Usability and Human Factors

Electronic Health Records and Usability
Lecture c

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Electronic Health Records and Usability

Learning Objectives

1. Explain how user-centered design can enhance adoption of EHRs (Lecture c)
2. Discuss the role of usability testing, training and implementation of electronic health records (Lecture c)
3. Describe Web 2.0 and novel concepts in system design (Lecture c)
4. Identify potential methods of assessing and rating EHR usability when selecting an appropriate EHR system (HIMSS document) (Lecture c)
Usability Challenges in Healthcare

Complex needs, time pressure

Vary from setting to setting, specialty

50 specialties; other professions
  - (OT, PT, pharmacists, respiratory therapists etc.)

Team-based work

Clinician mobility, primary focus on patient (should be)

Legal, ethical, errors, high-stakes

Multiple standards, evidence-based Medicine

Hard to get clinician feedback

Confidentiality makes in situ observation, testing difficult

Cost of change (time, vendor, consensus, cost)

Interruptions, time pressure, institution policies
More issues

- Clauses mean institution liable
- Clinician responsible even if no choice or access to guts of software
- 25% medication errors (2006) involved computer technology
- 82% of these CPOE/data entry

Hold harmless

Learned intermediary

Patient Safety
Basic Minimums

Usability = Efficiency of use + usefulness + ease of use?

For EHRs, we want to:

- Minimize likelihood of user error
- Provide cognitive support – guide interaction to foster good work, no errors

Avoid:

- Errors of commission: e.g. wrong patient chart
- Errors of omission: e.g. fail to notice abnormal result
- Failure to complete task (due to interruption and no handling of interruption)
Evidence-based Usability/Cognitive Support

• Usability is not just screen or software design
  – Affected by workflow, time pressure, physical space layout, lighting, policies for use, and even user experience during implementation

• Design needs to be evidence based, and evidence is available
  » Karsh, 2010
Fact:
• Healthcare is complex, training will be required

Myths:
• No training needed with good usability
Fact:
- Users not trained in science of usability and cognition
- What they want may be wrong, mis-specified, or inarticulate

Myth:
- User-centered design = give users what they want
Evidence-based Usability/Cognitive Support (cont.)

Myth:
• Health IT should integrate into workflow

Fact:
• Healthcare workflow is emergent
• what is needed is more flexible availability of data
Evidence-based Usability/Cognitive Support (cont.)

• Usability is not a fixed target
• Don’t think we have the answers
• Ongoing research is needed

» Karsh, 2010
Evidence-based Design Exists: AHRQ Resources

Electronic Health Record Usability:
- Interface Design Considerations: Recommended actions to support development of an objective EHR usability evidence base, formative policies
- Evaluation and Use Case Framework: literature and best practices regarding the usability of EHRs, use cases for primary care IT evaluation
- Vendor Practices and Perspectives: current usability processes, practices, and perspectives of certified EHR vendors

• Available at: http://healthit.ahrq.gov

“In routine handling, the Sorrento feels responsive in corners, with nicely weighted, quick steering… The gated zigzag shifter is awkward to use”

“It posted a commendable speed through our avoidance maneuver. Avoidance maneuver, max. spd: 51.5 mph. 0 to 60 mph: 7.6 sec”

Two Voices in Consumer Reports Car Reviews
Subjective v. Objective

Subjectivist/Qualitative ("art criticism")
- Not everything of importance can be quantified
- Differences of opinion are okay
- The value is in the “thick description”
- Rigorous methods exist (one is formal criticism)

Objectivist/Quantitative
- Believable knowledge derives from measurement of attributes that are inherent in objects
- All observers should agree on measurement results (inter-subjectivity)
- On what result is “better” (polarity)
  - Accuracy
  - Response time
  - Time to identify / Time spent searching
  - Eye gaze
Heuristic Evaluation

Expert(s) evaluate system according to heuristics (Norman)

10 main axes:

• 1. Visibility of system status
• 2. Match between system and the real world
• 3. User control and freedom
• 4. Consistency and standards
• 5. Error prevention
• 6. Recognition rather than recall
• 7. Flexibility and efficiency of use
• 8. Aesthetic and minimalist design
• 9. Help users recognize, diagnose, and recover from errors
• 10. Help and documentation
Focus Groups

Use for formative evaluation

• Find out information designers can use
• What should the system do?
• What are users worst problems?
• What is their workflow?
• How do they do the task now?

Use for summative evaluation (after system is built)

Method: get typical users to view and discuss system and related ideas

• Group similar users together
• Don’t put supervisors with staff (people should feel free to speak)
Focus Groups (cont.)

- Prepare open-ended questions, not yes/no
- Provide fixed time, food
- Compensate users
  - Clinicians are busy and highly paid
  - Compensate appropriately, e.g. $100/hour
- Get permission in writing
  - Institutional Review Board
- Define privacy policy
  - e.g. participants will be anonymous in any publications, talks
Focus Groups (cont.)

Record meeting (two digital or tape recorders); obtain permission of subjects

Transcribe and code thematically
Usability Testing
Think aloud, in-lab

• Subject (typical user) uses system in quiet office, software captures video of their screen actions and voice (and face, if desired)
• User is told to think aloud while using software for typical tasks
• Video is coded and analyzed for themes, action patterns, problems, time for tasks…
• Morae software is a common tool
  – http://www.morae.com
  – Requires webcam with sound, can do remote testing
• Video can be edited for administrators, clients, decision-makers, programmers
Field Usability Testing

Examine user’s interactions in their normal workplace setting

Field observation

• Important method to establish conditions of work, workflow

Answer questions such as

• What are time constraints, interruptions, noise, information sharing with colleagues, information flow, information sources, needs, team members?

Observation, log file analysis, user interviews, and perhaps remote

• Morae testing will be the main methods

Problems not detected in a laboratory test likely to come to light after deployment

Monitor usage closely soon after deployment
Cognitive Walkthrough

• Method of inspecting software for problems
• Have goal, sub-goal, actions taken, system response, potential problems
• Classify problems:

1. Cosmetic
   • Need not be fixed unless time available

2. Minor usability
   • Low priority for fix

3. Major usability
   • High priority

4. Usability catastrophe
   • Imperative to fix
Scenes from a Walkthrough

Context: Patient Presents with a medical problem to a Family Physician’s Office
Task: Diagnostic Reasoning

Goal Structure and Action Sequence
Goal: Represent chief complaint
Chief Complaint: Patient complains that she has been feeling pretty tired for the past 6 months

Subgoal 1: Characterize Patient’s Observation of Tiredness
Action 1: Open Top-Level Category General Condition
System Response: Displays Findings Organized by Category
Potential Problem: System has sluggish response

Subgoal 2: Enter Finding Fatigue
Subgoal 3: Locate Finding
Action 2: Open Category/Select Finding "Fatigue"

Subgoal 4: Describe Severity/Quality
Subgoal 5: Translate quality "Pretty Tired" into Quantity indicating Severity
Action 3: Enter severity: Three +++
Action 4: Selects Quality: Lack of energy

Subgoal 6: Indicate Chronology
Action 5: Selects chronology duration of 6 months
System Response: Displays chronology in "years"
Potential Problem: “years” is not appropriate unit for 6 months

The Special Case of CPOE

• Poor CPOE design can facilitate medical error
  – e.g. overdose, wrong patient given drug
• Quantitative and qualitative studies show flaws leading to errors
• Many adverse drug events due to poor interface
• Heavy cognitive demands
Koppel: EHR Interface flaws

- Can’t clearly identify the patient
- Can’t view all meds on single screen
- Log-in/log-out failures
- Extra steps required to ‘activate’ orders
- Automatic cancellation of pre-surgical orders
- Downtime delays
- Orders near midnight interpreted as ‘tomorrow’
- Cumbersome interface – charting difficult
CPOE-related Usability Problems

Avoid:

- Deep navigational structures requiring multiple clicks
- Too close screen elements -> errors in selections
- Same color for data entry fields and others
- Long drop-down menus requiring scrolling
- Documentation templates different from clinician cognitive model of ordering
- Use of string sensitive data fields for abbreviations
- Excessive alerts, alerts which do not appear at appropriate time (when clinician would look for that information)
- Excess screen density, or too many screens
- Obscure hierarchies of orders or order sets
CPOE Design Recommendations

- View complete medication record on one screen, avoid scrolling/other screens/fragmentation
- Avoid subtle differences in layout, forms, labels for large functional differences
- Explicit time indications
- Map interface to ordering workflow
- Maximum 3 layers of screens
- Use consistent terms, organize elements into logical groups, separated by space, alignment
- Distinguish active and passive elements
- Consistent, sparing color
Technology Effects

Effects with technology

- How performance changes when one uses a system

Effects of technology

- Longer-term effects of technology on cognition, even when the technology is no longer being used
Information Gathering Strategies

- **Hypothesis-driven strategy:** Requests for information guided by clinician’s hypothesis independent of the screen displays.

- **Screen-driven:** Guided by the ordered sequence of information on the computer screen.

- **With experience:** Novice changed from hypothesis-driven strategies to screen-driven.
Study Results

• Paper-based records
  – Narrative form, with connected and linked text and sentences

• EMRs
  – More info on patient’s past medical history, lifestyle, and primary diagnosis
  – Information entered in point form, not linked in narrative
  – Followed structure and sequence of system
  – Time course not adequately captured

• Post EMR paper-based record
  – Closely resembled EMR in structure and format
  – No connecting narrative
  – Limited info on time course
Web 2.0 and Modern Approaches

‘Web 2.0’ is a change in internet approaches

- Give the user more control

Both philosophical approaches & technical approaches

Social networking applications

- e.g. Facebook

Crowd sourcing:

- Obtain information or judgment from a large group of users
Web 2.0 and EHRs

• Facilitate user control, a better user experience, new forms of interactive information display, and social networking

• Address problems of clinician collaboration, optimal design of EHRs, flexibility to meet rapid change, and other problems
Electronic Health Records and Usability
Summary

• EHR usability is a complex area in which we do not yet have standards, but best practices are being intensively studied
• Usability is one of the most important factors affecting adoption, satisfaction, and optimal use of EHRs
• Usability should be an important factor in selection and deployment of a system
• In the next two years much research will be done in this area; it is important to keep abreast of developments
Electronic Health Records and Usability

References – Lecture c

References


10. Khajouei, R., Jaspers, MWM. CPOE System Design Aspects and Their Qualitative Effect on Usability. eHealth Beyond the Horizon.