Managing Alarm Fatigue: New Approaches and Best Practices

Marjorie Funk, RN, PhD, FAHA, FAAN
Maria Cvach, RN, DNP, CCRN
Sue Sendelbach, RN, PhD, CCNS, FAHA
Session Goal
To discuss the problem of alarm fatigue and identify actions nurses can take to proactively manage clinical alarms to improve patient safety.

Session Topics
- The problem of alarm fatigue
- Case Study in Alarm Management: The Johns Hopkins Experience
- Strategies for managing monitor alarms
The Problem of Alarm Fatigue

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Professor
Yale University School of Nursing
Co-Chair, Nursing Research Committee
Yale-New Haven Hospital

Disclosure:
Philips Healthcare: In-kind contribution of equipment for research project on monitor alarms
Cacophony of Alarm Sounds

Physiologic Monitor  Feeding Pump  Ventilator

Infusion Pump

Bed Exit

Pulse Oximeter

Sequential Compression Device  Intra-aortic Balloon Pump
Purpose of Clinical Alarms

To alert clinicians to deviations from a predetermined “normal” status.

-- Graham & Cvach

Enhance patient safety

- Patient status: Detect patient deterioration
- Technical status: Detect device malfunction

The Perfect Alarm System

100% sensitivity:
Detects all clinically important events

100% specificity:
Does not sound alarm for clinically insignificant events
Downward Spiral of Alarm Fatigue

- Staff overwhelmed by alarms
- Alarm desensitization
- Missed alarms/delayed response
- Sentinel events/patient deaths

ECRI Institute: Top 10 technology hazards for 2013.
More than 90% of alarms are false.
Alarm Fatigue: Critical Safety Issue

- Identified alarm hazards as #1 of Top 10 Health Technology Hazards for 2013

- Alarm fatigue can jeopardize patients

- Urged hospitals to “take a focused look at this serious patient safety issue.”
Physiologic Monitors

Greatest number of alarms on most hospital units
Monitor Alarms: The Johns Hopkins Hospital Experience
A National Model for an Interdisciplinary Approach

Maria Cvach, RN, DNP, CCRN
Assistant Director of Nursing
Johns Hopkins Hospital

Disclosure:
No relevant financial interests
Case Study Introduction:
The Johns Hopkins Hospital Experience

- **2006: JHH Medical Progressive Care Unit (MPCU)**
  identifies alarm hazards as significant risk to patient safety

- JHH leadership requests Nursing/Clinical Engineering to:
  - Assemble team
  - Guide MPCU to investigate potential problem of missed alarms

- Small interdisciplinary group starts to assess issue
  - Later expands to hospital-wide Alarm Management Committee
Comprehensive Unit Safety Program (CUSP) Team
Interdisciplinary Monitor Alarm Committee

Support From Hospital Administration

- Nursing
- Clinical Engineering and IT
- Physicians
- Human Factors
- Respiratory Therapy
CUSP Team: Goals

- Minimize recurring alarms that obscure, desensitize, or distract clinicians
- Simplify and standardize alarm management approach
- Assess:
  - Educational needs of clinicians regarding bedside monitoring
  - Reliability of adjunct alarm notification systems
  - New technology and systems
Missed Alarm: Results of Fault Tree Analysis

Failure to respond to a critical physiologic alarm in a timely manner

OR

- Alarms not recognized (detected)
- Nurses desensitized (auditorily or conceptually)
- Insufficient monitor skills
- Late response time
- Inadequate interface design
- Staffing challenges
- Equipment failure
MPCU Alarm Assessment: 12-Day Sample
2010 Baseline

Total Alarms: 94,600
Average Alarms/Bed/Day: 563

- System Warning (Technical) 3%
- Crisis: High Priority 1%
- Warning: Medium Priority 12%
- Advisory: Low Priority 84%
Types of Physiologic Monitor Alarms

**Patient Status**
Detects Patient Deterioration

Focus of alarm parameter changes

**Technical Status**
Detects Device Problems

Focus of equipment alarms
Goals: Patient Status Alarm Parameter Changes

- Standardize alarms across similar units
- Enable actionable alarms
- Reprioritize auditory and visual alarms
  - Auditory: Higher priority
  - Visual: Low priority
- Adjust parameter limits appropriately for patient population
<table>
<thead>
<tr>
<th>Patient Status: Modest Default Parameter Changes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Before</strong></td>
</tr>
<tr>
<td>Crisis High Priority</td>
</tr>
<tr>
<td>Asystole</td>
</tr>
<tr>
<td>V-Fib/V-Tach</td>
</tr>
<tr>
<td>V-Tach (&gt;5 beats)</td>
</tr>
<tr>
<td>VT &gt;2 (3-5 beats)</td>
</tr>
<tr>
<td>V Brady</td>
</tr>
<tr>
<td>Warning Medium Priority</td>
</tr>
<tr>
<td>Couplelet</td>
</tr>
<tr>
<td>Bigeminy</td>
</tr>
<tr>
<td>Pause</td>
</tr>
<tr>
<td>Trigeminy</td>
</tr>
<tr>
<td>Tachy</td>
</tr>
<tr>
<td>Brady</td>
</tr>
<tr>
<td>HR &lt;50 or &gt;115</td>
</tr>
<tr>
<td>Advisory Low Priority</td>
</tr>
<tr>
<td>ST (limit -1 to 1)</td>
</tr>
<tr>
<td>Arterial</td>
</tr>
<tr>
<td>SpO₂ (limit 90%)</td>
</tr>
<tr>
<td>System Warning</td>
</tr>
<tr>
<td>Accel Vent</td>
</tr>
<tr>
<td>R on T</td>
</tr>
<tr>
<td>PVC</td>
</tr>
<tr>
<td>Irregular</td>
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<tr>
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<tr>
<td>Arterial</td>
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<tr>
<td>Tachy</td>
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<tr>
<td>Brady</td>
</tr>
<tr>
<td>(Limits changed:</td>
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<tr>
<td>SBP &gt;180 and &lt;90</td>
</tr>
<tr>
<td>MAP &gt;120 and &lt;55</td>
</tr>
<tr>
<td>DBP &gt;110 and &lt;40</td>
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<tr>
<td>SpO₂ (limit 89%)</td>
</tr>
<tr>
<td>System Warning</td>
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<tr>
<td>VT &gt;2 (3-5 beats)</td>
</tr>
<tr>
<td>ST (limit: -2 to +2)</td>
</tr>
</tbody>
</table>

**AMERICAN ASSOCIATION OF CRITICAL-CARE NURSES**

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**Greatest Reduction: Advisory Alarms (Low Priority)**

**Average Alarms/Bed/Day:**

<table>
<thead>
<tr>
<th>Crisis (High)</th>
<th>Warning (Medium)</th>
<th>Advisory (Low)</th>
<th>System Warning</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Before:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>20%</td>
<td>46%</td>
<td>82%</td>
<td>7%</td>
</tr>
<tr>
<td><strong>After:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>71</td>
<td>472</td>
<td>15</td>
</tr>
<tr>
<td>6</td>
<td>38</td>
<td>84</td>
<td>14</td>
</tr>
</tbody>
</table>

**Total:**

- Before: 563
- After: 144
Monitor Alarm Reduction Initiative
Results of Patient Status Alarm Changes

Average Alarms/Bed/Day

<table>
<thead>
<tr>
<th></th>
<th>ICU A</th>
<th>ICU B</th>
<th>ICU C</th>
<th>IMC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>317</td>
<td>771</td>
<td>563</td>
<td>251</td>
</tr>
<tr>
<td>After</td>
<td>203</td>
<td>431</td>
<td>144</td>
<td>145</td>
</tr>
</tbody>
</table>

36%  44%  74%  42%
Types of Physiologic Monitor Alarms

**Patient Status**
Detscts Patient Deterioration

**Technical Status**
Detscts Device Problems

Skin prep, electrodes, sensors, batteries, connectivity
## Technical Alarms

<table>
<thead>
<tr>
<th>Electrode Related</th>
<th>Non-Electrode Related</th>
</tr>
</thead>
<tbody>
<tr>
<td>Arrhythmia Suspended</td>
<td>NBP Fail</td>
</tr>
<tr>
<td>Leads Fail</td>
<td>NBP Max Time</td>
</tr>
<tr>
<td>RR Leads Fail</td>
<td>NBP Over Pres</td>
</tr>
<tr>
<td></td>
<td>Sensor</td>
</tr>
<tr>
<td></td>
<td>SPO₂ Probe</td>
</tr>
<tr>
<td></td>
<td>Change Battery</td>
</tr>
<tr>
<td></td>
<td>No Telemetry</td>
</tr>
<tr>
<td></td>
<td>NBP Module</td>
</tr>
</tbody>
</table>
**Daily Electrode Change Pilot**

*Average Alarms/Bed/Day*

<table>
<thead>
<tr>
<th></th>
<th>MPCU</th>
<th>CCU</th>
</tr>
</thead>
<tbody>
<tr>
<td>Before</td>
<td>183</td>
<td>195</td>
</tr>
<tr>
<td>After</td>
<td>97</td>
<td>106</td>
</tr>
</tbody>
</table>

47% ↓ 46%
Lessons Learned

- Use data to drive change
- Set alarm parameters to actionable levels
  - Thresholds set too tight → false alarms
- Minimize duplicate alarms
- Ensure accountability for alarm management
- Replace electrodes regularly
- Prep skin appropriately
- Identify alarm management “champions”
- Establish interdisciplinary Alarm Management Committee
Actions We Can Take Now

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Disclosure:
No relevant financial interests
Strategies to Reduce Risk: Overview

1. Establish Interdisciplinary Team
2. Assess Safety
3. Implement Best Practices
4. Measure Key Metrics
1. Establish an Interdisciplinary Team

- Administrative sponsor
- Key medical staff
- Patient safety officer/risk manager
- Nurse manager
- Clinical nurse specialist
- Frontline staff nurses
- Monitor/telemetry technicians
- Biomedical/clinical engineering
- Information technology
- Others as needed
2. Assess Safety

- Investigate past alarm-related events/near misses
- Evaluate how alarms are used throughout the hospital
- Review clinical alarm-related policies and procedures
- Evaluate parameter limits and levels
- Evaluate actual practices
- Identify technology-related capabilities and limitations


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2. Assess Safety (cont’d)

- Review hospital’s incident reporting system
- Map alarm notification and response process
- Discuss alarm-related concerns with clinical staff

3. Implement Best Practices

- Prep skin properly
- Replace electrodes daily
- Set alarm parameters to patient population
  - Tachycardia/high heart rate
  - Bradycardia/low heart rate
- Prioritize alarms
- Ensure ongoing education

4. Measure Key Metrics

- Partner with equipment vendors
- Challenge: Complexity of gathering data
- When do we start?
  - Delay changes until we have metrics?
  - Start changes without metrics?
Be Realistic

“Solving all alarm-related problems at once is probably an unrealistic task.”

Recommendations

- Establish interdisciplinary Alarm Management Team
- Validate the problem:
  - Assess risk – Where are your vulnerabilities?
  - Measure key metrics
    - Alarms/bed/day; nurse/patient attitudes (surveys)
  - Conduct unit analysis
  - Remeasure to assure sustainability
- Develop an interdisciplinary policy and dissemination plan
- Identify unit champions
AACN Implementation Tools
Designed to help you apply these practices in your environment

- **Inventory of Clinical Alarm Default Settings**: Worksheet
- **Tools and Tactics**: Blueprint for Managing Clinical Alarms
- **AACN Practice Alert**: Alarm Management
- **Bridging the Gap to Improved Patient Safety**: A Gap Analysis for Managing Clinical Alarms
- **Developing a Comprehensive Alarm Management Plan**: A Step-by-Step Guide
- **Learn Network online discussion forums**
  - Ask the Expert
  - Share Your Story

Find these tools on the Managing Alarm Fatigue webinar information page at www.aacn.org.
Start Managing Clinical Alarms Now — Improve Patient Safety


2. Discuss the tools and recommended practices with your colleagues.

3. Implement practices that are suitable for your unit.

4. Join the Webinar Series Learn Network online discussion forum to continue the conversation.