Effects of Patient Load and Other Monitoring System Design Choices on Inpatient Monitoring Quality

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Thank You to Our Industry Partners

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Disclosures

- Melanie Wright, Research funding from the Agency for Healthcare Research and Quality, National Library of Medicine, and Trinity Health
- Noa Segall, Research funding from the Agency for Healthcare Research and Quality

Effects of Patient Load and Other Monitoring System Design Choices on Inpatient Monitoring Quality

Recognized problems

- Delayed response to life-threatening emergencies
- Delayed response to deterioration

Research challenges

- Outcome metrics not well-defined
- Complexity and variety of implementations
- Low frequency of events
- Difficult environment to observe or control

Failure Modes in Delayed Response to Emergencies

Patient not monitored when event occurs,

System fails to deliver alert to bedside RN,

Alert delivered to bedside RN but not seen or heard,

Alert delivered to bedside RN and seen/heard but not heeded.

Pennsylvania Patient Safety Authority. *Alarm Interventions During Medical Telemetry Monitoring: A Failure Modes and Effects Analysis.* Harrisburg, PA: Pennsylvania Patient Safety Authority;2008.

Andersen PO, Maalã¸e R, Andersen HB. Critical incidents related to cardiac arrests reported to the Danish Patient Safety Database. *Resuscitation.* Vol 81 2010:312-316.

Factors Associated with Failures

Alarm management (false alarms)

Monitoring practice model/technologies

Continuity and load of monitor watch stations

Practices related to maintaining continuity of monitoring

Training and assessment of watcher, bedside RN

Patient acuity and bedside RN load

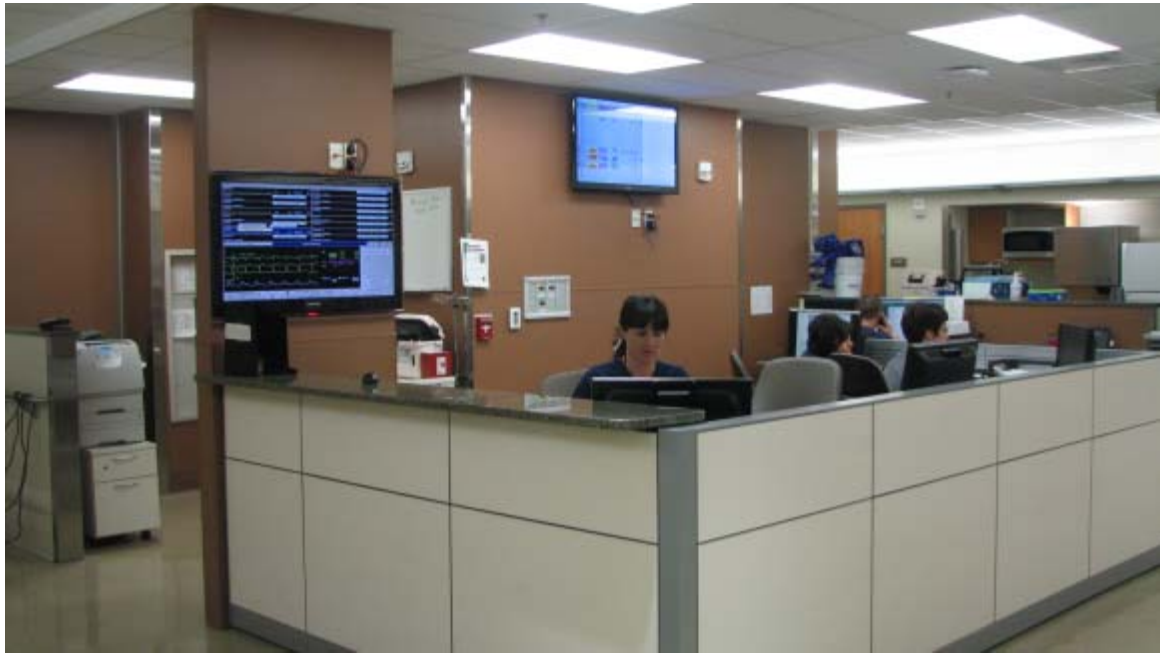
Communication technologies, practices, culture

Ordering and escalation practices

More…

Defining Best Practices

Requires metrics and experimental comparisons, more than SRE review.



Defining and Measuring Monitoring Quality

Mortality, Failure-to-Rescue

Codes outside of ICU

Response time to emergencies/other events

Time not monitored

Defining and counting “late recognition”

Defining and counting “poor patient states”

Patient Load Effects on Response Time to Critical Arrhythmias

Introduction

Patient Load Effects on Response Time to Critical Arrhythmias

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Patient Load Effects on Response Time to Critical Arrhythmias

Methods

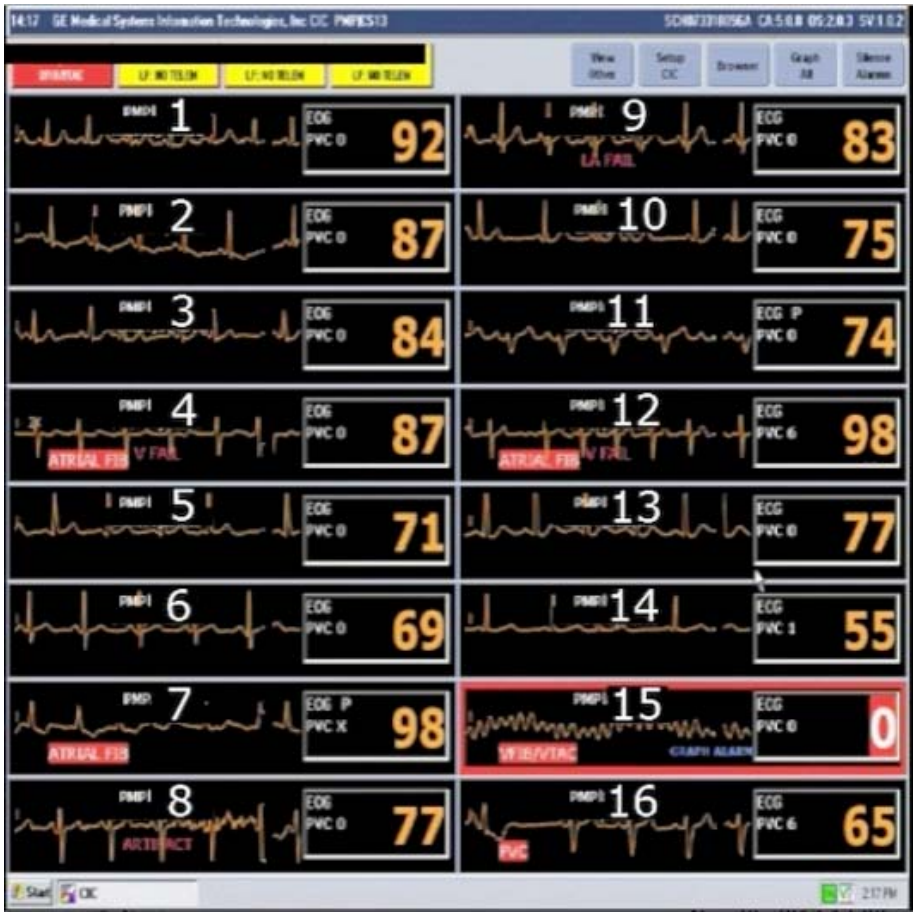
Study design

- Randomized trial
- Independent variable
  - Patient load: 16, 24, 32, 40, and 48 patients
- Dependent variables
  - Response time to a simulated ventricular fibrillation
  - Participants requiring 20 sec or longer to respond
  - Task performance
  - Rhythm interpretation
- Participants
  - 15 remote telemetry technicians
  - 27 nurses from cardiac units

Patient Load Effects on Response Time to Critical Arrhythmias

Methods

Simulation design



Patient Load Effects on Response Time to Critical Arrhythmias

Methods

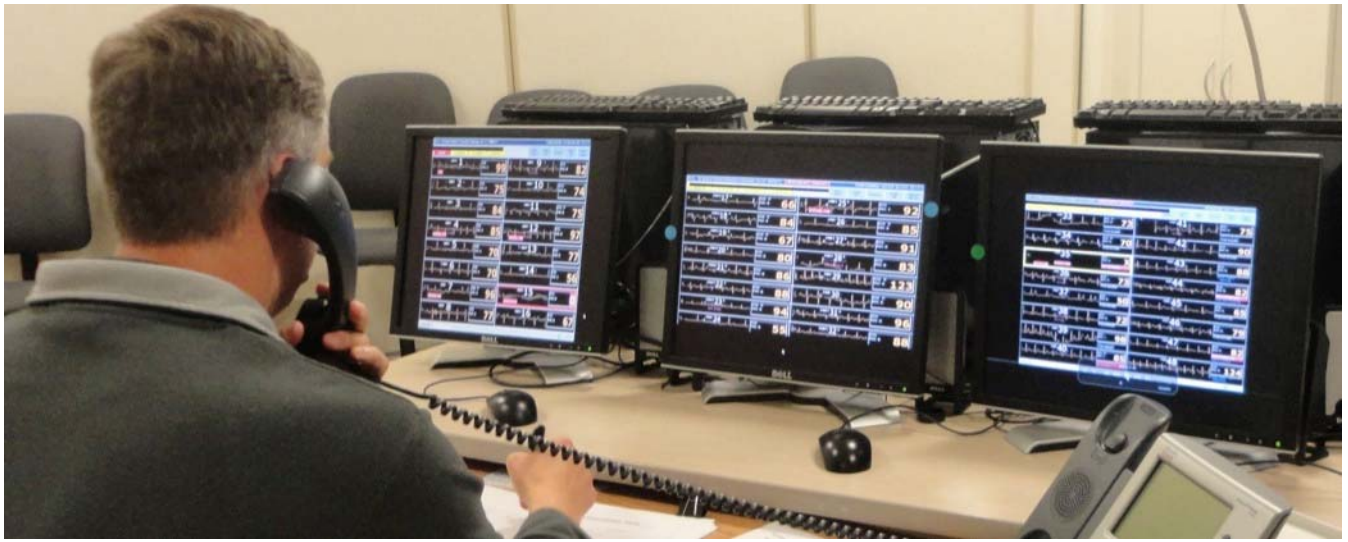
Simulation design

Patient Event	Required Tasks	Weight
Tachycardia (a 30-bpm increase from baseline)	Call HUC	5
	Make phone call within 1 minute	4
	Ask to speak to the patient's nurse	3
Bradycardia (< 45 bpm)	State correct problem	4
	Print rhythm strips	1
Converting to a different rhythm, e.g., Afib	Send 1 strip to the patient's nurse	1
	Document the patient's number, the current time, the nurse's name, and the rhythm	1

Patient Load Effects on Response Time to Critical Arrhythmias

Methods

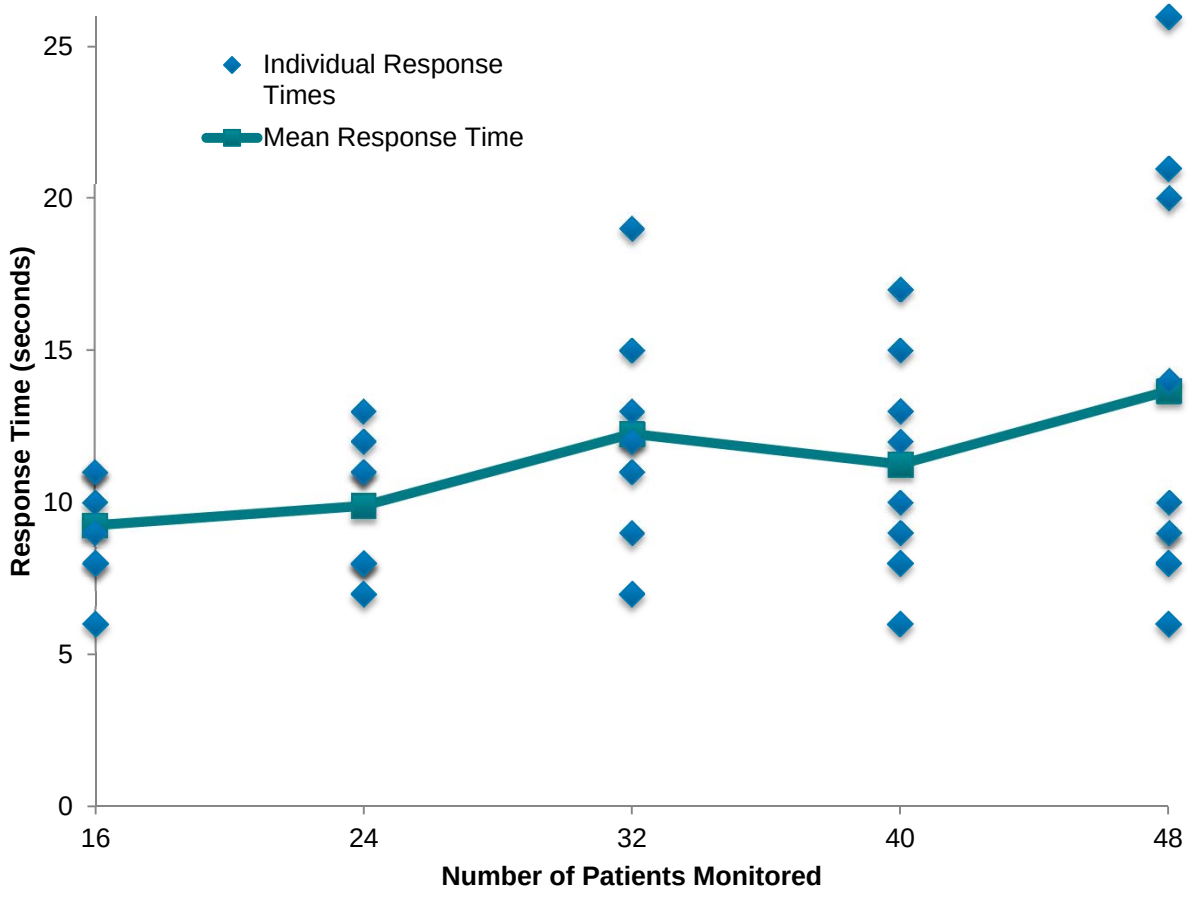
Simulation design



Patient Load Effects on Response Time to Critical Arrhythmias

Results

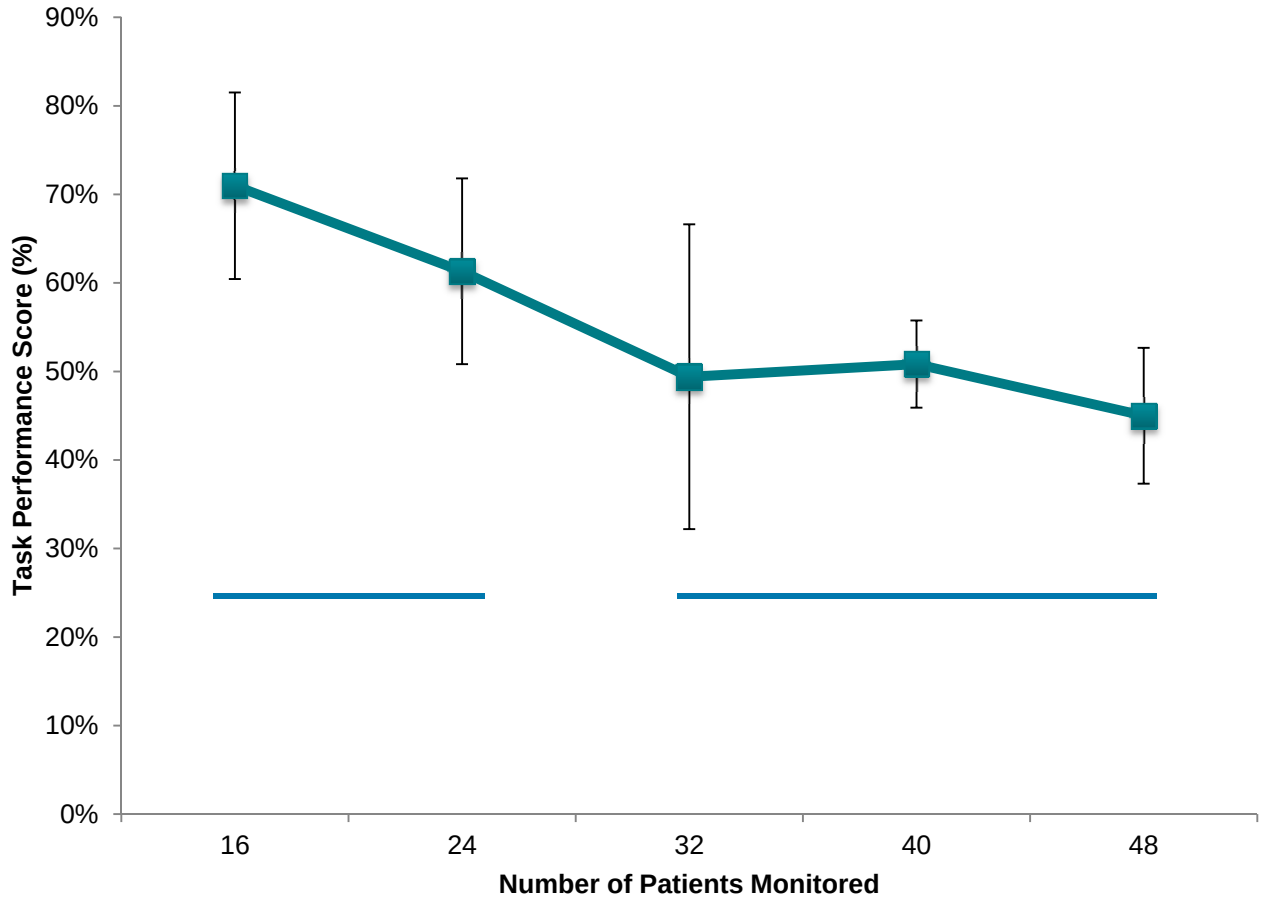
Response time



Patient Load Effects on Response Time to Critical Arrhythmias

Results

Task performance



Patient Load Effects on Response Time to Critical Arrhythmias

Results

Survey

	Strongly Disagree / Disagree	Neutral	Agree / Strongly Agree
The experiment was long enough to accurately assess my workload	1	0	39
The lethal rhythm (VF) was realistic (similar to a real VF)	1	0	41
The waveforms were clear enough to interpret	3	5	34
The pace of patient events was realistic (technician responses only)	0	1	14
My documentation tasks were realistic (technician responses only)	0	2	13
The phone conversations were realistic (technician responses only)	1	0	14
Overall, the experiment was realistic (similar to real cardiac monitoring) (technician responses only)	1	2	12

Patient Load Effects on Response Time to Critical Arrhythmias

Discussion

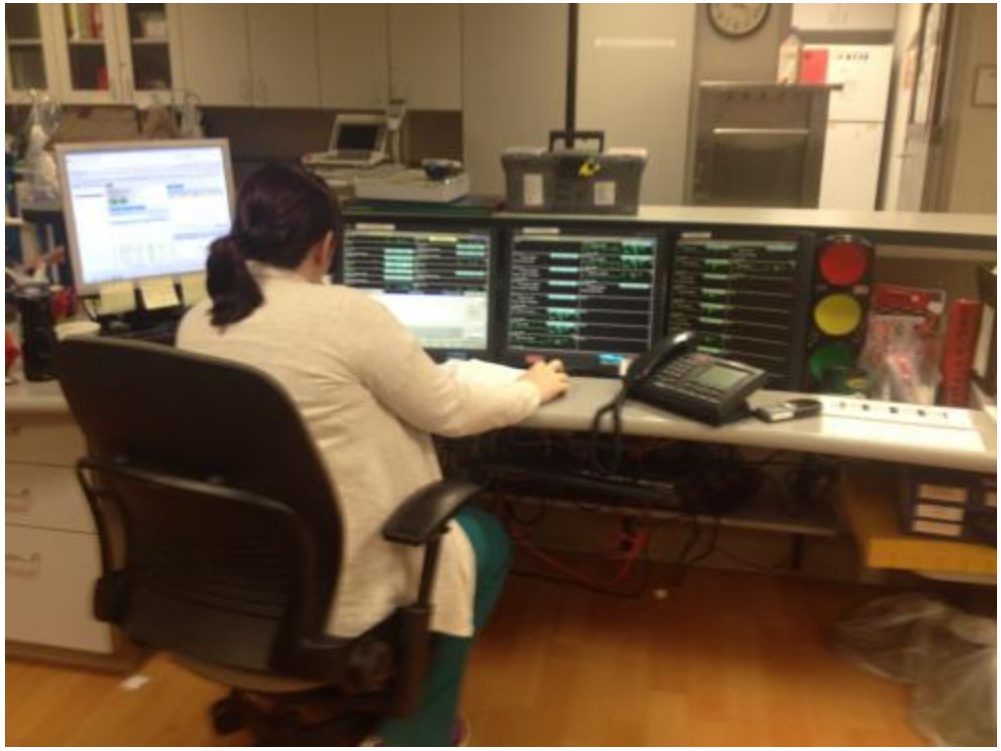
- Response times to the simulated arrhythmia increased as patient load increased
- More “outliers” in 48-patients group
- Task performance decreased as patient load increased

Trinity Health Research to Identify Best Practices

- Develop and validate a metric of patient monitoring quality that can be used in comparisons across hospitals and care settings.
- Define characteristics of monitoring system design expected to influence monitoring effectiveness.
- Conduct case studies to identify best practices in in-hospital monitoring.

Factors that impact monitoring quality

From 11 interviews, 7 site visits (preliminary data)



Interviewee initiated responses:

- Alarm management
- Communication – directness
- Architecture/environment
- Communication – quality/culture
- Training of monitor watchers
- Training of bedside nurses
- Involvement/use of rapid response teams
- Technology coverage
- Technology usability
- Technology familiarity
- Backup or escalation alerting practices

Interviewer raised and confirmed:

- Human watching and data filtering
- Performance monitoring and feedback
- Ordering/discontinuation policies and enforcement
- Monitor watcher patient load
- Bedside nurse patient load
- Accessibility of expert resources
- Patient acuity – unit type

Interviewer raised, not confirmed

- Secondary alerting
- Multi-parameter early warning signs

Red – variability within Trinity Health

Green – variability outside Trinity Health

Next Steps

Observational, case-based studies:

- Validate and select relevant outcome metrics.
- Make comparisons across units and hospitals to identify best practices.

Lab-based and simulation studies:

- Computer simulation to evaluate the impact of design choices on response time to emergencies.
- Expand monitor watch lab-based patient load research to include patient load and task assignment.

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