Socio-technical Requirements for Expert Users to Design Structured User-Interfaces for OpenEHR-based Electronic Health Records

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Background

• The main purpose of medical quality registers:
  • to contribute to better quality for the patient,
  • to reduce unwanted variation in the quality of treatment and care.

• In Norway:
  • 51 National Medical quality registers.

«Good health registers, better health»
The aim of the paper

- Describe and discuss the socio-technical challenges related to expert users designing and electronic openEHR-based forms in relation to:

  - The complexity of the design tools
  - The compromise between instant benefit and long-term requirements
  - The need for extensive governance for user-designed software
  - The importance of contextualization
Research question

• Which socio-technical challenges are addressed when expert users design openEHR-based forms?
The empirical project

The implementation of an openEHR based EPR system
Collaboration with the Norwegian registry for spine surgery

Design an electronic registry form to include in the openEHR based EHR system

The paper form

The EPR

The new electronic form
Method

- We have used a qualitative action research approach, with the objective of contributing to a co-constructive learning process for stakeholders in the implementation program, the surgeons, developers, and the researchers.
- The study was done according to Creswell's three elements of action research.
- The data collection is described as follows:

<table>
<thead>
<tr>
<th>Participatory observation</th>
<th>Meetings/workshops with:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Participated in the design process</td>
<td>The vendor</td>
</tr>
<tr>
<td>Mapping variables to archetypes</td>
<td>Clinicians</td>
</tr>
<tr>
<td>Design archetypes</td>
<td>Project management</td>
</tr>
<tr>
<td>Designing templates (OET/OPT) and the form</td>
<td>Members of OpenQ-reg Registry</td>
</tr>
<tr>
<td>In total 320 hours</td>
<td>National Archetype Administration</td>
</tr>
<tr>
<td>In total 50 hours</td>
<td></td>
</tr>
</tbody>
</table>

Data collection from November 2018 to March 2019
The design process

Methodology for structuring EHR forms

- Coherence between the design tools
- From archetype to template
- From template to form
- Use national or local archetypes
- Mapping variables and archetypes
- Knowing the design tools
1) The mind map was used to get an overview of the variables in the paper-based form.
2) The Archetype Editor was used to design archetypes
3) The Template Designer was used to align and constrain archetypes into a template for this specific use case.
4) The Form Designer was used for configuration the template into the registry form – the user interface for clinicians.

Expert users designed the structured registry form for the EHR
Mapping variables and archetypes

Variables identified and placed in a mind map in XMind

Variables mapped against existing archetypes
Use National Archetypes or Develop Locale

- It is preferable to use national approved archetypes to ensure semantic interoperability of clinical information

- **National archetypes**
  - High quality nationally approved information models
  - Reusable
  - Complex data models that demands extensive adjustments
  - Time consuming to fill out

- **Local archetypes**
  - Simple data models
  - Only locally approved by the design team, NRUA and the vendor
  - Contain several clinical elements that cannot be reused separately
  - Have to be reused as a whole

The decision was made to design mainly local archetypes
Coherence between the Design Tools

- To design local archetypes, the Ocean Informatics’ Archetype Editor was used.
- The Archetype Editor has a given set of data types used to design clinical variables as data elements in an archetype.
- If it was uncertain how the variable would be used in the form, it was possible to design different data elements representing the same variable.
From Archetypes to Template

The archetypes were assembled in a template by using Ocean Informatics' Template Designer.

Archetypes were constrained in the Template Designer, in terms of making data elements/variables inaccessible.
From template to form

- The template is exported to DIPS Form designer
- Dependencies, relations and calculations are added
- User interface defined in collaboration with clinicians
## Methodology for Structuring EHR Forms

<table>
<thead>
<tr>
<th>Tasks</th>
<th>Collaborating partners</th>
<th>Responsible part</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Archetype work</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mapping archetypes and existing variables</td>
<td>Expert users, NRUA, clinicians,</td>
<td>Expert users</td>
</tr>
<tr>
<td>Decide to using local or national archetypes</td>
<td>Expert users, NRUA, Vendor</td>
<td>Expert users</td>
</tr>
<tr>
<td>Designing local archetypes</td>
<td>Expert users, NRUA, Vendor, clinicians,</td>
<td>Expert users</td>
</tr>
<tr>
<td><strong>Template Design</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Design a template from the archetypes</td>
<td>Expert users, Vendor, NRUA</td>
<td>Expert users</td>
</tr>
<tr>
<td>Constrain archetypes if needed</td>
<td>Clinicians</td>
<td>Expert users</td>
</tr>
<tr>
<td><strong>Forms design</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Upload template to the Form Designer</td>
<td>Expert users</td>
<td>Vendor/ICT department</td>
</tr>
<tr>
<td>Define dependencies, annotations, calculations etc. between archetypes</td>
<td>Expert users, clinicians, Vendor and/or ICT consultants in health organizations</td>
<td>Vendor/ICT department</td>
</tr>
</tbody>
</table>
Socio technical challenges of the design process

- The complexity of the design tools
- The compromise between instant benefit and long-term requirements
- The need for extensive governance for user-designed software
- The importance of contextualization
The complex design tools

- The four design tools available for the expert users are quite complex to use.

- Everyone can download the mind map tool and the tools from Ocean Informatics.

- Using the tools requires extensive training of the expert users.

- Each step conducted in each of the different tools are interdependent to make the overall infrastructure evolve.

- Important to include clinical experts and technical competence to end up with a user friendly form.

- This demand for expert users taking the role as translators between ICT and clinical practice.
Compromise between instant benefit and long-term requirements

Bootstrapping. Efficient design process for instant use, low hanging fruits

Adaptability: Designing robust archetypes for scaling and long-term use

Adaptability is the ability to change (or be changed) to fit altered circumstances.
The need for extensive governance for user-designed software

• Structuring user interfaces is a complex infrastructuring process

• Demands for an extensive IT governance organization for
  • Storing and retrieving local and national archetypes used
  • Storing variables, forms, and dependencies for forms
The importance of contextualization

- Nationally approved archetypes are developed through a thorough design process managed by high-qualified expert users
  - developed as maximum datasets to be useful in any clinical context and for different clinical specialties
  - National approved archetypes constitute the basis for semantic interoperability in openEHR-based systems

- This adheres to the II design principle of standardization, and the importance of communicating through defined clinical standards

- Maximum datasets, need to be contextualized, i.e., constrained and tailored to specific use contexts

- In line with the openEHR specification, configurations must be done by local health care organizations
Conclusion

Expert users must designing high quality structured forms

Balance between an efficient design process and robust archetypes

Establish extensive governance for user-designed software

Contextualize national high quality archetypes to different local contexts
Thanks for listening 😊