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Towards a National Health Information System Evaluation

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Abstract

Most EU Member States have a documented policy on eHealth. Documented follow-up and evaluation strategies for assessing whether national level systems have reached their set aims and outcomes are, however, rare. Methodologies for large scale information system assessment and evaluation are poorly established. This article describes the approach used to generate the Finnish National Health Information System (NHIS) evaluation plan. The core elements of the plan are illustrated, discussing also challenges and solutions in implementation. The article is based on NHIS evaluation planning project [15] and its presentation in the MIE workshop in Sarajevo in 2009 [16], where core issues and challenges of large-scale evaluations were discussed using the Finnish NHIS evaluation plan as a frame of reference.The Finnish plan offers other countries tools with which to assess their own plans and generate national methodologies for NHIS evaluation.

Keywords:

Medical informatics, eHealth policy, Program evaluation, Evaluation methodology

Introduction

By the end of 2006, 25 out of 27 EU member states and the four other countries active in the i2010 initiative of the EC, were identified as having a documented government level policy on eHealth [1]. In Finland, a decade of implementation activities of the eHealth strategy culminated in the publication of the Finnish eHealth Roadmap in 2007 [3]. Permanent legislations introduced in 2007 on electronic processing of health and social care client data and on ePrescribing, were a major step in the implementation of the Roadmap.

The most common aims for EU eHealth policies are reforming the health care system, improving its performance for more efficiency and quality of care, promoting quality of life and citizen centeredness in care, better data for management of the system and better communication among stakeholders. [1].

In contrast to the vigorous development of national health-IT programs, surprisingly few national level plans and actions were found in a rapid literature review that documented the steps taken for follow up and evaluation of these programs. [2]. Among EU Member States, only the UK was found to have launched national level evaluation [2].

In Finland, the legislation of 2007 stipulated that a National electronic Health Information System (KanTa) [20] is to be built in Finland. The Social Affairs and Health Committee of the Parliament required an action to *monitor and assess the implementation of national eHealth services with a view to providing timely support to the different actors involved.* The project described in this paper is premised on the given requirement. An evaluation planning project (KaTRI) was launched in November 2008 as a joint venture between the Ministry of Social Affairs and Health (MoH) and the National Institute for Health and Welfare (THL). The KaTRI-project set out to draft a plan on how to monitor and assess the implementation of the NHIS (KanTa) taking into account the Committee's requirement. Rather than producing a detailed evaluation plan, the idea was to lay the groundwork for research collaboration to generate knowledge that is mutually beneficial to the government and all parties and that could support success of the construction work of the NHIS.

Evaluation Materials and Methods

In order to define the objects, objectives, questions and methodologies for the NHIS evaluation, three preparatory strands of work were undertaken by the core KaTRI-project team consisting of the authors:

1. A selective literature review of international experiences on evaluation of large scale systems
2. Content analysis of documents describing the NHIS to be implemented in Finland.
3. Content analysis of the bills of ePrescription and eArchiving legislation, which set official objectives, intended outcomes and requirements for the system.

Results of the eHealth ERA project (Towards the Establishement of an eHealth European Research Area) [1] together with a more globally oriented review of the adoption of health in-

formation technology [21] confirmed the leading role of a handful of countries. Due to this fact and our limited project resources, the literature review focused on the experiences of the UK [4], Canada and Australia [5-7] using materials available through official web sites. The analysis focused on objects and objectives of evaluation, methodologies and organisation of evaluation.

Content analysis of documents describing the NHIS and its elements focused on questions depicted in Table 1. Content analysis of the documents stating objectives and intended outcomes of the NHIS was conducted using a qualitative data analysis programme AtlasTI. Open coding of the data was grounded on the data, axial coding was done by using elements from the ICT-enhanced service change model [10] and elements of the IS success model [13] as a conceptual framework to group the codes. This approach provided 10 dimensions for evaluation. These are depicted in Table 2.

The results were fed to eight working groups (WGs), formed by extending an open invitation to end user organizations, research and industry, as well as organizations representing patients and lay people. Leading scientists on Health IT from Universities of Oulu, Tampere and Turku were appointed to lead each group: Prof. Pirkko Nykänen from University of Tampere led the NHIS development and requirements assessment teams, Dr. Eija Karsten from Åbo Akademi led the implementation team, Prof. Reima Suomi from Turku School of Economics led the process change and cost-benefits -teams, Dr. Persephone Doupi from the National Institute for Health and Welfare led the quality evaluation team, and Dr. Ilkka Winblad from University of Oulu led the health benefits assessment team. Dr Hannele Hyppönen from the National Institute for Health and Welfare coordinated and collated the work.

The task of each WG was to refine the evaluation outlines, the core evaluation questions and methodologies identified in the three preliminary studies listed above, taking into account the Committee requirement. The reports of the WGs were then collated into the NHIS evaluation methodology. The Steering Group for the work was led by the Ministry of Social Affairs and Health, and consisted of representatives of all key stakeholders.

Results

Review of evaluation methodologies for large-scale health information systems

The elements included in NHIS systems vary, but all are build around an Electronic Health Record. Evaluations have focussed on benefits to healthcare access, quality and productivity; patient safety; user satisfaction, usability and acceptability and organisational aspects. The use of multiple methods is emphasised, focusing on combining formative and summative evaluation, and covering the whole roll-out life-cycle (pre-implementation, implementation and post-implementation phase). A useful tool (Delone and McLeans model [13]) for structuring the required pre-post-implementation data was identified through the Canadian documentation. Organizational, cultural and business process elements are out of the tool's scope, and needed to be added. The model also does not cover the planning and implementation phases of an IS. A suitable conceptual model and evaluation methodology was, thus, not found, and had to be generated. National level evaluation also raises challenges for and demands development of large scale methods for data collection [2, 10].

Analysis of the object of evaluation - the NHIS and its functionalities

The National Health Information System in Finland consists of a national EHR (Electronic Health Record) archive and ePrescription centre, with ePrescribing, eArchiving and citizens' eViewing as the main functionalities. The architecture (planned to be functional by 2011) is depicted in Figure 1.

The national EHR archive and ePrescription centre will be maintained by Kela (Social Insurance Institute) and used via different legacy systems in public and private health care organisations and pharmacies over public networks. In order to be operational, the core services require interoperable EHR-systems, various national terminologies and classifications, consent management, certification and registering as well as security services.

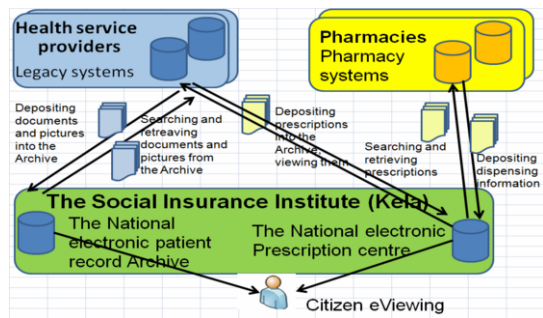

Figure 1- The Finnish NHIS architecture with key actors and their roles

For the purposes of evaluation, a more detailed description of the NHIS system and services was needed. To generate a structured overview of the NHIS and its characteristics, a classification of questions generated in the field of Health Technology Assessment (HTA) [11] was found useful.

The key questions for NHIS are depicted in Table 1. Most elements of the NHIS are "manufactured" by different actors for specific purposes. Together they form the NHIS. Some elements (e.g. legacy systems, variously structured records) exist, but need updates in order to be operational with NHIS. Other elements (e.g. ePrescription centre, national archive, citizens' access) are new, replacing existing ways of transferring and dispensing prescriptions, archiving patient records and accessing the EHR data NHIS evaluation is not a question of comparing a paper-based system to a fully electronic NHIS. The setting is much more complicated, consisting of comparison of combination of local and regional IS systems and services in different phases of transition towards the NHIS.

Table 1- HTA-drawn questions [11] for defining the NHIS as an object of evaluation

Nr	Question (EUnetHTA question ID nr in brackets)
1	Who manufactures technology (A0019)?
2	What are the technical and functional characteristics of technology (B0001)?
3	Are there any special features relevant to this technology (B0006)?
4	For what purpose (Why) is technology used (B0002)?
5	What are the current "tools" used for this purpose (A0011)?
6	Do other evidence-based alternatives exist? If so, what (A0014)?
7	Who are the users of the technology and where is it utilized (context of use) (B0004-5)?
8	How much is the technology being used, are there any restrictions on the use of technology (A0009, C0004-5)?
9	Are there variations in use across countries/ regions /settings (A0010)?
10	How many people belong to the specific target group (A0007)?
11	What is the phase of technology (design, testing, pilot/experimental, diffusion, routine use), is it a new use for an existing technology (B0003, A0015, C0003?
12	What material investments, equipment and special premises are needed to use the technology (B0007-9)?
13	What kind of records/registers are needed to monitor the use of technology? (B0010-11)?
14	What kind of training is needed for the personnel using or maintaining the technology (B0012-13)?
15	What kind of training is needed for the patients, their families and for the general public (B0014-15)?
16	Are there published guidelines how the condition should be managed (A0012)?
17	Has the technology been included/ excluded in the benefit basket of any country? Are there differences in coverage across countries (A0017-18)?
18	Does the technology need a license or certification (C0001)?

Analysis of the objectives of the NHIS/ domains of evaluation based on the text of the Finnish bills

The bills on eArchive and ePrescription stated the official objectives and anticipated impacts of the NHIS architecture and related services. The relative importance of the generated dimensions was estimated by calculating frequencies of dimension-specific key words in the bills. Several important observations can be made from Table 2. The relative importance of meeting of the requirements set for the eArchive, followed by improvements of the service processes due to ePrescribing became evident. There was a strikingly low frequency of statements related to health impacts of ePrescribing and eArchive. This may be due to health impacts being quite far in the impacts-hierarchy (many of category 1-5 impacts need to be realised before health impacts become visible). Health impacts also need time to mature and are dependent on a multitude of other factors. The seemingly low expectations of cost-benefits of ePrescribing may be due to overlapping with category 4 objectives.

Table 2 - Dimensions of evaluation and frequency of dimension specific statements in the Finnish ePrescribing and eArchive bills

NHIS Objectives => dimensions of evaluation (keywords in brackets)	ePresc.	eArchive
1. Quality of development process (process requirements, actor roles)	14	35
2. Meeting the set requirements (requirement, interoperability, secuirty, usability, reliability etc.)	42	124
3. Successful implementation (training, procurement, change management, implementation, support system)	12	11
4. Improvements in service processes (activity, processes, practices etc.)	57	31
5. Quality improvements (information quality, service quality)	24	25
6. Positive health impacts (health, welfare)	3	3
7. Cost-benefits (economy, costs, savings, productivity, efficiency)	8	31
8. Secondary impacts (secondary beneficiaries e.g. state authorities, supervisors, researchers)	18	11
9. NSIS-development boost (National Social Information System development, Social services)	0	48
10. Future service models (future)	4	3

The analysis showed the importance of constructive or formative data from the key stakeholders' viewpoints to be used to inform the development of the systems (dimension 1), especially for eArchiving, where development started later than that of the ePrescribing system. However, the relative importance of objectives related to implementation and diffusion for both the eArchive and ePrescription was strikingly low. This is in contrast to the requirement of the Social Affairs and Health Committee of the Parliament to monitor and assess the implementation of national eHealth services with a view to providing timely support to the different actors involved.

Generating a comprehensive evaluation plan

Figure 2 illustrates the proposed evaluation activities versus the evaluation studies that have actually been launched thus far. The evaluation planning project KaTRI suggested the evaluation to be organised into three main projects, targeting different phases of the NHIS system life cycle: The development support project (Project 1) should focus on providing information through formative assessment of NHIS project activities during the NHIS construction phase, and through assessing the system against set requirements in the testing phase. The implementation support project (Project 2) would use formative assessment methods and focus on support for the service provides' during implementation. The diffusion and impacts follow-up project (Project 3) would focus on providing information

mainly for the national decision makers on diffusion of the system and meeting of its objectives using primarily questionnaires and register data. For each phase a list of key evaluation questions and suggestions for data collection methods were drafted.

A coordinated programme funding to cover the key projects was seen as an ideal way of organizing the evaluation. However, this type of funding mechanism was not available in Finland. Three consortia (for formative assessment, assessment of implementation and impact assessment) have been collaborating and seeking separate funding. Projects 1 and 2 have not received funding so far in spite of the rhetoric and evidence [10; 14] on importance of this work. Two studies in project 3 have started (study 1 and study 2).

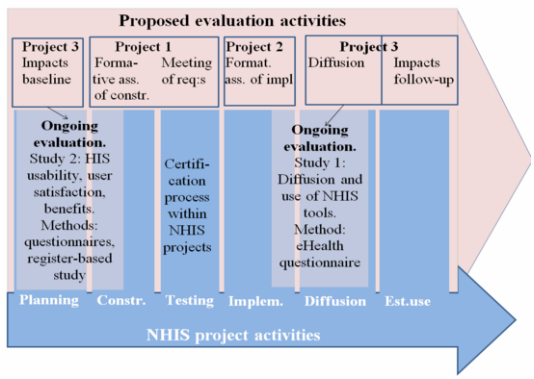

Figure 2- Evaluation framework and ongoing projects in different phases of NHIS implementation.

The diffusion study (Study 1 in Figure 2) focuses on questions in Table 1 (specific focus on questions 4, 5, 7, 8, 9, 11, 12, 13, 14) and is funded by the Ministry of Health and Social Affairs. It is a questionnaire-based study; aiming to map the state of the art of Information Systems used in health care at regular intervals to see a change from old IS tools and services to the new. The questionnaire is targeted at the health care information officers, and results are targeted for the national decision makers [18].

Study 2 in Figure 2 focuses on collecting baseline information on questions 4-7 in Table 2. Two sub-studies have started as stakeholder collaboration without external funding. The first is a questionnaire-based study for doctors (sample = 12 000), collecting baseline information on usability of current HIS and their impacts on service processes, quality, efficiency and health. The Canadian NHIS evaluation tool based on the Delone and McLean's IS success model [13] together with conceptual tools from a co-construction framework [10] was used to construct an information model for the study. The results are targeted to benefit NHIS project participants and decision makers. The ex-ante study offers concrete information on state-of-the art and user needs related to IS usability, user satisfaction and experienced benefits on service processes, quality, productivity and health. The ex-post study will inform on changes in these. For decision makers the results can be used to clarify short and long term objectives and steer the activities of the NHIS project.

The second sub-study aims at defining register-based indicators for process, quality, productivity and health related change, which can be used to indicate NHIS impacts. The sub-study has performed a small-scale pilot structuring EHR data manually with selected national EHR classifications, which will be implemented in Finland by 2011. The pilot aimed to test the utility of the selected classifications for evaluation purposes. Classifications are part of NHIS semantic interoperability development, and exploited as part of a national register reform which aims to implement an on-line nation-wide register on primary care patient visits directly from EHR data with unified data structures [19].

Discussion and conclusion

The planning project KaTRI was set out to draft a preliminary plan on how to evaluate construction and impacts of NHIS. Work done by other national evaluation efforts was elaborated by combining elements of HTA [11], IS success model [13] and ICT-enhanced change model [10]. The work to operationalize the elements and to develop an information model of the individual measures has been started in the diffusion and indicator -studies. The work generates a solid basis for implementing the recent EU Council conclusions (to follow-up and evaluate the health benefits and cost-effectiveness of different eHealth services, building on accumulated knowledge at EU and national levels) [17]. With the results of this work Finland joins the still small number of EU countries with a documented follow-up and evaluation plan of their national level eHealth programs. The plan offers also other EU countries tools with which to develop their plans and methodologies for NHIS evaluation. The work done offers basic building blocks for a solid conceptual framework and methodology, which covers the entire life cycle of a NHIS development from planning to implementation and impacts evaluation.

There are several risks for realizing the plan produced by the planning project KaTRI, which need to be tackled, starting from the availability of resources for committing the evaluation studies. Currently the Finnish NHIS is under construction and the first ePrescriptions are to be launched soon. Delay of evaluation in relation to NHIS development and implementation increases the risk of being too late for effective feedback. Availability of the required data especially for financial and register-based evaluation, limited possibility for controlled studies and challenges inherent in multidisciplinary work required form yet other challenges. The will to invest in this work can determine the future of the NHIS. In the end, the NHIS will not be defined by its current problems and challenges, but by the way they will be solved.

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