National Electronic Health Record in Iceland

Cost Estimation and Expected Implementation Time

Workgroup #1
June 2012

Internal report
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1 Executive Summary

In early April of 2012 the Ministry of Welfare reactivated the workgroup which in December of 2011 submitted a report on integrated electronic health records in Iceland. The assigned task was to define the scope of a new Electronic Health Record system (EHR) on a national level and estimate the total cost of such a project along with the expected implementation period.

The scope was defined as three suggested waves, referred to as A (Migration), B (Optimization) and C (Expansion). This definition was used as a basis for all the cost and time estimation work.

The estimated total cost was achieved by applying three different methods:

- Sending a Request for Information (RFI) to some vendors asking for a cost/time estimate.
- Asking experienced experts in the EHR field to individually estimate the total cost.
- Gather some international EHR reference cases and adjust the cost to Icelandic situations.

Following is a summary of the total cost calculations for the complete scope:

<table>
<thead>
<tr>
<th>No.</th>
<th>Method</th>
<th>Total cost [M€]</th>
<th>[Billion ISK]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RFI replies from vendors</td>
<td>89,4</td>
<td>14,2</td>
</tr>
<tr>
<td>2</td>
<td>Experts’ assessments</td>
<td>74,7</td>
<td>11,8</td>
</tr>
<tr>
<td>3</td>
<td>EHR reference cases</td>
<td>67,0</td>
<td>10,6</td>
</tr>
<tr>
<td></td>
<td><strong>Average</strong></td>
<td><strong>77,0</strong></td>
<td><strong>12,2</strong></td>
</tr>
</tbody>
</table>

The total cost is estimated as 77 M€ or about 12 billion ISK. The expected implementation time for the A, B and C waves is 5-7 years including preparation time; provided enough resources are available and full commitment is guaranteed. The A wave contributes for over 50% of the total cost and the longest implementation period. Still implementing only part of the total scope would severely limit the benefits of the project and is not recommended.

Valuable information was gathered regarding EHR implementation strategies and is described in some details along with suggestions on the project preparation and execution in due time. One suggestion is to use a so called competitive dialog tender process, due to the complexity of the project. Risk assessment is included in order to assist for preparation of the project. Other material collected should also be of great value when a preparation work for a new national EHR starts.

The total cost of the full scope solution is considerably higher than anticipated, but benefits in form of increased effectiveness and patient safety are significant, as described in the report. Moderate socio-economic savings of 2% in the Icelandic health system due to investing in a national EHR system could possibly result in a payoff time of five years.

It is suggested that the summer time is used to digest the content of this report and hopefully in early fall, a decision on a short term and a long term EHR strategy can be agreed on, which is quite urgent as the Boston Consulting evaluation revealed. This report and the report submitted last December should serve as valuable input in that respect.
2 Introduction

In fall of 2011 the Ministry of Welfare hired a management consulting firm, the Boston Consulting Group, to evaluate the performance of the Icelandic healthcare system, and to make recommendations for improvements. One of their key observations was the lack of an integrated Electronic Health Record system (EHR) on a national level. The ministry then appointed a Steering Committee to implement the recommend activities. Subsequently, the Steering Committee appointed a workgroup to take on the task of suggesting an approach to reach the goal of a national EHR in Iceland. The workgroup submitted its first report in December of 2011. The main conclusion of the workgroup was to aim for a new comprehensive national EHR system, which would replace most of the current systems in use. The report pointed out that such a system is very expensive, time consuming to implement and financing uncertain. Hence, it was recommended to keep improving the current system for a few years. Furthermore, several projects for improvements were listed and prioritized in the report. It was also explained that by using this approach, many of the recognized objectives could still be reached.

The Steering Committee concluded that investing in a new comprehensive EHR system would be a more favorable approach towards reaching the ultimate goal of a national system. Focusing too much on improving the current system would only delay the implementation of a new national EHR system. Hence, the Ministry of Welfare and the Steering Committee allocated a new assignment to the workgroup in April of 2012. The new task was to define the scope of a new comprehensive EHR system on a national level, estimate the total cost and expected implementation time.

The members of the workgroup mostly consisted of the same specialists who delivered the first report. The workgroup members are:

- Björn Jónsson, CIO Landspitali (Chairman)
- Árni Hermannsson, CIO, Primary Healthcare Capital area
- Guðrún Auður Harðardóttir, specialist, Directorate of Health
- Ingi Steinar Ingason, specialist, Directorate of Health
- Ragnar M. Gunnarsson, Manager Icelandic, Health insurance
- Sigurður E. Sigurðsson, Chief Medical Officer, Akureyri hospital

Bjarne Kohl consultant, former CIO from Rigs Hospital and former consultant at Implement Denmark actively participated with the group during the whole process. Moreover, Per Louberg former CIO of Hvidovre, Bjarni Júlíussson consultant and Baldur Johnsen director of health care solutions at HP assisted regarding different parts of the work.
3 Workgroup Project Description

Following is a summary of the project description for the workgroup.

The Ministry of Welfare has set the goal of implementing a comprehensive state of the art Electronic Health Record system on a national level in Iceland.

A workgroup of specialists was formed as part of a preparation for that mission. The tasks for the workgroup were the following:

- Define the main goals of a new EHR system on a national level.
- List and prioritize all stakeholders and users for a new EHR system.
- Define the scope of a new EHR system.
- List which parts of the current EHR system shall be used with a new EHR.
- Estimate the total implementation costs and expected timeframe of implementation by:
  - Sending an RFI (Request for Information) to some possible EHR vendors.
  - Learning from other comparable EHR implementations.
  - Asking several experts in this field to make their individual estimates.
- Risk Assessment for an EHR system implementation on a national level.
- Define tender process approach for a new EHR.
- Suggestions for next steps.

The workgroup shall submit a report to the Ministry of Welfare no later than June 30th, 2012. The report provided by the workgroup is to be a basis for a more detailed requirement analysis and making of a tender document for a new EHR system.

The key goal of the workgroup was to roughly define the scope of a new comprehensive EHR system. Furthermore, to estimate the total cost and expected time frame of implementing such a state of the art system on a national level.

The assignment of the workgroup was clearly defined. It is important to notice that the goal of this work was NOT to:

- Describe in details all the requirements a new EHR has to fulfill.
- Evaluate various EHR systems.
- Estimate which EHR system is most feasible for Iceland.
- Prepare a tender document.
- Suggest on project governance structure.
- Deliver a Business case for a new EHR.
- Discuss the financing part of the EHR project.

This report is considered an internal document, intended only for the Ministry of Welfare, the Steering Group and relevant staff at various healthcare organizations. Some material in the report might be considered as sensitive, and due to the limited time the workgroup had for preparing this report, some displayed figures must be treated as indicative rather than facts.
Figure 1 shows the project plan for the workgroup. The workgroup had two and a half months to complete its task, as the plan was to submit the report before summer vacation.

Figure 1: Workgroup Project Plan

4 Approach

4.1 Scope of a new EHR

The scope of a new EHR system depends firstly on the level of functionality covered by the system and secondly on the number of stakeholders or users the system has to service. Functionality is defined in three steps or waves (A, B and C) which is the terminology used in the report. In the same way the stakeholders are defined into groups depending on their functions.

4.2 Expected total cost

Estimating the total cost of implementing a comprehensive EHR system on a national level is complicated, and the results depend highly on assumptions. In order to diminish the level of uncertainty, the work was carried out in parallel in three different ways.

- Preparing an RFI document based on the proposed scope and sending it to several potential EHR vendors. A cost estimate was then attained by comparing and adjusting the vendors’ responses.

- Asking some experts in the field of EHR to make their individual estimates for the cost. A cost estimate was achieved by comparing and adjusting their results.

- Collecting experience stories on EHR implementations in other countries and the associated implementation cost. By adjusting the size of the environment to Icelandic circumstances and adjusting for the functionality, comparable cost figures were attained. By calculating the median value of the total costs, a cost estimate was reached.
4.3 Expected implementation time

Implementation time depends on the scope of the EHR system. In order to estimate it, the workgroup made a draft of a time plan which was part of the RFI document sent to potential EHR vendors. The vendors were asked to review the time plan, and if applicable to suggest an alternative one based on their experiences. Furthermore, the expected implementation time was evaluated based on actual implementation time from other EHR installations.

5 Main Goals by a National EHR

In the first report, issued in December of 2011, the workgroup listed the main goals for implementing a state of the art EHR system on a national level. These goals were revised during this work. Moreover, CEO’s of healthcare organizations were asked for their opinions regarding the goals. The main goals are:

- Increased patients’ safety.
- Seamless and secure access for all clinicians to relevant medical records about their patients, regardless of where the records were created.
- Correct diagnosis and precise treatment can be started as soon as possible.
- Avoidance of patients having to undergo repeated or unnecessary tests.
- Standardized electronic health records shared by healthcare organizations.
- Reliable and comparable data used for quality control and benchmarking.
- Secure electronic access for healthcare consumers to their own health data.
- Secure data storage and clear access policy.

6 Stakeholders in the National EHR

To maximize the benefits of a new national EHR it is important that all stakeholders will use the new system. The workgroup has included all healthcare providers in Iceland, both publicly and privately run in the cost estimate for this project.

Following is a list of all stakeholders included in the National EHR project, listed in priority order proposed by the workgroup:

- Hospitals, Primary healthcare and regional hospitals.
- Larger private specialist offices.
- Administrative offices (Directorate of Health, Ministry of Welfare, Icelandic health insurance, etc.).
- Nursing homes & Elderly homes.
- Smaller private specialist offices.
- Other healthcare providers (i.e. psychoanalysts, physiotherapists, dentists, etc.)
7 The Icelandic Healthcare IT Environment

The Icelandic healthcare system is well computerized compared to many other countries, with the exception of some regions in the other Nordic countries. Iceland has the advantage to have one journal system (Saga) implemented in the majority of healthcare organizations and private practices (90-95%). However, this advantage has not yet been fully utilized with regards to possible interconnections among healthcare organizations. The passing of the Health Records Act no.55/2009 provided the first legal framework for access, sharing, and connections of electronic health record systems among different healthcare providers. The merger of Saga-databases in recent years within the 7 health regions has been a huge stepping stone towards a shareable EHR. Nevertheless, the Saga system needs upgrading, and due to the small market in Iceland the developers of the system have had a hard time competing with international large-scale EHR systems developed for much larger markets.

Currently the Icelandic healthcare system is using around 30 different clinical systems, including Saga (see Appendix C). However, only 2 hospitals have a medication administration system implemented, only 1 hospital has an operating theater system, and none of the healthcare institutions have an EHR designed especially for the ICU, ER or maternal and obstetrics care. A new national EHR system is likely to replace approximately 20 of the current systems, leaving around 10 systems to be integrated to the new system. Those systems are highly specialized with functionality not included in standard EHR systems; mostly laboratory systems. An integration cost to those systems is included in the cost estimate delivered in this report.

One has to bear in mind that while implementation of the new system is still in process, all systems currently in use will need to be run concurrently. This means that a completely new technical infrastructure has to be set up, since current hardware could not handle the added load of the new system. Security issues have to be addressed both in the field of secure interconnections and access. At this point in time it is difficult to predict how much investment has to be made in infrastructure, since it largely depends on the technology of the new system. However, an attempt has been made to include a realistic cost estimate in this report.

8 Scope of a National EHR in Iceland

The proposed scope of the new national EHR system is to include functionality to fulfill the needs for all services provided by every healthcare provider in Iceland, including a patient portal. The workgroup identified 54 major functionality areas (see Appendix B) that should be included in the new national EHR system, of which around half is implemented in the current systems to date, either partly or fully. Functionality areas in many cases correspond to modules in standard EHR systems.

The workgroup prioritized the implementation of the functionality areas into three waves (A, B and C), before sending the RFI to the vendors. The consistent message from the vendors was to move more functionality into wave A with the argument that since they already have a standard
module in their system to cover the functionalities, implementation should be done as soon as possible to maximize the benefits.

![Diagram showing proposed implementation by 3 waves]

**Figure 2: Proposed implementation by 3 waves**

An option (D) was given for some of the functionalities to use the old systems, or a 3rd party module integrating them to the new system. The vendors barely used this option, since they seem to have modules that cover most of the functionalities needed, and occasionally suggesting certain modules from 3rd party vendors they have experience working with.

The estimated number of users for the new national EHR system is around 11,500, not counting the same user twice, even when working for more than one stakeholder. Buying one system for all stakeholders will save user fees, and training costs will be much lower since healthcare professionals working for multiple stakeholders will be using the same system in all workplaces.

To lower the costs of the project some functionality areas, stakeholders or user groups could be omitted. However, buying some modules later or adding user groups can be very costly since negotiation leverage is lost after signing a contract with a vendor. If a fully integrated national EHR system is the long term goal, narrowing the scope of the project is not recommended by the workgroup, especially when narrowing the scope too much can result in a worse system than the current situation.

### 8.1 Other projects (not delivered by the vendors)

Some projects need to run parallel to the national EHR project with no or little input from the vendor:

- Standardization of data entry.
- Laboratory systems sharing.
- Secure interconnection and access control.

See more detailed description in RFI document (see Appendix A).
9 Implementation Strategy

The implementation strategy must assure as cost efficient and low-risk implementation process as possible.

9.1 Pre-implementation setup

When implementing a standard EHR-system, one has to decide on the degree of pre-implementation setup. One can decide to do a

- MINIMUM pre-implementation setup, in which case only the most general functionality needed everywhere is basically set up, while the larger part of the functionality is set up as the project meets the various organizational units that are to become the future users of the system.
- MAXIMUM pre-implementation setup, in which case almost all functionality is set up in advance, so that the implementation in each organizational unit is more like a roll-out than a set-up process. Still some adjustments and add-ons have to be done during implementation, but it can be as low as 5-10% of the final solution.

The project has to decide its setup strategy within the continuum established by these two poles (See figure 3). Even though minimum pre-implementation has some advantages – e.g. that the setup can be tailor made to each department – it is recommended to choose a strategy as close to maximum pre-implementation setup as possible. It is more cost effective, more efficient with respect to the use of clinical resources, less risky and results in fewer and smaller re-implementation activities in departments already implemented, when changes in the implementation in a new department forces the project to change the system for all other previously implemented departments. Furthermore, it facilitates support, change of functions between staff and the possibility of building new functions into the system in the future.

![Figure 3: Minimum and maximum pre-implementation setup](image-url)
It is assumed that before entering the implementation phase of the project the following results must be achieved:

- System is installed and localized.
- Agreement on system modifications and additions have been completed and tested.
- Interfaces have been established and tested.
- Data conversion procedures have been developed and tested.
- Basic functionality (i.e. functionality needed by most users) has been set up, incl. reports.
- Master data and classifications have been keyed into the system.
- Training method and material has been developed.
- A data warehouse has been set up to receive data from still more user units as implementation progresses.

9.2 Implementation in four lanes

Each wave (A, B, and C) will more or less simultaneously have to address the needs of several groups of users. Based on the prioritization of the stakeholders given by the Ministry of Welfare and the “inner logics” of the implementation task it is suggested to base each wave on four different lanes in order to assure progress, even if delays are encountered.

Implementation is proposed to take place in four lanes:

- A hospital lane.
- A primary sector healthcare lane.
- A nursing home/elderly care lane.
- A central data warehouse lane.

Hospital lane

- Landspitali.
- Akureyri hospital (FSA).
- Regional hospitals + home healthcare.
- Private home healthcare.

Primary sector healthcare lane

- The Capital Primary Healthcare, including home healthcare.
- Acute-bed sites.
- Major private healthcare providers.
- Minor private healthcare providers.
- Dentists, physiotherapists, occupational therapists, nutritional therapists, etc.

Nursing home/elderly care lane

- Nursing homes.
- Elderly homes.

Central data warehouse lane

- Directorate of Health.
- Ministry of Welfare.
Each implementation also includes relevant pre-hospital units (i.e. ambulances, 112)

### 9.3 Pilot preceding implementation

In general, it is advisable to test the setup of the system in a pilot implementation. The purpose of the pilot phase is to assure that the system works well in a practical daily context supporting the patient pathway across healthcare institutions and clinical specialties – from the most basic to the most advanced treatment situations. It is also the purpose to test the implementation method, including teaching material. Finally, the purpose is to test the capability of setting up forms, designing reports and do other tasks to "departmentalize" the system.

It is not the scope of the pilot to develop new functionality in the system, identify new needs for integration etc. Ideally, a pilot should be complex enough to reflect all types of usage and small enough to be manageable. Furthermore the pilot should tie organizational units together that contribute to the pathways of patients in one geographical area rather than reflect geographic diversity. Finally, a pilot should be reversible, i.e. it must be possible to roll it back to the situation prior to the project, if the functionality doesn’t work as intended and patients’ life or health is threatened.

One way of achieving this would be to select the Akureyri Hospital and the Health clinics in the Northern area as a pilot, as described in the figure below. This does not fully cover the functionality needed by the more complex specialties at Landspitali, but apart from this, it matches the criteria for selection as a pilot.

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**Figure 4: Suggested implementation lanes within a wave**
As illustrated, a common standard setup is made covering as much functionality as possible, interfaces are implemented, data are converted and many other preparation tasks are solved. This system setup is piloted in Akureyri and the healthcare centers in the northern region and will feed:

- Experiences and functionality into Landspitali, primary care units and – eventually – nursing homes/elderly care.
- A basis for finishing the implementation at Akureyri.
- Data into a central data warehouse, which during the course of a wave will be gradually enriched with still more management information data.

It must be underlined, that this is merely an example, and that further discussion prior to selecting the pilot environment is necessary.

### 9.4 Training

The training concept is proposed to be the “train-the-trainer” concept, where the vendor’s trainers train the customer’s trainers, who again train the users and super-users of the system (see figure 5).

**Figure 5: Proposed process for training new users**

The advantage of this method is that:

- It is possible to train many users in a short time.
- It is cost effective, because the vendor’s expensive staff only trains a limited number of people, while the major part of the training is done by cheaper staff.
- It is learning-effective, because the customer’s staff gets deeper understanding of the system through training.
- It matches the learning needs of the end-users by not only answering the HOW-question, but also the WHO and the WHY questions (goal, work processes and responsibilities).

Also e-learning is assumed used, both for training and follow up instructions/manuals.

### 9.5 Super-users

It is recommended to appoint super-users to support the implementation process and even more the usage of the system in the period after the project. A superuser should provide support and counseling to 25-40 peers with the system service-desk as a possibility of getting further assistance.
10 Project Plan

Based on the discussions in the workgroup it is expected to be possible to complete the implementation of a new, national EHR over a period of 5-7 years. All vendors have emphasized that the project period should be as short as possible, and several have indicated that a shorter period than 6 years is feasible. However, looking at the experiences in other projects it seems ambitious to plan for a project shorter than 5-7 years including the preparation and tender process.

10.1 The new EHR and the three waves

Based on input from the vendors in the RFI and on experiences from other projects, it is recommended to design the project with a 6-year timeframe starting with the project preparation and continuing with functionality to be made available to the users in 3 partially overlapping waves: A, B and C. Each wave consists of similar tasks as described in figure 6 below.

Figure 6: Proposed time plan for implementing a national EHR in Iceland

As figure 7 illustrates, it is expected that wave A will be the most demanding with regard to time and resources, while wave B and C are less demanding. After the project, development will go on continuously, as is the case for Saga and other existing solutions.
The **preparation phase** covers Project Preparation, Specification of demands, Tender and Contract. In this phase focus should be on mobilizing the best clinicians and administrators to work in the project and to involve potential vendors in a focused dialogue about the functionality of the new system, on the implementation process and the project plan.

The first wave - **Wave A** – should be devoted to migrate all users from Saga and other systems to be phased out to the new solution. Based on experience it is important to make sure, that all user groups experience at least some improvements with the new system compared to their old systems – and especially that they experience only very minor losses of functionality. This determines the users’ perception of their new system. In addition to this functionality scope other areas of functionality could be included, e.g. areas that are very poorly supported today and that are easily supported in the new system (“low-hanging fruits”), functionality that has been promised to be delivered before the beginning of this project, functionality demanded by strong opinion-leading communities etc. Of course the migration also includes migration of data and building interfaces to systems that are still going to be used, e.g. lab- and radiology systems. 

The activities in wave A include building first version on the new solution to meet demands from Saga and other systems, implementing and learning from a pilot, full-scale implementation, wrap-up (i.e. correcting errors, adjusting setup in response to experiences had during implementation) solution, pilot and implementation. From this point the functionality implemented in wave A will be in operation in all parts of the Icelandic healthcare system.

The second wave - **Wave B** – starts while wave A is still on, commencing at organizational units, that have finished their wave A implementation. Wave B should be devoted to optimize the solution implemented in wave A. This includes to some extent further implementation of the software solution (e.g. more functionality in existing modules, new modules, new interfaces) but the bulk of the effort is organizational: Optimizing the clinical processes to reduce unnecessary work, automate, create reminders and improve management information and processes at all levels etc. Furthermore, developing the skills of the users is crucial in this wave. All this work will
demand pilots, further implementation and wrap-up as described in wave A, and accordingly the new functionality and processes will be in operation after wave A.

The third wave – **Wave C** – also starts while the previous wave is not quite finished. It will focus on expanding the solution by taking in functionality that was too new, too complex or targeted to small user groups to have been included in any of the previous waves. Also, very specialized and complex integrations will be on the agenda in this wave. Some pilots may be needed, but in general implementation takes place only at one or few places, as this wave will have high focus on specialized healthcare units, primarily at Landspitali. Implementation will therefore often be integrated with piloting, so that different projects will address the needs of different specialties – and implement at all organizational units within one specialty at the same time. Wrap-up will be done in each of these projects, and from then on the enhanced solution will be in operation. Being the last, this wave will end with an evaluation.

# 11 Total Cost of a New EHR

As previously stated the estimated total cost of a comprehensive EHR system in Iceland was calculated by using three different approaches:

a. Sending an RFI document with defined scope to potential EHR vendors.
b. Asking several experts in the EHR field to individually estimate the cost.
c. Collecting information on similar EHR implementations internationally.

## 11.1 Methods for estimating project costs

The costs of an IT-project are not a well-defined concept as one might think. Some costs, such as costs paid to the vendor, are clearly a part of the project’s costs while other costs, such as time spent using the system after implementation, are clearly not. For this project it was chosen to estimate all costs that may be relevant, i.e. vendor costs, other external costs, internal project costs, related projects, and contingency, (see figure 8; *blue color*), and to exclude cost types from the final result, that would not materialize in the project’s financial balance, organizational implementation, and production loss (see figure 8; *green color*).

![Figure 8: Relevant EHR cost classifications](image)

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Vendor costs
The vendor costs cover everything paid to the vendor during the project period, including, but not limited to the license cost, project management, and development of interfaces, system development, data conversion, test, training, and travel expenses.

Other external costs
Other external costs cover hardware, third party software, buildings, other facilities, infrastructure, legal advice, consulting, site visits, 3rd party integration, and other costs that are paid for by the project, but are not a part of the vendor contract.

Internal project costs
Internal project costs cover salaries for project management, clinical system configuration, implementation, teaching, support, contract management, module testing, and any other task handled by the customer’s own staff. The border line between other external costs and internal project costs is not always easy to draw. In this context it is not so important, as both cost-types beyond doubt should be included in the total project cost.

Related projects
It is very likely that several projects have to be completed before or during the national EHR project. The reasons for this could be to remove technical or organizational obstacles to a smooth project process – or simply to handle some tasks outside the EHR project in order to reduce complexity. If commencing these projects is reliant to the EHR project, they must be included in the total cost. It must be noted, that the workgroup has not fully analyzed this area.

Contingency
The EHR project has to set aside a contingency to cover unforeseen costs, scope creep, changed demands, etc. These things happen in all projects, and even though they can be minimized through good planning and strict project management, they will always be a significant part of a project’s financial balance sheet.

Organizational implementation
The Icelandic healthcare system will use many clinical and administrative resources, that are not a part of the project organization itself (that cost is included in internal project costs) but are the various departments' involvement in the project for specification of local needs, end user testing, participating in training, etc.

Practice around such costs is very different. In some projects departments are compensated (partly or fully) for this type of expenses, and this is often evaluated very positively both by departments and by the project. However, it is more typical, that the departments are asked to squeeze this extra workload in, so that the departments are not compensated. In the cost calculation of the EHR project, these costs are calculated, but they are omitted from the final sum of the costs.
Production loss
The general experience is that there is a production loss of 5-10% for 14 days up to 2 months after the go-live with the new system. Generally, it is experienced that productivity after this period is in balance and continues to grow over the level of the old system (the users end up more productive with the new system).

In a free market economy the demand that could not be met in this period, would seek to other suppliers (e.g. abroad or to the private sector), but this is not expected to be the case here. Instead there will be an increased waiting time for a period of time, which will again be reduced by the increased productivity of the healthcare staff. Therefore, the workgroup has calculated the value of this production loss, but it is excluded from the total project cost.

11.2 Request for Information (RFI)

The workgroup prepared and sent a Request for Information (RFI) to five EHR vendors and asked for their assessment on the time plan, the total cost of the project and the cost of operating the solution after the project. These vendors have been selected based on the following criteria:

- The vendor must have an EHR standard package that can be expected to be able to fulfill >90% of identified demands.
- The vendor must have implemented this system previously in settings at least of the same magnitude as Iceland, preferably in the Nordic or Northern European region.

The request was accompanied by a thorough description of the present situation in Iceland and on the needs for functionality in various parts of the Icelandic healthcare system.

Four of the vendors delivered a reply in time, all giving very valuable viewpoints on project plan and implementation strategy. However, only two of them had to a full extent estimated the costs of the projects and only these two form the basis for the RFI cost estimation. These two cost calculations were discussed by the workgroup and adjusted to match the cost definitions outlined above. The major adjustments (in millions of €) are listed in table 1 below.

<table>
<thead>
<tr>
<th>Adjustment</th>
<th>Vendor</th>
<th>Reason for adjustment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cost of other projects</td>
<td>X</td>
<td>4,5</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td>4,5</td>
</tr>
<tr>
<td>Contingency of 10% added</td>
<td>X</td>
<td>9,2</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td>9,2</td>
</tr>
<tr>
<td>Work moved from customer to vendor</td>
<td>X</td>
<td>20,2</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>More resources for data conversion</td>
<td>X</td>
<td>2,8</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td>2,8</td>
</tr>
<tr>
<td>Functionality</td>
<td>X</td>
<td>4,0</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>Price reduction</td>
<td>X</td>
<td>-11,0</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>Organizational implementation</td>
<td>X</td>
<td>10,5</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td>7,9</td>
</tr>
<tr>
<td>Production loss</td>
<td>X</td>
<td>2,7</td>
</tr>
<tr>
<td></td>
<td>Y</td>
<td></td>
</tr>
</tbody>
</table>

Table 1: Cost adjustments for RFI calculation
Vendor X’s cost calculation (see table 2) including adjustments made by the workgroup results in a total cost of 87.8 million (M) €. If organizational implementation costs and production loss are included, a sum of 13.2 M€ (10.5 M€ + 2.7 M€) should be added, resulting in a total cost of 101.0 M€.

**Vendor X**

<table>
<thead>
<tr>
<th>RFI data + additions</th>
<th>Total cost (1.000 €)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wave A</td>
</tr>
<tr>
<td>Vendor costs</td>
<td>18.510</td>
</tr>
<tr>
<td>Other external costs</td>
<td>1.455</td>
</tr>
<tr>
<td>Internal project costs</td>
<td>12.523</td>
</tr>
<tr>
<td>Other projects</td>
<td>2.600</td>
</tr>
<tr>
<td>Contingency</td>
<td>5.500</td>
</tr>
<tr>
<td>Total</td>
<td>40.587</td>
</tr>
</tbody>
</table>

**Costs per wave**

46% 30% 23%

*Table 2: Cost summary for vendor X*

Vendor Y’s cost calculation (see table 3) including adjustments made by the workgroup results in a total cost of 91.0 M€. If organizational implementation costs and production loss are included, a sum of 10.6 M€ (7.9 M€ + 2.7 M€) should be added, resulting in a total cost of 101.6 M€.

**Vendor Y**

<table>
<thead>
<tr>
<th>RFI data + additions</th>
<th>Total cost (1.000 €)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Wave A</td>
</tr>
<tr>
<td>Vendor costs</td>
<td>26.687</td>
</tr>
<tr>
<td>Other external costs</td>
<td>6.093</td>
</tr>
<tr>
<td>Internal project costs</td>
<td>3.315</td>
</tr>
<tr>
<td>Other projects</td>
<td>2.600</td>
</tr>
<tr>
<td>Contingency</td>
<td>5.500</td>
</tr>
<tr>
<td>Total</td>
<td>44.195</td>
</tr>
</tbody>
</table>

**Costs per wave**

49% 27% 24%

*Table 3: Cost summary for vendor Y*

The average total cost (see table 4) based on the two vendors is 89.4 M€. If organizational implementation costs and production loss are included, a sum of 11.9 M€ (9.2 M€ + 2.7 M€) should be added, resulting in a total cost of 101.3 M€.
Average of X and Y

<table>
<thead>
<tr>
<th>Cost types</th>
<th>Wave A</th>
<th>Wave B</th>
<th>Wave C</th>
<th>All waves</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vendor costs</td>
<td>22.598</td>
<td>14.432</td>
<td>12.306</td>
<td>49.337</td>
</tr>
<tr>
<td>Other external costs</td>
<td>3.774</td>
<td>2.676</td>
<td>2.510</td>
<td>8.961</td>
</tr>
<tr>
<td>Internal project costs</td>
<td>7.919</td>
<td>4.950</td>
<td>4.506</td>
<td>17.375</td>
</tr>
<tr>
<td>Other projects</td>
<td>2.600</td>
<td>1.200</td>
<td>700</td>
<td>4.500</td>
</tr>
<tr>
<td>Contingency</td>
<td>5.500</td>
<td>2.500</td>
<td>1.200</td>
<td>9.200</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>42.391</strong></td>
<td><strong>25.759</strong></td>
<td><strong>21.223</strong></td>
<td><strong>89.373</strong></td>
</tr>
</tbody>
</table>

Costs per wave

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Wave A</td>
<td>47%</td>
<td></td>
</tr>
<tr>
<td>Wave B</td>
<td>29%</td>
<td></td>
</tr>
<tr>
<td>Wave C</td>
<td>24%</td>
<td></td>
</tr>
</tbody>
</table>

**Table 4: Average cost for vendors X and Y**

### 11.3 Experts’ assessment

After receiving the vendors’ replies to the RFI, the workgroup decided on a slightly different approach on which functionality should be made available in each wave. The general recommendation from the vendors in the RFI was to move certain groups of functionality from wave B and C into wave A. The workgroup followed this advice in the implementation strategy described above. This revised implementation strategy was handed over to a group of experts in large Healthcare IT-projects:

- Bjarne Kohl, consultant, former CIO at Rigshospitalet in Denmark
- Bjarni Júlíusson, consultant
- Hannes Þór Bjarnason, head of the Software unit in Landspitali
- Ingi Steinar Ingason specialist at Directorate of Health
- Per Loubjerg, former CIO of Hvidovre Hospital in Denmark

Ingi Steinar and Bjarne had previously studied the RFI cost estimates, but the other experts had only seen the RFI background paper and the text documents from the vendors (not including cost figures).

After individual preparation, the group used a one-day workshop to:

- Gain a common understanding of the project and its cost structure.
- Individually assess a more detailed breakdown of the costs.
- Align these individual estimates into a common estimation.

Following the workshop the result was documented and delivered to the experts in order to get comments, and the result adjusted accordingly. Finally, the result was distributed to the expert group to assure, that all agreed on the final result (see table 5).
The total cost (see table 6) based on the experts’ assessment was estimated to be 74,7 M€. If organizational implementation cost and production loss is added, the total cost of the EHR project was estimated to be 91,8 M€.

### 11.4 Reference EHR implementations

In addition to estimating the total cost from the RFI replies and the experts’ assessments, the workgroup collected several international reference cases on EHR implementation. That information was studied, formulated and adjusted in order to make it comparable to the Icelandic situations.

In some cases it was hard to get exact information about these implementations, especially on total cost, what was included in cost figures and what was missing. The same applies for the scope of these implementations and stakeholders involved. Adjusting figures to Icelandic reality was therefore a tricky task and results have to be viewed tentatively and seen as indicative rather than clear facts.
In order to adjust each case to Icelandic reality, the size of the environment is registered in comparison to Iceland. Population, number of employees, number of doctors and number of beds were used as indicators of the size (see table 7). Column “Cost A” shows the cost of each implementation scaled to the size of Iceland. It is assumed that there is a linear relationship between the size and the cost. Column “Cost B” is an adjustment for the scope and stakeholders involved (assuming the Icelandic EHR has complete functionality and all health care players included). The last column “ISK” is simply a conversion of Euros to Icelandic kronur (1€ = 159 ISK).

Table 7: International reference cases on EHR implementations

The average total cost of these EHR implementations adjusted to Icelandic situations is 86.7 M€. Calculating the median value which gives a more reliable estimate results in a total cost of 67.0 M€. Some of these reference cases were studied in more details (see Appendix D).

11.5 Change in net annual operational cost

The estimate for the change in the net annual operational costs is based on the only supplier that provided an estimate on this. Furthermore, the savings on no longer having to run the old systems was estimated by the workgroup (figures in 1000€).

Table 8: Change in net annual operational cost
The workgroup has excluded the personal costs because it is anticipated, that the employees in the IT-departments etc. who work with Saga and other EPR systems today, will instead work with the new system in the future. There may be some economies-of-scale because all users are using the new system; but on the other hand there will be increased functionality to support, so it is expected – all in all – that the effort will be on about the same level. Based on this it can be expected that annual operational cost will increase by 1,7 M€.

11.6 Summary of estimated total cost

The following table shows the expected total cost of implementing a comprehensive EHR on a national level in Iceland, using the three methods.

<table>
<thead>
<tr>
<th>No.</th>
<th>Method</th>
<th>Total cost [M€]</th>
<th>Total cost [billion ISK]</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>RFI replies from vendors</td>
<td>89,4</td>
<td>14,2</td>
</tr>
<tr>
<td>2</td>
<td>Experts’ assessments</td>
<td>74,7</td>
<td>11,8</td>
</tr>
<tr>
<td>3</td>
<td>EHR reference cases</td>
<td>67,0</td>
<td>10,6</td>
</tr>
<tr>
<td></td>
<td><strong>Average</strong></td>
<td><strong>77,0</strong></td>
<td><strong>12,2</strong></td>
</tr>
</tbody>
</table>

Table 9: Summary of estimated total cost

Assuming all methods have the same weight the average total cost is 77 M€. This assumes full functionality scope including all three waves (A, B and C) and all stakeholders (the four lanes). Roughly, it can be assumed that 55% of the cost is related to wave A where the rest splits equally between wave B and C. In addition to this implementation cost, an increase of yearly operational cost of 1,7 M€ can be assumed.

11.7 Financing considerations

The total project cost estimated in this report is substantially higher than previously expected and calls for considerations about how to finance the project. In one of the reference cases (Soarian from Siemens implemented at Dudley, UK) the full cost of the implementation, licenses etc. and the annual operational costs were all financed through an 18-year service contract.

When responding to the RFI, the vendors were all open to discuss alternative financing models. However, it was a general condition, that license and consulting costs should be paid up front or at the latest when the services were delivered.

If a long-term financing model is needed, some effort has to be put into preparing the demands, and to handle legal and financial issues related hereto, e.g. handling of interest, risk, and currency changes, to name a few.
12 Benefits and Return on Investment (ROI)

It is internationally recognized that implementation of an electronic health record (EHR) system can increase patient safety and improve the quality of health care\(^1\). However, it is expensive and time consuming to implement a comprehensive EHR system. Implementation is a complex resource-intensive process\(^2\), which requires financial, policy, and management commitment, skilled staff, time, adequate training, user support, and sufficient hardware.

The cost of implementation varies substantially, depending on what system is implemented and what systems are currently in place\(^3\). The main barrier to widespread adoption of EHR has been the high expenses of implementation and concerns about ongoing maintenance costs\(^2\). Furthermore, how to accurately measure the cost-benefits for EHR implementation is complicated, as the recognized benefits have mostly been intangible (quality) benefits rather than monetary gains. Hence, when the benefits and return of investment (ROI) for health IT is evaluated, intangible or value-based benefits need to be a part of the evaluation process. Intangible or value-based benefits include increased quality of patient care, which involves improved patient safety, generally due to reduced risk of adverse events. Preventable adverse events occur mainly when patient information is lacking at time of care.

In general EHR-projects result in substantial productivity improvements. According to an EU report from 2009, when Kronenberg in Sweden switched from a paper-based health record system to an integrated EHR system, it only took 4 years from the start of implementation (8 years from preparation) until the estimated annual benefits exceeded the estimated annual costs (see figure 9). The annual net benefit ratio to costs continued to rise steadily after implementation (p.56)\(^3\).

![Figure 9: Cost and benefits of EHR implementation at Kronenberg, Sweden\(^3\)](image)

DeKalb Medical Center in Georgia, U.S.A. reported a 66 percent reduction in medication administration errors, such as wrong person, wrong drug, and wrong route of medication administration, after implementation of an EHR system\(^2\). Likewise, after implementing an EHR at NorthShore University Health System in Chicago, delays in medication administration were reduced by 70 percent and omission errors decreased 22 percent. Transcription errors were eliminated. Furthermore, inpatient diagnostic and treatment phases were shortened leading to decrease in length of hospital stay. NorthShore estimated cost savings related to shorter length of hospital stay were around $1 million over a period of 6 months after fully implementing the EHR\(^4\).

Many of the successful EHR implementations involve healthcare institutions that are changing from paper–based health records to electronic health record environments. Iceland has already implemented electronic health records in all of primary health care, hospitals have partial implementation and some specialists and nursing homes have already made the exchange to partially electronic environment. However, many different systems are being used, and integration among the systems is lacking considerably. Moreover, only 2 hospitals have installed a medication administration system; none have a function of patient barcoding. Hence, it is clear that an implementation of a comprehensive EHR system at a national level in Iceland would improve resource utilization and eliminate waste, i.e. printing and paper cost, re-collection of data that are already somewhere else, staff productivity and patient outcomes. An integrated EHR system makes it possible to exchange data and information at the point of care. When health care professionals have better access to key patient information it may be possible to start the correct treatment earlier, thus perhaps saving on medication expenses, avoid the repeating of expensive tests, and patients can possibly be discharged earlier. Moreover, an integrated EHR system can perform electronic checking and alerts to aid in professional decision making. Information on current medications and known allergies plays a significant role in regards to patient safety. Improved quality of care and patient safety results in better patient care outcomes and increased patient satisfaction\(^3\). Moreover, surveillance should be easier with better access to reliable information for policy makers and administrators.

The workgroup has not made any attempt to estimate the monetary benefits of implementing the new national EHR system in Iceland, since this is a complex cost-benefit analysis, and was not one of the tasks given to the workgroup. However, some estimates were made based on the total health expenditures in Iceland for the year 2010 (880 M€) and expected total cost of the national implementation. Figure 10 illustrates the ratio of estimated costs and potential socio-economic benefits at different levels of productivity increase (1%, 2% and 3%). Socio-economic savings of 2% in the Icelandic health system, due to investing in a national EHR system, could possibly result in a payoff time of five years. It is not uncommon to achieve at least 5% increase in efficiency after implementation of a comprehensive EHR system.

\(^4\) European Commission, 2009. *The socio-economic impact of the EHR system at NorthShore University HealthSystem, Evanston, IL (Chicago), USA*
Figure 10: Estimated cost and potential benefits of a new national EHR in Iceland

Albeit the cost of investing in a national, comprehensive EHR system is high, the costs of not investing in one should be considered.

13 Risk Assessment

A project with the scope as big as an implementation of a comprehensive national EHR with conversion from an already well-established EHR system is certainly not without risks. A detailed risk assessment analysis can be found in Appendix E, but some highlights are:

- Clear vision of what goals should be reached needs to be established beforehand.
- Some EHR system are already in place in large parts of Icelandic health care so careful choice of system is imperative so functionality meets stakeholder’s needs. If the new system is not substantially „better“ than the system in place risk for rejection by health care workers is high.
- If funds and other resources do not meet all the requirements needed for a project this size, there is an increased risk for the project to run over time and therefore also over budget. In worst case scenario this could result in project failure. Furthermore, safety risks are increased the longer both system need to be run parallel. Hence, adequate funding for the project is paramount.
- Experience tells that changes of this magnitude are always met with resistance so high level of dedication and involvement from stakeholders is imperative and acceptance and involvement of healthcare workers (especially physicians).
- Ensure adequate local resources otherwise the risk for inadequate knowledge and experience will leave gaps in implementation.
- Careful time plan needs to be established. Too short time for implementation will drain too many resources while too long time will cause safety and financial issues.

Above mentioned are a few of the major factors that can affect successful implementation. All major vendors have experience in small and large scale implementation so use of their experience is a key factor for avoiding project failure.

14 Tender Approach

Due to the nature of the national EHR project, variable scope, functional and technical complexity and the association of comprehensiveness of the possible solutions with price, a standard tender process is not considered applicable. Instead the workgroup suggests a different type of tender approach, a so called competitive dialogue process for choosing the new EHR solution.

Needs for a comprehensive EHR

The needs of the Icelandic healthcare authorities for a new EHR have been demonstrated with different scopes to a possible solution (scope A, B and C). The dialogue is aimed to guide which of the scopes can be expected to act as a frame for the final solution. It is therefore assumed that in a certain phase of the dialogue, the contracting authorities will decide which of the scopes will be selected, based on solutions from the participants and the overall financial commitment from the Icelandic healthcare authorities.

Requirements for the needs

Requirements are defined as the detailed items that explain the necessary content and functionality of the proposed solution, limited by the above mentioned scopes. The requirements are addressed as common, independent of the chosen scope, but also as specific for the corresponding scope in mind. The proposed solutions from participants should compete based on how well they address the needs and the corresponding requirements. Due to the complexity of the project and how the proposed solutions will develop during the dialogue, it is assumed that the requirements can be altered during the dialogue to meet the needs and the expectations of the Icelandic healthcare authorities for the new EHR.

Duration of the project and phases of the Competitive dialogue process

It is expected that the whole competitive dialogue process can take about 12 months. Site visits to other countries to examine and analyse existing systems from the participants compared to proposed solutions are expected during the phases of the dialogue process. The phases are expected to be four, each phase lasting from 2 to 5 months in successive stages:

- Phase 1, Initial dialogue:
  - Participants propose solutions for the scopes mentioned, without price.
  - Contracting authorities comment on the solutions as to guide the participants.
  - Participants present altered solutions with budget price.

- Phase 2, Scope selected:
- **Solutions commented and requirements altered based on scope selected.**
- **Dialogue with participants on solutions and requirements.**

- **Phase 3, Final requirements for the corresponding scope:**
  - Participants give their detailed solutions for the corresponding scope based on the final requirements with competitive price. The participants present and explain the proposed solution and how it is thought to respond the needs and the requirements.
  - Contracting authorities comment on the solutions as guide for final solutions in this phase.
  - Final solution presented based on the above mentioned comments.
  - It is expected that the number of the participants will be less after this phase based on the final solutions.

- **Phase 4, Final phase:**
  - Participants modify their solutions based on the comments and final dialogue.
  - Participants present last solutions with competitive prices.
  - One solution selected for contract as the most economically advantageous one.

- **Post-dialogue discussion:**
  - Selected participant and contracting authorities to further clarify, specify, and fine tune the selected solution.
  - Commitment to contract based on the selected solution.

Trial phases for solutions or trials for certain sub-solutions can be expected during the phases to further clarify the proposed solutions and test the expected outcome.

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### 15 Other Recommendations

The last couple of months the members of the workgroup have learned a lot from their work preparing this report. We would like to share some recommendations that would be useful to decision makers and the project team if funding for a new national EHR will be approved.

- Although it was not a task for this workgroup to choose candidates for the new national EHR system we think it is wise to consider the following when choosing a system:
  - The system must have been used for some years after its initial development by regions similar to Iceland in size or larger to ensure a smooth operation.
  - The system must be used by several customers in at least 3 different countries to make sure that localization issues can be handled.
  - The system should be built on modern technology and continuous development towards new areas/technology should be evident in recent development history of the system.
  - The vendor developing the system must have a strong financial background to ensure the safety of the investment.

- Establishing strong project governance and choosing the best possible project team is crucial to the success of the project. Establishing a good structure for the project should be one of the first steps after deciding to launch it. Project leaders need to have respect and credibility among all participants in the project. Part of the project team should have the known responsibility of long term support after installation since it is very important
that the support staff has an in-depth understanding of the system and the implementation.

- The vendor needs to have some kind of representation in Iceland, both during the implementation phase and for long term support. This can be accomplished by the vendor either by a local office or a strong partnership with a local partner.
- A big issue when starting a project of this magnitude is management commitment and resource availability. One of the experience stories mentioned an interesting point to solve this issue. Instead of starting a technology project the idea was to define the project as a clinical project. Existing workflow processes were very inconsistent, so instead of implementing a system to support the old workflow all the clinical processes were redesigned and the system developed to support the new processes.

16 Proposed Next Steps

The calculated total cost of 77 M€ for implementing a comprehensive EHR system in Iceland is significantly higher than expected. The scope could be reduced and the number of stakeholders cut down, but still the cost is considerable. However, it should be noted that if the scope is too limited, many of the goals with a national EHR won’t be reached. The expected implementation time is 5-7 years for the complete scope and it is difficult to reduce that time.

It must be noted that the benefits by a national EHR both intangible and financial are substantial. There is also a general consensus on, that a new comprehensive EHR system is the future way to go, but the workgroup claims it must be based on a complete or close to the complete proposed scope.

By submitting this report before summer vacation, the summer can be used to digest the content and results of this work. Hopefully in early fall decisions both regarding a short term and a long term strategy regarding patients’ electronic health records on a national level can be agreed on. The following decisions need to be made as soon as possible:

1. When can preparation for a new EHR start?
2. What shall be done in the meantime, at least for the next 5-7 years?

It must be emphasized that a decision to invest in a new EHR is a commitment for the whole project. Hence, a long term financing must be agreed on before starting the project, even though funds needed in the first couple of years are only about 5% of the total cost.

The report by the Boston Consulting Group in October of 2011, clearly states the importance of, and need for an integrated EHR on a national level in Iceland. This is in line with most other opinions. Doing nothing towards that goal is therefore not an option.

In order to estimate the total cost and implementation time of a new EHR, numerous materials have been collected. Not only is it relevant for the cost estimation part, but it also contains important information on suggested implementation strategy and project execution. Some of this material is presented in this report and appendices. There is also a lot of other material stored in the central file system of the project, which will be made available for future use.
17 Appendices

A. RFI document sent to a group of vendors
B. Scope and prioritization of system components
C. Systems in use and integration needs
D. Detailed summary of other EHR installation
   Case A - The Spaarne Hospital, Netherlands
   Case B - Region Midt (Aarhus), Denmark
   Case C - Hospitals Dudly Group, United Kingdom
   Case D - Faroe Islands
   Case E - Region South, Denmark
E. Risk assessment