

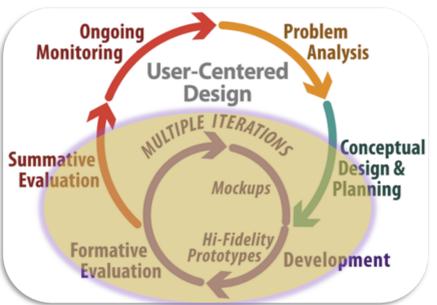
Tracing a User-Centered Design Process to Validate Guidelines for Clinical Decision Support

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Computerized decision support (CDS) has and will continue to be an important feature of Electronic Health Records (EHRs). On behalf of the Office of Knowledge Based Systems, Health Informatics, Office of Informatics and Analytics at the Veterans Health Administration, one of the authors published a draft formulation of Usability guidelines for Clinical Decision Support (Miller, 2014). The Draft Guidelines address past concerns about CDS by providing guidance about the presentation of CDS functionality in user interfaces (UIs) based on knowledge of human cognitive work and decision making in real-world healthcare environments.

In order to assess the usability and utility of the Guidelines, a vendor team attempted to implement five CDS User Interface Interventions (CDS UI Interventions). The vendor team (comprising the first three authors and additional team members) followed a User-Centered Design (UCD) approach, implementing the CDS UI Interventions in wireframes, mockups and prototypes, and conducted formative and summative evaluations of the successive implementations.



Weinger, M. (2013). Perils and Pitfalls of Anesthesia Displays. Paper presented at the Annual Meeting of the Society for Technology in Anesthesiology.

Effort focused on a portion of the UCD process, covering design through multiple iterations of evaluation and development.

CDS Interventions of Interest

Pending Action/ Lost to Follow-up (PA/LTF)

Out-of-Range Notifications (OORN)

General Notifications (GN)

Drug Allergy Notification (DAN)

Drug- Drug Interaction (DDI)

CDS Guidelines

- Facilitate rapid situation assessment in routine situations
- Support plans in action by tightly linking plans and actions over time
- Support global SA

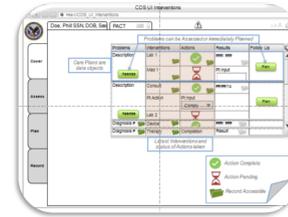
- Highlight atypical data values
- Show all pertinent dimensions of the situation for data entry
- Display relationships that are pertinent to the situation

- Support routine and a priori projection of plan-action relationships
- Support execution by actively monitoring against task and goal dependencies

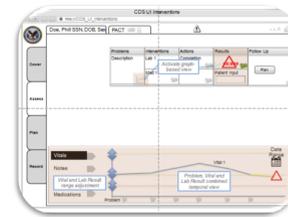
- Support perception of parameter-plan-action relationships
- Support execution by actively monitoring against task and goal dependencies
- Support the representation of future states or events

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Wireframe Concepts



Problem-based care plan providing most recent problems, interventions and status. Enables action and/or sense making.



Out-of-range alerting, presented in context for individual patient and with trending data.

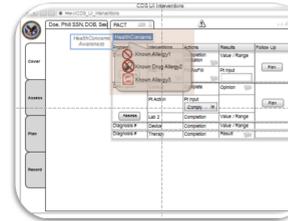


Notification awareness without intrusion. Updating based on current patient status and care plan.



Persistent allergy information throughout diagnostic and care planning.

Also applicable



Flexible care plan revision to mitigate potential interactions.

Sample Formative Feedback

- “Great in theory, but in practice there are many issues”
- “Having BOTH problem based screens (with Primary problem associated with each order) and Action/Intervention based screens would be helpful to review”

- “This kind of display for medications actually could be quite useful in some clinical settings”
- “Medications and their timing is very clear, and that’s excellent. Seeing correlations.”

- “I would use this to prompt me to remind me about thing I would otherwise forget in the rush of a schedule.”
- “Three boxes, fairly easy to click on, about my thinking.”

- “Like going from problem charted, to taking action.”
- “Medications is nice, clean list. Just shows general, without being cluttered with dosage and frequency.”

- “Integrated medication search into care plan – I’m sure that’s convenient if I’m using it real-time”
- “The alert text is clear, not complicated.”

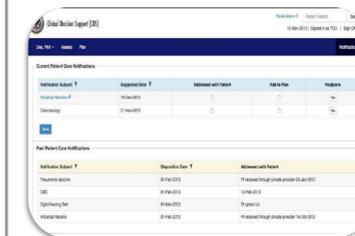
Prototype Implementation and Summative Results



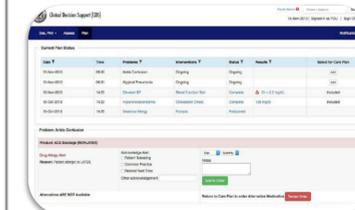
- Content and action pathways were understood by some
- Mostly well received as a design concept, following orientation
- Visual notification of the Panel Alerts was not often noticed



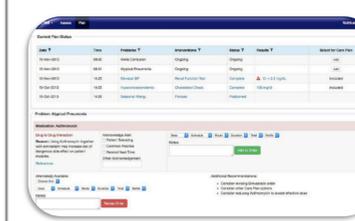
- Content and action pathways were broadly understood
- Well received, particularly trend data graphs
- Visual notification was broadly noticed



- Visual notification was rarely noticed
- Content and action pathways were broadly understood



- Content and action pathways were understood by some
- Confusion regarding need for an alert if no alternative pathways are available



- Content and action pathways were broadly understood
- Well received, particularly the alternative pathways for resolution

The effort was constrained by a number of factors. Participant engagement during formative evaluation was limited to only 9 participants, owing to the difficulty of scheduling a time-constrained clinical workforce. All evaluations were conducted via online conferencing, which frequently constrained the already limited time participation.

In order to evaluate each intervention, it was necessary to develop a framework UI, which in turn limited the level of effort that could be devoted to implementing multiple design concepts. Thus, only one design version for each intervention was evaluated.

Early design concepts called for extensive interactivity, including the use of linked data, drag-and-drop data objects, and flexible, multi-option action sequences. Early expression of these concepts was limited by the expressive capacity of the wireframes medium (PowerPoint). Later implementation of the concepts was limited by the adoption of certain programming toolkits. Interactivity was limited to hyperlinking, static images representing dynamic states, and single-pathway sequences.

CDS Guidelines were useful starting point for design considerations.

Effort revealed numerous challenges to effective and efficient implementation of UCD.

Voluminous data were generated regarding clinical perspectives on the design concepts, which should prove useful to future CDS implementations.

Recommendations for future UCD efforts include the need to rapidly generate multiple design concepts, and the need for highly interactive prototypes.