Status of Interoperability Requirements related to IHE Integration Profiles in Finland

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Abstract

IHE (Integrating the Healthcare Enterprise) integration profiles provide means for uniform application of central interoperability standards for specific use cases in healthcare. The IHE model involves global development and local deployment of integration profiles. This paper reports the results of a national survey and a set of expert interviews which explored the current integration needs of healthcare organizations, application vendors and national health IT initiatives in relation to the requirements covered by IHE integration profiles. For several integration needs, the use cases of IHE integration profiles match the current needs of the respondents. IT infrastructure and radiology profiles received most responses, but also other domains or profiles such as laboratory, patient care devices and personal health records received interest. Based on the results, factors influencing the adoption of external profiles or implementation guides of standards for local or national projects are discussed.

Keywords: interoperability, standards, IHE, health information systems

Introduction

Integrating health data from various sources in a comprehensive Electronic Patient Record (EPR) is a major prerequisite for eHealth [1]. According to an international survey, more than 20% of the costs that hospitals spend on information technology are represented by integration costs [2]. In addition, faster production of interoperability solutions to support practical integration challenges and everyday processes in healthcare are required [3]. Integration projects using non-standard interfaces are less predictable and thus can turn out to be costly for software solution providers as well.

IHE (Integrating Healthcare Enterprise) is an international non-profit initiative to support interoperability and sharing of information between health information systems and in health information networks [4,5]. IHE selects appropriate standards for specific use cases and develops constraints, aiming to support simplified systems integration [6]. The specification work of IHE results in integration profiles which are detailed instructions for implementing workflows, information exchange and content in specific use cases for health information systems, reducing optionality in applying standards [4,7]. More than 160 companies have developed IHE compliant systems and participated in the cross-vendor testing events organized by IHE [6]. Due to its testing and profiling activities,

IHE has also been identified as one of potential approaches for EHR quality and interoperability certification [8]. IHE has been seen as increasing compliance and the real-world usefulness of standards [1]. More than 80% of experts in an international eHealth standards study [2] identified IHE as somewhat or very important eHealth standards organization in the future.

In the landscape of health information systems in Finland, both major national information infrastructure development projects [9] and local integration projects require integration solutions [3]. In addition to functional requirements, the solutions must be applicable in Finnish healthcare operating model and comply with the regulatory requirements.

Although the IHE initiative was initiated some 10 years ago in the domain of radiology by RSNA and HIMSS [4] and has since then expanded to many new domains and regions, there have not been established IHE activities in Finland. This has hindered consideration of some IHE profiles, such as the Cross-Enterprise Document Sharing (XDS) profile, for national health information sharing, in addition to perceived lack of flexibility to specific security and archiving requirements. Only a few implementations of IHE profiles have been made, primarily by radiology software vendors. In addition, international models for conformance testing such as IHE have not been well known among the Finnish stakeholders [10].

Facilitation of IHE work in Finland was boosted in 2007 by two influential technology agencies: the Finnish Funding Agency for Technology and Innovation (TEKES) and the Finnish Healthcare Technology Association (FiHTA). They initiated a project to explore the applicability of IHE profiles in Finland, to support national IHE activities, and to improve the compatibility of Finnish healthcare information systems in the international markets. The IHE.fi project resulted in a survey of IHE profiles in Finnish context and measures to raise awareness of IHE through events and informative material. This paper discusses the results and findings of the conducted surveys and interviews related to the IHE.fi project.

Materials and Methods

The material for this study was gathered by two means: an online survey for health IT stakeholders in Finland and a semi-structured expert interview for the stakeholders of the IHE.fi-project. The data gathered in the different phases of the study was treated as a qualitative material and was analyzed systematically to form the conclusions. In addition, the IHE.fi project produced more detailed descriptions of central IHE profiles, and arranged several events and workshops. All the results were published in Finnish [11], complementing previous IHE studies.

The aim of the survey was to gather information about current trends in interoperability needs in Finland, the level of knowledge on IHE initiative among Finnish stakeholders and more importantly, to form a picture of current and emergent detailed integration needs and use cases, using domains covered by various IHE profiles as the framework to which these needs are mapped. The questions were designed to emphasize the domain of interest instead of content of IHE profiles themselves, as the respondents were unlikely to know the contents of the profiles in detail.

The survey was published online between July and September 2008 to gather the information from local healthcare professionals, healthcare IT professionals and research/technology agencies. The invitation to take part in the survey was directed to 184 selected professionals via email. To ensure that the recipients were related to many potential stakeholder groups of IHE, including both user and vendor organizations, they were selected among the participants of the national conference of healthcare IT, which gathers annually the major development projects

and their facilitators of eHealth in Finland. The selection protocol included the acquisition of participant list and selection of two (where possible) or one recipient from each participating organization. In the course of the study, to attract more respondents, the survey was also promoted in events related to healthcare IT and through some related mailing lists. The first part of the survey consisted of general questions about IHE, interoperability and about answerer's experience and knowledge of IHE. The second part surveyed the development needs in the recipient's organization in relation to IHE domains and profiles. The second part was supported by brief descriptions of primary use cases and requirements of the 70 IHE profiles which were available during the study (See Table 1).

The semi-structured interview was presented to seven selected expert members of the organizations involved in the board of IHE.fi project between July and September 2008. The interviewees were representing organizations varying from the developers and utilizers of eHealth solutions to research/technology agencies interested in the topic. The interview consisted of topics related to IHE and the field of healthcare information technology in general in six main themes. These included the domains of interest and organization of IHE activities in Finland, as well as interoperability and standardization of healthcare information technology in Finland and internationally.

The notes of interviews and the free text responses from the online survey were analyzed separately and synthesized to form a view of the overall landscape of the field of interoperability and healthcare IT standardization, and to provide basis for IHE related activities. The results were published in the report of the project along with actionable proposals on how to proceed with the future deployment, participation and communication work of IHE in Finland [11]. The report also included additional information about IHE domains and profiles which attracted most interest based on the results.

Table 1. IHE frameworks and profiles [7] in the study (based on available profiles and supplements in Q2/2008).

IHE Framework	**Profiles available in the Framework**
IT infrastructure (ITI)	Document sharing (XDS, XDS.b), Consistent Time (CT), Audit Trail and Node Authentication (ATNA), Retrieve Information for Display (RID), Enterprise User Authentication (EUA), Patient Identifier Cross Referencing (PIX), Patient Demographics Query (PDQ), Patient Synchronized Applications (PSA), Patient Administration Management (PAM), Personnel White Pages (PWP), Cross-Enterprise Document Media Interchange (XDM), Cross-Enterprise Document Reliable Interchange (XDR), Sharing of Scanned Documents (XDS-SD), Patient Identifier Cross-Reference and Patient Demographics Query for HL7v3 (PIX/PDQ/v3), Retrieve Form for Data Capture (RFD), Notification of Document Availability (NAV), Cross Enterprise User Assertion (XUA), Cross Community Access (XCA), Basic Patient Privacy Consents (BPPC)
Radiology (RAD) and Radiation Oncology (RO)	Scheduled Workflow (SWF), Patient Information Reconciliation (PIR), Post-Processing Workflow (PWF), Reporting Workflow (RWF), Import Reconciliation Workflow (IRWF), Nuclear Medicine Image (NM), Mammography Image (MAMMO), Evidence Documents (ED), Simple Image and Numeric Report (SINR), Key Image Note (KIN), Consistent Presentation of Images (CPI), Presentation of Grouped Procedures (PGP), Image Fusion (FUS), Portable Data for Imaging (PDI), Cross-enterprise Document Sharing for Imaging (XDS-I), Teaching File and Clinical Trial Export (TCE), Access to Radiology Information (ARI), Audit Trail and Node Authentication - Radiology Option (ATNA),

	Charge Posting (CP), Mammography Acquisition Workflow (MAWF), Radiation Exposure Monitoring (REM), RT Objects
Laboratory (LAB) & Pathology (PAT)	Laboratory Testing Workflow (LTW), Sharing Laboratory Reports (XD-LAB), Laboratory Device Automation (LDA), Laboratory Barcode Labeling (LBL), Laboratory Point Of Care Testing (LPOCT), Laboratory Code Sets Distribution (LCDS), Pathology workflow (PWF)
Patient care coordination (PCC)	Medical Summaries (MS), Exchange of Personal Health Record Content (XPHR), Emergency Department Referral (EDR), Antepartum Care Summary (APS), Functional Status Assessments (FSA), Emergency Department Encounter Summary (EDES), Query for Existing Data (QED)
Patient care devices (PCD)	Device Enterprise Communication (DEC)
Eye care (EYE)	Eye Care Workflow (EYECARE), Charge Posting (CHG), Eye Care Evidence Documents (ECED), Eye Care Displayable Report (ECDR)
Cardiology (CARD)	Cardiac Catheterization Workflow (CATH), Echocardiography Workflow (ECHO), Retrieve ECG for Display (ECG), Evidence Documents (ED), Implantable Device Cardiac Observation (IDCO), Stress Testing Workflow (STRESS), Displayable Reports (DRPT)
Quality, research & pub.health (QRPH)	Clinical Research Data Capture (CRD), Patient-level Export of Quality Data / ACEI-ARB Content (PEQD / ACEI-ARB)

Results

Survey

The online survey received 26 responses from all recipients which were representing the three different categories: 14 were working in healthcare provider organizations, eight were employees of healthcare IT software vendors and the rest were employed by research/technology agencies and public professional service providing organizations involved in healthcare IT (See Figure 1). Since the exact number of participants who received the survey request through mailing lists and events is unknown (in addition to the systematic selection from national health IT conference participants), the exact response rate can not be calculated, but it can be estimated that response rate is well below 10% of the recipients.

Part I: integration priorities and general knowledge of IHE

In the first part of the survey respondent's views and needs on interoperability were surveyed in general and regarding to IHE. IHE in general was well identified among the respondents, 20 of the answerers knew IHE beforehand. Most of the respondents, however, had no experience on utilizing the IHE work (18). Only five of the respondents had actual experience on IHE specifications. Out of these, one respondent had completely positive experiences on the IHE work and the rest stated that the maturity and applicability of the work varies from domain

to domain or did not leave any comments on this subject. The respondents had positive perceptions of the IHE initiative, even though the actual experience was mostly absent. When asked "Should the development and acquisition of the systems be based on IHE specifications?", 18 of the responses were positive and six were conditionally positive (depending on the case). Two of the respondents did not comment on this subject.

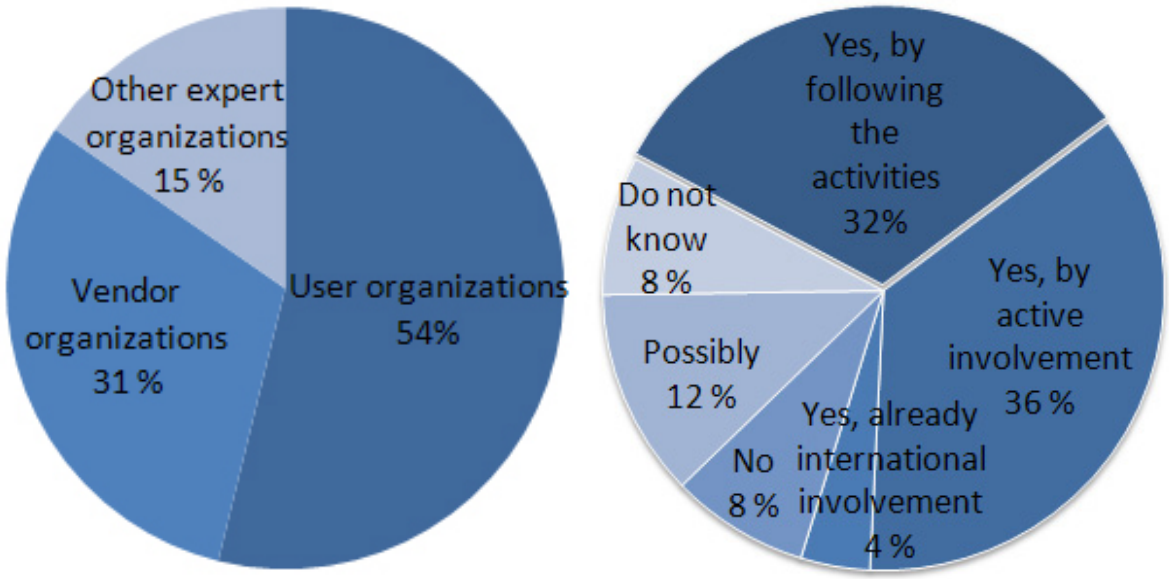

Figure 1. The division of respondents (N=26) and their interest to participate in IHE activities as percentages.

When asked about the interest in participating in the IHE work, most of the responses (19) were positive (See Fig. 1). Nine respondents were more actively interested in participating in the work or already participating on international level. Three of them were interested in participating conditionally depending on projects and topics of interest. Those who were reluctant to participate were mostly referring to lack of time. Small majority of the respondents (14) were eager to have more information on IHE.

In general, the respondents clearly saw benefits in utilizing pre-specified, repeatable standards solutions for interoperability problems. According to responses, these kinds of solutions would prove to be most beneficial in specification, implementation and testing stages of the projects and also in planning the investments. Both the software industry and healthcare service provider respondents were supportive to the export and also import possibilities of healthcare software which could be supported by repeatable integration profiles.

Part II: Status of integration domains of specific profiles

Part two of the survey was optional, surveying the specific interest in IHE frameworks and profiles in more detail. The respondents were given the profile name with a link to actual specification and a brief description of the main scope of the each of the 70 profiles. The results are displayed in Figure 2, grouped by technical frameworks. In addition, selected profiles which have been discussed in more detail within Finnish IHE activities, are individually displayed in Figure 3.

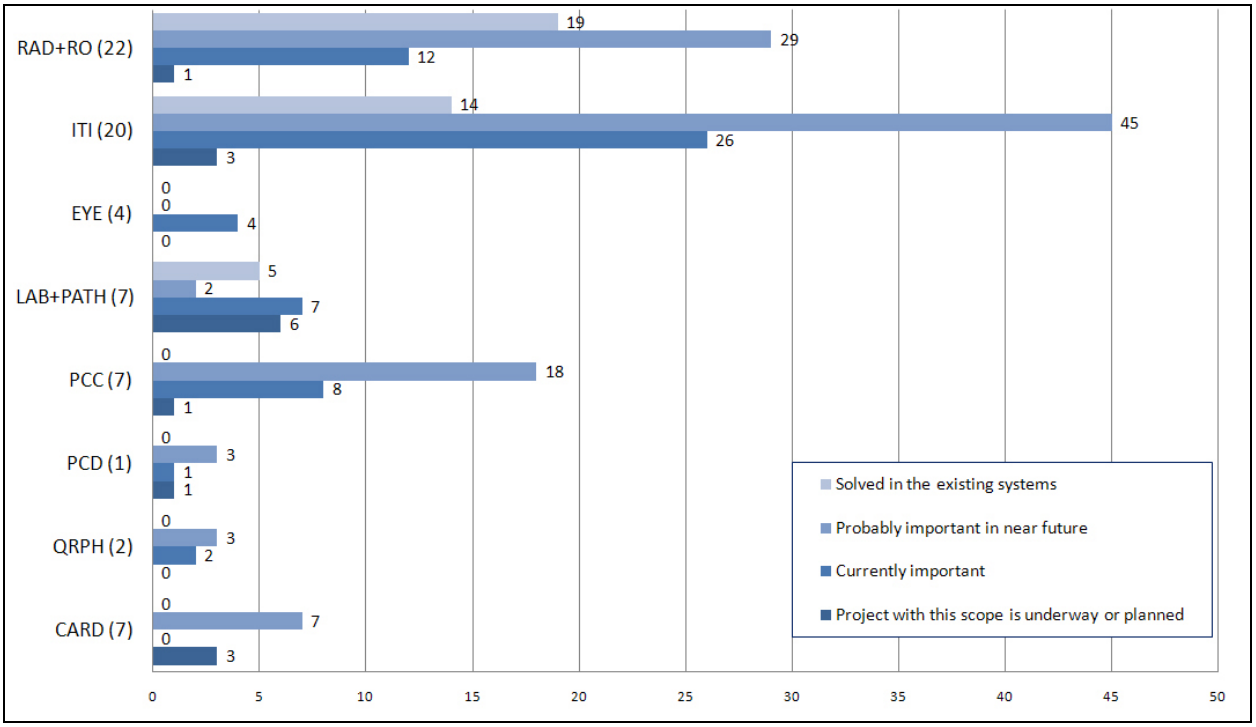

Figure 2. Levels of interest and development projects in the domains of IHE Technical Frameworks, x-axis: number of respondents in different options, y-axis: Technical Framework (number of profiles).

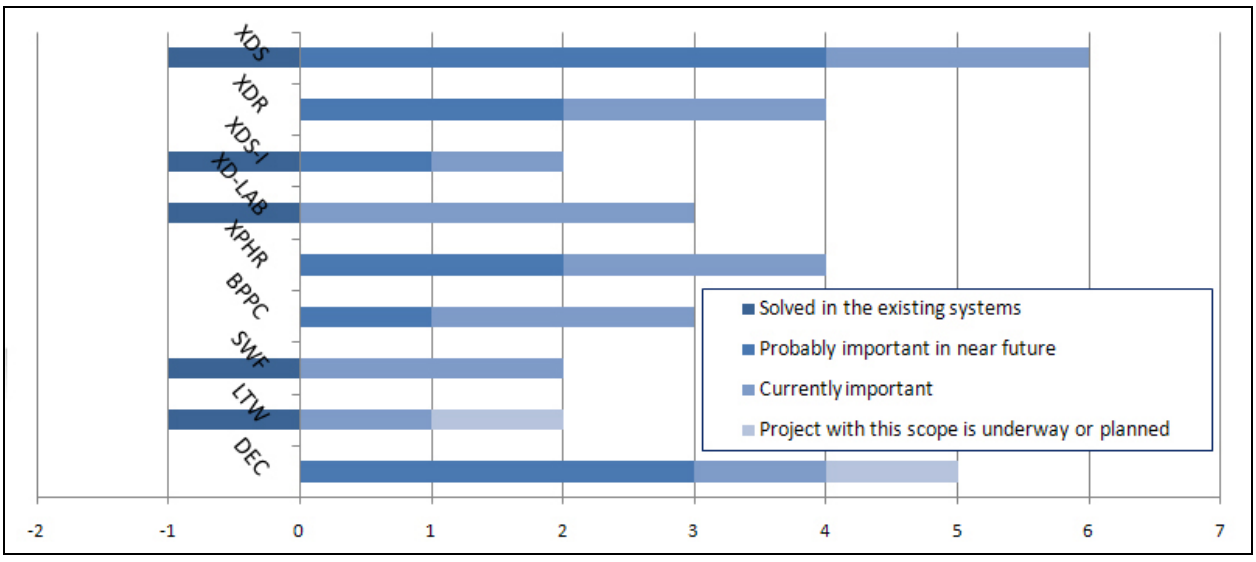

Figure 3. Width and types of interest in domains of selected profiles of interest in Finnish IHE activities.

The respondents were given a chance to express their interest of the domain of profiles using choices: “Project with this scope is underway or planned”, “Currently important”, “Probably important in near future” and “Solved in the existing systems”. The respondents were instructed to answer to only those domains which they wanted to indicate interest or activity in, thus it was possible to leave the answer blank for each domain. In Figure 3 the choice “Solved in the existing systems” is represented as negative interest, since the area is currently solved in the respondent's environment. The domains that raised the most interest were IT Infrastructure (ITI), Radiology (RAD), Laboratory (LAB), Patient Care Devices (PDC) and Patient Care Coordination (PCC) and all of the domains were seen currently important or involving project activities by at least one of the respondents.

The most urgent area of interest was IT Infrastructure, in which all the topic areas of the profiles were under some level of development. The interest can be explained by the fact that this IHE domain has common building blocks for the whole healthcare organizations’ and inter-organizational communications, not only for specialized health-care systems like most of the other IHE domains. In addition, many subjects in this domain are active under the national health information infrastructure development projects.

The radiology domain had highest response rates in the “Solved in the existing systems” choice. This is explained by the fact that many regions have lately acquired PACS and RIS systems. In this domain IHE specifications have also reached a state of maturity and stability to emerge in imaging solutions and products internationally. Patient Care Device (PCD) profiles also received interest from several respondents. Current interest in interoperable personal health systems and devices, such as Continua Health Alliance activities, can also be observed in these results.

Stakeholder interviews

In addition to the online survey, seven interviews were organized. The target group consisted of representatives of healthcare IT industry, experts from technology and development agencies and university hospital IT management departments. The answers of the interviewees mainly reflected the same developments as the results of the survey. According to the respondents, the most dominant development needs were related to the national infrastructure services and solutions. This also boosted interest in related IHE topics: technical frameworks and profiles whose functionalities were related to information exchange (XD* profiles), patient consent, security issues and workflows in different domains were especially discussed (See also Figure 3).

The interviews also included a more in-depth insight of the healthcare information technology landscape in Finland and internationally. During the interviews several recurring themes stood out, and combined with the free text answers of the survey, main observations can be summarized as follows:

- The markets of health IT application solutions are fragmented internationally and centralized on national level in Finland. Despite this, on both markets, the demand for information exchange is increasing. Open interoperability solutions were seen as one of the tools to open up the markets, giving service providers more choice and international and time-to-market opportunities for vendors.

- There are clear deficiencies in information exchange and interoperability: individual interoperability standards and specifications cannot solve the problems in general, but there is a need for more comprehensive - “Enterprise Architecture-like" -approach. This was identified especially on the national level. Base standards provide shared building blocks which have to be made more accurate using profiles or implementation guides on the levels of data and technology architecture, but other architectural views must be established as well.

• Complementing the previous observation, the field of standardization and interoperability solutions specifying should be harmonized and aligned in a coordinated manner (at minimum on national level), to form the technology standards portfolio for the healthcare domain. This also requires participation in the international specification activities. The interviewees especially mentioned ISO, HL7, CEN and IHE specification groups.

• The national development projects in Finland and in other countries have been producing their own dedicated implementation guidelines, even if the base standards are shared. Shared implementation guidelines and profiles are likely to increase in the future, which is also reflected in the EU level propositions and guidelines [12].

• Health service providers are increasingly looking for integrated service offerings instead of separated applications. Clinical decision support, device connectivity, care process re-engineering and remote consultations are among the main drivers for increased interoperability.

• The interviewees identified no significant international alternatives to the profiling and testing activities of IHE. At the moment, integration profiles were seen to respond to many needs in technical interoperability, but semantic and process interoperability solutions need further attention.

Discussion and Conclusions

Neither the sample size or the number of responses of the survey satisfy statistical requirements. To attract more responses, we knowingly decided to use events and open mailing lists in addition to the systematic receiver selection for the promotion of the survey, although this lowered response rate and made it impossible to calculate exact rates. The material was gathered in a particular moment of time, in a strongly emerging and developing field with limited circumstances of a project and thus can not entirely be reproduced, although a similar survey could also be performed on European level, for instance. In addition, the selection of survey respondents may have failed to reach the best possible respondents in participating organizations. Furthermore, since the survey questions focused on domains covered by IHE profiles, there is no doubt that other important integration needs among stakeholders exist as well. Despite this, the results of the survey and the interviews can be used to outline the picture of the integration requirements and applicability of IHE profiles in the Finnish setting. Some profiles, however, which did not receive high rate of responses in the survey, have received considerable interest in the IHE group activities.

It can be observed that IHE profiles make a major contribution to interoperability issues regarding data and workflows but to some extent they lack flexibility for adoption to different organizational conditions and security integration [13]. On the other hand, strict uniformity in application helps preserve possibilities for quick integration projects (exemplified by IHE testing events where applications are integrated within hours or days) and credibility in compliant products. This also fosters market relevance which is one of the most important factors in the success of interoperability specifications [6]. In addition, standards development organizations have started to harmonize their work for EPR systems standardization [1], and healthcare-specific interoperability approaches increasingly make use of industry best practices such as service-oriented architectures [3]. Likewise, the IHE profiles utilize healthcare-specific and domain-neutral standards, architecture and systems portfolio for healthcare organizations.

The results of the study indicate that IHE can be an efficient part of a solution assisting and supporting goals of the stakeholders on national and local level. The results of the interviews and the survey supported the establishment of a formalized organization of IHE work in Finland, and during the project, first efforts for this were made. IHE

Special Interest Group was formed in HL7 Finland association in spring 2008. It has gained satisfactory success in organizing IHE-related activities and increasing knowledge of IHE, its profiles and their potential. The distribution list following IHE activities and participating in events comprises about 80 participants which is a good number in this highly specialized, yet emerging, field of healthcare IT. There are, however, few documented international and national experiences from user standpoint and few active collaborative projects to take on the profiles. Thus, there is not yet a formal full national IHE initiative in Finland. Despite this, some central IHE profiles for imaging, laboratory or IT infrastructure are expected to gain more ground for specialized domains as well as some national considerations in near future. This, however, requires continuous open access policy and availability of international IHE information, as well as active local participation. Some signs of this are clearly emerging, such as a national interoperability demonstration which included use of IHE profiles between products from seven vendors in May 2010 in a national healthcare IT conference.

Acknowledgments

The authors thank the participants of the IHE.fi and SOLEA projects as well as members of the HL7 Finland IHE SIG.

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