Visualizing Complex Data  
(Perceiving and Synthesizing Complex Data)

- Perils and Pitfalls of Anesthesia Displays  
  Matthew B. Weinger, Vanderbilt University
- Touch Your Patient - A Tactile Display of Information  
  Mark Ansermino, Univ. of British Colombia
- Visualizing Complex Data  
  Heike Hofmann, Iowa State University

Perils and Pitfalls of Anesthesia Displays
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Key Learning Points
- Data visualization is about supporting users’ work goals.
- Different goals require different data presentation modalities.
- Data must be detected, perceived, interpreted, and utilized correctly.
- Context is critical.
- Display design is challenging.

Human Factors in Display Use
- Human limitations
- Communication
- Technology fit
- Expertise/experience
- Workload and stress
- Interruptions and distractions
- Decision support
- Just-in-time learning
- Workflow
- Automation
- System resilience
- Teamwork
- Organizational learning

No relevant disclosures

Traditional displays are far from optimal

Increasing evidence that failed menu navigation is a significant cause of usability related events

Some data displays are extremely demanding of clinicians' attention ... Sometimes at inappropriate times.

<table>
<thead>
<tr>
<th>Task Being Performed</th>
<th>Day</th>
<th>Night</th>
</tr>
</thead>
<tbody>
<tr>
<td>Record</td>
<td>18.8 ± 2.5</td>
<td>15.8 ± 1.5</td>
</tr>
<tr>
<td>Observe Monitors *</td>
<td>17.1 ± 2.2</td>
<td>25.4 ± 2.3</td>
</tr>
<tr>
<td>Other Care Task</td>
<td>12.1 ± 1.5</td>
<td>14.1 ± 2.3</td>
</tr>
<tr>
<td>Observe Surgical Field</td>
<td>6.8 ± 2.1</td>
<td>8.3 ± 1.4</td>
</tr>
<tr>
<td>Idle</td>
<td>6.3 ± 3.3</td>
<td>5.0 ± 1.2</td>
</tr>
<tr>
<td>Attending Conversation</td>
<td>4.2 ± 1.3</td>
<td>2.3 ± 1.1</td>
</tr>
</tbody>
</table>

* = Significant at P<0.05, DAY vs. NIGHT

§ = Mean ± SEM for the 9 Most Common Tasks

Task-dependent response times of 12 senior anesthesia residents to a vigilance light mounted in the monitoring array during cardiac surgery.

Human Factors in Display Use

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User Centered Design Cycle

1. Understand Context of Use
2. Specify User Requirements
3. Hi-Fidelity Prototypes
4. Formative Evaluation
5. Multiple Iterations
6. Summative Evaluation
7. Concepts
8. Mockups
CTA-derived Concept Map from 9 expert anesthesiologists regarding the post-anesthesia decision to extubate a patient

Data Displays to Support Tasks

User Centered Design Cycle

It’s not just about Looking Pretty
Example: VA CPRS Pressure Ulcer Advisor

Usability testing of original design: “where do I find...”
High levels inefficiency & dissatisfaction

After user centered redesign: “this fits with how I would normally assess pressure ulcers. When will it be implemented?”

Example courtesy of Anne Miller, Ross Spear, & Steve Brown of the VA OA

It matters with whom you test a display

In a simulator study, benefit in terms of time to diagnosis of the object-oriented display [C] was found in anesthesia resident participants but not in non-clinicians.

Gunsah-Debrah K, Weinger MB, England CE. Visual display format affects the ability of anesthesiologist to detect acute physiologic changes. A laboratory study employing a clinical display simulator. Anesthesiology. 03(6) 1184-93, 1985
Display design may be very user and context dependent

- Complex display for ICU RNs
- Iterative UCD using ICU RNs at hospital A
- In final simulation test, superior with hospital A but not hospital B ICU RNs

Presentation at the 2nd Annual STA Meeting
San Diego, CA, 1992
“Human factors in the design of visual display technologies for anesthesiology”

APSF Workshop Presentation, 2000
“The future of perioperative information management”

Conclusions

- Data visualization must support users’ work goals.
- Different goals require different data presentation modalities.
- Design and evaluation is challenging.
- Understanding use context is critical to design success.

Collaborators and Sponsors


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Veterans Affairs (VA) Health Services Research & Development
National Heart Lung and Blood Institute (NHLBI)
Anesthesia Patient Safety Foundation (APSF)
National Patient Safety Foundation (NPSF)
I DON'T MEAN TO FRIGHTEN YOU, BUT YOU'LL HAVE TO DO SOME ACTUAL WORK.

THAT'S CRAZY TALK.

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