A Framework for User Involvement and Context in the Design and Development of Safe e-Health Systems

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Issues of Context of Use in Healthcare IT Design/Testing

- Involving users in Heath IT research and development is complex, and exhaustive testing under a range of conditions of use is difficult.

- Issues of lack of fit of Healthcare IT with end users
  - Complexity and variety of healthcare environments makes this difficult.
  - Need to know all classes of possible users, range of possible tasks and understanding of different conditions of use.
Issues Continued

- How “users” are defined, who are they, and what they are engaged in (i.e. what tasks) – issues regardless of development methodology chosen (Kushniruk & Turner, 2011)

- Additional issue of understanding the range of contexts health information technology will be used in – how the system will be used in different settings – Perhaps biggest challenge for healthcare IT
Socio-technical approaches argue for importance of users, and technological innovation is a social process, needing in-depth formative evaluation in specific social contexts.

However, frameworks for practically considering the following question are needed:

– Under what conditions does a technology work in healthcare contexts and when doesn’t it?
To develop understanding of:

- User goals – what are they ultimately trying to achieve?
- What personal, social, and cultural characteristics do different users bring?
- How are users influenced by different environments?
- How does users’ previous knowledge and experience influence their work?
- What do users value most that will make a system useful/usable for them?
Steps in Conducting a User-Task Analysis

1. Assemblage of a group who regularly interact with the users – a "user profile team"
2. Brainstorming of a preliminary list of users and potential uses (tasks)
3. Creation of a user/task matrix or a user/characteristic matrix to serve as an initial model
4. Discussion of the characteristics assumed to be typical of the user community
5. Deciding on how to test user assumptions
6. Testing of assumptions on users and tasks – results of testing can be fed back into refinement of user model (in iterative cycles)
### Initial user/task matrix for HIT communication software

<table>
<thead>
<tr>
<th>Users</th>
<th>Getting comfortable with software</th>
<th>Basic use</th>
<th>Advanced use</th>
<th>Training patients</th>
<th>Customizing the software</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patients</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Patient families</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Novice clinicians</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>Expert clinicians</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
<td>X</td>
</tr>
</tbody>
</table>
Advantages

- User-task analysis forms initial model of users and their uses of technology
- User/task matrix can be effectively used to drive use case development during:
  - Early development in user requirements specification
  - During development in selecting “participants” from the “user contingent”
  - Later in development cycle in testing
Towards a Multi-Dimensional Framework for Considering Use of Health IT

- Traditional approaches to user and task analysis are important and essential to development of Health IT.
- However, Health IT continues to be developed with inadequate knowledge of:
  - The specific and varied contexts of use of the IT
  - Need for addition of 3rd dimension – healthcare context
A 3-Dimensional Framework for Health IT Use – Extending the User-Task Matrix to User-Task-Context Cube

USER DIMENSION
- experience/expertise
- age
- gender
- language skills
- health profession
- job level
- education

TASK DIMENSION
- specific function of task
- technical requirements of task
- task activities
- task complexity
- Expected successful completion and error rates

HEALTHCARE CONTEXT DIMENSION
- physical location
- urgency
- uncertainty
- time constraints
- multiple players
- organizational goals and norms

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Application in Design and Testing of HIT Software

- Constitutes an initial model of users, their tasks and the impact of setting and context – specification of all 3 dimensions

- Empirical validation of the model
  - Observation, interviews, questionnaires, user profile focus groups

- Development of design use cases based on this

- Development of test use cases (later in SDLC) also based on this type of analysis – going back to the initial model from requirements to test if they are achieved in completed system
Implications for Improving Adoption of HIT

- Matching of technology to right contexts
  - Providing realistic expectations is key
    - e.g. use of speech recognition embedded in EMRs
      - Not as applicable for dictation tasks in noisy clinical context as in private office context
  - Improved understanding under which conditions (e.g. setting or environment) specific system components or features are useful (and when they are not expected to be useful)
Implications for Safety of HIT

- Better matching of technology to “safe” context of use
- Can use the framework to characterize both safe contexts of use and unsafe contexts of system use
  - E.g. rigid bar-coding medication administration system may increase safety in non-urgent settings but may constitute safety risk in emergency contexts
Application in Gathering Requirements for a Healthcare Data Warehouse

- Current work -- refining user requirements for a regional health data warehouse
- Application of user-task matrix helped to define new categories of users (and uses) that had not previously been considered (as input into design phase)
  - Previous requirements gathering left out key user categories
- Addition of context dimension lead to refined understanding of requirements for each of those user classes
Assumptions about users and adequacy of understanding context of use of HIT need to be analyzed, explicitly stated and validated
- not doing this constitutes a major risk

Software engineering literature repeatedly shows lack of adequate understanding of end user interactions with systems is one of largest factors in failure of IT projects – Boehm

Need to understand use of system in contexts
- This should be explicitly modeled
- Particularly essential in healthcare!