-IS questionnaires: Reykjavik Health Care Services, AS-IS questionnaire: LSH, AS-IS questionnaire to institutions

In addition, the MoH had a contract with eMR, related to the upgrade to Saga 3.1, for ISK 23,400,000, which was charged in 2002 and 2003. The MoH provided an additional budget for the primary health care centres and the health care institutions providing primary care of ISK 45 million due to Saga EPR upgrades. Currently, the MoH has an active service contract, one that does not include upgrades or further development of the EPR system.[37]

[36] *Fjöldi útstöðva hjá heilsugæslustöðvum*. MoH. 13.7.2004.
[37] "Other IT costs at the MoH." MoH (E-mail) 1.7.2004.

Table 5. Overview of IT costs in 2003 (*figures in ISK*).

IT Expenditure in 2003 and Project Budgets			
	IT Expenditure	**Project EPR Spending**	**HealthNet Budget**
Ministry of Health	68,000,000	-	585,000,000
Landspítali	800,000,000	70,000,000	Not applicable
FSA	55,000,000	25,000,000	Not applicable
Reykjavík Health Care Services	108,000,000	Not available	Not applicable
Other Health Care Institutions	39,000,000	Not available	Not applicable
Primary Care	16,900,000	Not available	Not applicable
Total	1,086,900,000	95,000,000	585,000,000

Sources: Fjartengingar heilbrigðisstofnana, AS-IS questionnaires: Reykjavik Health Care Services, AS-IS questionnaire: Landspitali, AS-IS questionnaire to institutions, Icelandic HealthNet: Budgetplan.

The Nordic Context

This section views the status of IT in the neighbouring countries, which are commonly referred to for comparison of progress and status.

In the Nordic countries (Denmark, Aland, Faroe Islands, Finland, Greenland, Iceland, Norway, Sweden) the health service is a public matter where the financing and the organisation is governed by municipalities and the government according to the legislature in each country. Although health service is publicly provided there are fees involved in all countries for some types of treatment. The standard of health care in the Nordic countries is high, with "well developed hospital services and advanced specialist treatment."[38] Iceland is the only country covered by NOMESCO where funding for the health service is provided primarily by the state, whereas in the other countries it is funded by municipal and/or county taxes as well as with grants from the state.[39] A financial injection of DKK 510 million was made by the Danish government in 2003, partly to hurry up the use of IT systems as the "money shall be specially allocated to continued increased activity within the following areas: cancer, cardiology, medicine, postgraduate education for physicians and introduction of IT systems in the health sector."[40]

The common denominator in the IT strategies of the Nordic countries is the issue of data security, but, at the same time, they have set up action plans and committees to advance the adaptation of government services to electronic processes. The integration of applications is also one of the main tasks.[41]

All the Nordic countries have launched national strategies on IT in health care. Co-ordination of pilot projects, development and implementation is a shared challenge, as are new IT investments, legislative issues and standardisation. Despite the challenges there is a powerful argument for a considerably rapid implementation of the IT strategies: the demand for increased efficiency within the health sector.[42]

[38] *Health statistics 2001.* NOMESCO. Pg. 12.
[39] *Health statistics 2001.* NOMESCO. Pg. 44.
[40] *Health statistics 2001.* NOMESCO. Pg. 5.
[41] *A Public Sector With an "e" – A Study of the Nordic Countries.*
[42] *A Public Sector With an "e" – A Study of the Nordic Countries*. Pg. 53-54.

EPR systems are in use in some form in all Nordic countries and Sweden and Denmark have connected electronic data exchange via national health nets as shown in table 6.[43]

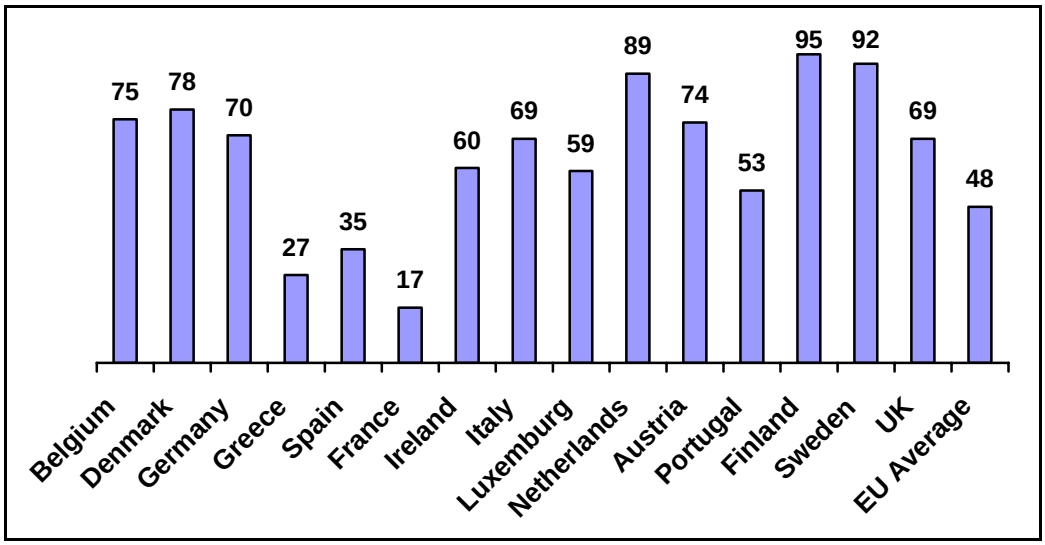
Table 6. IT Status in the Nordic Countries.

IT in the Nordic Countries			
	IT in % of total health care budget	**Infrastructure**	**Coverage**
Sweden	3.5%	National health net (Sjunet)	All counties, hospitals and primary care
Iceland	2.0%	Proposed national health net in 2006	None
Denmark	2.8%	National health net (MedCom)	All hospitals, laboratories and pharmacies, 2,100 GP practices and 10 municipalities – in total over 2,500 different organisations – were using the health care network on a daily basis at the end of 2003. More that 2 million messages are exchanged each month, which represents 60% of cross-sector communications
Norway	Not available	National health net connecting regional nets (Si@!)	Variable between regions, but increasing
Finland	Not available	Regional data dystems	Regional coverage used by the social and health care sectors

Source: *A Public Sector With an "e" – A Study of the Nordic Countries.*

In Denmark around 90% of doctors use electronic health records, in Norway the percentage is 75% of all hospitals, in Iceland the implementation of an electronic patient record system has reached nearly all health care institutions in the country and in Finland it was decided in 2002 that an electronic health records system should be in common use throughout the health care in the country by 2007.[44] Figure 2 shows the use of electronic health records in the EU context.

Figure 2: Electronic health records in the EU.



Source: *Mapping the Potential of eHealth: Empowering the Citizen Through eHealth Tools and Services*, pg. 8

[43] *A Public Sector With an "e" – A Study of the Nordic Countries*.
[44] *A Public Sector With an "e" – A Study of the Nordic Countries*. Pg. 78-89.

The EU carried out a research to assess online government functions by evaluating the status of 20 common public services. The research shows that "within local municipalities the evaluation found that IT is most widespread in administration and technical operations, while it is least used in care and nursing activities. Furthermore, few municipalities collaborate on IT-based tasks."[45] The health care services are then lagging behind the administrative functions on the IT journey destined for greater efficiency, increased services, secure data documentation, retrieval and storage, as well as for improved health care and timely and accurate reporting of trends and national or individual health information.

[45] *A Public Sector With an "e" – A Study of the Nordic Countries*. Pg. 45.

Chapter 4

Vision

Vision of an Integrated Collaborative Environment

The vision proposed for ICE-Health is to enable a transformed health care system, where:

Patients experience a modern, secure, IT-enabled and collaborative health care system, which has memory across institutions and individual health care professionals. Examples of this include:

- Prescriptions are checked for dosage/cross-effects before safe electronic transfer to any chosen pharmacy.
- At discharge, relevant medication is immediately available to patient's own GP and homecare.
- By giving consent, the patient may make his/her medical history immediately available to any chosen clinic.
- Patient's own GP is well informed from specialists, emergency calls, etc.
- Access by patients to their own data should be facilitated, allowing for increased self-diagnosis and self-help; this is in accordance with MoH objectives of utilising the internet as a service channel for non-critical patient contact.
- By taking full advantage of the system, the effects of residence-dependent access to different types of health care should be minimised.
- The general benefits of the ICE-Health project can be further enhanced by taking advantage of the fact that Iceland enjoys one of the highest rates of computer literacy and internet access in the world. This provides a solid foundation for the realisation of the full benefits of the ICE-Health project.

Professionals experience that relevant clinical patient information, regardless of its source, is available electronically where and when it is needed. Information entered into a system at any point of care will, at the command of the attending clinical professional, be entered directly into the patient's medical journal at the location of his primary GP. Examples of this include:

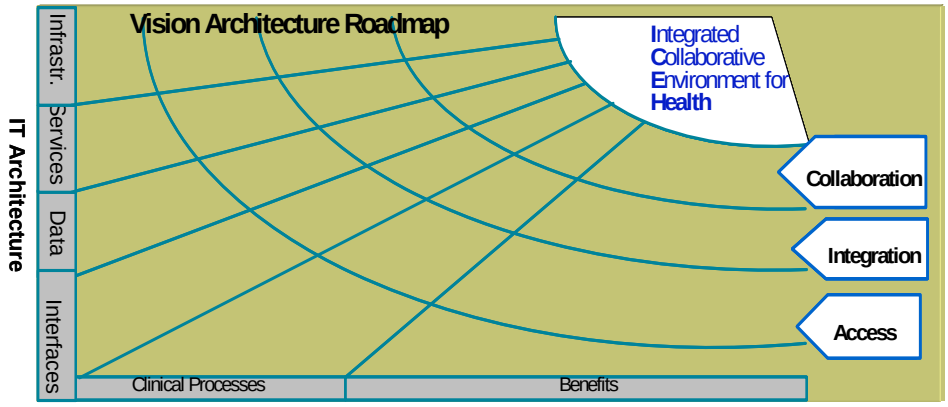
- Lab results, X-ray results et cetera are transferred immediately to the patient's record.
- Changes in medication are immediately available to all relevant staff.
- No time wasted on retrieving patient records that have been archived, transferred or misplaced.
- Any health care contact of an individual entered into the system is immediately available to any attending physician.
- Dissemination of Best Practices through increased communication.

Managers, researchers and other professionals not involved in direct patient care experience that they have ready access to reliable and current information (suitably aggregated and anonymised) to support research, planning and management of care services. High-quality information supports the implementation of clinical governance and improvement of public health. Examples of this include:

- Clinical quality databases support development and implementation of best clinical practices.
- Analysis of geographical variations in diagnoses and treatments support public health initiatives, such as outcome measurements reporting and the effects of ageing.

Reaching Towards the Vision

Figure 3: Vision architecture roadmap



The major challenge of the ICE-Health project lies in its implementation. For the implementation to be successful enough to fully realise the benefits of the project, sufficient organisation and knowledge of the subject and the system, along with substantial experience, must be readily available to program management. Appropriate financing of the project is certainly required, but that alone does not ensure its success.

Many health care institutions have already started to reach for a more integrated and IT-enabled environment. To realise the vision it is now crucial to coordinate local and national initiatives in a coherent national action plan. The ICE-Health vision and architecture will serve as the guiding light of this plan.

It is, however, equally important to understand the realisation of the plan as a journey that must deliver added benefits at every stop. Each leg of the journey should have a short-term goal, providing recognisable benefits for patients and professionals while at the same time providing the foundation and incentive for the next step.

Specific goals for each step should be agreed and documented by program management, involving key stakeholders in a dialogue and agreeing to a detailed roadmap for reaching the vision.

Chapter 5

Architecture Scenarios

Scenarios for External Integration

The term “External Integration” refers to integration of EPR systems on a national level, ensuring that information and data flows freely from one institution to another. The different approaches to achieve this objective have been summarised in the table below:

	Standardised Interfaces	**Standardised Applications**
Distributed data repositories	**1. Collaborative EPR (ICE-Health recommendation)**: + Competitive market + Template standards available + Minimal regulation required - Sharing limited to common core - Limited cross-organisation analysis	**3. Uniform EPR:** + Simplified integration + Increased buying power - Vendor dependency - Lack of development (unless funded by buyers) - Time-consuming consensus - One size may not fit all
Shared data repository	2. (Not feasible as sole scenario, but **applicable for selected core data sets**, e.g. encounters, medication, vaccination, CAVE)	**4. National EPR:** + Total integration + Extensive cross-organisation analysis - Vendor dependency - Large + Complex = High Risk

The major distinction between scenarios is decided by the location of data repositories, either utilising a single data repository shared by a number of health care institutions or smaller data repositories located at each clinic or hospital. Secondly, it should be decided if the project should cover only a standardised interface between the systems chosen by individual institutions or if the applications used within institutions should also be standardised and selected as a part of the ICE-Health project.

The concept of a single national EPR with a shared data repository (Scenario 4) appears attractively simple. Considering, however, the variety of requirements that such a system would face (from GPs to specialised departments) it would imply a major specification and development effort hardly justifiable by the scale of the domestic health care sector. In any case, such a project would be a high-risk software project due to the size and complexity of such a system. Still, the small size of the Icelandic market and the fact that this project will not support a number of software providers must be balanced against the possible drawbacks of vendor dependency.

Procurement of uniform EPR (Scenario 3) is similar to the current situation with the Saga system in GP clinics (except that this has generally not been utilised for integration between clinics). Extending this strategy to cover all health care institutions may facilitate integration, but would also create a de facto monopoly likely to stifle product development. In any case, an off-the-shelf EPR system meeting the varied needs of GPs and hospitals is not readily available.

The alternative strategy of standardising (only) the interfaces between autonomous EPR systems (Scenario 1) has been pursued successfully in other Nordic countries, notable Sweden (CareLink) and Denmark (MedCom). This means that experience, standards and products are available for adaptation to local needs.

For certain key data, however, such as medication, vaccination and medical warnings such as allergies, a message-based interface is not the most efficient solution. This key data should be set up with the objective of providing an Emergency Journal to the attending physician at the arrival of a patient at hospital, but could also be used in accordance with the UK NHS model of providing the same information to individuals over the internet. For such data it is recommended to combine scenario 1 with a selected set of shared national repositories.

Weighing the current situation in the Icelandic health care system with the arguments provided in this paper, the recommended national EPR architecture is a combination of scenarios 1 and 2. To further elaborate on this recommendation, a short discussion of the pros and cons of each scenario follows:

Scenario 1: Collaborative EPR

Distributed data repositories with a standardised interface

Pros:

This scenario will create a competitive market by allowing individual institutions to select their own EPR systems and making available all standards developers need in order to create software that can take advantage of the interface system. Minimal regulation and official control would be required by this scenario.

Cons:

Sharing of software is limited to a common core, the interface system. This could lead to greater total system-wide costs than other options. Additionally, this approach limits the research opportunities the system can create, since data is not shared between institutions.

Scenario 2:

Shared data repositories with a standardised interface

This scenario is not feasible as the sole solution, due to complexity and cost. However, this solution is highly applicable for selected core data sets such as data required for the emergency EPR and data such as encounters, medication, vaccination, CAVE and more; this needs further analysis involving clinical professionals.

Scenario 3: Uniform EPR

Distributed data repositories with standardised applications

Pros:

This scenario would highly simplify the integration between institutions and probably lower the cost of the interface system. Additionally, this would significantly increase the buying power when selecting an EPR system since the deal is substantial for one company.

Cons:

Vendor dependency with regard to EPR is an obvious result of this approach, but lack of development unless funded by the buyer would very likely also be a drawback. The process of gaining consensus amongst all health care institutions, when selecting an EPR system, would most likely be very time-

consuming; additionally, one system that fits all applications and can handle all requirements of GPs and hospitals may not be available.

Scenario 4: National EPR

Shared data repositories with standardised applications

Pros:

By selecting this scenario, ICE-Health would lead to total integration, creating a large database of health care data allowing for extensive research opportunities and cross-organisation analysis.

Cons:

Vendor-dependency may be a drawback of this scenario, but this is also a high-risk project due to size and complexity.

Scenarios for Internal Hospital Integration

An equally important project involves the integration of software systems within each hospital, involving a similar solution to the one for the external interface layer.

The recommended strategy is to let the specialised hospitals (having the most complex integration requirement) identify suitable solutions before a final architecture decision is made for the community of other local hospitals.

Specialised hospitals (LSH+FSA)	Community of other hospitals
A1: Message broker integration: ▪ Low cost of integration platform ▪ Integration limited to messaging ▪ Requires integrated hospital EPR	**B1: Upgraded GP EPR:** ▪ Simple solution reusing part of primary care EPR ▪ Simple integration with primary care ▪ Limited support for hospital processes
A2: Business object integration: ▪ Higher cost of integration platform ▪ Closer integration of processes & data ▪ Allows modular hospital EPR	**B2: Downgraded copy of LSH/FSA solution:** ▪ Fuller support for hospital processes ▪ Higher cost ▪ Requires more IT skills

The portfolio of systems in the specialised hospitals is already complex and will continue to grow. Cost effective integration of these systems will require implementation of a common software platform generally known as an ‘integration platform’. Such software products generally come in two levels of functionality:

A1: Message brokers, which act as common exchange/translation points between systems, but without permanent data storage. This system would have lower initial cost but integration is limited to messages between systems. An integrated hospital EPR system would also be required.

A2: Business object integrators, which in addition may store and recall information on certain business concepts or events. The initial cost of this platform is higher than for A1 but this allows for a much closer integration of processes and data and allows a modular hospital EPR, eliminating vendor dependency and lowering cost of each module as compared to an integrated solution.

Level A2 is recommended as target, since the somewhat higher cost is likely to be more than offset by the additional options this will bring. A software package selection process is already initiated at LSH. It is recommended that this be continued jointly with FSA to ensure a suitable common solution.

For the other hospitals two relevant scenarios must be considered:

B1: Acquisition of an upgraded GP EPR system. This would be a simple solution for smaller hospitals, reusing at least parts of the primary care EPR system. Integration with primary care would be rather simple but limited support for hospital processes could be a drawback.

B2: Adaptation of a downgraded copy of the LSH/FSA solution would provide fuller support for hospital processes but at a higher cost and requiring more IT skills than other solutions.

A final decision on this may await selection of the LSH/FSA solution, but it should be carefully considered if the smaller hospitals really require the same level of hospital process support as the large hospitals do, or if their needs are closer to the needs of primary health care facilities.

To facilitate this process, optional licenses should be included in the contract for an integration platform purchased by the larger hospitals.

Make-or-Buy Options for Hospital EPR

Potential sources of hospital EPR systems have been analysed and summarised in the table below, displaying four options. The basic recognition of this analysis is that the domestic market alone will not sustain development or ongoing evolution of an adequate full-function hospital EPR system.

	Private Funding of Development	**Public (Co-)Funding of Development**
Local Partner	**1. EPR Software Export** + Creates local work in a deregulated market - Requires major development effort and calendar time - Relies on entry on highly competitive international market - Risk capital may be insufficient	**3. Subsidised EPR Product** + Creates local work + Public influence on product - Requires major development effort and calendar time - Creates vendor dependency - Requires public capital
International Partner	**2. Existing Package Solutions**	4. (This combination is only relevant for strictly local features, e.g. translation)

Scenario 1: EPR software export

Local partner, private funding of development

Pros:

Scenario creates local work, building on local expertise and ensures that all parties have a voice in software design.

Cons:

The development effort required can be substantial, requiring a longer period of time. The small size of the Icelandic market demands successful entry into a highly competitive international market if future development of the software is to be ensured. Due to this complex situation, risk capital may be insufficient.

Scenario 2: Existing package solution

International partner, private funding of development

Pros:

This would allow simpler, faster implementation of EPR and faster integration since the software can be expected to follow the appropriate standards. Future product development and software support should also be ensured since the system is used in other markets, not just the Icelandic market.

Cons:

The fact that local clinical professionals would have little influence on the software works against this approach. A number of current implementations would also have to be redone.

Scenario 3: Subsidised EPR product

Local partner, public (co-)funding of development,

Pros:

This approach creates local work and allows for influence on product.

Cons:

The development effort required can be substantial, requiring a longer period of time. The small size of the Icelandic market demands successful entry into a highly competitive international market if future development of the software is to be ensured. Public funding would be required.

Scenario 4:

International partner, public (co-)funding of development,

This combination would only be relevant for strictly local features, for example translation.

Public co-funding of EPR development by a local partner (option 3) is similar to the strategy that has been pursued for primary care resulting in the Saga system for GPs. A hospital EPR faces much more complex requirements, and pursuing a similar strategy is therefore seen as risky due to the larger development effort and the intrinsic vendor dependency in this option.

Local partners may, however, privately fund investment in such product development (option 1). A key prerequisite for creating a sustainable business from this will be successful entry of such products on international markets. With the growing maturity of health care IT markets in general, international market entry will require highly sophisticated products and hence availability of sufficient risk capital. For this reason, it is not recommended to rely on this option as the only option in a software selection process.

Existing package solutions (option 2) are available from a number of sources. An EPR package may either be an integrated, full-function EPR system from a single source, or it may be a best-of-breed combination of EPR components to be integrated by a business object integrator.

The recommended selection strategy is to keep options 1 and 2 open and balanced in the selection process. This will ensure reasonable choice and competition in the process.

Chapter 6

Action Plan 2004-2006

The overall role of the national action plan will be to establish the national EPR architecture while leaving local implementation to local management.

The actions necessary are grouped into 3 action streams reflecting the organisational structure of the health care sector:

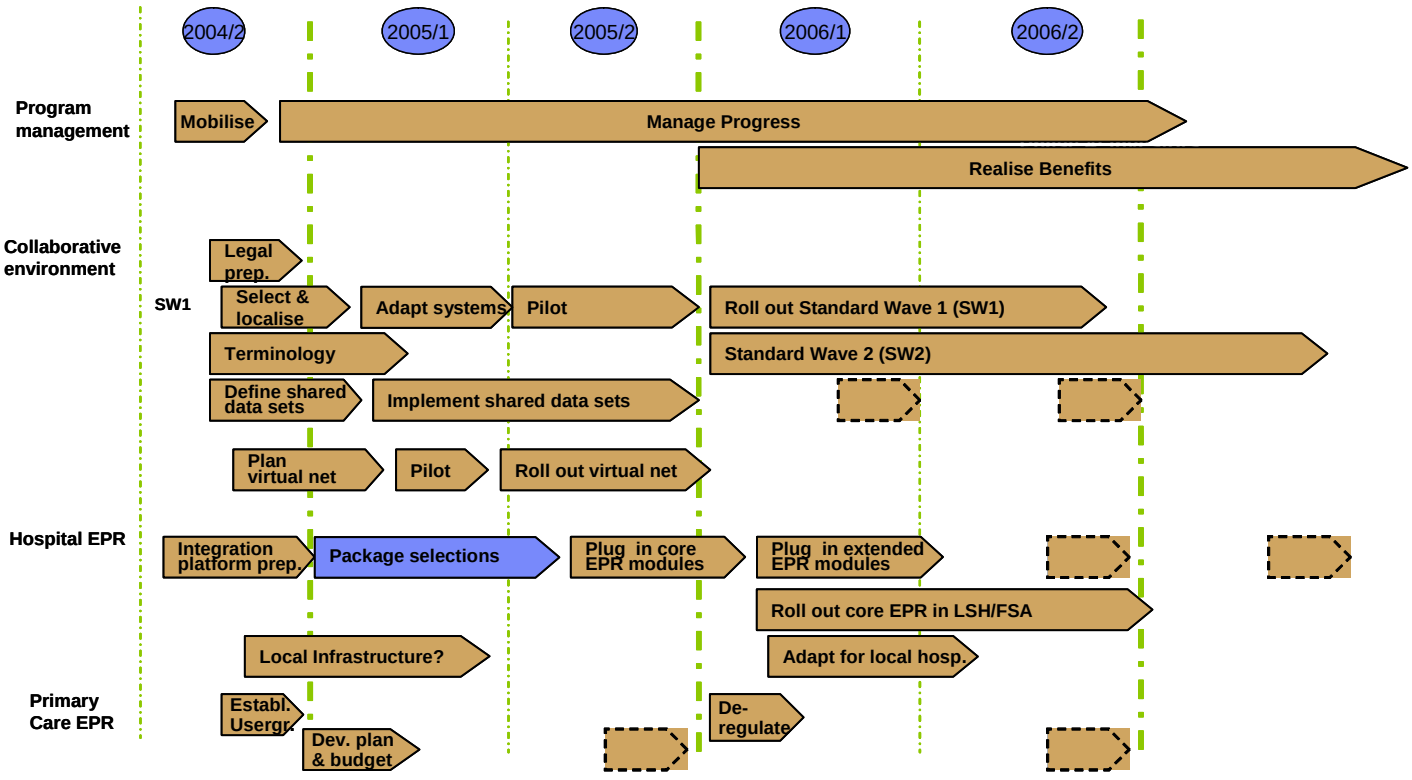
Collaborative environment stream will identify and prioritise interface standards, leveraging national as well as Nordic and other international experience, and facilitate nationwide implementation of these through operational pilot implementations. This stream will also define and implement national core data sets for sharing of key data.

Hospital EPR stream will define the common integration strategy for hospital EPR (based on analyses already performed by the larger hospitals) and provide an adaptation of this suitable for the local hospitals.

Primary care EPR stream will prioritise investments in the current primary care EPR (Saga) and prepare an opening of standards of the primary care EPR market, allowing more vendors to provide modules for the Saga system.

Each stream will deliver benefits step by step, but realisation of the full potential requires a careful coordination of all 3 streams. This is the purpose of the *Program management stream.*

Outline of Action Plan



Key assumptions of this plan and schedule are:

- Outline plan and budget approved by 1 October 2004
- Collaborative environment standards based on existing international templates
- Hospital EPR based on proven existing packages
- Health care institutions are ready to redirect their IT strategies towards the national action plan

Key Actions

Collaborative environment

The core of this stream is the careful selection of highest priority interface standards and core data sets. This selection will leverage results of the HealthNet project as well as international experience. To realise benefits as soon as possible, implementation of standards is broken into two or three waves, each delivering a useful subset of the entire collaborative environment. Following selection, focus will be on testing and roll-out of systems conforming to the new national standards.

It is very important to ensure the adherence of the system to international standards of health-related data transfer, such as HIPAA and HL7. This is necessary to ensure longevity, compatibility and future development opportunities of systems, but most importantly to ensure that the date stored by the systems and generated by the systems has as long a lifetime as possible.

Examples of core data sets to consider in the prioritisation:

- Lab order/report
- Radiology order/report
- Prescription
- Pathology
- Referral
- Discharge/report
- Patient transfer
- Blood donation/transfusion
- Medical certificate: health certificate, disability certificate etc.

The necessary secure data transmission platform is established as a virtual network using existing wide area networks to connect all institutions to a secure health care data interchange.

Hospital EPR

The core of this stream is the selection of a suitable integration platform and core EPR modules for the specialised hospitals. Based on the preparations already done, a fast-track selection process is assumed to be feasible within the EU procurement rules.

Following selection and integration of the platform and core modules, implementation will occur in parallel in two tracks:

- Roll-out to all clinical departments in the specialised hospitals
- Adaptation of the selected architecture to the needs of local hospitals

Concurrently, planned upgrades of local infrastructure will prepare the infrastructure for smooth installation and operation of the selected modules.

The functionality provided by core EPR modules will be extended step by step through addition of further modules to the integration platform.

Primary Care EPR

Primary care will continue to use the EPR already installed in most health care centres. Further development of this will focus on:

- Conforming to the new national interface standards
- Adapting to the national core data sets

Additional functionality in the primary care EPR will be prioritised by user group, representing different groups of primary care users. This will be done on an annual basis (or more frequently) by negotiating a development plan and associated budget between the users represented by the user group and the vendor.

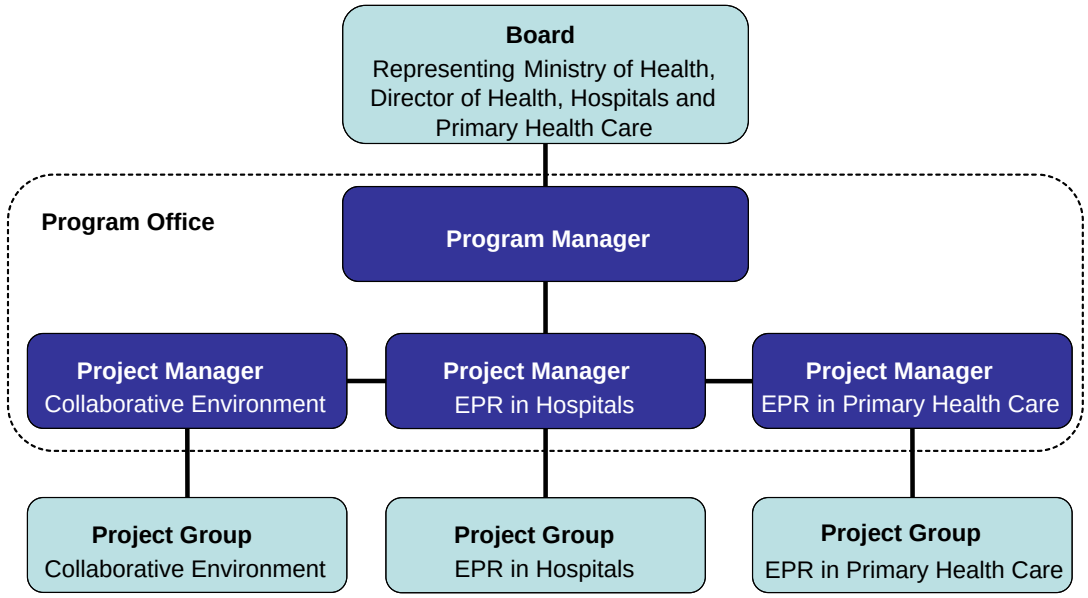
The longer-term objective will be to prepare an opening of standards for primary care EPR, allowing any primary care institution to contract for any preferred EPR system as long as this is compliant with national interface standards and national core data sets. Again, the small size of the Icelandic health care market is a serious obstacle to competition since it can hardly sustain one software development house; this must be balanced against any strategy aiming for less vendor dependency and more competition.

Chapter 7

Program Management

Due to the number of stakeholders and the importance of an integrated architecture, efficient program management is a key success factor. The recommended approach is to establish a task force as outlined below and detailed on the next page

Figure 4: Program office organisation chart.



A task force is organised in order to:

- Establish a forum outside regular hierarchy.
- Keep undivided focus of program staff on meeting program objectives.
- Allow MoH to concentrate on policy-making, allow hospitals to concentrate on operational responsibilities.
- Avoid scope and budget creep by allocating a fixed and visible budget for each action stream and maintaining responsibility for results within the program.
- Allow for temporary assignment of specialists.

Realign HealthNet activities with ICE-Health:

- Include realigned activities in the program.

Assign project managers to the three main action streams and assign coordination tasks to program manager:

Program Initiation:

- Organise and lead program office.
- Establish goals and milestones.
- Enter into contracts with stakeholders.

Ongoing:

- Communicate progress.
- Resolve issues.

Closure:

- Document and report results.
- Manage hand-over to permanent organisation.

The board's tasks include:

- Defining goals and frameworks for EPR in Iceland.
- Following up on the fulfilment of goals and progress and working towards the realisation of these goals in the members' own organisations and across the boundaries of the health care sector.
- Approving projects/programmes and appointing steering committees.
- Discussing and clarifying matters of principle in relation to EPR.
- Promoting the use of common solutions and standards in the health sector.
- Making proposals and suggesting solutions to stakeholders, wherever relevant.

The program office's tasks include:

- Taking responsibility for the project area in managerial follow-up and co-ordination.
- Following up on the fulfilment of goals and progress in the project area and working towards the realisation of these goals in the members' own organisations.
- Prioritising and taking decisions within the remit of the program office.
- Securing resources for the project area via the participation of the members' own organisations.

The workgroup's tasks include:

- Promoting the spread of EPR by providing information on the aims and content of the EPR action plan.
- Carrying out cross-organisational follow-up and co-ordination on behalf of the board.
- Monitoring constantly the need for cross-organisational initiatives and proposing these to the board.
- Carrying out projects in selected key action areas in co-operation with interested parties.

Chapter 8

Investment to Date

When studying possible investment in IT, including purchase of hardware and software, user training and annual operations of such systems within the Icelandic health care system, it becomes evident that a substantial sum of money has already been invested. This adds up to an excellent infrastructure and high user acceptance of EPR and IT in general.
The health care system has a solid IT foundation; an additional investment, managed according to the suggested ICE-Health strategy, would therefore be very effective in pulling IT use to the next level.

IT Investment

The report, "Health and Social Sectors with an "e" – A Study of the Nordic Countries", was conducted in 2003 and 2004 by the Nordic Council of Health and Social Ministers. The report covers, among other things, the level of IT spending in health care in the Nordic countries. The results are shown in the table at right.

Nordic Health Care
IT spending in Health Care
Percentage of total HC budget

Sweden	3.5%
Iceland	2.0%
Denmark	2.8%
Norway	N/A
Finland	N/A

These results can be used as a basis for calculations, using the Icelandic percentage to estimate the total IT spending within the Icelandic health sector.

Based on these calculations, health care institutions in Iceland have spent between ISK 605 million and ISK 1,148 million annually on information technology since 1998. The year 1998 has been chosen as the starting point, as the Saga system was fully implemented in 1998 (see table below).

According to the LSH annual accounts for 2003, however, the hospital's total spending on IT amounted to ISK 803 million, or 81.5% of the figure for total IT spending in Icelandic health care reached by the above calculations. This figure is not fully appropriate for our purposes, since it includes overhead, service expense and other technology investments not consistent with the constraints of this project. An estimate based on figures from LSH indicates that actual health-care specific IT investment at LSH could be as follows:

Health Care Budget
Million ISK

	MoH total	Clinical Services Cost	IT investment Estimate
1998	62.406	30.266	605
1999	72.621	30.843	617
2000	78.479	33.694	674
2001	84.560	38.971	779
2002	96.361	44.097	882
2003	100.742	49.281	986
2004	110.181	57.411	1.148
	605.350	*284.562*	*5.691*

	1998	***1999***	***2000***	***2001***	***2002***	***2003***	***2004***
LSH IT annual cost (million ISK)	276	391	467	534	551	690	670
Number of workstations	1440	1938	2200	2386	2400	2500	2600

In 2004, LSH accounts for ISK 24.8 billion of the total clinical services budget of ISK 57.4 billion, or 43.2%. In light of the actual amount spent on IT at LSH, the estimated total amount spent on IT in Icelandic health care based on the Nordic Council report seems too low, leading to the conclusion that the 2% estimate for the share of IT spending of the total health care budget seems to be somewhat understated. It must, however, be kept in mind that a substantial percentage of IT costs at LSH involves operations and maintenance of equipment that is not relevant to the ICE-Health project.

In order to obtain a more secure estimate that is easier to define, we therefore suggest that the Nordic Council estimate of 2% be used for the purpose of this project. It is therefore assumed that Estimate I in the table below will be used as a basis for our projections.

Health Care Budget
Million ISK

	MoH total	Clinical services Cost	IT investment Estimate I	IT investment Estimate II	IT investment LSH
1998	62.406	30.266	605	818	276
1999	72.621	30.843	617	834	391
2000	78.479	33.694	674	911	467
2001	84.560	38.971	779	1.054	534
2002	96.361	44.097	882	1.192	551
2003	100.742	49.281	986	1.333	690
2004	110.181	57.411	1.148	1.552	670
	605.350	*284.562*	*5.691*	*7.694*	*3.579*

Source:

In the absence of a more detailed study of the accounts of individual health care institutions, Estimate I provides an acceptable base. It must also be considered that health care institutions have prioritised differently with regard to IT. Some have strategically used available funding to boost IT, far above what budgets have indicated, and therefore have an advantage compared to others and can realise the benefits of the proposed investment sooner.

Additionally, we need to keep in mind that before 1998 a substantial amount had already been invested in IT for health care. The 1998 version of the Saga system, version 2.6, is estimated to have a replacement cost of 277 man-months, which would cost about ISK 390 million today.

Estimated replacement value of the additional features of the current version, Saga 3.1

- Invested by MoH: ISK 100 million
- As a rule of thumb, it can be assumed that software houses invest about 1.5 times the funding they receive; thus the estimated replacement value of the additional features of Saga 3.1 could be about 250 million

Current IT Investment
Estimated Monetary Investment Value

1998 to 2004	Million ISK
System-wide IT investment	5.691
Estimated Replacement Value of Saga	445
Total	*6.136*

- It is estimated that 50% of the value of Saga 2.6 became obsolete at the installation of Saga 3.1
- This brings the replacement value of Saga to about ISK 445 million

Therefore the estimated monetary value of current IT investment is ISK 6,136 million.

Estimated Impact of Incurred IT investment

Software systems have already been implemented

The IT investment effort over the last few years has brought substantial benefits to the Icelandic health care system. EPR is already established, use of the systems is well established and registration of patient data has become accepted practice. User acceptance is very high, familiarity with the processes involved is excellent and users of the systems have become highly demanding in terms of usability, output, statistical research capabilities etc.

There is, however, a difference between primary health care and hospitals. Use of the Saga EPR is very widespread in primary health care while hospitals have not carried out such widespread implementation of EPR. This is not due to a lack of interest or understanding of the possible benefits, but rather because the Saga system is not fully adapted to a hospital environment. Hospitals do, however, have a more advanced technical infrastructure, more investment capabilities, higher levels of technical knowledge and a higher number of advanced users.

With an excellent infrastructure and high user acceptance of EPR and other systems, the health care system already has a very solid IT foundation.

An additional investment, managed according to the suggested strategy, would therefore be very effective in raising IT use to the next level.

A complete infrastructure

It can be argued that the following four factors sum up the estimated impact of incurred IT investment since 1998.

Hardware Existing servers will mostly handle the additional workload following the implementation of these proposals; only a few upgrades seem to be required. Workstations are mostly new, few upgrades needed.
Connectivity Networks within institutions are new or very recent, with LSH for example operating an IP network. National infrastructure is highly advanced and should handle the added load without problems.
Software Saga EPR is in use in all primary health care facilities and in most hospitals but a number of other clinical software systems is also in use in hospitals. Operational software, such as MS Office, is also included in the IT investment of the last few years.
Computer literacy is very advanced in the health care sector.

Chapter 9

Benefits

A strong and growing international body of evidence supports the conclusion that clinical IT applications improve quality, increase patient safety, reduce length of hospital stay, increase efficiency, improve working conditions and have a marked impact on cost. Programs designed to measure the benefits achieved by EPR implementation must take into account the fact that the effect is not only monetary but is measured to a large extent in terms of society-wide effects.

Chapter 8 provides an estimate of the incurred investment in health-related IT since 1998. The figure of ISK 6.1 billion represents the estimated monetary value of the current IT infrastructure in the Icelandic health care system; building on and taking full advantage of current investment is a major objective of the ICE-Health project.

The main value resulting from this investment is the high acceptance of the type of workflow that an EPR system requires. All GPs and most hospital physicians have embraced this technology; they appreciate its benefits and are familiar with the discipline required in order for them to be realised. This can also be stated for all professional disciplines within the health care sector that will be required to operate EPR systems; as providers who enter data and use it to provide care, as research scientists who appreciate the research opportunities this project will create, and as administrative staff that will use the systems to monitor cost and quality of care.

It should be pointed out here that the single most visible monetary benefit of the ICE-Health project will probably be realised in a reduction of medication errors. In the United States, where the health care system is approximately 1,000 times larger than the Icelandic system, it is estimated that medication errors cost about USD 2 billion annually (this is based on data provided by LSH.). Assuming the same cost per capita, the cost of medication errors in the Icelandic health care system can be estimated at about USD 2 million (ISK 140 million) annually. By realising some of these potential savings the hospital can increase ROI for the ICE-Health project by a significant proportion.

A Committee, commissioned by the MoH, that has been working on the Redefinition of Division of Work between LSH and FSA, states in its preliminary conclusion that in order to ensure continuity of service and patient safety, and increase the efficiency of operations, information must be safely shared between all health care providers. The establishment of a nationwide EPR and health-net functionality are, in the opinion of the Committee, a requirement for reaching that goal.

The report *Revolutionizing Health Care Through Information Technology*, by the [United States] President's Information Technology Advisory Committee (June 2004) states that: "Nationwide implementation of health information technology is the only demonstrated method of controlling costs in the long term without decreasing the quality of health care delivered." The Committee suggests a national "framework for a 21st century health care information infrastructure" comprised of these four

components: electronic health records; computer-assisted clinical decision support; computerised provider order entry; secure, private, interoperable, electronic health information exchange.

It should be pointed out that the structure suggested by the Committee and the scenario suggested by the ICE-Health project are very similar and have the same general objectives. The Icelandic health care infrastructure is however better suited to the model suggested; therefore the opportunities for nationwide implementation are better in Iceland.

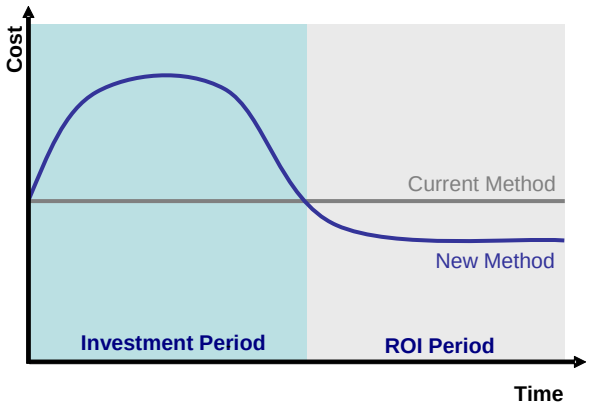
The report also states the following: “There is no question that linking sites of care in a health information infrastructure can reduce duplicate services and unnecessary hospitalisations that occur because caregivers lack critical patient information located elsewhere. Unquestionably, electronic health records and computerised provider order entry tools markedly reduce medical errors and adverse drug events.”

The Veterans Administration hospitals in the United States have, according to the report, pioneered the use of the four infrastructure components, testing the effects of these advances in health IT against critical benchmarks. The hospitals have reduced the rate of incorrectly administered medications from 1 in 20 ambulatory care prescriptions to less than 1 in 100,000, the initiatives have reduced hospitalisation, markedly improved all critical benchmarks and simultaneously cut the annual cost of care per eligible veteran by nearly half.

It is not suggested that these exceptional results can be fully realised here, but this should decisively support the implementation of the ICE-Health project.

According to a project plan for EPR in hospitals in Copenhagen in Denmark (*Handlingsplan for den kliniske IT-arbejdsplads/EPJ I Köbenhavns Amt)*, such a system will increase quality, efficiency and patient safety. The potential financial benefits following the implementation of the system are said to be hard to estimate, but better data access will reduce length of hospital stay (LOS.) It is estimated that LOS will be reduced by one day in 25% of medium-length stays and by one day in 50% of longer stays.

Figure 5: Investment Cost and ROI over time



Due to an estimated 10% increase in efficiency, some savings in salaries can be expected when the full effect of the new system have been realised. The Danish report states that the financial benefits of the system can not be accurately estimated, but it is expected that the full benefits of the system will be realised in four years, with a 5% realisation in year one, 20% in year two, 30% in year three and 45% in year four.

The realisation period of this type of investment is illustrated in the graph above. The investment has to result in certain savings based on the same service level in order to be justifiable. Initial costs include organisational change, training and other preparation costs. The size of savings required is a matter of pre-determined strategy. Decision-makers have to choose between savings and increased service.

A recent Icelandic example of how IT has been used in a strategic way to facilitate more informed decision-making and to help government manage growth in public spending is the drug database that

the State Social Security Institute has operated since the year 2000. Its main purpose is to verify the validity of state participation in the financing of medical costs.

Before the inception of the database, verification of all medical prescriptions was performed manually. This was done by clerks doing random checks on all prescriptions using a paper-based process. Now all information on prescription drugs is processed electronically and each prescription is run through 20 automatic checks. The registration, which was earlier done on paper, is now done electronically by drug retailers so there is no new registration cost.

One by-product of this whole enterprise is that the information can now be used to make decisions that are based on empirical facts. One type of decision regards the volume of state participation in financing individual drug types, targeting public money to better help those groups of patients that are most in need of help. This is clearly an example of IT use that helps government use public funds more effectively without increasing budgets in the process.

A comparative study that was published in the *Proceedings of Participatory Design Conferece* estimates the broader impact of EPR implementation. The study was performed at two primary health care centres in Sweden and shows the importance of system design and staff training for cost-effectiveness of EPR programs. Direct, indirect and unexpected costs in the first year of EPR implementation where weighed against the benefits. The conclusion was that the societal cost of implementation significantly exceeded the benefits, with a benefits/cost ratio of only 3.5% (SEK 72,935/SEK 2,092,950). The causes were identified as being faulty system design, lack of coherence between system and workflows, and insufficient staff training. The cost and negative implications of this mostly fell on individuals or the society at an aggregate level and were thus not a part of the cost-benefit calculations done by the centre administrations. Thus the financial impact was considered acceptable although the societal benefits were minimal in the first year.

Another study done amongst medical staff at a university hospital in Sweden showed a willingness to increase system knowledge and competences outside working hours, rather than engaging in on-the-work training. The medical personnel seemed content with more job satisfaction in return and did not indicate that more pay was required.

The above presents only a part of the supporting evidence for the ICE-Health project, but it still provides a foundation for the proposed investment, suggesting it will be effective in raising IT health care to the next level and help the government to realise the benefits of the work already carried out.

It is, however, necessary to be aware that the main success factor lies within the change management aspect of the implementation of the ICE-Health project, involving not only technology but, even more so, processes and people. Furthermore, experience shows that proper funding of a project of this magnitude and complexity is paramount.

Even though substantial direct financial benefits can be realised from the ICE-Health project, as listed in the following section, the less tangible benefits of enhanced public safety, better quality of life, improved efficiency of health care staff and improved working conditions at health care facilities, will create a far more valuable long-term effect of the system than can be measured by for example ROI.

Possible Benefits of the ICE-Health Project

Highly enhanced public safety and quality of life for patients

The nationwide health care information infrastructure proposed by the ICE-Health project provides a more equal access to all levels of health care regardless of place of residence. The EPR system and collaborative environment allow instant access to patient data, regardless of point-of-origin or current point-of-care for patient, thus improving quality of care and the safety and well-being of patients.

Risk of errors in communication is reduced, response times for lab tests will be improved and waiting times will be shortened. Patient freedom of choice will increase, as the system facilitates movement of patients between providers, be it physicians or other health care professionals, since any provider can access the appropriate data for each patient, in accordance with security and access controls.

The ICE-Health project will increase opportunity for preventive measures, further enhancing cost-reducing effects of the system, through improved guidance by GPs and improved access to statistical information and research. The ICE-Health project will include large databases of health-related statistical information that can be utilised for research.

The system will greatly improve reporting to administrative agencies and the MoH, both in terms of operations and clinical control; even if the system will not lower the cost of health care, it will provide information that supports policymaking for the management of further growth.

Highly improved efficiency

Paperwork will be reduced through fewer printed letters, fewer examinations will be required since information about patients is accessible, and the number of duplicate examinations will be reduced. MedCom in Denmark estimates that this type of system saves 4 minutes per each “message” within the health care system, and that telephone follow-up calls to hospitals are reduced by 66%.

The EPR system provides workers with an overview of a patient’s complete medical history and documents the specific services received by the patient while providing a channel for clinical communication among health workers. The system provides an improved base for planning and decision-making regarding care provisions, including care actions delayed for financial or organisational reasons.

Hurdles

A possible hurdle to the realisation of potential benefits is getting practitioners to enter data at point-of-care, since direct incentives for personnel are often lacking.[46] Using the EPR can be bothersome and time-consuming for the doctor compared to voice recording or hand-written notes.

It is difficult to quantify the benefits and returns up front. These depend greatly on the organisation and method of implementation, as well as system choice, hardware and infrastructure.

Direct savings

Net ROI of the ICE-Health project could be considered to be at least 40% on the proposed investment of ISK 1,979 million, with potential savings of ISK 850 million annually. To provide for a fully realistic ROI, however, the earlier investment of ISK 6.1 billion should be included, along with very substantial savings resulting from both the above and the more intangible effects such as increased public safety,

[46] *Status Report 2002: Electronic Health Records*. Waegemann, C. Peter: (http://www.medrecinst.com/uploadedFiles/MRILibrary/StatusReport.pdf).

improved working conditions within health care and the potential value of research opportunities provided by a centralised EPR system.

Health care expenditure to private clinics amounted to ISK 2,290 million in the year 2002. They keep their own patient records and some of them use Saga while others use other systems or even small filing programs such as Access. These clinics will benefit from the public nature of the ICE-Health initiative, which represents a culmination of information and standardisation work that will be available as a public domain data. This should facilitate their funding of an EPR system that suits their needs. The private clinics will furthermore have access to the general financial benefits of any EPR system that gives them easy access to relevant information on demand.

Approximately 140,000 messages pass between individuals and institutions in the Icelandic health care system each month, in addition to about 150,000 prescriptions each month. According to MedCom data, savings of four minutes per message can be achieved. This equals 19,333 hours each month, or about 117 man-years.

According to a conservative estimate provided by LSH, over 100,000 formal medical notices are sent by medical staff to other medical institutions. An estimated 15 minutes' time can be saved per notice by the use of electronic EPR, for a total annual savings of 13 man-years.

Adding up these potential savings of 130 man-years and assuming that the average total cost per health-care employee is ISK 550,000 per month, potential savings could add up to ISK 850,000 million a year.

Net benefits for Uppsala County in Sweden were estimated at SEK 5.7 million.

Improved working conditions

Increased communication provided by the system, between hospitals, between hospitals and primary health care, and between primary health care facilities, will lead to improved information access, access to specialised expertise and to staff feeling more able to provide quality care to patients. Highly improved access to patient data will help improve quality of work, increasing the ability of staff to efficiently provide excellent health care while reducing the amount of routine work.

The proposed system allows health care providers to cope with increases in demand without compromising safety or quality, and allows for proof of activities by documenting processes. The positions of GPs within primary health care will be greatly improved as they will increasingly become able to guide their patients to general health, well-being and a healthy lifestyle through an improved overview of their health care.

Example of successful implementations of EPR

It is difficult to quantify the financial benefits of using EPR systems. The method most likely to give a realistic picture of what might be expected is to find an actual example of similar size. Such an example can be found in the Geisinger Health System in Danville, Pa. USA. The health organisation consists of over 600 physicians and 300,000 patients. As American health organisations are run as free-market enterprises, quantification of financial benefits is easier there than in countries where the system is state-funded.

A preliminary analysis of investment returns shows that the system used by Geisinger (EpicCare ambulatory Electronic Medical Record system) has saved around USD 3,300 per provider per year.

The need for medical record staff has fallen, in regards to chart creation, data entry, and repeated chart pulls. Mailing and copying costs have also been reduced.

The system has been used to encourage doctors to use cheaper types of medicine when these are available, and even to suggest well-proven treatment methods for certain diseases. As a consequence, medicine costs are down by USD 1,000 per primary care physician per year. The use of treatment suggestions is estimated to have prevented 62 cases of myocardial infarctions or strokes in the first two years after implementation, by increasing administration of aspirin to patients with coronary heart disease.

Worries about reduced productivity proved unfounded. Productivity did not change notably in the first year of implementation, compared to the two preceding years, but increased significantly in the following two years (measured in relative value units)[47].

Mid-Carolina Cardiology in Charlotte, N.C., USA, numbering 25 physicians and 45,000 in-office patients per year, spent around USD 1 million on the implementation of an EMR system, including licenses, hardware and infrastructure. The organisation registered a 35% raise in revenues and a fall in overhead costs from 62% to 46%. Furthermore, patient satisfaction with the services increased.

Benefits of the system ranged from more efficient check-ups to more efficient usage of examining rooms. The system includes a range of quality of service measurements, such as waiting times, allowing comparison between periods and physicians and encouraging effectiveness amongst doctors. The system is connected to the billing system, ensuring fast and accurate billing and reducing billing staff.

The availability of paper charts, when needed, was estimated at 40%, as charts were often unavailable due to other personnel usage, copying etc. The availability of the electronic charts is estimated at 99%, as multi-user access is provided.

Patient care is also more efficient. Doctors have ready access to charts on their computers and use less time trying to find general patient information, X-rays etc. Nurses answering phones have immediate access to the records of the patient calling and the patients can be serviced at once, and do not have to be put on hold or called back when their journal has been located. This also affects time spent servicing each patient.

Other benefits include reduced transcription costs (USD 105,000), reduced postage costs, reduced paper expenses (USD 30,000), reduced overtime for nurses (USD 61,000), reduced need for temporary personnel in case of sickness (USD 157,000), savings due to printing forms for super bills (USD 11,000), better emergency service at night, easier prescription refills and easier communication with referring physicians[48].

Numerous examples can be found of the opposite experience, i.e. non-beneficial implementation of EPR systems, but the examples above shows that such implementation has great potential. The implementation cost of the latter example is high, about USD 40,000 per doctor in the organisation, but the ROI is also considerable. The system is thus justified from a financial point of view.

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[47] "Electronic Medical Records: one organisation's experience" – "This is the Future". Jancin, Bruce: in *OB/GYN News*, Nov 1, 2002 (http://www.findarticles.com/p/articles/mi_m0CYD/is_21_37/ai_94261007/print)

[48] "Cardiology practice proves that electronic medical records do raise revenue" – "Medical Records". Linney, Barbara: in *Physician Executive*, May-June, 2003 (http://www.findarticles.com/p/articles/mi_m0843/is_3_29/ai_101937881/print)

Benefits – References

MedCom – Denmark

According to *Et dansk sundhedsdatanet på to år,* published by MedCom in 1996*,* a conservative estimate of resource time saved is 4 minutes per message between individuals within the health care system or between external and internal individuals. Current volume in Denmark is 2.5 million messages per month (70% of all communication in the primary health care sector). Telephone follow-up to hospitals is reduced by 66% (*Ref: MedCom IV – Status, planer og projekter,* Oktober 2003) following the implementation of an EPR solution similar to that which is proposed by ICE-Health.

The proportional volume in Iceland would be approx. 140,000 messages per month corresponding to 9,000 man-hours/month. Reduced transmission cost (paper forms, postage, and handling) may be estimated at a minimum of ISK 100 per message or potentially ISK 14 million per month.

CareLink – Sweden*

Uppsala County council gross benefits were estimated to be around SEK 8 million but cost of realising the benefits was estimated to be around SEK 2.3 million. Net benefits were therefore estimated at SEK 5.7 million. Benefits for the patients and community, including more effective health care, were not measured

CareLink conclusions on potential benefits are that evaluation is possible but difficult since health care has no tradition in calculating economic benefits. The benefits that can be easily identified cover the cost of the investment, but the largest benefits are probably found in sectors outside of health care. Health care quality improves due to local institutions gaining access to central specialist expertise, therefore having a more secure access to knowledge and information, while health care availability improves due to shorter waiting times, faster treatment of acute conditions and less travel for both patients and doctors.

Cost-saving activities include fewer examinations, inexpensive and more efficient communications and synergies through increased interactivity and co-operation.

* Ref: *Nortelemed – Sjunetvärdering. What is the potential of increased communication in health care?* by Mats Larsson Carelink AB and Göran Lundgren IP Management AB, 2004.

NHS (National Health Service, UK) – National Specification for Integrated Care Records Service*

Benefits to service users include better access to advice, information and care services; privacy, security and confidentiality will improve and booking services will be more flexible and responsive. Clinical processes will be more effective, co-ordination of discharge facilities will improve and quality will increase leading to better outcomes of care. Computer support leads to more appropriate prescribing.

Benefits of care professionals and staff include more effective use of clinical staff time, better time and workload management and improved access to evidence and knowledge. Support for implementing and monitoring National Service Frameworks will improve and litigation risk will be reduced through better documentation. Better co-ordination of discharge arrangements will further improve quality of care and job satisfaction.

Business benefits include better information and reporting, better information to support national and local priority areas, higher efficiency and productivity and improved resource deployment and transaction processing.

* Ref: *Delivering 21st Century IT Support for the NHS – National Specification for Integrated Care Records Service, Consultation Draft,* 2002

The Council of the European Union* notes that **e-Health** is the use of information and communication technologies, including the internet, to improve or enable health and health care. It offers potential benefits for providers and professionals. Examples of successful e-Health developments include health information networks, **electronic health records**, electronic monitoring systems and health portals. e-Health offers European citizens significant opportunities for improved access to better health systems. e-Health resources can help to:

- Improve health status by supporting healthy lifestyles, improving health decisions and enhancing health care quality.
- Empower people and patients to take control of their health by supporting better informed health decisions within the citizen-centred health delivery system.
- Allow health care providers, through substantial productivity gains and improving efficiencies in the health system and prevention, to cope with increased demand
- Enhance public health services by facilitating health professionals' practise and the exchange of best practice and communication
- Reduce public health disparities by applying new approaches to improve the health of remote communities and at-risk population groups.

* Ref: *e-Health – making health care better for European citizens: An action plan for a European e-Health area*, 2004.

Chapter 10

Cost and Resources

Ice-Health – Three-Year Budget Plan

The proposed budget includes start-up investments and estimated annual operation, itemised where applicable.

Total Budget	*ISK 1,979 million*
Collaborative Environment	*ISK 412 million*
Hospital EPR	*ISK 1,208 million*
Primary Care EPR	*ISK 264 million*
Program Management	*ISK 96 million*

The table on the following pages includes a short explanation for each budget item that sometimes includes strategic suggestions relevant to the item. It is suggested that the reader familiarise himself with the content of the explanations.

EPR Operating Costs

The second table provides an overview of the estimated operating costs for the different components of the project. It should be stated that the operating costs are “estimates based on an estimate” and are only provided for the purposes of this report; some items which will certainly have some annual cost associated with their operations have no estimated cost due to a lack of information or material on which to base estimates. The actual operating costs will be calculated based on actual cost and operational considerations regarding each item; please note that these operating costs will be IN ADDITION to current operating costs of IT systems.

Total Annual Operating Cost	*ISK 101 million*
Collaborative Environment	*ISK 14.3 million*
Hospital EPR	*ISK 82.6 million*
Primary Care EPR	*ISK 4.3 million*

Ice-Health Program				Total Budget ISK 1,979,135,100
Three-Year Budget Plan				**% of Total Budget**
Collaborative Environment	**Total**	**ISK 411,529,100**		**20.79%**
1.	**Project management/consultancy**	**Total**	**ISK 112,750,000**	**5.70%**
1.1	**PM assistance**	Total	ISK 15,000,000	The project action plan 2004-2006 demonstrates the number and nature of different tasks to be performed during the Ice-Health project. Due to the vastness of the project, the project manager will need advisors or consultants to provide expert research or support at individual stages of the project.	0.76%
		Average expert rate per hour	ISK 10,000	Based on an average of known consultancy fees in Iceland	
		Number of hours	1,500	Number of hours allocated for the PM to purchase expert reports, calculations and points-of-view. Number of hours is based on IBM BCS experience from similar projects in Europe.	
1.2	**Standards assistance**	Total	ISK 60,000,000	The support and consultation pertains to the process of ensuring that the message broker system or business object integrator will communicate properly with current or existing systems in use. Consultation will be required from those who best know individual systems that need to communicate within the collaboration. The budget includes the cost of programming interfaces between the message broker/business object integrator and existing applications.	3.03%
		Average expert rate per hour	ISK 10,000	Based on an average of known consultancy fees in Iceland.	
		Number of hours	6,000	Number of hours allocated to the workgroup focusing on the collaboration environment.	
1.3	**Legal assistance**	Total	ISK 10,000,000	Due to the sensitivity of the data in question, and as indicated by experience from past debates, a legal advisor will be required before program initiation.	0.51%
		Average expert rate per hour	ISK 10,000	Based on an average of known legal fees in Iceland	

		Number of hours	1,000	Number of hours allocated to the project in terms of legal assistance during the project initiation.	
1.4	**Training and staff development**	Total	ISK 20,000,000	Estimated budget for purchase of seminars and training for workgroup participants. Training for workgroup participants working on the collaborative environment program implementation. It is assumed that participants will need to attend seminars, training sessions etc. in order to allow them to maximize the application of their expertise to the tasks of this project. These workgroups will later have a hand in the actual implementation of the EPR system.	1.01%
		Average cost per participant	ISK 7,500	Estimated fee per participant.	
		Number of participants	2,667	Number of attendees covered by the budget, which approximates 19% of FTE positions in Icelandic health care.	
1.5	**Project infrastructure**	Total	ISK 4,000,000	Accommodation, housing, project reports and status meetings with local project managers, telephone cost and other general project operations.	0.20%
1.6	**Travel and accommodation**	Total	ISK 3,750,000	Based on average cost of roundtrips between Iceland and Europe and domestic flights. Average business class roundtrip Iceland-Europe is ISK 82,000. Average domestic roundtrip is ISK 15,000. Average cost per hotel night is ISK 15,000.	0.19%
2	**Implementation waves**	**Total**	**ISK 119,875,000**		**6.06%**
2.1	**Training delivery**	Total	ISK 4,875,000	Offer of training for system developers and user test teams.	0.25%
		Average cost per participant	ISK 7,500	Estimated fee per participant.	
		Number of participants.	650	Number of system developers and user test teams needed.	
2.2	**Pool for co-funding of development**	Total	ISK 100,000,000	Programming interfaces between message broker/business object integrator and existing applications. To ensure rapid implementation of standards, a development pool is available, where projects to upgrade existing systems may apply for co-funding. The budget covers adaptation and development of messages	5.05%

				between existing systems and BOI, database connections and setup, and other programming needs concerning the shared data sets implementation.	
		Average hourly rate for programmers	ISK 7,200	Based on average rate of programmers in Iceland.	
		Number of programming hours	13,889	Number of hours allocated for programming needs as described above.	
2.3	**Support/evaluation of pilot**	Total	ISK 5,000,000	A local pilot for the system is assumed. This budget item covers support and evaluation of user testing at all locations.	0.25%
		Average hourly rate of system specialists	ISK 10,000	Based on average rate of system specialist evaluating the progress of testing.	
		Number of allocated hours	500	Number of hours allocated to support of local pilots.	
2.4	**Support for roll-out**	Total	ISK 10,000,000	During the roll-out of the system, the ICE-Health program will support local projects in this phase. Roll-out at each institution must be planned and managed immediately after test and pilot test operations. This also covers the cost of diffusing knowledge by sharing clinical professionals between institutions.	0.51%
		Average hourly rate of system specialists	ISK 10,000	Based on average rate of system specialist supporting implementation.	
		Number of hours	1,000	Number of hours allocated to the specialist support.	
3	**Collaborative environment software shared data sets**	**Total**	**ISK 135,001,600**	Shared data sets refer to health information which needs to be centrally stored and accessible for health care professionals. An example of shared data is vaccination data, which allows a patient to enter any health care facility in Iceland and update his or her vaccinations. The shared data sets increase public safety, allow the Directorate of Health to monitor public health, status of epidemics and defences. The DoH is currently working on definitions of shared data sets. A feasible option is to define emergency EPR as a shared data	**6.82%**

				set in order to increase patient safety at hospital arrival.	
3.1	**Software development and maintenance**	Total	ISK 110,001,600	Covers the cost of developing a message brokering system for information entered in one health care location which needs to be sent and stored at the patient's local health care facility. The cost of software systems and adaptation to the requirements of the ICE-Health specifications.	5.56%
		Software purchases/start-up costs	ISK 45,000,000	Purchase of basic software package, not defined at this stage.	2.27%
		Average hourly rate of programming	ISK 7,200	Based on average rate of programmers in Iceland.	
		Programming hours	7,222	Number of hours allocated for programming needs, design of messages, routing, databases.	
		Testing support	1,806	Number of hours allocated to software support to clinicians testing the software.	
3.2	**Operations centre**	Total	ISK 25,000,000	A shared operations centre is assumed to manage daily operation, data security and technical support.	1.26%
		Start-up cost of operations centre	ISK 10,000,000	Based on an international estimate of possible need for hardware and related equipment.	0.51%
		Annual operating cost	ISK 15,000,000	Annual operating cost for the three-year duration of the ICE-Health program.	0.76%
4.	**Virtual network**	**Total**	**ISK 43,902,500**		**2.22%**
4.1	**Health care data interchange**	Total	ISK 37,500,000	The hub of the virtual network will be this data interchange, routing messages through a secure virtual network between all health care institutions. Operational cost is estimated as approximately 1.7 million messages per year at an average cost of ISK 5 per message. The cost is mainly caused by hardware purchases. This functionality could be outsourced to an ISP. Based on the report *MedCom IV - Status, planer og projekter*, Oktober 2003, ythe current monthly volume of messages in Denmark is 2.5 million,	1.89%

				or 0.5 per capita. At the same rate, the annual number of messages in Iceland would be around 1.7 million.	
4.2	**Expansion of WAN**	Total	ISK 0	The upgrade start-up cost is nil (ISK 0). The monthly charge will increase, however, since the minimum connections are 1-2 mb/s for each location. Eight health care facilities are currently in need of upgrade.	
4.3	**Virtual private network connections**	Total	ISK 6,402,500	To ensure data protection and privacy on the health network, every institution should be connected via virtual private network connections to the health care data interchange. This budget item is incurred due to installations of VPN drivers and connections at each workstation. Some hardware purchases may be required.	0.32%
		Average hourly rate	ISK 6,500	Based on an average rate for technical professionals in Iceland.	
		Number of hours	985	Number of hours allocated to VPN setup and preparations, e.g. tutoring the use of VPN.	
		Operating cost	ISK 2,400,000	Annual operating cost of 20% of start-up cost	0.12%
Hospital EPR		**Total**	**ISK 1,208,108,000**		**61.04%**
1.	**Project management**	**Total**	**ISK 48,000,000**		
1.1	**External audit**	Total	ISK 6,000,000	Refers to an independent third party auditor who reviews project quality and progress.	0.30%
		Average hourly rate	ISK 10,000	Based on an average hourly rate for consultancy in Iceland.	
		Number of hours	600	Number of hours allocated for external audit covering the three-year project plan.	
1.2	**Project management assistance**	Total	ISK 30,000,000	The project action plan 2004-2006 demonstrates the number and nature of different tasks to be performed during the hospital EPR implementation. Due to the vastness of the project, the project manager for the hospital EPR implementation will need advisors or consultants to provide expert research or support at individual stages of the project.	1.52%

		Average expert rate per hour	ISK 16,000	Based on an average of known consultancy fees in Iceland and in Europe; it is expected that foreign consultants will be needed at this stage.	
		Number of hours	1,875	Number of hours allocated for the PM to purchase expert reports, calculations and points-of-view. Number of hours is based on IBM BCS experience from similar projects in Europe.	
1.3	**Training and development**	Total	ISK 12,000,000	Training for workgroup participants working on the hospital EPR implementation. It is assumed that participants will need to attend seminars, training sessions etc. in order to allow them to maximize the application of their expertise to the tasks of this project. These workgroups will later have a hand in the actual implementation of the EPR system by providing knowledge of the system, the implementation process and assistance to general users.	0.61%
2.	**Hardware and IT infrastructure**	**Total**	**ISK 492,348,000**		**24.88 %**
2.1	**Network**	Total	ISK 22,208,000	This budget item represents the expected required upgrade of network systems resulting from the increased need for workstations; total addition of workstations is 694 pieces.	1.12%
		Start-up cost	ISK 13,880,000	Cost of upgrading existing networks based on ISK 20,000 per additional workstation	0.70%
		Operating cost	ISK 8,328,000	Cost of operating the network upgrades; annual cost of ISK 2,776,000, i.e. 20% of the start-up cost.	0.42%
2.2	**Workstations**	Total	ISK 277,600,000	Based on estimates from LSH, it is assumed that 694 new workstations will be needed.	14.03 %
		Start-up cost	ISK 111,040,000	Based on estimated unit cost of ISK 160,000 per workstation.	5.61%
		Operating cost of workstations	ISK 166,560,000	Cost of operating the new workstations; annual cost of ISK 55,560,000, i.e. based on annual operating cost at LSH of ISK 80,000 per workstation.	8.42%
2.3	**Wireless network**	Total	ISK 48,300,000	Based on estimates from LSH, it is assumed that 840 new wireless network hubs will be needed.	2.44%
		Start-up cost	ISK 42,000,000	Based on a unit price per wireless hub of ISK 50,000.	2,12%
		Operating	ISK 6,300,000	Based on annual operating cost of 5% of start-	0.32%

		cost of wireless networks		up cost.	
2.4	**Servers**	Total	ISK 68,000,000	Based on the average price of IBM xSeries servers; unit price ISK 2,500,000 (HP Server RX 4610, base price USD 22,995, internet research 15.9.2004, http://store.yahoo.com/col88/hprx4610.html)	3.44%
		Start-up cost	ISK 42,500,000	Estimated requirements for 17 servers.	2.15%
		Operating cost	ISK 25,500,000	Operating cost for three years, i.e. 20% of start-up cost.	1.29%
2.5	**Storage (storage net, tape systems and storage capacity)**	Total	ISK 76,240,000		3.85%
		Start-up cost	ISK 47,650,000	Start-up cost of ISK 450,000 for back-up systems for each of the 17 new servers; additional start-up cost of ISK 40,000,000 for storage nets at LSH and FSA.	2.41%
		Operating cost	ISK 28,590,000	Operating cost for three years, i.e. 20% of the start-up cost.	1.44%
3.	**Integration platform**		**ISK 156,000,000**		**7.88%**
3.1	**Integration platform preparation (tender process)**	Total	ISK 3,000,000	This budget item is incurred due to preparation of documents, analysis and legal assistance required for the tender process.	0.15%
3.2	**Integration tools**	Start-up cost	ISK 80,000,000	Purchases of basic business object integrator software, based on figures from LSH.	4.04%
3.3	**Integration project assistance**	Technical consultation	ISK 48,000,000	Technical consultation for the three year start-up phase of the system, based on a 20% annual operating cost of software cost. This budget item includes user training.	2.43%
		Software adaption	ISK 25,000,000	This budget item refers to programming the interfaces between existing systems and the EPR.	1.26%
		Average hourly rate of programming	ISK 7,200	Based on average rate for programmers in Iceland.	
		Programming hours	3,472	Number of hours allocated for programming needs, design of interfaces, connecting databases.	

4	**Clinical workplace**	**Total**	**ISK 511,760,000**	The strategy suggested is that current EPR systems at LSH and FSA will be discontinued and a new system will be implemented according to the tender prescription.	**25.86 %**
4.1	**Clinical modules**	Start-up cost	ISK 470,000,000	This budget item is incurred due to a new investment in the clinical modules, software purchases, where existing EPR system will be discontinued. Based on information from LSH and FSA. For comparison, at the HS: Copenhagen Hospital Corp. the cost of clinical modules was DKK 75,000,000 excluding annual operating cost of 20% of start-up costs.	23.75 %
4.2	**Clinical quality databases**		ISK 41,760,000	Cost related to clinical databases based on facts from LSH at annual cost of ISK 10,000,000 and at FSA at ISK 40,000 per licence annually.	2.11%
Primary Care EPR		**Total**	**ISK 263,498,000**		**13.31%**
1.	**Project management**		**ISK 56,000,000**		**2.83%**
1.1	**External audit**	Total	ISK 6,000,000	Refers to an independent third-party auditor who reviews project quality and progress.	0.30%
		Average hourly rate	ISK 10,000	Based on an average hourly rate for consultancy in Iceland.	
		Number of hours	600	Number of hours allocated for external audit covering the three year project plan.	
1.2	**Project management assistance**	Total	ISK 30,000,000	The project action plan 2004-2006 demonstrates the number and nature of different tasks to be performed during the Primary EPR implementation. Due to the vastness of the project, the project manager for the primary care EPR implementation will need advisors or consultants to provide expert research or support at individual stages of the project.	1.52%
		Average expert rate per hour	ISK 16,000	Based on an average of known consultancy fees in Iceland and in Europe; it is expected that foreign consultants will be needed at this stage.	
		Number of hours	1,875	Number of hours allocated for the PM to purchase expert reports, calculations and points-of-view. Number of hours is based on IBM BCS experience from similar projects in Europe.	

1.3	**Training and development**	Total	ISK 12,000,000	Training for workgroup participants working on the primary care EPR implementation. It is assumed that participants will need to attend seminars, training sessions etc. in order to allow them to maximize the application of their expertise to the tasks of this project. These workgroups will later have a hand in the actual implementation of the EPR system.	0.61%
1.4	**Establishment of user groups/deregulation**	Total	ISK 2,000,000	Setting-up of user groups including members of each professional discipline within primary health care; in order to promote free exchange of patient data, legal definitions of "ownership" and responsibility of data may have to be clarified. First year only, half man-year. This budget item covers the cost of legal assistance expected to be incurred by legislative work on current law regarding health records.	0.10%
1.5	**Plan and budget development**	Total	ISK 6,000,000	Planning and budgeting must be careful and accurate. Common priority list established for add-ons and changes to existing EPR; consulting fees included.	0.30%
2.	**Hardware and IT-infrastructure**		**ISK 43,500,000**		**2.20%**
2.1	**Network**	Total	ISK 1,280,000	Network situation mostly excellent but some modification and software upgrades will be needed to accept the estimated number of new workstations	0.06%
2.2	**Workstations**	Total	ISK 30,720,000	It is estimated that the primary health care will require 120 new workstations, at ISK 160,000 each, in order to reach the goals of this project; this does not account for regular renewal of workstations, but includes cumulative annual operating cost for the three-year project duration.	1.55%
		Start-up cost	ISK 19,200,000	The cost of 120 workstations at ISK 160,000 per unit.	0,97%
		Operating cost	ISK 11,520,000	Annual operating cost of 120 workstations is ISK 3,840,000.	0.58%
2.3	**Wireless network**	Total	ISK 11,500,000	Based on estimates, it is assumed that 200 new wireless network hubs will be needed for the Primary Care facilities.	0.58%
		Start-up cost	ISK 10,000,000	Based on a unit price per wireless hub of ISK	0.51%

				50,000.	
		Operating cost of wireless networks	ISK 1,500,000	Based on annual operating cost of 5% of start-up cost.	0.08%
2.4	**Servers**	Total	-	It is assumed that servers in primary health care facilities are relatively up-to-date; no upgrades outside of regular renewal is required	0.00%
3.	**Clinical workplace**	**Total**	**ISK 163,998,000**		**8.29%**
3.1	**Clinical modules**	Total	ISK 133,758,000	This estimates the cost of upgrading and adapting current clinical modules of the Saga system to the requirements of this project; some new modules will be needed. Even if the current number of workstations is used as a base for calculation we assume that the number of workstations will grow significantly and new modules will be implemented for all stations.	6.76%
3.2	**Clinical quality database**	Total	ISK 30,240,000	Investment in decision-support databases, coding-systems databases etc., in addition to current expenditures.	1.53%
Program Management		**Total**	**ISK 96,000,000**		**4.85%**
1.	**Program management**	Total	ISK 96,000,000		4.85%
1.1	**External audit**	Total	ISK 6,000,000	Refers to an independent third-party auditor who reviews project quality and progress	0.30%
1.2	**Project management assistance**	Total	ISK 30,000,000	Consultation and support for project manager, utilising the appropriate experts at each stage, including legal assistance after project initiation.	1.52%
1.3	**Program manager**	Total	ISK 60,000,000		3.03%

EPR Operating Costs			Annual Operating Cost ISK 101,266,000		
No.	**Group**	**Item**	**Amount**	**Explanation**	**% of Operating Cost**
Collaborative Environment		**Total**	**ISK 14,300,000**		**14.12%**
3.2	**Operations centre**	Annual operating cost	ISK 5,000,000	Annual operating cost for the three-year duration of the ICE-Health program.	4.94%
4.	**Virtual network**	**Total Operating cost**	**ISK 9,300,000**		**9.18%**
4.1	**Health care data interchange**	Total	ISK 8,500,000	Operating cost estimated as approximately 1.7 million messages per year at an average cost of 5 ISK per message. (Current monthly volume of messages in Denmark is 2.5 million, or 0.5 per capita. At the same rate the annual number of messages in Iceland would be around 1.7 million.) The numbers are based on the report *MedCom IV - Status, planer og projekter*, Oktober 2003.	8.39%
4.3	**Virtual private network connections**	Operating cost	ISK 800,000	Annual operating cost of 20% of start-up cost	0.79%
Hospital EPR		**Total**	**ISK 82,626,000**		**81.59%**
2.	**Hardware and IT infrastructure**	**Total**	**ISK 82,626,000**		**81.59%**
2.1	**Network**	Operating cost	ISK 2,776,000	Cost of operating the network upgrades; annual cost of ISK 2,776,000. (20% of the start-up cost.)	2.74%
2.2	**Workstations**	Operating cost of workstations	ISK 55,520,000	Cost of operating the new workstations; annual cost of ISK 55,560,000, i.e. based on annual operating cost at LSH of ISK 80,000 per workstation. Number of new workstations is 694 units.	54.83%
2.3	**Wireless network**	Operating cost of wireless networks	ISK 6,300,000	Based on annual operating cost of 5% of start-up cost.	6.22%
2.4	**Servers**	Operating cost	ISK 8,500,000	Operating cost for three years. (20% of start-up cost.)	8.39%
2.5	**Storage (storage net, tape systems and storage capacity)**	Operating cost	ISK 9,530,000	Operating cost for three years. (20% of the start-up cost.)	9.41%

Primary Care EPR		**Total**	**ISK 4,340,000**		**4.29%**
2.	**Hardware and IT-infrastructure**	**Total**	**ISK 4,340,000**		
2.2	**Workstations**	Operating cost	ISK 3,840,000	Annual operating cost of 120 workstations is ISK 3,840,000.	3.79%
2.3	**Wireless network**	Operating cost of wireless networks	ISK 500,000	Based on annual operating cost of 5% of start-up cost.	0.49%
Program Management		**Total**	**-**		**0.00%**
1.	**Program management**	Total			0.00%

Appendix 1

References

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