Estonian EHR Case Study

1. Executive Summary
The Estonian Electronic Health Record (EHR) is part of a broader initiative, which began in 2000, to improve and extend health services for patients and citizens, the Estonian National Health Information System (ENHIS). Within this initiative there is the EHR project, along with projects on Digital Registration, Digital Imaging and Digital Prescription. In order to effectively manage development of these eHealth projects of the ENHIS the Ministry of Social Affairs initiated the establishment of a separate administrative body, the Estonian eHealth Foundation (EeHF), in 2005.

An open procedure for procurement was employed by EeHF for the procurement of Health Information Exchange (HIE) infrastructure. Invitations were sent to suppliers who could comply with the EeHF’s standards for hardware and software. Compliance with the standards set by the EeFH is the main specification for the procurement of EHR.

From 2008 to 2010, the EeHF, delivered the basic infrastructure. From 2011, infrastructure services have been purchased from a private service provider.

The EHR is part of the Health Information Exchange (HIE) platform. Its main goal is to enable the exchange of information between doctors by connecting IT systems for health services. The EHR gives doctors the possibility to see a defined selection of a patient’s health information and provides time critical information to ambulance services.

The HIE platform utilises already existing state infrastructure such as electronic ID cards and X-Road security and communications. The Health Information Act 2008 specified the content of information stored centrally. Electronic documents use the standard HL7 CDA to format documents that are stored in a central database and archived electronically. Legal regulations specify the security requirement for the EHR and its access. All healthcare providers must send agreed data to the EHR.

Lessons learnt and recommendations include the need for leadership, technical expertise, strong resource planning and awareness-raising particularly on the need for a transition phase. Constant adjustment and improvement is required in order to maintain an effective system. The procurement of an EHR is not an event, it is a continuing process. At its core is healthcare’s improved management of the supply side of eHealth.
2. Context

2.1 Health system

About 1.3 million people live in Estonia. Approximately 17% of the population are aged 0 to 14 years, and 16% are 65 and older. The age dependency ratio is 48%. Life expectancy at birth is about 71. Cardiovascular diseases are the main cause of death. Infant mortality is steadily declining\(^1\).

There have been two significant health system changes since Estonia gained independence in 1991. The first was shifting to a decentralised model from a centralised state-controlled system. The second was replacing the state healthcare budget and financing model with social insurance contributions. Family practitioners are the core of the health service. The whole system is under the umbrella of the Ministry of Social Affairs, set up in 1993 from the merger of the ministries of health, social welfare and labour. Eesti E-tervis Sihtasutus, the Estonian e-Health Foundation (EeHF), was created in 2005. It leads the countries eHealth initiatives, a role transferred from the Ministry of Social Affairs.

Taken together, Estonia’s healthcare system has transformed over the last twenty years, and it is set to continue with the introduction and continuing development of the Health Information Exchange (HIE) platform. This seems consistent with Estonia’s technology prevalence. More than 70% of the population use the Internet.

2.2 Strategic setting

The EHR is the central project of a broader initiative to improve and extend health services for patients and citizens, the Estonian National Health Information System (ENHIS), that enable health information exchange. The Prescription Centre, including ePrescription, is the other large part of the ENHIS. These two initiatives combine with other components to empower patients through four channels:

Various international strategic documents, such as the eHealth Action Plan (European Commission, 2004) and i2010 (European Commission, 2005) and the “Estonian Information Society Strategy 2013”\(^2\), emphasise the need to accelerate ICT uptake in the health sector. These also emphasise the need for evidence and well-monitored evaluation of the governance of public investments and overall policy implementation. ICT developments have a potentially very strong and long-lasting impact, which also raises the relative risk level.\(^3\)

The Ministry of Social Affairs as the main policy developer and the Estonian Health Insurance Fund as the main funding agency in healthcare participated in the role of project partners and advisory board members to improve the alignment, scope and priorities of the project with national health policy.\(^4\)

The Ministry of Social Affairs initiated the projects, partially financed by the EU Structural Funds, and played the coordinating and directing role in the implementation process.\(^5\) In 2008, EeHF took over the process, which consists of:

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\(^4\) Ibid. p.7

\(^5\) Ibid. p.10
As this process evolved, the project transformed into the Estonian HIE platform.

The EHR project was central to the development of the eHealth projects. This is because it offers core services to other eHealth projects which make it possible to create nation-wide interoperable eHealth systems (first level components of EHR). The main goal: to exchange information between doctors.

3. eHealth investment brief

The eHealth projects, with the EHR project as the central project, started in 2005, when EeHF was established, and ended in 2008. To see the comparable schedules of these projects see the figure below.
The main purpose of the eHealth projects is to create a nation-wide integral network of interoperable eHealth services which make it possible to change all types of health data between doctors.⁷

The four projects and their initial EU Structural Fund allocations were:

Figure 4: EU Structural Fund allocation for the four Estonian eHealth Projects of ENHIS

<table>
<thead>
<tr>
<th>EHealth Project</th>
<th>€m</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electronic health record</td>
<td>1.6</td>
</tr>
<tr>
<td>Digital registration</td>
<td>0.2</td>
</tr>
<tr>
<td>Digital imaging</td>
<td>0.2</td>
</tr>
<tr>
<td>Digital prescription</td>
<td>0.24</td>
</tr>
<tr>
<td>Total</td>
<td>2.24</td>
</tr>
</tbody>
</table>

⁷ Ibid.
This represents spending of about €1.80 per head. The Estonian health system increased this to about €7 per head from its own resources, less than half of 1% of Estonia’s estimated 2011 gross domestic product of about $19,000 (CIA).

The main features of the EHR are:

- The central database of EHR includes two types of data:
  - Patient’s primary information (for example the contact information, insurance information, allergies, important drug information etc)
  - Link directory that points to other sources which include some medical data about the patient (for example IT systems of hospitals and GPs)

- EHR connects current IT systems of hospitals, GP’s and other Health Service providers through interfaces, so there is no need to replace these IT systems.

- EHR gives to the doctors possibility to see patient’s entire health information when they need it.

- EHR provides time critical information to ambulances staff (for example if patient has any allergies or if there are any drugs that are dangerous to the patient).

- EHR also acts as patient’s inoculation journal.

- GP can send patient’s medical information through EHR system to the specialist who treats the patient. The patient doesn’t have to carry any papers himself. GP can also choose the most appropriate specialist for the patient through EHR.

- EHR gives doctors possibility to receive consultation from colleagues as they can exchange patient’s medical information through EHR system.

- Patient can receive medical certificates through EHR without having to deal with any papers. These certificates can also be sent to employers or state authorities through EHR system in electronic form.\(^8\)

\(^8\) Ibid.
The main points in time in the development of eHealth in Estonia are represented in the timeline below.

Figure 5: Timeline of Estonian eHealth projects
4. eHealth investment description

The decision to implement occurred approximately eight years ago. The project started in 2000. Procurement then began in 2005 with the allocation of the EU Structural Fund budget. The EHR launch was on 12 December 2008, as part of the HIE platform project. Built on a comprehensive state-developed ICT infrastructure, the EHR registers residents’ medical history from birth to death. The “architectural big picture” diagram below shows the place of the EHR in the whole HIE context. The technology that the EHR utilises is the same as the state infrastructure solutions for ID cards as well as the X-Road communications and security facility that most Estonians already use extensively. EHR fused successfully with other public IT services offered to Estonian citizens, and so is convenient for all types of users. Citizens and healthcare professionals can use EHR to enter or view a patient’s health-related data to make enquiries and book appointments.

Utilisation began in March 2009, and has steadily increased.

Figure 6: Utilisation of EHR medical document retrieval by health care professionals

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4.1 Strategic planning

In order to effectively manage development of the four eHealth projects of the ENHIS the Ministry of Social Affairs initiated the establishment of a separate administrative body, the Estonian eHealth Foundation. This was founded in 2005 by the three largest hospitals in Estonia, the Ministry of Social Affairs, the Estonian Society of Family Doctors, the Estonian Hospital Union and the Association of Ambulance Doctors. In short, it unified various stakeholders in Estonian healthcare to ensure compliance and cooperation in developing the four projects.\(^\text{12}\)

The main virtue of EHR is its enabling role in securing the changes in the healthcare system through standardised and seamless information exchange between all users and providers of medically relevant information.\(^\text{13}\) It integrates into the HIE platform, so it has an expanded role in helping to change the power relationship between patients, doctors and health insurance organisations and enable higher quality and more efficient health services.\(^\text{14}\)

Patient access to their medical records offers an opportunity to improve patients’ choices and help them to change their behaviour towards better health. The iPatient application enables:

- Better, quicker and secured access to the EHR for medical history, images, results of exams and analyses
- Up-to-date information over 24 hours from any location
- Greater patient choice and involvement in their care
- Patients to share the information in the EHR with other clinical specialists;
- Access to all medical data, including medical image reports.

This wider context for the EHR has a resource plan of continuous development.

4.2 Design stage

The leading principle in designing the EHR has been to make as much use as possible of Estonia’s existing and functioning infrastructure and solutions. Examples are X-Road as an existing public sector facility,\(^\text{15}\) the Estonian ID card and the ICT systems of healthcare providers.\(^\text{16}\)

\(^{13}\) Ibid. p.6
\(^{14}\) Ibid. p.6
\(^{15}\) See: Estonian Information System’s Authority \text{http://www.ria.ee/index.php?lang=en}
The Estonian National Health Information System (ENHIS) includes the EHR, documents archive, demographic and booking services. It links to the Prescription Centre, and the surveillance, statistics, decision support and ambulance modules.

Citizens in Estonia have had online access to their medical data in the EHR since the beginning of 2009. The EHR serves healthcare professionals and citizens simultaneously. The Patient Portal is their means of access, and allows citizens to view their medical data and related information.

The EHR is a single nationwide global EHR system for the whole country, registers virtually all residents’ medical history from birth to death, based on the comprehensive State-developed basic ICT infrastructure. The launch of the Estonian nationwide EHR was at the end of December 2008. Since the 1st of January 2009, all healthcare providers have been obliged to send an agreed number of standardised medical documents to the EHR.

All of the main stakeholders in EHR participated in the development of the framework and indicators and in gathering evidence and validating the results. The core team included representatives from hospitals and specialist primary care physicians in addition to researchers and policy analysts.\(^\text{18}\)

### 4.2.1 Clinical procedures

The content of medical and health related information in the central database consists of the following services:

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\(^{17}\) NOVAK A. 2012. Presentation of Estonian Health Information System overview 18.01.2012.

Medical files
Time critical data (allergy, chronic diseases)
GP and hospital visits
Summary of ambulatory and stationary cases
Link to medical images
Prescribed and dispensed medication
Expressions of will/preferences
Closing medical records (opt out)
Names of trusties
Donation of organs
Overview of logs

The person compiling the medical document has to be identifiable: documents containing medical information or a physician’s decision must have the physician’s digital signature, or it must be date-stamped by the healthcare service provider’s information system.

4.2.2 Organisational changes
In 2005 EeHF gradually began taking on the responsibility for activities from other ICT partners. The process of shifting roles among participants needed prior planning so a utilisation plan was developed. Due to the complexity of the system, as well as the numerous associations between projects and sub-systems, the utilisation plan assumed that time was required to adapt to the project. The decision was then made that rather than excluding new people and not assigning responsibilities during critical sections, new participants joined from the start to work in teams with consultants already familiar with a specific area.

A clear division of roles and responsibilities was also critical as most standardisation and development work takes place in close cooperation with a variety of parties. Therefore, one person was appointed responsibility for each task and sub-process, and a key role in performing activities and monitoring the subsequent work progress.”^{19}

Successful comprehensive changes need the engagement and understanding of stakeholders and effective leadership and management for a shift in common practices to take place. In healthcare in particular, the care process connects closely to human interaction. Therefore, leadership and management of integrating ICT into the healthcare sector is needed for any eHealth project to succeed. This was, to some extent, the role of EeHF as the leader of the four eHealth projects.

^{19}Ibid. p.16
However, responsibility also rested with healthcare professionals and managers to provide leadership and successful system adaptation.  

### 4.2.3 Legal changes

The Health Services Organisation Act and Associated Acts Amendment Act of 20 December 2007 established an obligation for healthcare providers to forward their patients' medical data to the EHR system as from 1 September 2008.

### 4.2.4 Economic and financial aspects

Investment in the EHR is about €7 per person, less than 0.1% of GDP per head. About 25% of the finance was from the EU Structural Fund. The hospital services financed the remaining 75% as their contribution to the EeHF and their eHealth strategies and plans.

### 4.2.5 Technical aspects

To secure the access to the EHR, the Estonian countrywide data exchange platform X-Road is used. X-Road adopts a principle of using one integral set of user interfaces for organising communication with databases. The system ensures sufficient security for the treatment of inquiries made to databases and responses received. It is suitable for managing a dialogue between the consumer (citizen, civil servant and entrepreneur) and numerous databases as well as for realising co-operation between application programs and databases. The technical solution of the X-Road does not lie in the transition of all databases to some larger data management system but in the creation of unified user interfaces for different databases. Citizens and institutions can join and use the X-Road free of charge. Identifying each person as a user relies on the compulsory ID-card issued by the State. ID-cards are used both for identification of the user and for digital signing of documents, e.g. discharge letters, radiology reports.

The EHR is a nationwide framework with a standardised central information exchange function. However, EHR does not replace the in-house information system of healthcare providers, which supports their health service process. Healthcare provider organisations retain responsibility for creating their own information systems. In order to interface with the central system and send data to and obtain information from other healthcare institutions, each local information system must be updated and modified to enable data exchange according to the technical specifications set by the system’s administrator.”  

As the services have been developed in association with a broad range of stakeholders, EHR was structured in accordance with the best practice of service orientation. Interaction with end users works through alternative channels that connect the various information systems to the central EHR messaging services. Healthcare institutions, specialist healthcare registries and others have made use of the possibility to connect to EHR for message exchange.

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20 Ibid. p.26  
22 Ibid. p.12
The role of the EHR project has increased considerably at the national level in Estonia, as the volume of digitised medical documents added to the central database increase during the course of the project. However, this has led to very high standardisation requirements for medical documents, the business processes of and adaptation of information systems by interfacing organisations and the development of the EHR central system.23

The security arrangements built around X-road adopt five principles:

1. Secure authentication of all users
2. Maximum accountability and transparency, with all actions leaving an unchangeable and unremovable secure trail
3. Separating personal data from medical data, the so-called coding of personal data
4. Encrypted database that minimises the confidentiality risk from the technical administrators
5. Effective monitoring tool for all actions and the corresponding counter-measures both organisational and technical.

The main authentication methods are:

1. Knowledge-based authentication, where the server identifies the clients by their user names and passwords
2. Device-based authentication, where the server identifies the client using a specified object, such as a chipcard, magnetic card or key
3. Biometrical authentication, where the server identifies clients by the voice, face, fingerprint, or retina.

Knowledge-based authentication is not sufficiently secure for security-critical Internet services, so all three are used. Estonia’s ID card is an effective security device. Its primary task was the digital signature but the same mathematical method and device can be successfully used for each kind of secure authentication, including authentication through client-server based Internet.

1) Technology

The HIE platform is a combination of activities and technologies. The solution comprises:

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23 Ibid. p.15
Figure 8: Description of HIE solution

Technical solution

- HIS, GPIS
- Oracle Portal
- MISP
- xRoad Gateway
- Tomcat, Sybase IQ, Webfocus
- webMethods Integration Server
- webMethods Broker
- Oracle DBMS, Advanced Security, Database Vault
- Nagios, Cacti

HIS is the Health Information System

MISP is Mobile Internet Service Provider

GPIS is Graphics Peripheral Interface Standard

Figure 9: Description of HIE platform document processing

Document processing

- Timecritical report agent
  Allergy: pollen

- Health record agent
  Event: Medication, Diagnosis, Procedure

- Infection decease agent
  Diagnosis: chickenpox

- Demographics agent
  Address: Männi 1-2, Tallinn

Lab notice
Swineflu notice
Infection notice
Discharge letter
Demographics
D1000110
Männi 1-2, Tallinn
Männi 1-2, Tallinn
Männi 1-2, Tallinn
Diagnosis
chickenpox
Allergy
pollen

Health record
Demographics
Timecritical reports
4.3 Procurement phase

Compliance with the standards set by the EeFH is the main specification for the procurement. These included:

- Integration through the central system (Opt-out)
- Health Level Seven International (HL7) v3 (extended)
- Documents are kept in Extensible Markup Language (XML) format HL7 Clinical Document Architecture (CDA)
- All structured data fields have Object Identifiers (OID)
- Only final versions of clinical documents are sent into central system
- Using existing national ICT infrastructure, including
  - ID card for authentication and digital signature
  - X-road for secure communication.

Four modules procured as part of the HIE platform were the EHR, digital prescription, digital images and digital registration.

The EHR has six main features around the EHR core. The DHR holds patient information. The EHR then links to the epicrisis database, time-critical medical information and information for medical statistics. Two other components, the register of vaccinations and the examination databases transfer information to the EHR.

The digital prescription module has a prescription database at its core. It replaces paper documents and includes prescription and purchasing information and automated discount calculations. It is interoperable with the EHR and links to the pharmacy information system, which transfers purchasing information to the prescription database. The doctors’ information system also links to the prescription database and to the health insurance fund information system, where the discounting function operates.

The digital images module provides access to medical images for all healthcare providers. The medical imaging information system is interoperable with the EHR to provide access to results. It also links to the imaging archive of medical images that in turn links to the EHR.

The digital registration module included a unified patient registration system and information about patients’ waiting times. Patients use the patient portal to register and access registration and waiting list information. The portal links to the registers of healthcare providers and doctors and specialists to provide this information to patients.

The approach to procurement for the HIE, including the EHR was conducted by EeHF. Invitations were sent to suppliers who could comply with the EeHF’s standards for hardware and software. The process complied with government rules.

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4.3.1 Legal Aspects

**EU Directives**

Estonia adopted the following EC directives on procurement into its legal system in September 2006.

**Figure 10: Adoption of EC Directives by Estonia**

<table>
<thead>
<tr>
<th>Title</th>
<th>Effect Date</th>
<th>OJEC Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Utilities Remedies Directive 92/13/EEC</td>
<td>25th February</td>
<td>OJ:L76 23.3.92</td>
</tr>
</tbody>
</table>

The general principles are to ensure fair competition, efficient employment of pecuniary means and open and transparent proceedings.

Estonia’s main legislation regulating public procurement is the Public Procurement Act 2001. There have been several amendments, particularly harmonising with the EC Directives before the accession to European Union in 2004. Government regulations set out detailed requirements for the public procurement of works. They also specify the requirements of the official list of recognised contractors of works, complying with Article 29 of the Directive 93/37/EEC.

**National organisation**

In June 2003, the Minister of Finance established a working party to prepare a new Public Procurement Act. The aim was to improve the current public procurement legislation and to transpose the principles of EC Directives. The new Public Procurement Act of Estonia came into force in May 2007, thus transposing the EU Directives on public procurement (2004/17/EC and 2004/18/EC). It includes legal provisions enabling the further development of eProcurement.
(eAuctions, dynamic purchasing system, eCatalogues etc.) so as to give better opportunities for taking forward a fully electronic Procurement tendering process.²⁶

The Ministry of Finance has been responsible for public procurement policy and drafting laws for public procurement since 2002. It co-operates with the Public Procurement Office, other Ministries and State Authorities, contracting authorities and the third sector of associations of entrepreneurs, Chambers of Commerce and Industry and other bodies by drafting public procurement law and designing public procurement policy. The Ministry also provides systematic training for public procurement and training materials, detailed guidelines and manuals for the contracting authorities.

The Public Procurement Office maintains the State Register of Public Procurements in an electronic form. The Register publishes all public procurement notices with a contract value equal to, or exceeding, the relevant EC thresholds. If the estimated value of the contract is equal to, or exceeds, the international threshold value specified in the EC Directives, the notices are sent to the EC Office for Official Publications before publication in the State Register of Public Procurements.

**Open public procurement procedure**

For an open procedure, all interested contractors may submit tenders. It is the principal procedure for public procurement. The contracting authorities are obliged to use this procedure unless the Act expressly provides that they may use other procedures granting less transparency and openness than the open procedure. Provisions for these procedures align with the EC Directives. It is the model used for the EHR procurement.

**Estonian Health Information System**

In 2005, when the ENHIS started, the legislation was appropriate for paper records. An example is the requirement for replying to referral letters. The reply had be on the back of the referral letter, and returned to the referrer. The standards and ICT adopted for the EHR were not compatible with this legislation, so a new legal framework was designed to match the proposed interoperable eHealth environment.

The Health Information Act 2008 specified the content of information stored centrally. Electronic documents use the standard HL7 CDA to format documents that are stored in a central database and archived electronically.

Legal regulations specify the security requirement for the EHR and its access. As mentioned above, all healthcare providers must send agreed data to EHR. All access rights and data use are regulated by the law. Compulsory ID-card is the means of authentication and the digital signature for both doctors and citizens. Only licensed medical professionals have doctors’ access.

Citizens can access their own data through the Patient’s Portal, where they can also declare their intentions and preferences. The patient has a right to set access restrictions to documents, cases of illness, and to all his/her information in the EHR. The access ban can be set to one specific document or applied to the complete data in the EHR.

As EHR forms part of the state information system, the content of the centrally stored information was decided upon and fixed in statutory law (for further information, see The Health Services Organisation Act and Associated Acts Amendment Act, clause 59, section 27).\(^{28}\)

A critical aspect of establishing such a system has always been a clear definition of rights and obligations. Therefore, an important date on the EHR timeline was 20 December 2007, when the Estonian Parliament (the Riigikogu) ratified the Health Services Organisation Act and Associated Acts Amendment Act, thus creating a solid legal basis for the successful implementation of EHR.\(^ {29} \)

### 4.4 Implementation and use

The Electronic Health Record (EHR) project is the central project and there are other side-projects. All projects are developed using a step-by-step approach by dividing them into smaller components in order to manage risks that arise from developing large nation-wide projects.\(^{30} \) For an overview of the different project components see below:

Figure 11: Components of EHR Project and its Side-Projects\(^ {31} \)

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27 Available online at: [https://www.riigiteataja.ee/ert/act.jsp?id=12909773](https://www.riigiteataja.ee/ert/act.jsp?id=12909773)


29 Ibid. p.9


31 Ibid.
As can be seen from the figure above the development of eHealth services is divided into three levels. Higher levels use services from lower levels. Therefore the lower levels must be already implemented before higher levels can be developed.

The first level provides core services for all higher levels: for the EHR project and also for the side-projects. This approach makes all current and future eHealth services interoperable and cheaper to develop.

The second level consists of the most important feature of EHR – the services around epicrisis and patient’s primary information. In addition there are a number of side-projects:

- Blood Information System
- Electronic Prescription
- Digital Images
- Electronic Registration
- Computerised Communicable Disease Surveillance System

The third Level includes eHealth services which use data and services from first and second level, but also services that are not developed under EHR or its side projects – namely other medical registries.

The Main benefits of such structure are:

- All eHealth services are interoperable as they use same standards
- It is cheaper to develop new services in future because the necessary core services are already in place
- Dividing projects into smaller components decreases risks

By April 2011, the EHR contained medical data of 583,114 citizens, about 44% of the population. Of the 670,666 queries, 27,623 were by different citizens, an average of more than 24 each, since the launch of the patient portal at the beginning of 2009. The most used service based on the EHR is electronic prescription. By the end of 2010, approximately 75% of prescriptions were in an electronic form. ePrescription allows citizens to buy medications in any pharmacy in Estonia based on electronic identification. Physicians write electronic prescriptions, which upload automatically to the Prescription Centre. Pharmacists in any location in Estonia can download the prescription, see the dispensing status, make a note about the dispensing of the medications, and see other prescribed medications.

After implementation, new challenges emerged. Resources planned for EHR were only for central development. Subsequent local initiatives needed additional resources. Performance monitoring helped to define and identify hotspots and establish the root cause and specify the corrective action needed. Some data quality rules needed checking and redefining. A review of the balance between

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32 Ibid.
security and usability identified the need for improvement. In particular, family doctors found the need to use their PIN codes for every document time consuming and disruptive. Changes in response to these challenges were after the December 2008 live date.\(^3\)

In spite of a more than ten years history of digital collection of medical data by doctors, the medical data collected prior to 1st of January 2009 were not transferred to the EHR due to their poor quality and insufficient standardisation.

### 4.5 Monitoring and evaluation

The DIGIMPACT project developed adequate methodology to evaluate the impact of the implementation of a nationwide EHR Record. The PENG method analysis assembles the potential costs and benefits over time of an ICT project (Dahlgren et al., 2003). The EeHF selected this to complete a socio-economic evaluation of the EHR. It includes a facility to compile numerical and non-numerical data. It is consistent with the eHealth Impact methodology used for the EC’s DG INFSO’s eHealth Impact, and its Interoperable EHR and ePrescribing projects.\(^3\) The framework should enable an improved decision-making process, and increase information, motivation and trust among all health system stakeholders in using ICT solutions.\(^3\)

Buccoliero et al. (2008) conclude that e-health projects are particularly heterogeneous by nature, making them increasingly difficult to evaluate. They highlight three important aspects of eHealth project evaluation. First, that evaluation must be able to model the complex processes that are involved in the field. Second, evaluators must be able to assume multiple viewpoints in mapping costs and benefits depending on the stakeholders involved. Third, evaluators should be flexible and adapt to new situations. Evaluators must understand and interpret complex socio-technical situations.

The patient cohort for the evaluation was Type II diabetes patients. The prevalence of these are about 8% of the population\(^3\). Diabetes Type II patients are not representative of patients with other conditions. The Digimpact report says that the validation of the assumption about their use is a future project\(^3\). This cohort comprised the PENG model’s disease in calculating the benefits for patients, healthcare providers, citizens and society as a whole.\(^3\)

The evaluation also included second order economic benefits of increased GDP, increased taxes and reduced benefits. There are limited, unclear cause and effect links between EHRs and economic performance, with many other variables operating. ehealth evaluations usually excluded them.

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\(^3\) NOVAK A. 2012. Presentation of Estonian Health Information System overview 18.01.2012.

\(^3\) See www.ehealth-impact.org and www.ehr-impact.eu


\(^3\) Ibid. p. 5
Adjustments to the findings for sensitivity, optimism bias and risk do not seem to be included in the methodology. Some intangible negative impacts are considered more as threats and risks to a project’s success than specific expense items, and are neither quantified nor included in socio-economic analysis.\(^{39}\)

The calculations only represent the first validation exercise of this methodology and as such are based on expert opinions rather than direct empirical measurement of the EHR’s implementation.\(^{40}\) The annual socio-economic return after about ten years exceeds 2,000%. This more than twice the rate that other equivalent studies have found, and more than four times the average for the Interoperable EHR and ePrescribing Study.\(^{41}\)

5. Procurement process

Two principles adopted are to integrate the market position of the healthcare system by concentrating the procurement role in the EeHF and an open procurement process to seek the widest array of suppliers with the expertise needed for the EHR specification and context. This enhances EeHF’s role in the market.

Bids are eligible for the supply of whole products or shared products. The aim of the principal procurement is to find a supplier or group of suppliers. Subsequent procurements enable the EeHF to find alternative suppliers. The whole process is consistent with the Government’s procurement procedures, rules, and processes.

Procurement complied with the Government’s procedure model, rules and process. It began in the summer of 2005\(^^{42}\) and ended with the HIE platform going live in December 2008, a period of about three and a half years. It requires compliance with requirements for confidentiality, intellectual property rights, warranty, work stages, payment stages, testing and sign-off.

The EeHF constructed an open approach to procurement for the HIE, including the EHR. Invitations were sent to suppliers who could comply with the EeHF’s standards for hardware and software.

Currently, the division of roles is similar to the initial phase in 2005. The Ministry of Social Affairs is responsible for the administration of the four projects as a whole, while the Estonian eHealth Foundation manages the operating system. To elaborate, the Estonian eHealth Foundation (EeHF) is responsible for the standardisation and development of digital medical documents, maintenance of EHR, international and scientific cooperation with universities and development of new services for citizens and doctors.\(^{43}\)

From 2008 to 2010, the EeHF, delivered the basic infrastructure. The expertise of internal technical staff has allowed for the development of internal solutions and appropriate selection of external

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\(^{39}\) See: ibid. p.39  
\(^{40}\) See: ibid. p.44  
\(^{41}\) See [www.ehealth-impact.org](http://www.ehealth-impact.org) and [www.ehr-impact.eu](http://www.ehr-impact.eu)  
\(^{42}\) LEEGO E. 2005. Presentation on the Estonian National Digital Health Record  
software solutions to supplement the basic infrastructure where necessary. From 2011, infrastructure services have been purchased from a private service provider.\textsuperscript{44}

The procurement and contractual arrangements include confidentiality, security, intellectual property rights, warranties, work stages, payment stages, testing and formal sign-off by the EeHF team. Provisions for renewal and development operate after this stage.

\section*{6. Outcomes and lessons}

The HIE platform procurement adopted a plan that compiled standards, modified legislation, procured the EHR as an integrated part of the HIE platform, planned and secured continuing procurement for associated developing technologies and allowed appropriate time. The EeHF is a legal entity established to manage this process. Standards are at the core of the process, and the EeHF procurement strategy applies these effectively to aggregate the market and purchasing of the healthcare system and use this with its standards to enhance its influence in the eHealth market.

The creation of the EeHF in order to co-ordinate and manage the Estonia Health Information system has proven highly successful. A co-ordinating body with this singular purpose allows for an accurate overview of project progress to be maintained. The EeHF is also staffed with experienced experts so as to ensure best results without third party referral.

The initial financing from the EU Structural Fund was a small proportion of the EHR cost. It is essential that the procurement authorities ensure that finance for the full affordability is in place early in a project’s life to avoid financial crises and potentially disrupted procurement.

Through EHR, it is now possible to share information that was previously only available in local databases and information systems unable to communicate with one another. However, only through capturing the full potential of EHR is it possible to decrease the level of bureaucracy, increase the quality and efficiency of healthcare and create a truly patient-centric healthcare system.\textsuperscript{45}

Procuring and implementing an EHR is not the end of the process. EeHF has overseen and developed the continuous adoption and use of additional technologies. High, sustainable levels of the technical knowledge and skills of EeHF staff have set the criteria for software solutions. After the principal EHR procurement, other suppliers have provided add-ons, avoiding both potential lock-ins creating legacy systems.

In the initial months after implementation, the utilisation, and so benefits of an EHR are relatively limited. This will change when access volumes begin to increase. For an agency model like EeHF, and where archived information is not included in an EHR, it is helpful to prepare healthcare provider organisations for this transitional phase and ensure they understand the prevalence of this build up phase immediately after implementation.

\textsuperscript{44} Ibid. p.10
\textsuperscript{45} Ibid. p.9
A crucial element of the EHR’s success was informing and educating people on the forthcoming changes in the provision of healthcare provision to raise public awareness. This was instrumental in increasing peoples’ confidence and trust in the project. 46

The EeHF works in a highly complex environment of service consumers, service providers, resources and stakeholders. A common vocabulary and structure maintains and controls this complexity. 47

7. Generalisation of lessons

Combine standards, healthcare’s combined market and purchasing power and open procurement to exert influence in the eHealth market. This enables the procurer to manage the supply side of eHealth and secure what is required.

Compile standards then modify legislation to support new eHealth concepts and opportunities so as to ensure the smooth progress of procurement projects.

Plan and secure continuing procurement for associated developing technologies.

Allow appropriate time for procurement, utilisation, benefits realisation and the whole project, over optimism will only cause stakeholders and the public to lose confidence in the project.

Raise awareness of changes to healthcare provision through communication and education so as to ensure stakeholder and user acceptance and project success.

Strong leadership of initiatives through organisation restructuring for this specific purpose ensures that the project will remain on track and reach its objectives.

Knowledgeable and experienced technical staff and healthcare leaders to smoothly transition new solutions to situ and aid project acceptance.

46 Ibid. p.14
47 Ibid. p.17
8. References


