



KEY POINT SUMMARY

OBJECTIVES

The objective of this study was to develop a methodology for identifying and classifying flow disruptions in the cardiac operating room.

Realizing Improved Patient Care through Human-centered Operating Room Design

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Key Concepts/Context

The authors indicate that disruptions in the workflow of surgeries can extend surgery times and contribute to the escalation of healthcare costs. Aware of the success of human factors engineering approach to assessing adverse events in other industries, this study used the combined expertise of industrial engineers, healthcare architects and cardiovascular anesthesiologists to document the occurrence of every disruption during 10 cardiac surgeries. It was found that the physical layout category accounted for 31% of the flow disruptions in the OR.

Methods

The methodology involved the observation of 10 cardiac operations to document any and all disruptions in the workflow. The observations started with the setting up of the room until the cleanup after the patient was moved to the intensive care unit. Two industrial engineers with expertise in human factors engineering observed and documented and time stamped every disruption on architectural layouts of the OR. The study took place in one of the cardiac surgical suites of the Medical University of South Carolina. The observations (duplicates were counted as one) were organized and counted with the help of Excel. Deductive qualitative coding was done to organize the observations into clusters and then affinity clustering was used to create sub-groups.

Findings

Of the total 1158 observations, 140 were duplicates, leaving 1080 observations for analysis. The initial coding categorized the flow disruption into six clusters and subsequently into 33 sub-groups. Flow disruptions pertained to the physical layout (31%), general interruptions (24%), usability concerns (20%), communication issues



(15%), environmental hazards (9%), and equipment failure (1%), and were also counted by phases of the operation: preoperative, operative and postoperative.

- Disruptions associated with physical layout:
 - Inadequate use of space (158)
 - Wrongful positioning of furniture (81)
 - Wrongful positioning of equipment (65)
 - Connector positioning or difficulty handling entangled wires, tubes, etc. (19)
- During the preoperative phase, physical layout disruptions had the highest occurrence (152 times); inadequate space was the biggest concern, followed by incorrect positioning of furniture and equipment.
- During the operative phase, physical layout disruptions were fewer than those associated with general interruptions. The main physical layout disruption pertained to inadequate space.
- During the post-operative phase, incorrect positioning of equipment was the most frequent disruption.
- Categorized under environmental hazards, slips and falls were observed to be disruptive to the workflow in the OR, especially during the preoperative and operative phases.
- The personnel most affected by physical layout disruptions were:
 - Anesthesia team: Inadequate space, positioning of equipment, furniture, connectors and permanent structures and impeded visibility
 - Perfusion team: Inadequate space, positioning of equipment, furniture, connectors and permanent structures and impeded visibility
 - Surgery team: Inadequate space, environmental noise, positioning of equipment, furniture and connectors and impeded visibility
 - Nursing team: Inadequate space, positioning of furniture, equipment, connectors and permanent structures and impeded visibility

Design Implications

The design team should:

- Consider equipment density and surface area to:
 - Address potential lack of space concerns in ORs
 - Plan for uncongested walkways in the ORs
- Consider non-skid floor tiles for ORs.
- Consider options for minimizing the presence of wires and cables.
- The authors suggest that closed circuit televisions and operative head cameras be incorporated in the design of ORs so that trainees in remote locations can view the procedure and interact without being disruptive to the flow.



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Limitations

The authors consider the following to be limitations of their study:

- The duration and impact of each disruption was not recorded or measured.
- The severity of the disruption and its impact on the surgery could not be assessed.
- Since patient data was not collected, there was no scope to connect the disruptions to patient outcomes.