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Can openEHR Archetypes Be Used in a National Context? The Danish Archetype Proof-of-Concept Project

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Abstract. Semantic interoperability and secondary use of data are important informatics challenges in modern healthcare. Connected Digital Health Denmark is investigating if the openEHR reference model, archetypes and templates could be used for representing and exchanging clinical content specification and could become a candidate for a national logical infrastructure for semantic interoperability. The Danish archetype proof-of-concept project has tried out some elements of the openEHR methodology in cooperation with regions and vendors. The project has pointed out benefits and challenges using archetypes, and has identified barriers that need to be addressed in the next steps.

Keywords. semantic interoperability, openEHR, archetypes, models, terminology

1. Introduction

Semantic interoperability and secondary use of data are important challenges in modern healthcare when aiming to provide continuity of care based on thorough documentation, and best available evidence. These challenges are not new within health informatics, and the informatics community is working globally to provide some of the required cornerstones: a (process oriented) information model, an extensive health terminology and specification of the clinical content to be documented in specific situations [1].

National and international programs for establishment of such a logical infrastructure for semantic interoperability are currently taking place. Organisations as The International Organization for Standardization (ISO), The European Committee for Standardization (CEN), openEHR, HL7 etc. are developing and providing standards [2], and work is also ongoing to harmonize standards for modelling of clinical content [3]. The International Health Terminology Standards Development Organisation (IHTSDO) is disseminating SNOMED CT, and the European commission have taken a variety of initiatives. Countries like UK [4], the Netherlands [5] and Sweden [6] have extensive programs run by national organisations.

In Denmark, the organisation Connected Digital Health – cooperation between the government, the regions and the local authorities – is responsible for coordination of the national health informatics activities and implementation of the national strategy for

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eHealth [7]. Denmark has translated SNOMED CT into Danish, and plan to implement this terminology. Several regions have been working with clinical content specifications (detailed clinical models), but there are not yet any standard for representation or communication of these specifications. Furthermore, decision on a model for healthcare information has not been made in Denmark.

In Denmark, the use of archetypes has been explored at a regional level [8–10]. CDH are investigating if the openEHR reference model, archetypes and templates can become a candidate for a National logical infrastructure for semantic interoperability. The Danish archetype proof-of-concept project has tried out some elements of the openEHR methodology in cooperation with regions and vendors. The project has pointed out benefits and challenges using archetypes, and has identified barriers that need to be addressed in the next steps.

2. Method

Purpose of the project was to explore if the archetype technique can be used for sharing data between it systems – i.e., contribute to semantic interoperability. The exploration was based on practical experience with development and implementation of archetypes. The project was based on the openEHR specifications [11, 12], including the reference model, the archetypes and the templates (see Table 1).

The project explored the challenges in creating Danish archetypes using the archetype methodology and tools, and the use of structured terminology (SNOMED CT) in connection with archetypes. Furthermore, the technical challenges in importing and integrating archetypes into the EHR applications were investigated. The possibility for the using archetype framework as a candidate for a common logical infrastructure in the Danish healthcare sector was discussed during the project.

Table 1. Brief description of openEHR archetypes and templates

OpenEHR describes archetypes as "… reusable, structured models of clinical information concepts that appear in EHRs". Archetypes are described in a formal language. Archetypes are used to create detailed clinical models of for example observations like blood pressure or a specific laboratory result, information related to the evaluation of a clinical problem, related to activities like prescribing of medications etc. The openEHR templates are used to adjust and combine archetypes for specific use cases and local needs. Templates are connected to entry forms (documentation templates), and may be bound to terminologies [13].

The project was organised in two tracks – a regional track and a vendor track with EHR providers. In the regional track three out of the five Danish regions participated. This track was exploring the development of archetypes and templates based on regional clinical content specifications and existing OpenEHR archetypes.

Seven providers of hospital EHR systems participated in the vendor track, covering all major hospital systems in Denmark. This track was exploring the implementation of archetypes and provided a demonstration of how archetypes could be imported into the systems. At the end of the project a common workshop was organised, where vendors presented results to each other and to the regions.

3. Results

The Regional Track

The regional clinical content specifications were taken as a starting point. These descriptions consisted mainly of tables in a text document listing information to be documented in a specific use case, including relevant values for each information element. These tables were supplemented by screen dumps from EHR systems including field descriptions.

Two clinical areas were explored. The first area was obstetric examination i.e. examination of the pregnant uterus and the fetus – consisting of an abdominal and a vaginal examination. The second area was handling of tube feeding – including preparation of the patient, tube insertion, control and removal.

Regarding obstetric examination several relevant archetypes were found in the openEHR library [14]. These archetypes are modelling a selected concept, but aims to cover all aspects of that concept – i.e., they are maximum-models.

In total ten archetypes were used to cover the Danish clinical content specifications of obstetric examination. The ten archetypes were combined into a template using the Ocean Informatics Template Designer. Furthermore, constraints were imposed to adjust to the Danish use case. The constraints were imposed both on the structure (i.e., what attributes not to use) and the attribute values (i.e., reducing the value set).

Interestingly, almost all the elements in the Danish clinical content descriptions could be represented by using this strategy, i.e., combining the maximum-archetypes and constraining them in the templates. In one area a new archetype had to be developed, but even in this case it was based on the existing "palpation" archetype. In one area the clinical terminology (used in UK) seemed to differ from the Danish one.

A second strategy was also explored. In this case an archetype was developed from scratch using the openEHR Archetype Editor. The archetype was aimed at just covering the use case in the clinical content descriptions. It was relatively straight forward to develop this non-hierarchical archetype, which in a sense functioned as a pre-constrained or a "minimums"-archetype.

The obstetric examination did mainly consist of observations, the second, handling of tube feeding, did also include other kind of archetypes, i.e., instructions and actions.

The Vendor Track

The vendors were provided with the openEHR archetypes in ADL format (archetype definition language) for obstetric examination, as well as selected archetypes developed in the project. The vendors mainly worked with import of archetypes into their systems, they demonstrated the resulting entry screens and then populated these with data. The vendors did not work with openEHR templates.

None of the EHR systems were internally based on the openEHR reference model, but had to map the archetype elements into their own model. However, several systems were based on a two-level modelling, with a generic reference model and flexible configuration of clinical models and entry screens on top of the reference model.

The vendors used either the ADL file provided or the corresponding XML file generated by the Archetype Editor. These files were imported/mapped into the EHR configuration module. Some vendors introduced constrains at this level. Entry screens based on the archetypes could be displayed and populated with data. These data were handled by the systems in line with existing data.

4. Discussion

The Regional Track

It was possible to represent the information described in the clinical content specifications by combining and constraining small, reusable archetypes in the templates. The advantage with this strategy is that it is possible to build on existing modelling work, and it is much easier to remove items from a maximum model, than to invent the right items from scratch. The disadvantage is that the templates are becoming complex and difficult to overlook. The need for translation, as in our case, increases the challenge to keep consistency.

The alternative strategy, to develop archetypes just covering a specific use-case, results in less complex archetypes. This method will usually not result in re-usable archetypes and it is less likely that existing archetypes can be re-used. These minimums-archetypes actually work as templates, and are not taking advantage of the possibility to create several template variants compatible with the underlying archetype. However, this method is a big step forward from the existing tables in a text document, and in addition opens up the possibility for exchange and sharing of the clinical content descriptions in a standardised and machine readable format.

During the project it was demonstrated how SNOMED CT could be bound to the archetypes and templates, i.e., to single attributes and attribute values in the archetypes and as SNOMED CT subsets for a value set in templates. However, there is still a need for further exploration and discussion to understand how to use a terminology efficiently and consistently with archetypes and templates.

Experiences with the tools (openEHR Archetype Editor and the Ocean Informatics Template Designer) are that they are crucial for the work, but needs to improve user friendliness and application stability.

The Vendor Track

The vendors found it easy to import the observation archetypes into their systems. Regarding Observations there were clear similarities between the openEHR and the vendor's reference models. Regarding other kind of archetypes (Evaluation, Instruction, Action) several differences were identified and implementations in this area vary.

Since the vendors did not work with templates, some did not introduce constraints on the imported archetypes. The resulting entry screens often became unfit for use, and in some cases pointers to archetypes could not be resolved. Some vendors stated that they were able to export the data in accordance with the openEHR specifications (i.e., in the dADL format); however, this was not demonstrated. Vendors noted that – unlike the ADL – the template and export specifications are not yet accepted standards.

The vendors found that the openEHR specifications could be a candidate for a common logical infrastructure at a national level, but more investigations are needed before a decision can be made. The governance seems to be the largest barrier, i.e., the rules and agreements for handling archetypes and templates on the international, national and regional level. Other challenges are how to develop a sufficient coverage of archetypes, how to handle non-observations and process related information.

However there is broad agreement that the archetypes are very useful for structuring clinical content specifications and sharing of clinical content for Observations, and that is it likely that archetypes can be used for exchange of selected data, i.e., for central reporting, harmonisation of data for clinical databases, etc.

5. Conclusion

The conclusions arise from the regional track, the vendor track and the common workshop. The main viewpoints are that the archetype methodology is very useful for representing clinical content specifications of the type Observation. Furthermore, it is seen as favourable that the clinical content specifications can be stored, exchanged and imported in a standardized, machine readable format (ADL).

Vendors assess that archetyping is a useful technique for import of semantically rich data specifications into their systems. After adding user functionality and constraints in their own configuration module, data entered in the resulting entry screens can be integrated with their own data.

Vendors believe the openEHR specifications can contribute to semantic interoperability and is a candidate for national logical infrastructure. However, more experience and pilots are needed before a decision can be supported. As a starting point archetypes could be used as a common reference for selected data that is exchanged, i.e., for central reporting and to clinical databases.

Regarding non-observation archetypes there are differences between the vendor and openEHR reference models that need to be resolved over time. For designing clinical systems process related data and specification of the user interaction is also needed. Archetypes are probably less suitable for representing this kind of information.

Regions and vendors assess that governance is a big challenge and information/experience on how this should be handled on a large scale is required.

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