ICU nurses’ evaluations of integrated information displays on user satisfaction and perceived mental workload

Sven H. KOCH a,b, Dwayne WESTENSKOW b,c,
Charlene WEIR a,d, Jim AGUTTER e, Maral HAAR f, Matthias GORGES c,g, David LIU c,h, Nancy STAGGERS b,l

aInstitute for Medical Biometry and Informatics
Medical Informatics Section
Univesity of Heidelberg, Germany
b,l Other affiliations see last slide

Sven.h.koch@gmail.com
Outline

• Background: What are integrated displays and why nurses might benefit?

• Study: Nurses‘ satisfaction and perceived workload with integrated displays

• Discussion
Problems at current ICUs with information displays

- Observations study:
  Nurses information needs currently not met
  - Essential information missing at bedside e.g. medication compatibility
  - Information retrieval time consuming and laborious
  - Unaware of changes in second patient
    [Koch et al. ICU nurses' information needs and recommendations for integrated displays to improve nurses' situational awareness. JAMIA 2012]

- Information at many different locations
  [DeLucia 2009, Stead 2009]

- Poor usability e.g. infusion pumps
  [Alexander & Staggers 2009]
Basic idea: Integrated Displays
Single, integrated display for monitoring and control

Steps
- Observation
- Display development
- Evaluation
Integrated Displays

• Integrated displays
  – “…hold tremendous promise for improving [...] clinical outcomes in the intensive care unit”
    [Egan 2006]

• Before actually building integrated displays:
  – Would nurses actually be happy with them - or not?
  – Would nurses feel they are laborious to use
    …and potentially not use them?
Evaluation study

- Evaluation hypothesis: Compare using integrated display to using traditional displays
  - Higher satisfaction?
  - Lower perceived workload?
  - (Nurses performance: paper under review)
Methods

• Repeated-measures study design
  – Within-subjects
  – 2 Displays (integrated vs. traditional)
  – Random display order
  – Tools: Paper prototypes

• Participants: Burn Trauma ICU nurses
  – 12 nurses (8 female, 4 male)
  – Age 31.5 years (median; range 23 – 57)
  – Work experience 3 years (median; range 1 – 24)
Methods

• Tasks performed using each display
  – Medication management
  – Patient awareness
  – Team communication

• Measurements after using each display
  – User interaction satisfaction QUIS*
  – Perceived mental workload NASA-TLX**
  – Both questionnaires have adequate validity and reliability
  – 2 free text questions

*QUIS: [Norman 1998, Questionnaire for user interaction satisfaction QUIS. College Park, MD]
**NASA TLX: [Hart 1988, Development of NASA-TLX (Task Load Index): Results of empirical and theoretical research. Human mental workload. Amsterdam, Netherlands]
Results
User Satisfaction

- Significantly higher with integrated display (p>0.01)
  - For all QUIS dimensions
  - For summed QUIS score
- Test: t-test for dependent samples, pairwise comparison
- Bonferroni correction
Results

Perceived workload

Significantly lower using the integrated display

- In mean weighted (overall) NASA-TLX score
- In 2 of 6 NASA-TLX dimensions:
  - Effort
  - Frustration
- Not significant dimensions:
  - Mental workload
  - Physical workload
  - Temporal workload
  - Performance
- Test: t-test for dependent samples, pair wise comparison

* Significant ly lower, Bonferroni corrected

Sven H. Koch
Free text questions

• More positive comments for integrated than traditional displays (23 vs. 10 positive comments).

• E.g. nurse 7 wrote
  – “Great. It is very helpful to have all different kinds of information available from one source- instead of having to look several different places and compare.”
Discussion

• Comparison with other research
  – Higher user satisfaction
    • with graphical vs. text based system [Staggers & Kobus 2000]
    • with custom vs. commercial system [Murff et al. 2001]
  – Mental workload
    • other display evaluations only some NASA TLX dimensions significant [Görges & Staggers 2008]

• Limitations: Generalizability
  – Laboratory setting
  – Paper prototypes
Future work

- Evaluate in simulated environments
- Clinical evaluations
- Bi-directional communication between devices needed to enable integrated displays
Take home message

• Information integration feasible
  – For medication management, patient awareness, and team communication
  – Increases nurses’ satisfaction
  – Partially lowers perceived workload
  – (Paper under review: Faster / more accurate task performance)
Affiliations/Acknowledgements

- University of Utah, UT, USA
  - Sven H. KOCH a,b, Dwayne WESTENSKOW b,c, Charlene WEIR a,d, Jim AGUTTER e, Maral HAAR f, Matthias GORGES c,g, David LIU c,h, Nancy STAGGERS b,i
  - a Institute of Medical Biometry and Informatics, University of Heidelberg, Germany;
  - b Department of Biomedical Informatics, Univ. of Utah, Salt Lake City, UT, USA
  - c Department of Anesthesiology, Univ. of Utah, Salt Lake City, UT, USA
  - d Salt Lake City Veterans Healthcare System, Salt Lake City, UT, USA;
  - e Graduate School of College of Architecture + Planning, Univ. of Utah., SLC, UT
  - f Drager, Lübeck, Germany;
  - g Electrical and Computer Engineering D., U. of B.C., Vancouver, Canada;
  - h School of Inf. Tech. and El. Eng., U. of Queensland, QLD, Australia;
  - i School of Nursing, University of Maryland, Baltimore, MD, UT, USA

- University of Heidelberg, Germany
- Draeger Medical, Lübeck, Germany