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Poll

Which best describes you?
A. Researcher
B. Programmer
C. Usability expert
D. Patient safety expert
E. Administration/policymaker
Objectives

1. HIT: Transforming Complex Work
2. Definition of usability
3. Relationship between usability and safety
4. Usability testing methodologies
5. Evaluation scenarios that ensure complexity
The Era of HIT and Complexity
“Adopt a proactive approach: examine new technologies …for threats to safety and redesign them before accidents occur.”

IOM report “To err is human” p. 150
Laments with Transformative HIT

• Some HIT workflows that do not match clinical processes create inefficiencies
• Poorly designed HIT screens that slow down the user and sometimes endanger patients
• Large numbers of files containing historical patient information that are difficult to search, navigate, read efficiently, and identify trends over time
• Confusing, and often conflicting, error messages
• Alert fatigue leading to users ignoring potentially critical messages
• Excessive mouse clicks, cursor movements, keystrokes, etc. during frequent tasks
Poll

What is your knowledge of usability testing?
A. Little knowledge
B. Know what it is
C. Have done a usability test
D. Expert in the area
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Definitions

Usability:
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

Patient safety:
System attribute that influences the risk of patient harm due to errors

Q: What is the relationship between these for HIT?
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Framework: Use Errors and Patient Harm

Use Error Root Cause (I)
- Wrong patient record open
- Wrong mode for action
- Inaccurate data displayed
- Incomplete data displayed
- Non-standard measurement system, convention, or terms
- User required to recall information
- Inadequate feedback about automation
- Corrupted data storage

Severity
Frequency
Detectability
Complexity

Risk Parameters (II)

Adverse Events (IV)
- Wrong patient
- Wrong treatment
- Wrong medication
- Delay of treatment
- Unintended treatment

Evaluative Indicators (III)
- Workarounds
- Redundancies
- User burnout
- Low task completion rate

Patient Harm
- Sub-standard care
- Morbidity
- Mortality
Use Error: Wrong Patient Record Open

EHR: Patient A

EHR: Patient B

Imaging: Patient A
Use Error: Wrong Mode for Action

Direct Dose Mode (mcg/min)
Weight Dose Mode (mcg/kg/min)

Test Mode
Production Mode
Use Error: Inaccurate Data Displayed

Lidocaine Hydrochlor
Use Error: Incomplete Data Displayed

80 mg
Use Error: Non-standard measurement system, convention, or terms

Kilograms or pounds?
Use Error: User Required to Recall Information

One Time Dose
Use Error: Inadequate Feedback about Automation

1 tablet
Use Error: Corrupted Data Storage

Next

Finish
Poll

Have you or a family member experienced this at least partially due to a design flaw with HIT?

A. Wrong patient
B. Wrong treatment
C. Wrong medication
D. Delay of treatment
E. More than one
Framework: Use Errors and Patient Harm

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Ohio State Medical Center
Adverse Events

Wrong patient: Actions with potentially harmful consequences are performed for one patient that were intended for another patient or a patient is not informed of the need for treatment

Wrong treatment: Treatments that were not intended for a patient are provided or missed

Wrong medication: A patient receives the wrong medication type, dose, or route

Delay of treatment: A patient receives a significant delay in the provision of care activities

Unintended or improper treatment: A patient receives unintended care due to confusion or due to actions taken to test software, train users, or demonstrate software to potential customers
Framework: Use Errors and Patient Harm

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- Non-standard measurement system, convention, or terms
- User required to recall information
- Inadequate feedback about automation
- Corrupted data storage

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Patient Harm
- Sub-standard care
- Morbidity
- Mortality
Solution 1: No Action
Solution 2: Sue the Builder

- Code of Hammurabi, 229

If a builder builds a house for someone, does not construct it properly, and the house which he built falls in and kills its owner, then that builder shall be put to death.
Solution 3: Name and Shame

Your contact details
When your complaint is added to the database, would you like your identity and all personal information kept anonymous?
- Anonymous
- Ok to use my name

Your name: 
E-mail: 
City: 
Telephone #: 

Complaint categories (select all that apply):
- refunds
- safety
- baggage
- incompetence
- rudeness
- mileage plus
- other, please specify: 
- special needs
- misinformation
- premier class
- in-flight seating
- in-flight meals
- unaccompanied minor
Solution 4: Summative Usability Testing

[Diagram of the three-step process:
- Step I: Application Analysis
- Step II: Expert Review/Analysis of EHR
- Step III: Usability Test]

NI STI R 7804 (DRAFT)

Figure 1. Three-step process for design evaluation and human user performance testing for EHR
Poll

What is your preferred primary approach to making HIT safer for patients?
A. No action
B. Patients sue the vendor
C. Anonymous reporting
D. Usability testing
E. Something else
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Usability Evaluation Methods: Overview

User Experience (UX) Methods

- Participatory design
- Card sorting
- Eye tracking
- Ethnographic research
- Summative usability testing
- Formative usability testing
- Surveys
- Focus groups
- Expert evaluation
- KLM-GOMS
- Cognitive walkthrough

Do not involve users vs. Involve users diagram.
Summative is Not Formative Usability Testing

- Formative usability testing
- Ethnographic research
- Focus groups
- Participatory design
- Card sorting
- Eye tracking
- Summative usability testing
- Surveys
Usability Testing Process

Kickoff / Discovery
Preparation
Data Collection
Analysis / Reporting
Use Error Checklist Items: Example

<table>
<thead>
<tr>
<th>1. A Patient Identification Error</th>
</tr>
</thead>
<tbody>
<tr>
<td>When a second patient’s record is open, is the first patient record automatically closed?</td>
</tr>
<tr>
<td>When a second user opens a patient chart, is the first user automatically logged out?</td>
</tr>
<tr>
<td>When another application (e.g., imaging) is opened from within the EHR, does the display have a title or header with an accurate unique patient identifier?</td>
</tr>
<tr>
<td>If an action will cause data to be destructively overwritten with another patient’s data, is the user alerted?</td>
</tr>
</tbody>
</table>
# Use Error Reporting Form: Example

<table>
<thead>
<tr>
<th>No.</th>
<th>Potential use error</th>
<th>Mitigation Plan</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.C.1</td>
<td><strong>Data accuracy error:</strong> Medication doses truncated in pick list menu makes it easy to pick the wrong dose</td>
<td>Do not truncate names at 40 characters, but instead display 75 characters and the remainder viewed upon mouse roll-over</td>
<td>High</td>
</tr>
<tr>
<td>1.F.6</td>
<td><strong>Recall error:</strong> Physicians might forget that patients have allergies to medications while ordering, even though it is displayed</td>
<td>Provide pop-up “Are you sure?” alerts when a physician orders and a pharmacist verifies a medication order to which a patient has an allergy</td>
<td>High</td>
</tr>
</tbody>
</table>
Use Error Tracking Form: Example

<table>
<thead>
<tr>
<th>No.</th>
<th>Date Found</th>
<th>Date Fixed</th>
<th>Date Fix Released</th>
<th>Reported?</th>
<th>Contact</th>
<th>Resolution</th>
<th>Related Issues</th>
<th>Priority</th>
</tr>
</thead>
<tbody>
<tr>
<td>2011-1.C.1</td>
<td>5/31/11</td>
<td>6/2/11</td>
<td>6/6/11</td>
<td>Yes</td>
<td>Smith, John</td>
<td>Medication doses truncated in pick list menu makes it easy to pick the wrong dose</td>
<td>2011-1.C.3</td>
<td>High</td>
</tr>
</tbody>
</table>

Clear: Closed
Green: Awaiting fix
Yellow: Analysis ongoing
Red: Newly reported, awaiting analysis
Summative Usability Report Elements

- Introduction
- Method
  - Participants
  - Design
  - Tasks
  - Procedure
  - Test location and environment
  - Usability metrics
- Results
- Discussion
  - Overall Results
  - Potential Use Errors
  - Effectiveness
  - Efficiency
  - Satisfaction
- Appendices
  - Test plan
  - Screener
  - Moderation Guide
  - Tasks
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# Scenarios: Target Characteristics

<table>
<thead>
<tr>
<th>Level</th>
<th>Integrity Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Surface validity</td>
<td>Professionals judge face valid and are engaged</td>
</tr>
<tr>
<td>Model of support</td>
<td>Impact on cognition; includes capability gaps</td>
</tr>
<tr>
<td>Justification for implementation</td>
<td>Assess claims; users’ and organization’s perspectives</td>
</tr>
<tr>
<td>Representative complexity</td>
<td>Nominal and challenging cases</td>
</tr>
<tr>
<td>Performance observability</td>
<td>Externally observable actions and utterances</td>
</tr>
</tbody>
</table>
Complexity Factors: Domain-Independent

- Data overload (Needle in a haystack)
- Attention demands (Attention bottlenecks)
- Missing information (Information gap)
- Uncertain Information (Unreliable data)
- No predefined procedure (Novel situation)
- Overconstrained task (Can’t do it all)
- Workload (Time pressured)
Embedded HIT Complexity Factors that Approach Real-World Complexity

• Increase dose of existing medication
• Drug interaction warnings: false alarms
• Taper dose for steroids
• First dose now and subsequent doses tomorrow
• Verbal order
• Change form of medication (PO to IV)
• Handoff
• Interruptions
• Follow-up documentation of prior work
• Batch transfer of medications
Scenario #1 Complexity Factors

- Documentation of activities dependent on provider recall (Removal of transdermal patch)
- Dealing with PRN Meds
- Dose escalation/”Taper” Dosing
- Sensitive Dx Documentation (Substance Abuse)

Ambulatory Care
Mid-level Provider
Diabetic Patient
Scenario #2 Complexity Factors

- Verbal order documentation
- Workflow interruptions
- Documentation of patient handoffs
- Inpatient to outpatient medication processing

Inpatient Care
Physician Provider
Cardiac Patient
Scenario #3 Complexity Factors

- Document change in DNR status (Removing DNR)
- Document I/O’s
- Documentation of medication administration

Critical Care
Nurse Provider
Cardiac Patient
Concluding Thoughts: Infrastructure Investments Are Easier Earlier

With present equipment, flying is so difficult that many individuals cannot learn to pilot an aircraft safely, and...human errors account for a major proportion of aircraft accidents...As aircraft become more complex and attain higher speeds, the necessity for designing the machine to suit the inherent characteristics of the human operators becomes increasingly apparent.

Fitts, 1947, reprinted in Karsh et al., 2010, p. 621
References: HIT/Usability


References: Patient Safety


Thank you for your attention!

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