Usability Factors in the Organization and Display of Disparate Information Sources in the Operative Environment

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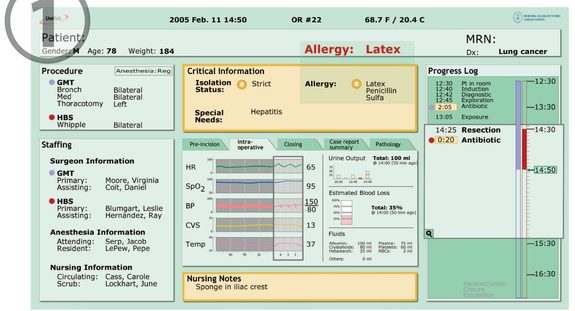
Progressive Design Iteration

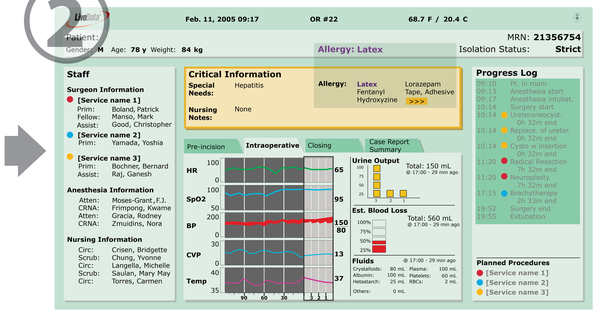
Through an iterative design process, elements were added, changed and removed, and work continues to further modify the system based on user feedback.

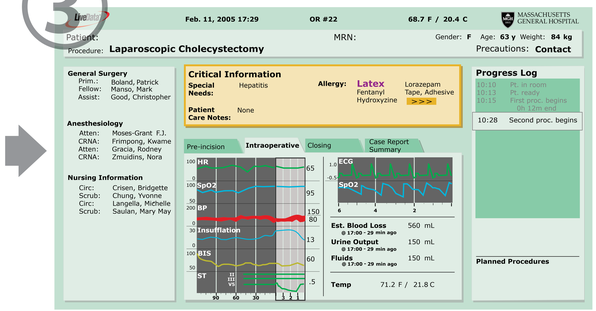
The display layouts are created using Adobe Illustrator and then converted into an SVG. This process allows a great deal of flexibility in the design stage to move and alter elements, allowing very rapid changes to be made and presented to the team.

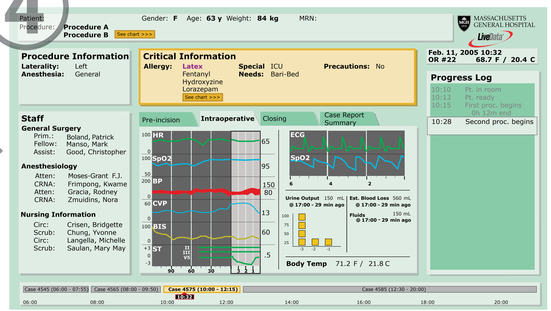
Starting from a rough layout of pertinent information and design elements, development progressed toward the current iteration over several months of weekly meetings with a small core of team members and human factors designers from Aptima.

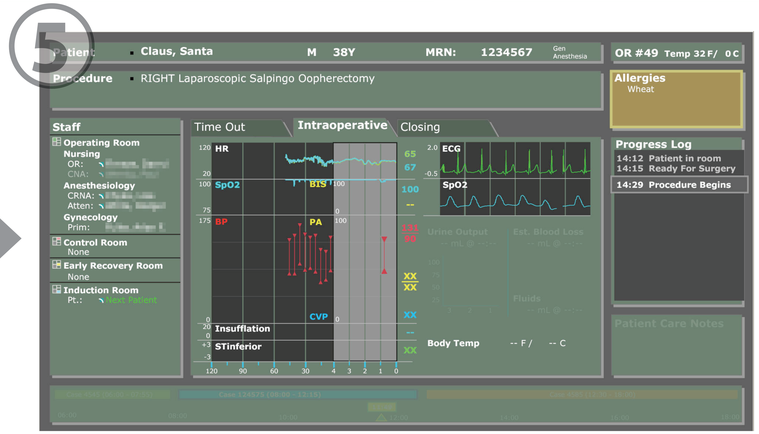
Information displayed was determined by data availability and by expert opinion and team consensus on what data should be included. Data would be displayed if it was of use to at least two of the following: surgeon, anesthetist, nursing staff.











Introduction

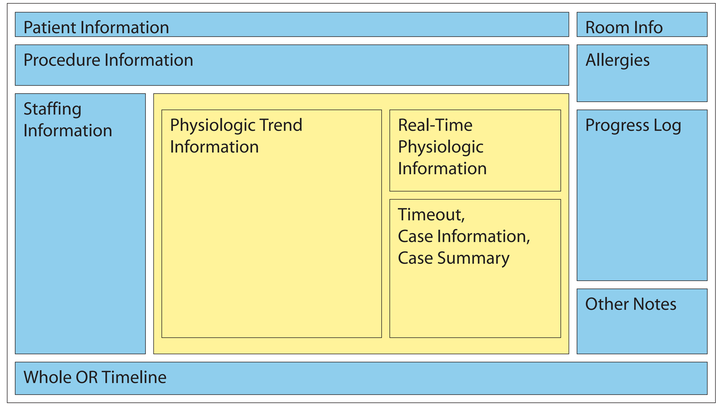
A collaborative project by Massachusetts General Hospital, LiveData and Aptima is integrating a number of disparate information sources into a single display for the operating theater. Presenting information from hospital information systems, anesthesia and surgical systems, surgical equipment, and workflow support systems in a usable and cohesive way on a single wall-mounted 42" LCD screen is a challenge. The information must be rich, complete and useful for team situational awareness and also visible and legible anywhere in the operating room, up to 9 meters away.

Persistent Information Panes

Persistent information panes include:

- Patient Information
- Procedure Information
- Staffing Information
- Room Information
- Allergies
- Progress Log
- Whole OR Timeline
- Other Notes

This information serves to uniformly orient members of the team to the procedure, patient and personnel during the case and during staffing changes. Allergies and precautions are displayed throughout the case along with a progress log of the case. The progress log allows for easy knowledge acquisition of events that have occurred and the current position in the procedure. The OR Timeline allows for easy orientation to the progress of the current day and the status of patients already having had surgery in the OR.



Changing Information Panes

Dynamically changing panes are organized through a tabbed scheme to illustrate the current, prior and future stages in the case progression.

Tabs are present for:

- Pre-Incision
- Intraoperative
- Closing

These tabbed panes progress automatically based on the stage of the case without interaction from the surgical team.

All panes contain physiologic trend data and real-time waveforms. The pre-incision pane provides case verification information for the surgical "timeout". The intraoperative pane shows fluid status with blood loss, urine output, and infused fluids. The closing pane provides information on the post-anesthesia care unit assignment and post-op notifications, needs and orders.

Current Design Iteration

Originally designed for low light levels to not detract from the adjacent operative display, this iteration was almost universally favored in all light levels over the original colors.

In order to adequately display the vast amount of information present in a surgical case, a combination of persistent and dynamically switching information panes provides a clean and elegant solution.

Information to help orient team members is always present, while information pertinent to particular stages of the case is organized into automatically advancing tabbed panes. This allows for maximal flexibility in presenting pertinent information to the entire team while staying within visibility and usability constraints.

Evaluation of the usablity of the system is currently underway by use of the Questionnaire for User Interaction Satisfaction, a tool designed to assess subjective satisfaction of a human-computer interface.

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