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Preventing Technology-Induced Errors in Healthcare: Usability Engineering

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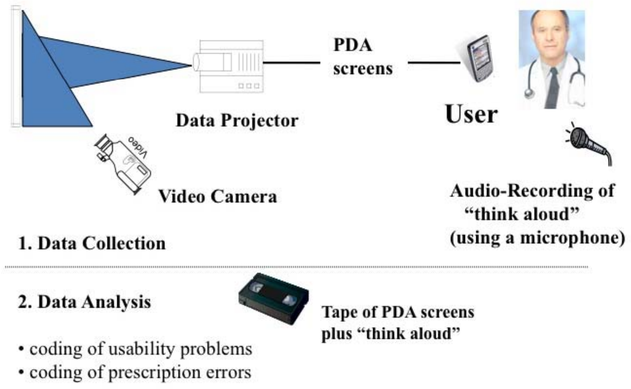
Usability Engineering in Health Care

Usability - Measures of "ease of use" of a system

1. Learning
2. Effectiveness
3. Efficiency
4. Safety
5. Enjoyability

- **Objective: Can usability analysis be used to predict errors in design before deployment of systems?**



1. Data Collection

2. Data Analysis

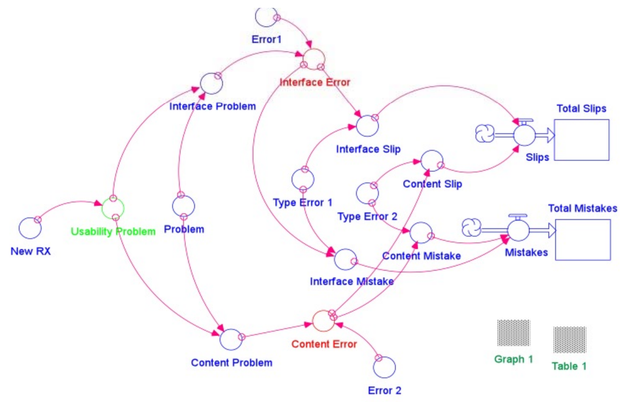
Tape of PDA screens plus "think aloud"

- coding of usability problems
- coding of prescription errors

Fig. 1 Portable Handheld Usability Laboratory (Kushniruk, Triola, Borycki, Stein, & Kannry, IJMI, in press)

Analysis and Results

- **The transcripts were coded in two independent passes**
  - To identify usability problems
  - To identify medication errors
- **Total number of coded usability problems – 73**
  - most frequent were problems related to display visibility (19), procedure (11), and data entry (9)
- **Total number of errors in entry of meds – 27**
- **37% of the identified usability problems were associated with a medication entry error**
- ***All* of the errors were associated with a coded usability problem**
- **Can predict how often usability problem will result in an actual error (for each class of problem)**



Technology Induced Error and Usability

A Continuum of Studies and Settings (from lab to real-world and back again)

LABORATORY

- Fixed usability lab
- Experimental tasks
  - "think aloud"
  - cognitive task analysis

- Simulations
- E.g. "simulated" doctor-patient interviews
- Computer-based simulations

NATURALISTIC

- Study in the real setting (e.g. clinic)
- "Virtual" usability lab
- Analysis of Web-based systems
- Data mining

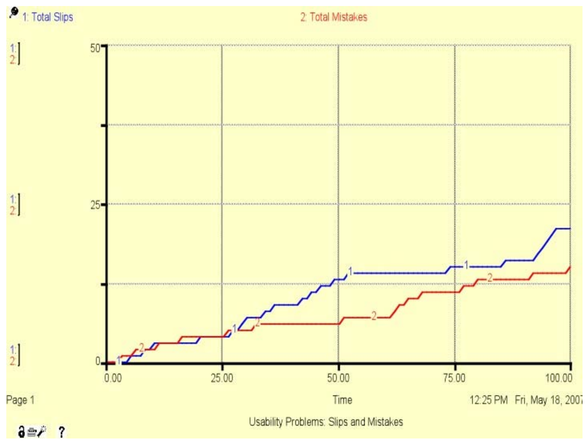
From: Kushniruk, "Evaluation in the Design of Health Information Systems" 2001

Evaluation Design

- Subjects
  - 10 physicians who were all experienced PDA users but who had not used the program being studied
- Procedure
  - Each subject received training on use of the program
  - Subjects were then asked to
    - Enter medications from a paper list (as accurately as possible)
    - Read a clinical scenario involving patient cases and enter medications
  - Subjects were asked to "think aloud"
  - All screens of the device were video recorded

Usability Problems and their Relationship to Medication Entry Error (using a PDA application)

Problem	# Usability Problems	Errors	% problem associated with error
EASE OF USE:			
Display Visibility	19	16	84.2
Procedure	11	0	0
Data Entry	9	7	77.8
Printing	8	1	12.5
Locating	6	1	16.7
Navigation	4	0	0
Speed	3	0	0
CONTENT:			
Database	8	0	0
Defaults	3	2	66.7
Training Manual	1	0	0



Low-cost, Portable Simulation and Usability Testing Environment

From: Kushniruk & Borycki (2006), Low-cost rapid usability engineering, Healthcare Quarterly

Example of Coded Transcript (of subject "thinking aloud" while entering a medication)

02:26 "Amoxillin, 250 capsules, po, two times a day, is that one of our options q8, darn, q8 hours times 7 days"

SUBJECT ENTERS 250 mg tid X 7 days (30 dispensed)

02:30 "Oh wait, I wanted to dispense, come back. Let me think about that, 7, 8, 24. He just got 6 extra tablets!"

USABILITY PROBLEM #1 – DISPLAY VISIBILITY – not clear that a drop down menu should be used in order to enter "q8h"

ERROR #1 MISTAKE – "tid" entered instead of "q8h"

USABILITY PROBLEM #2 – DEFAULT INAPPROPRIATE

Phase II – Input into Computer Simulation

Parameter	Value
New RX	Random Number (0-1)
Usability Problem	Probability = 1.00
Interface Problem	Probability = 0.84
Content Problem	Probability = 0.16
Interface Error	Probability = 0.41
Content Error	Probability = 0.167
Interface Slip	Probability = 0.52
Interface Mistake	Probability = 0.48
Content Slip	Probability = 0.50
Content Mistake	Probability = 0.50

Conclusions

- Combining results from clinical simulations with computer-based simulations may provide a useful approach to assessing the usability (and error rates) of healthcare systems
- The approach is being refined (and packaged) so that it can be disseminated into healthcare organizations
- Need for combination of clinical simulations with computer-based simulations to fully understand system impact

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