

BACKGROUND

The Newborn/Infant Intensive Care Unit (N/IICU) at Children’s Hospital of Philadelphia (CHOP) takes a structured interdisciplinary approach to patient safety and quality improvement initiatives. In our efforts to mitigate patient harm from CLABSI and safety events secondary to alarm fatigue, we encountered barriers to implementation and sustainment due to technological limitations and suboptimal workflow. With the addition of a Human Factors Engineer to the organization, the N/IICU Quality and Safety Team quickly initiated a partnership with the goal of integrating human factors methodology with organizational patient safety and quality improvement methods in order to tackle those barriers.

Human factors engineering (HFE) provides a method to analyze the interaction of humans and the corresponding environment, and a process to design and engineer the system to maximize human performance within that environment. As a body of knowledge, HFE is a collection of data and principles about human physical and cognitive characteristics, capabilities, and limitations in relation to technology, work, and environments. As a process, it refers to the design of systems, workflows, and environments to take into account the safety, efficiency, and satisfaction of human users and operators.

PROJECT INITIATIVES

Secondary Alarm Notification

- **AIM:** To design a secondary alarm notification system via nursing Ascom phones.
- **BARRIERS:** The majority of the secondary alarms being sent to phones consisted of non-actionable alarms, leading to alarm fatigue and decreased effectiveness of the alert.
- **HUMAN FACTORS APPLICATION:** Decreasing perceived workload and increasing perceived effectiveness would in turn increase the efficacy and acceptability of the new system.

Methods



Human Factors Concepts

- Signal detection theory to reduce false alarms and increase saliency of actionable/critical alarms
- Decrease cognitive workload



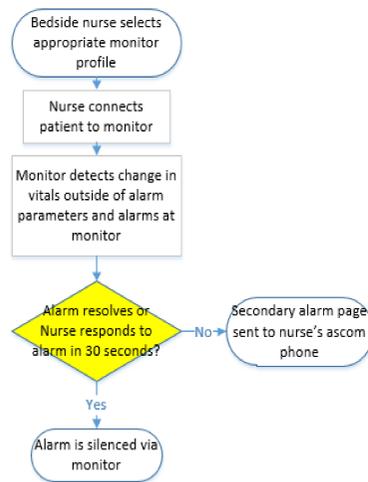
Proposed Solution

30 Second Ascom Notification Delay

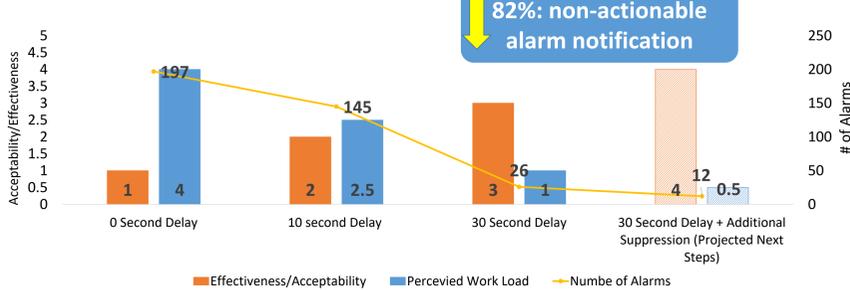
- Allows finishing of tasks
- Allows time to don PPE
- Prevents self-resolving (non-actionable) alarms from reaching secondary notification

Increases saliency of alarms received

Secondary Notification Process Map



Results



- The 30 second delay decreased the number of non-actionable alarms being sent through the paging system by 82%.
- The 30-second delay was effective in decreasing the perceived and cognitive workload for the NICU nursing staff, which increased the saliency of critical/actionable alarms.

Central Line Change Standardization

- **AIM:** To create a standard for central line (CVL) changes in the N/IICU.
- **PROBLEM STATEMENT:** Direct observations confirmed a large amount of variability in line change practice across nursing staff. Sources include line change practice, bedside cart arrangement, bed/room/pod layout.
- **HUMAN FACTORS APPLICATION:** Standardization of processes is a key strategy in preventing error. Standardization lessens the cognitive workload required to complete tasks and increases reliability in task completion. Because of the understood benefit of standardization, there is potential to decrease variability by standardizing CVL line change procedures.

Methods

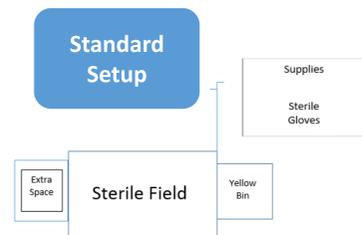


Human Factors Concepts

- Perception, Attention, Comprehension
- System visibility (situation awareness)
- Human error and workload



Proposed Solution

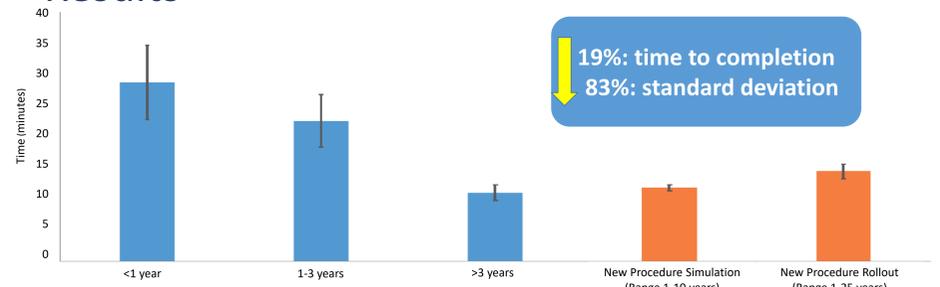


Addresses sources of variability

Mental "time-out" to maximize task attention



Results



- Baseline data indicated a high degree of variation in practice and an average time of 17.7 minutes ($SD = 28.7$) to complete a line change.
- Aggregate unit data demonstrated 100% reliability to procedure and a mean time to completion of 14.4 minutes ($SD=5.0$)

CONCLUSIONS AND NEXT STEPS

Integrating human factors methodologies in addition to traditional methods has the potential for broader and more reliable improvements to processes and outcomes. As healthcare organizations continue to strive for high reliability, systems must be created in order to make it easy to do the right thing. By working to implement system changes to support human limitations and minimize variation, we further mitigate risk to patients by improving sustainability of improvements. Human factors engineering should be considered for all initiatives in the future to support human centered design and sustainable implementation.

Our N/IICU will continue to partner closely with the Human Factors Team in order to integrate human factors approaches to future projects, including:

- Redesigning PPE carts to promote proper donning and doffing of PEE
- Measuring perceived workload of nursing staff through specific task analysis
- Additional suppression of non-actionable alarms

“We cannot change the human condition, but we can change the conditions under which humans work.” – James Reason*

* Reason J. Human error: Models and management. *BMJ*. 2000 Mar 18; 320(7237):768-71