A Review on Usability Features for Designing Electronic Health Records

Luis Bernardo Villa
Ivan Cabezas

The 1st International Workshop on Reliability of eHealth Information Systems

In conjunction with
16th International Conference on E-health Networking, Application & Services (HealthCom 2014)
October 15-18, 2014, Ponta Negra, Natal-RN, Brazil.
Content

• Introduction
• Problem Statement
• Usability Standards
• EHR Usability
• Contribution
• Final Remarks
Introduction
Electronic Health Record

- Electronic Health Record – EHR

- EHR: Health information of a person, which is created, gathered, managed, and consulted by authorized health care clinicians and staff
EHR Requirements

- An EHR should:
  - Be available
  - Gather complete and reliable data
  - Allow a timely access
  - Bring support to clinicians staff on decision making

(Goldberg et al., 2011) (Thizy, 2013)
Problem Statement
Problem Statement

The considered problem is two fold:

- Users are ignored during the EHR design process, leading to a low usability EHR

- There is a lack of clarity regarding how to incorporate users’ requirements in EHR design

(Gans, Kralewski, Hammons, & Dowd, 2005)
Research Questions

The addressed problem raises the following research questions:

- ¿How to achieve a usable EHR?

- ¿How to incorporate users’ requirements within EHR design?
Usability Standards
ISO 9241-210 Standard

- Identify Need for human centred design
- Understand and specify organizational requirements
  - System satisfies specific user and organizational requirements
  - Evaluate designs against requirements
  - Understand and specify context of use
  - Produce design solutions

(ISO, 2010)  
(Travis, 2011)
ISO 9241-11

Concept of Usability (ISO 9241-11)
The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use.

- Effectiveness
- Efficiency
- Satisfaction

Interaction design supports usability

Dialogue Principles (ISO 9241-110)

- Suitability for the task
- Conformity with user expectations
- Self-Descriptiveness
- Controllability
- Suitability for Individualization
- Error Tolerance
- Suitability for learning

Information design supports interaction design

Characteristics of Presented Information (ISO 9241-12)

- Clarity
- Conciseness
- Detectability
- Comprehensibility
- Discriminability
- Consistency
- Legibility

NISTIR 7741

(National Institute of Standards and Technology NIST, Schumacher, & Lowry, 2010)
<table>
<thead>
<tr>
<th>Direct involvement of Users</th>
<th>Indirect Involvement of Users</th>
<th>Additional Methods and Techniques</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observation of Users</td>
<td>Document-Based Methods</td>
<td>Log Files</td>
</tr>
<tr>
<td>Performance-Related Measurements</td>
<td>Model-Based Methods</td>
<td>Video Capture</td>
</tr>
<tr>
<td>Critical Incidents Analysis</td>
<td>Expert Evaluation</td>
<td>Scan Converter</td>
</tr>
<tr>
<td>Questionnaires</td>
<td>Automated Evaluation</td>
<td>Electronic Surveys</td>
</tr>
<tr>
<td>Interviews</td>
<td></td>
<td>Parallel Design</td>
</tr>
<tr>
<td>Thinking Aloud</td>
<td></td>
<td>Focus Group</td>
</tr>
<tr>
<td>Collaborative Design and Evaluation</td>
<td></td>
<td>Brainstorming</td>
</tr>
<tr>
<td>Creativity Methods</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(ISO, 2002)
Usability of Electronic Health Records
EHR Design

**Principles of Quality Management**

**User-Centered Design**

**Patient Safety Events**

**CRITERIA** | **CONSIDERATIONS**
---|---
**Strategy** | Associated to a development stage when the evaluation is performed.
**Location** | Related to where the evaluation is performed.
**Prejudice** | Subjectivity or objectivity inherent to a method which will affect the outcome.
**Measure of Usability** | Type of measurement provided by a method (i.e. quantitative or qualitative).
**Information** | Granularity of the response provided by a method.
**Immediateness of Response** | Speed with which a method generates a response.
**Intromission** | Changes in user behavior due to an evaluation scenario.
**Cost** | Required resources to perform an analysis and an evaluation.

(Armijo, McDonnell, & Werner, 2009)
EHR Usability Evaluation
Usability Evaluation Methods

USABILITY EVALUATION METHODS

Expert Analysis
- Cognitive Walkthrough
- Heuristic Evaluation
- Expert-Based Evaluation
- Focus Group

User Participation
- Technical Consultations and Interviews
- Empirical Methods
- Monitoring Physiological Responses
- Techniques Based on Observation

ISO (2002)
(Vadakumacherry, 2011)
EHR Evaluation
Usability Protocol

Step I: EHR Application Analysis

- Identify critical use risk

Step II: EHR Interface Expert Review

- Identify UI design issues and iterate design
- Describe remaining UI issues

Step III: EHR Validation Testing

- Critical safety test scenarios

Final EHR User Interface

(Lowry et al., 2012)
Contribution
Proposed Interpretation of the ISO 9241-210 Standard
## Prioritization of Usability Characteristics

- **Case of study:** EHR focused on patients on an emergency situation

<table>
<thead>
<tr>
<th>Characteristic / Design Component</th>
<th>User Centered Design</th>
<th>Principles of Quality Management</th>
<th>Patients Safety Events</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learnability</td>
<td>LOW</td>
<td>NONE</td>
<td>LOW</td>
</tr>
<tr>
<td>Operability</td>
<td>HIGH</td>
<td>MEDIUM</td>
<td>MEDIUM</td>
</tr>
<tr>
<td>Protection against user errors</td>
<td>HIGH</td>
<td>HIGH</td>
<td>HIGH</td>
</tr>
<tr>
<td>Aesthetics of the user interface</td>
<td>MEDIUM</td>
<td>NONE</td>
<td>NONE</td>
</tr>
<tr>
<td>Intelligibility</td>
<td>LOW</td>
<td>HIGH</td>
<td>HIGH</td>
</tr>
<tr>
<td>Accessibility</td>
<td>MEDIUM</td>
<td>NONE</td>
<td>LOW</td>
</tr>
</tbody>
</table>
Prioritization according to UCD

- **HIGH**
  - Operability
  - Protection against user errors

- **MEDIUM**
  - Accessibility
  - Aesthetics of the user interface

- **LOW**
  - Intelligibility
  - Learnability
Prioritization according to Principles of Quality Management

- **HIGH**
  - Intelligibility
  - Protection against user errors

- **MEDIUM**
  - Operability
Prioritization according to Patient Safety Events

- **HIGH**
  - Intelligibility
  - Protection against user errors

- **MEDIUM**
  - Operability

- **LOW**
  - Accessibility
  - Learnability
Final Remarks
Final Remarks

- The proposed interpretation of the ISO 9241-210 UCD was conceived in the context of patients in an emergency situation.

- Protection against user errors, intelligibility and operability are among the main characteristics that a usable EHR should fulfill.

- Proposed interpretation of the standard may be used beyond an EHR design process.
Final Remarks (ii)

- EHR usability is a key factor within an e-Health system
- The goals of the proposal and the presented characteristics prioritization, as well, are:
  - Guide developers to achieve and improve an EHR usable design
  - Consider principles of quality management and patient safety events
  - Improve acceptance rates of e-Health systems by physicians
  - Reduce adverse events caused by human error due to lack of information about patients
References

Thanks  Obrigado  Gracias
A Review on Usability Features for Designing Electronic Health Records

Luis Bernardo Villa
Ivan Cabezas
Support Slides
Usability

- "The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction in a specified context of use."

- The effectiveness, efficiency and satisfaction with which specified users achieve specified goals in particular environments.
  - Effectiveness: the accuracy and completeness with which specified users can achieve specified goals in particular environments
  - Efficiency: the resources expended in relation to the accuracy and completeness of goals achieved
  - Satisfaction: the comfort and acceptability of the work system to its users and other people affected by its use

(ISO, 1998)
# Usability Characteristics

<table>
<thead>
<tr>
<th>Characteristic</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Learnability</td>
<td>Degree to which the software product allows users to learn its application</td>
</tr>
<tr>
<td>Operability</td>
<td>Degree to which users find the product easy to use and control</td>
</tr>
<tr>
<td>Protection against user errors</td>
<td>Degree to which the system protects users from making mistakes</td>
</tr>
<tr>
<td>Aesthetics of the user interface</td>
<td>Extent to which the interface allows an enjoyable and satisfying user interaction</td>
</tr>
<tr>
<td>Intelligibility</td>
<td>Extent to which the software product allows users to recognize whether the software is suitable for your needs</td>
</tr>
<tr>
<td>Accessibility</td>
<td>Ease of use and safety for users with specific disabilities</td>
</tr>
</tbody>
</table>

(ISO, 2011)
ISO 9241-210

Current Approach

- Identify Need for human centred design
  - Understand and specify organizational requirements
    - Evaluate designs against requirements
      - Produce design solutions
        - System satisfies specific user and organizational requirements

Proposed Interpretation

Understand

- Understand and specify context of use
  - System satisfies specific user and organizational requirements
  - Evaluate designs against requirements
    - Produce design solutions
      - Identify Need for user centred design

Design