

## Usability: Past Work and Future Directions



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## Nancy's Research Interest(s)



- NI Competencies
- Human-Computer Interaction, Usability

## Your Backgrounds?



## Today's Discussion

- Why usability continues to be a timely topic
- A synthesis of usability research
- Suggested future directions for usability research
- Delving into a rich example: Change of shift report
- Conclusions



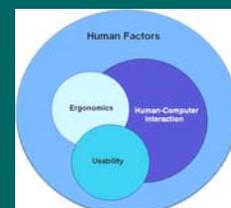
## Grounding the Concept of Usability

- Usability is the extent to which a *product* can be used by specific *users* in a specific *context* to achieve specific *goals* with effectiveness, efficiency and satisfaction

Adapted from ISO 9241-11, 2006

## Usability and Related Concepts

- Human Factors
- Ergonomics
- Human-Computer Interaction
- Usability



## One Aspect...



## Usability Goals

- **Improved effectiveness**
  - *Decision making*
  - *Safety*
  - *Fit with workflow*
- **Improved efficiency**
  - *Speed*
  - *Productivity (reduced interaction errors)*
- **Improved satisfaction**



## EHR/IT/CIS Penetration

- Electronic Health Records (EHRs), Personal Health Records (PHRs), Personal Digital Assistants (PDA) applications
- EHR penetration
  - HIMSS Analytics 2008, > 4,000 sites
    - 0.1% have a full EHR
    - 1.9% have Computerized Provider Order Entry (CPOE), Clinical Decision Support Systems (CDSSs)
    - 32.9% have clinical documentation
    - Self-report data



## Usability and CPOE

- Health care practice
  - Positive press about the impact of CPOE on patient safety but integration into workflow is imperative
  - Institute of Medicine
    - Health Information Technology as a solution to errors
  - Leapfrog Group
    - Computerized Provider Order Entry (CPOE)

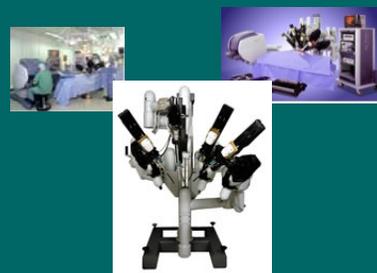


## Systems Penetration

- Obama's ARRA package
  - Nearly \$20 billion for health information technology
  - HIT is seen as a solution
- David Brailler (2009)
  - 200,000 informatics specialists needed



## Da Vinci Surgical System



## Continuum of Information and Technology in Nursing Practice

Nurse using technology to support their specific domain of practice

Informatics Nurse Specialists supporting, expanding and transforming nursing practice by the design implementation of information and technology

A Continuum of Information and Technology Integration into Nursing Practice

ANA, 2008

## Usability for PHR's Needed

- For individuals
  - Presidential Executive Order 2004
    - All Americans will have an electronic record by 2014
  - Health information on the web
  - Personal health records (PHRs)



## Personal Health Records for All Americans?



## Issues with Usability



- Healthcare IT chasm!
- Information technology:
  - Lacks cognitive support for clinicians
  - Does not integrate well into clinical workflow
  - Does not take advantage of human-computer interaction principles
  - Leads to poor designs, potential errors (Stead et al., 2009)
- IT could actually worsen future healthcare

Stead et al., 2009

## Usability and INSS



- Informatics Specialists must understand and apply usability concepts
  - Content is not just pertinent but imperative
  - U. Utah student, "I use the material from the human-systems interaction course more than any other course content in my informatics job."

## And So?

- We have unusable clinical technology in many arenas
- What do we know about usability and the design of clinical technology?



## A Synthesis of Past Work

- Greg Alexander, U. Missouri, and I in a moment of scholarly dementia decided to write a paper
- Purpose: Focus on research about the design and evaluation of user interfaces for clinical technology
- Used formal processes for a systematic review

Alexander & Stagers, in press, *Advances in Nursing Science*

## Extensive Search Process

- Extensive search and retrieval process
  - Inclusion criteria
    - The years 1980-2009
    - Peer-reviewed articles in English, refereed journals
    - Stated research findings
    - Any research design
    - Any country
    - Any tool, interface design, EHR, CIS
    - Design targeted for health care practitioners

Alexander & Stagers, in press, *Advances in Nursing Science*

## Extensive Search Process

- Exclusion criteria:
  - Ergonomic studies such as cumulative trauma disorders, related occupational health research
  - Medical transcription devices, humidifiers and similar equipment
  - Designs for patients
  - Exploratory studies of errors
  - Descriptions without research data

Alexander & Stagers, in press, *Advances in Nursing Science*

## The Data Sources

- Nursing and Allied Health Literature
  - CINAHL
  - Ovid MEDLINE
  - PsycINFO
  - INSPEC
- Evidence-based Medicine Reviews:
  - Health Technology Assessment Database (CLHTA)

Alexander & Stagers, in press, *Advances in Nursing Science*

## Systematic Review Process



- Process
  - Greg drowns in literature and then survives, thrives
  - Greg and Nancy independently review articles
  - Examined citations for any missing references
  - Rated for relevancy to this systematic review
    - Articles discussed if G&N disagreed on ratings
- Results
  - Initial **11,916** citations; reduced to 2,234 in health
  - 215 included some aspect of nursing or nurses
  - **34** relevant articles

Alexander & Stagers, in press, *Advances in Nursing Science*

## The Studies

- Interface designs or screen designs
  - 18 studies of 17 unique interface designs
  - 6 studies of 5 different graphical user interfaces
  - 5 studies of “telemedicine” or remote systems
  - 5 studies of medical devices
    - IV pumps
    - PCA pumps

Alexander & Stagers, in press, *Advances in Nursing Science*

## Organizing the 50 Studies

- 34 articles with 50 studies
- Outcome variables organized into
  - **Effectiveness** = 24
    - Usefulness, safety
  - **Efficiency** = 10
    - Interaction speed, interaction accuracy
  - **Satisfaction** = 16
    - Perceptions about the product



Alexander & Stagers, in press, *Advances in Nursing Science*

## Effectiveness Results

- Various products
  - Pedigree from a family history
  - Mobile devices for emergency medical personnel
  - Nurse practitioner database
  - Laboratory procedures system
  - One electronic health record (EHR)
- Results
  - More effective searching for info with homegrown app
  - Complex queries answered more successfully with GUI



Alexander & Stagers, in press, *Advances in Nursing Science*

## Effectiveness Results

- More effective information searching
- More accuracy for complex queries, determining medications, initiating appropriate treatment
- Potential errors with medical device designs
  - Due to limited interface visibility, confusing labels, poor navigation systems and getting lost in the system
  - Potential catastrophic errors with IV pumps, PDAs
- **However**, nurses' medication detection was lower for values outside the immediate view



Alexander & Stagers, in press, *Advances in Nursing Science*

## Efficiency Results

- Improved user interaction performance (speed)
  - Poor designs can take twice or three times as long
- Improved user interaction accuracy
  - Both redesigned PCA interfaces and Graphical User Interfaces of all types
    - Reduced errors
    - Improved speeds



Alexander & Stagers, in press, *Advances in Nursing Science*

## Satisfaction Results

- Higher satisfaction
  - Redesigned interfaces, graphical designs
- Lower satisfaction
  - System inflexibility, poor navigation, poor information quality, limited visibility of system status
- Users want
  - Interfaces with visible formats (MM/DD/YYYY)
  - Consolidated information (high level info first)
  - Fewer levels, ability to customize to their work
  - Integrated applications



Alexander & Stagers, in press, *Advances in Nursing Science*

## Discussion

- Knowledge worthy of mention
  - Dense screens important for practiced users
  - Graphical designs positively impact efficiency and effectiveness
    - Effective especially for navigation tasks
  - Heuristic evaluations of devices
    - Potential errors can be alarming
    - Facilities should incorporate usability into device selections
- No apparent rationale for selecting products to evaluate, e.g., frequency of use



Alexander & Stagers, in press, *Advances in Nursing Science*

## Future Directions: Usability Research

- Expand types of studied devices, settings, participants
  - Have a systematic method for choosing devices
- Develop integrated displays
- Expand the types of study outcome variables



Alexander & Stagers, in press, ANS

## Future Directions: Usability Research

- Expand device studies
  - Only 2 IV pumps, 2 PCAs, 1 EHR studied
  - Examine cognitive burden workflow issues across devices
  - National database is needed for study results
  - Conduct comparative studies of EHRs

Alexander & Stagers, in press, ANS

## Future Directions: Usability Research

- Expand to administration, education, research
- Expand to testing in actual clinical settings (vs labs)
- Emulate the way work is done in interdisciplinary teams



Alexander & Stagers, in press, ANS

## Future Directions: Usability Research

- Develop integrated displays
  - “Big picture of the patient” often missing in current electronic health records
  - Data-rich, information-poor systems
  - Recent report from Academic Press
    - Need for integrative data



Alexander & Stagers, in press, ANS

## Future Directions: Usability Research

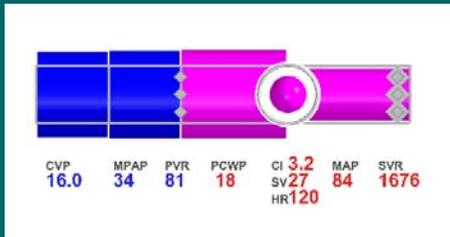
- Expand outcome variables in studies
  - Most common were satisfaction, heuristic violations, speed, errors
  - User satisfaction can be controversial
    - Can conflict with performance data
    - Need to understand *why* the design works, not
  - Multi-modal studies, mixed methods needed
  - Bridge research and practice arenas
    - Research interfaces deemed useful
    - Challenge is to move these into practice

Alexander & Stagers, in press, ANS

## An Example of Integrative Displays



## An Example of Integrative Displays



## Integrative Displays



- Change of shift report
  - Crucial handoff
  - An area for integrative, synthesized interfaces
- What do we know about [change of shift report]? Surprisingly little!
  - Dracup & Morris, 2006
- No research for over a decade in the US
  - EHR's greatly expanded
  - Safety Imperatives Increased

Staggers & Jennings, in press, *Journal of Nursing Administration*

## Purpose of Shift Report in General

- Information exchange
- Educational
- Organizational
- Social
- Emotional
- Team-building, bonding



## Change of Shift Report Research



- Purpose: Explore the context and content of change of shift report
- Sample
  - 3 facilities, 7 medical and surgical units
  - 13 occasions, 38 nurses reporting on 53 patients
  - 4 shift times (7A, 7P, 3P, 11P)
    - 4, 8, 12-hour shifts
  - 3 types of report
    - Face-to-face, taped, bedside reports

Staggers & Jennings, in press, *Journal of Nursing Administration*

## Change of Shift Report Research

- Methods
  - Observation, audio-taped shift report
  - Followed up with questions for clarification
  - Took field notes
  - Transcribed audio files
  - Used conventional qualitative techniques to analyze the data

Staggers & Jennings, in press, *Journal of Nursing Administration*

## Sample

- Average age = 34; BSN education
- Women = 79%
- Face to face report
  - Conference room
  - Nurses' Station
  - Hallway
- Taped
- Bedside
- 3 reports included family members



Staggers & Jennings, in press, *Journal of Nursing Administration*

## The Content of Shift Report

- Content in 4 themes
  - The Dance of Report
  - Just the Facts
  - Professional Nursing Practice
  - Lightening the Load



## The Dance of Report

- Largest category at 33% frequency
- Synchronizing report
  - “You ready?”
  - “Any questions?”
- Screening
  - “Do you know this patient?”
- Extensive exchange, clarification
- Included “Speed Bumps”
  - Especially in conference rooms



Staggers & Jennings, in press, *Journal of Nursing Administration*

## Just the Facts

- Passing along patient parameters
  - “His last crit was 28.”
  - “She had her last pain med at 1800.”
- Included “Ballpark information”
  - “She’s sat’ing in the 90s”
  - “I’m pretty sure his b/p is in the 100’s over 70s”
- Conveying late or imprecise information
  - “Her urine is like soap.”



Staggers & Jennings, in press, *Journal of Nursing Administration*

## Professional Nursing Practice

- Actions, reasoned judgments, care decisions, problem-solving
  - Simple assessments, “Lung sounds are clear.”
  - Sifting through data, “Pain is his main issue.”
  - Displayed expertise, instinct
    - NPO patient with a fast-acting insulin order
    - “By the time we figured it out and came up with a new plan using regular insulin, I rechecked her blood sugar just for joy and it was 109 so I gave her nothing.”
- Included patient education
- “Nurse speak”

Staggers & Jennings, in press, *Journal of Nursing Administration*

## Lightening the Load

- Making it easier for the next shift
  - This pt is “a piece of cake”
  - “Keep an eye on him”
  - “I don’t like leaving the nurse with stuff.”
- Bonding, team-building
  - “Thanks for coming in for Molly.”
  - Shared laughter
  - A negative example



Staggers & Jennings, in press, *Journal of Nursing Administration*

## Context of Report

- No differences in content with types of report
- The noise!
- Report in the conference rooms, hallways
  - 10 dyads all talking at once
  - Interruptions
- Patient load of 4-5
- Received report from 2-3 separate nurses



Staggers & Jennings, in press, *Journal of Nursing Administration*

## Discussion



- Increased Speed Bumps with Face-To-Face
- Clipped speaking styles, jargon
- Patient safety is not the cornerstone of report
- No discernable structure to report
- Individually styled as to content, sequence
  - Often tailored between report partners
- EHR not a part of any of the reports
  - Despite a full EHR in 1 facility and a partial one in 2

Staggers & Jennings, in press, *Journal of Nursing Administration*

## Implications



- Potential for an integrated display
  - Potential to decrease late, imprecise information
    - Just the Facts very amenable to computerization
    - HOWEVER, need information-rich vs. data-rich display
  - Potential to decrease or increase report time
  - Which content besides Just the Facts?
    - Has to be synthesized info
    - Must be consolidated
    - Tailored by unit, pt diagnosis or condition
    - Is this a task too tall to tackle?

Staggers & Jennings, in press, *JONA*

## Implications



- At least these display designs
  - System/vendor generated
    - Separate formats for ICU, medical/surgical
    - Pulls system data
  - Nurse-centric
    - Adaptive
    - Can tailor to a nurses' usual presentation format
  - Patient-centric
    - By main pt issues, problems
    - Would need to be for that shift, that unit



Staggers, Guo, Blaz & Jennings, 2009

## Conclusions

- “Dr. Staggers, won't you work yourself out of a job by focusing on usability?”



## Contemplations? Questions?



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