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Interoperability Design of Personal Health Information Import Service

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Abstract. Availability of personal health information for individual use from professional patient records is an important success factor for personal health information management (PHIM) solutions such as personal health records. In this paper we focus on this crucial part of personal wellbeing information management solutions and report the interoperability design of personal information import service. Key requirements as well as design factors for interfaces between PHRs and EPRs are discussed. Open standards, low implementation threshold and the acknowledgement of local market and conventions are emphasized in the design.

Keywords. personal health records, interoperability, standards, SOA

Introduction

Personal health information management (PHIM) has been proposed as an important enabler for health reform, patient empowerment and individual wellbeing management [1,2]. This paradigm has been supported by different types of personal health record (PHR) system models such as stand-alone, provider-tethered and integrated PHR systems [2]. However, PHIM systems are hindered by the absence of data standards,shared terminologies, and common architectures [3]. PHR solutions, in particular, are at a substantial risk of being abandoned or not adopted at all, if they are not aligned with the information needs of the stakeholders [4]. Provider-tethered and especially integrated PHRs are likely to fulfill many information needs of patients or consumers, as they receive personal health information directly from the patient record systems of the providers without tedious re-entry of data. Integrated PHRs, in particular, should be populated from a variety of sources, providing access to provider-based records. Lack and immaturity of technical standards for interoperability, however, have been identified as one of the main barriers for integrated PHRs [2].

In this paper, we present the requirements, design options and design choices of open service interfaces for importing data for PHIM systems and applications from patient record systems. The results support standards-based interoperability in an ecosystem of electronic services for personal wellbeing information management.

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1. Methods and materials

The MyWellbeing (OmaHyvinvointi) project focused on the citizen as the center of wellbeing services and developed concepts and concrete solutions to support personal wellbeing [5]. Two central principles included the absolute control of individual to the information management, and the reception of electronic copies of documents from the service providers to personally controlled information management tools. This was supported by a service-oriented IT architecture which integrates personal, evidence-based and service information as well as personal and added value IT services [5].

Information Source Services were one of the identified central service types. The obtainability of personal information from health service providers was identified as a crucial success factor in introducing new tools to the consumers and in eliminating duplicate data entry. These requirements were also evident in project workshops and the literature survey on PHRs. Thus, a work stream was dedicated for the specification of open interfaces for importing personal health data to personal tools.

The requirements for information content and interactions of this Import service interface were collected from participants of the project, consisting of 6 universities and 10 service provider and system vendor organizations. Existing models and standards were also sought. Specifications for architecture and interfaces were produced and refined with participants, along with the overall conceptual architecture and participating electronic patient record (EPR) products. The Import service interface was discussed and refined in six workshops and five working meetings of the project. The results of the work were published in Finnish in a 70-page specification report [6].

2. Design criteria, requirements and comparison of alternatives

The main design principles were outlined based on the consideration of critical success factors for the specification and implementation. These principles consisted of:

1. *functional simplicity:* the import interface should incorporate onlythe most necessary functionality for obtaining patient information from various sources; other functionalities would be provided by other services,
2. *low implementation threshold*: the implementation and learning curve to the provider EPR systems and other applications should be as straightforward as possible, as it was crucial to keep the provision of data for the PHIM solutions affordable from the point of view of information sources,
3. *openness and standards-orientation:* the specification of the open interface should be based on established standards if possible, to promote the connectivity between many potential service implementations and as many source systems as possible,
4. *support for local conventions*: the scenario work performed in the project suggested that the specification especially needed to focus on Finnish EPR systems and organizations which are gradually building interfaces to the national EPR archive (KanTa) provided by the National Insurance Institution (Kela).

The functional scope of the import service was refined to cover two simple use cases: importing initial set of patient documents and updating a small piece of information or a set of information. The same use cases have been described in the Integrating the Healthcare Enterprise (IHE) Exchange of Personal Health Record Content profile (XPHR) [7] and are a small subset of core functionality of PHR systems [8]. Structured and coded information was deemed necessary to support

additional services which could translate medical terminology for consumer and combine coded medical data with interpretative knowledge and service provision data. However, the minimum level with unstructured documents and only structured metadata was also specified.

Standards and open specifications were evaluated in detail for information transfer and structured health information representation including terminologies, applying a structured evaluation model of personal eHealth services [9]. The core personal information data set includes identification and demographic data, provider information and service event (encounter) data. In addition, health problems and diagnoses, risk factors, measurements, selected nursing data, procedures, examinations such as lab results, medication, prevention, health certificates, information on functioning and personal aids as well as information for continuing care were included. Main options for interoperability standards for information and transport are presented in Table 1.

Table 1. Interoperability specification options for the import interface.

Option	Messaging and transport	Information
1	national HL7 v3 Medical Records + HL7 v3 Web services Profile implementation guides	National EPR core dataset encoded in HL7 CDA R2 document implementation guides
2	national HL7 v3 Medical Records + HL7 v3 Web services Profile implementation guides	HL7 CCD and ASTM CCR [10] / CDA R2 information contents and structures
3	specific transport API interfaces such as Microsoft HealthVault or Google Health API	HL7 CCD and ASTM CCR [10] / CDA R2 information contents and structures
4	Finnish medical society EBMeDS decision support web service transport	Finnish medical society EBMeDS decision support web service data structures

The national EPR core information specifications which had been used as a basis for implementation guides for national IT services were deemed suitable for the import interface based on the scenario requirements. While all options could fulfill principles one and three, the evaluated decision support and Continuity of Care Document(CCD) specifications did not fulfill principles two and four as well as option 1. The same observation applies to the IHE XPHR Content profile [7]. In addition, the HL7 v3 messaging specifications had already been implemented for many source systems for national e-Prescription and EPR archive interface. Consequently, option 1 provided low implementation threshold and utilized existing know-how and implementation components from the market.

3. Interoperability design of the import service interface

Following design principle 1, the interface was designed as *unidirectional*: it does not consider transfer of consumer-entered data to professional system (unlike specifications such as XPHR [7]). Patient-to-provider information flow can be realizedthrough viewing or sending functions [8] in the personal information management service which the import service is part of. A *push model* was selected where an event in the source system triggers the sending of an information package to the import service.

Three trigger events were specified for exporting data from the source (EPR) system. These included 1) the acceptance of a new patient record entry, 2) the transmission of patient documents to the national archive service, and 3) the user-initiated "send to patient" function. In particular, the situations in which documents are submitted to the national EPR archive were suggested as natural candidates for sending the information to the patient's personal information repository as well, provided the

interaction did not contain especially sensitive information which is legislated for personal disclosure (and indicated by specific metadata).

The address of the import service (or a mediating service) must be known in the source system. This person-specific "wellbeing mailbox address" can be communicated manually or by contract. The use of dedicated service directories would also be possible, but this would make the architecture more complicated. Transport-level acknowledgement in synchronous information transfer was specified, with an asynchronous option for the individual to provide a personal acknowledgement for cases where the sender requires such confirmation from the recipient.

According to the selected transport mechanism, the application roles and messaging interactions between the source system and the import service were specified as HL7 version 3 Medical Records messaging interactions. These roles and interactions were compatible with the specifications of the national eArchive solution in Finland. The sequence diagram in Figure 1 depicts the application roles and interactions in a communication scenario. In addition, the roles and interactions were specified for a scenario where the national archive service would serve as a mediator between the original source and the import service. The actual content isaccompanied with header metadata and wrapped in Clinical Document Architecture (CDA) documents inside the message interactions.

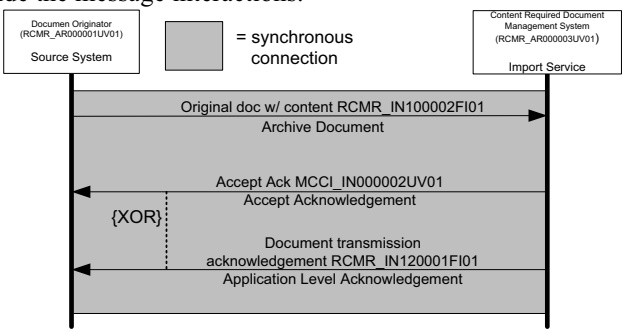

Figure 1. Sequence of interactions between source system and import service.

The necessary *security and identification* considerations include encryption and identification features to support confidentiality and integrity. The identification of individuals is based on the national social security number according to the supported scenario. Confidentiality of information is preserved by using encrypted point-to-point connections with standard web-based security protocols between source and the import service. The identity of the sender does not need to be validated by a third party, if the level of trust where the receiver may accept or reject incoming data based on message metadata such as time and free text sender information is found adequate. More sophisticated encryption or security service solutions such as use of personal individual security certificates would require unified security infrastructure from all participants and raise implementation threshold and costs. Provider-specific data received through import interface were not recommended for secondary use by health professionals although there was a mandatory requirement not to alter these data. This decision was due to not requiring unified digital signatures and public key infrastructures from all participants of the ecosystem which would be required to guarantee such integrity and non-repudiation. Information sharing between Finnish health service providers will be mainly based on use of national IT services with strong integrity enforcement mechanisms. This alleviates such requirements from PHIM solutions.

4. Discussion and Conclusions

Our case reinforces the need of complementary standards for personal health information management [2, 9]. In addition to interoperability design, contracts and consents are needed between the individual, health service provider and information management tool provider. These contracts were considered in separate specifications of the project. Additional functionality such as SMS notifications upon receiving new data, personal acknowledgements and information correction requests were identified but not incorporated as part of the standard solution or the interface specification.

The import interface specification has been proposed for a national PHR platform development project and a national programme for citizen eServices in Finland which both have been planning to produce or select detailed architecture and interface specifications in 2012. Design challenges reported here are likely encountered in all projects which consider integrated PHR designs and PHIM solutions based on patient information from several service providers. Although the import functionality is only a small subset of personal wellbeing information management, it fulfills central information requirements and increases convenience which is necessary for user acceptance and continued use of such solutions. Local implementation guides of international standards, however, are needed until universally adopted core data sets, terminologies and transformation services become available.

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References

[1] Angst CM, Agarwal R. Patients Take Control: Individual Empowerment with Personal Health Records. Working Paper No. RHS-06-013, 2004.
[2] Detmer D, Bloomrosen M, Raymond B, Tang P. Integrated Personal Health Records: Transformative Tools forConsumer-Centric Care. BMC Med Inf Decis Mak. 2008; 8:45
[3] Brennan PF. Personal Health Information Management Systems. In: Saranto K, Brennan PF, Casey A, eds. Personal Health Information Management - Tools and Strategies for Citizens' Engagement. Proc. of Post-Congress Workshop of NI2009, University of Kuopio. 2009; 31-40
[4] Greenhalgh T, Hinder S, Stramer K, Bratan K, Russell J. Adoption, non-adoption, and abandonment of a personalelectronic health record: case study of HealthSpace. BMJ. 2010; 341:c5814
[5] Tuomainen M, Mykkänen J. Reference Architecture of Application Services for Personal Wellbeing Information Management. In: Moen A, Andersen SK, Aarts J, Hurlen P, eds. Proc. of MIE 2011 Oslo. 2011 Aug 28-31. Stud Health Technol Inform. 2011; 169:98-102
[6] Tuomainen M, Mykkänen J. Vaihtoehtoja Import-palvelun rajapinnan toteuttamiseen. OmaHyvinvointi-hanke. Kuopio: Itä-Suomen yliopisto, 2010 [in Finnish].
[7] IHE Patient Care Coordination (PCC) Technical Framework Volume 2 (PCC TF-2); Transactions and Content Profiles - Revision 7.0. Integrating the Healthcare Enterprise (IHE), 2011.
[8] HL7 Personal Health Record Systems Functional Model, Release 1, Draft Standard for Trial Use, HL7 EHR Technical Committee, November 2007 Health Level Seven Inc, 2007.
[9] Mykkänen J, Tuomainen M, Luukkonen I, Itälä T. Analysis model for personal eHealth solutions and services. In: Blobel B, Hvannberg ET, Gunnarsdóttir V, eds. Proc. of EFMI STC 2010 Conference; 2010 June 2-4; Reykjavik. Stud Health Technol Inform. 2010; 155:205-211
[10] HL7 Implementation Guide: CDA Release 2 – Continuity of Care Document (CCD) Based on HL7 CDA Release 2.0 and ASTM CCR (E 2369-05). Health Level Seven, Inc, 2007.