The Management of *open*EHR Archetypes for Semantically Interoperable Electronic Health Records

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Introduction Walker et al. recently assessed the value of electronic health care information exchange and interoperability in the US and concluded that a compelling business case exists for its national implementation [1]. These findings are to be interpreted cautiously, and comparable studies are currently underway in other countries. In this context, the *open*EHR foundation (http://www.openEHR.org) has now published Release 1.0 of the *open*EHR specification as a common architecture specification for semantically interoperable Electronic Health Records (EHR). These specifications provide a sophisticated, uniform way to model clinical knowledge using archetypes. Archetypes are expressed using the Archetype Definition Language and are based on the *open*EHR reference model. For semantic interoperability between various Health Information Systems such as EHRs, systematic management of clinical knowledge is essential [2], [3]– no matter what the actual approach and methodology chosen to establish interoperable systems. Archetypes allow clinicians to efficiently agree on the content needed - and increasingly stakeholders in Australia and internationally choose archetypes as the means to define and standardize clinical knowledge. In this context, the aim of this paper is to analyse functional requirements for a web-based system that supports internationally collaborative creation and maintenance of archetypes as well as their systematic management (Domain Knowledge Governance, [4]).

Material and Methods To gather the requirements for the development of a web-based archetype repository which provides comprehensive support for archetype development and systematic management, we carried out a comprehensive requirements analysis. A series of workshops on archetype development for clinicians were conducted by two of the authors (EH, SG) and among many other activities an archetype road show was conducted (SH). Archetypes have been developed for The General Practice Computing Group, Australia (SH, EH) and the authors work together with researchers and clinicians in several countries including Australia, Turkey, Germany and Iran to define and refine archetypes. We conducted face-to-face and telephone discussions with members of ISO/TC 215, EHR Taskforce of the European Committee for Standardization (CEN), Standards Australia Electronic Health Record Committee, and founding members of the *open*EHR Foundation. Several versions of a prototype Archetype Finder which implements a subset of the required functionality have been developed and deployed (SG, SH, JG) to further refine the requirements for the archetype repository. The Archetype Finder was developed as Java Servlet using the Web Ontology Language (OWL, [5]) and the Protégé OWL Plug-In [6] to develop and maintain an Archetype Ontology which provides the necessary meta-information on archetypes. To document the results we applied the Unified Modelling Language (UML) to create an initial model capturing the requirements.

Results During our requirements analysis for the development of an archetype repository, we identified five primary roles (actors): Lead Developer, Reviewer, Unprivileged User, Archetype Admin and System Admin. For these actors, we identified the following top-level use cases: '*Search archetypes*', '*design archetypes*', and '*display archetypes*'. Also sophisticated user administration is needed. '*Designing archetypes*' is the most complex top-level use case consisting of 12 sub-use cases (e.g. '*define a new archetype*', '*compare archetypes*', '*edit archetypes*', '*review archetypes*', '*translate archetypes*').

So far, considerable amounts of the functionality of the top-level use cases have been prototypically implemented to validate the solicited requirements:

- Use Case '*Search archetypes*': The Archetype Finder (http://healthinformatics.cqu.edu.au/archetypefinder) currently implements much of the required functionality in this use case from ontology-based searches to broadening and narrowing search results. Support for automatically identifying archetypes due for review or enabling external applications to search for adequate archetypes via web service technology is still to be developed. The Archetype Finder is completely based on a separately developed and maintained multi-lingual OWL-based Archetype Ontology – thus generically generating the user interface from the ontology. Fig. 1 presents an example interface of this user interface.
- Use Case '*Design archetype*': At the moment, the editing functionality is implemented by the Ocean Archetype Editor (SH), a tool to support the authoring of archetypes as part of the *open*EHR initiative and the CEN EHR standardisations. Also, the Archetype Workbench developed by Thomas Beale provides technical support for this authoring. However, further functionality, such as reviewing or revising archetypes, needs a web-based environment and thus tighter integration into a web-based environment is being strived for. Both Editor and Workbench are available at http://www.openEHR.org or precompiled at http://oceaninformatics.biz.
- Use Case '*Display archetype*': This use case is basically fulfilled by Archetype Finder, Archetype Editor and Archetype Workbench – however for slightly different purposes. The Archetype Finder uses resources from the Archetype Editor for rendering archetypes in HTML.

Fig. 0: The German interface of the Ontology-generated Archetype-Finder.

Discussion The systematic management of archetypes can be supported by information technology as analysed in this paper. The web-based archetype repository will provide mechanisms to support Domain Knowledge Governance with a clear process for authoring, updating, managing, disseminating knowledge in archetypes as well as archetype version control. The OWL Archetype Ontology can provide the necessary meta-information on archetypes for this and also for example support reasoning to automatically find similar archetypes. The recent recommendation of Australia's National E-Health Transaction Authority (NEHTA) to "[a]dopt the European EN13606 standard on EHR Communication (parts 1 to 3) as the basis of an Australian Shared EHR Architecture Standard for specifying Australian Shared EHR Content" [2] shows the importance of setting up such an archetype repository as the CEN EN13606 standard is closely related to the *open*EHR approach. Also the development of international standards for managing international collaborative archetype authoring, maintenance and dissemination as currently proposed will further semantic interoperability in the long run. In essence, other approaches like HL7 v3 (http://www.hl7.org) or the Clinical Document Architecture (HL7 CDA, [7]) will need to do essentially the same thing with regard to Domain Knowledge Governance if semantic interoperability is to be achieved between

more than two systems at a time. For example, the standardisation of the HL7 Reference Information Model (RIM) is not sufficient; rather the standardisation of R-MIMs and use of templates or similar is required. By clearly separating knowledge and information, we believe that archetypes offer a good way to define and maintain the knowledge inherent in EHRs.

In conclusion, we believe that archetypes and adequate web-based Information Technology tools render comprehensive Domain Knowledge Governance feasible and efficient – leading to high-quality clinical content that is semantically interchangeable between systems.

References

[1] Walker J, Pan E, Johnston D, Adler-Milstein J, Bates DW, Middleton B. The value of health care information exchange and interoperability. Health Aff. (Millwood). 2005; W5-10-W5-8.

[2] National E-Health Transition Authority (NEHTA). Review of Shared Electronic Health Record Standards - Version 1.0, 2006.

[3] Hovenga E, Garde S, Heard S. Nursing Constraint Models for Electronic Health Records: a vision for domain knowledge governance. Int. J. Med. Inf. 2005; 74 (11-12): 886-98.

[4] Garde S, Heard S, Hovenga E. Archetypes in Electronic Health Records: Making the case and showing the path for domain knowledge governance. In: H Grain and M Wise, (Eds.) HIC 2005: 13th Australian Health Informatics Conference, Melbourne, 31.07.2005–02.08.2005, Brunswick East, Vic: Health Informatics Society of Australia, 2005.

[5] W3C. OWL Web Ontology Language Overview - W3C Recommendation 10 February 2004, 2004.

[6] Knublauch H, Fergerson RW, Noy NF, Musen MA (2004): *The Protégé OWL Plugin: An Open Development Environment for Semantic Web Applications*. Third International Semantic Web Conference - ISWC 2004.

[7] Dolin RH, Alschuler L, Boyer S, Beebe C, Behlen FM, Biron PV, Shabo Shvo A. HL7 Clinical Document Architecture, Release 2. J. Am. Med. Inform. Assoc. 2006; 13 (1): 30-9.