Managing Alarm Systems
Progress and Insights

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Beth Israel Deaconess Medical Center
Boston, MA
621 licensed beds
6,100 Full-Time Equivalent Employees (Excluding Research)
4776 Births
Level 1 Trauma Center and roof-top heliport

• 41,125 Inpatient Discharges
  – 524,521 Outpatient Clinical Visits
  – 56,589 Emergency Department Visits
  – 318,335 Radiology Visits
  – 12,068 Inpatient Surgeries
  – 13,929 Outpatient surgeries
  – 2,571 Inpatient cardiac catheterizations
  – 1,427 Outpatient cardiac catheterizations
  – 22,035 Outpatient GI procedures
  – 22,345 Radiation Oncology
About us

477 Med – Surg beds
- 216 of these with telemetry capability

77 ICU Beds
25 Inpatient Psychiatry
48 NICU
64 Ante/Postpartum
Event

Why?

Alarm at Central Nursing Station was not heard

Ventricular Tachycardia, illicited no response

Unexpected death of monitored 85 year old patient admitted with rectal bleeding

Patient’s preceding arrhythmias not assessed or documented

Why?

Volume on alarm turned down

Paper Notice with telemetry instructions taped over speaker

Only audible sound is when at central station (no other remote speakers or hallway monitors)

Inconsistent practice for timing of reassessment and oversight

Questionable competency of unit staff to interpret arrhythmia

Why?

Unclear why or for how long the volume had been turned down—described by staff to decrease nuisance noise

Inadequate Resource material for staff related to monitoring equipment

Audibility had not been consistently evaluated

Vague institutional standard

Rare use of telemetry on this inpatient unit

Telemetry monitoring capability expanded without standardized initial or ongoing competency assessment

Why?

Local unit control over volume with no standardized approach

Little collaboration between clinical engineering and clinical nursing staff
Call to action

• Event 1. Delayed response to monitored patient with pulseless VT: Desensitization to VT alarm
• Event 2. Delayed response to monitored patient with asystolic arrest: Mistrust of telemetry signal
• Event 3. Delayed response to cardiac arrest in patient whose monitor leads had fallen off: Apathy to leads off alarm
• Event 4. Delayed response to cardiac arrest after monitoring suspended for off-floor procedure: Miscategorization of risk
Considerations……

- Standards and Policy
- Education and Training
- Human Resource
- Technical/Equipment
- Human Factors
Response to Life-Threatening Events

Response to Monitored Events
- Alarms / Device
- # Active Devices

Response to Unmonitored Events

Total Number of Alarms = (Alarms emitted by each device) x (# active devices)
Response to Monitored Events

Alarms */ Device

- Actionable Alarms
- Non-Actionable Alarms
  - False Alarms
  - Nuisance Alarms

# Active Devices

- Not Indicated
- Clinically Indicated

Alarms / Device = (Actionable Alarms) + (Non-actionable Alarms)

* Technical Alarms and Clinical Alarms

Non-actionable Alarms = (False Alarms) + (Nuisance Alarms)
Response to Life-Threatening Events

Response to Monitored Events
- Alarms / Device
  - Actionable Alarms
  - Non-Actionable Alarms
    - False Alarms
  - Clinically Indicated
  - Not Indicated
    - Nuisance Alarms

Response to Unmonitored Events
- # Active Devices
- Continuous Monitoring of High-Risk Patients
  - Not Indicated
False Alarms

Recognized that false alarms (bad signal) often resulted from poor contact

• Changed lead product after reviewing a number of types

• Adopted new protocol to change electrodes daily
Nuisance Alarms

Reviewed alarm parameters with MD electrophysiology expert

- Modified unit default settings to minimize nuisance alarms
- Piloted new settings on telemetry-dense units without adverse outcome
- Adopted new settings as default parameters for all non-ICU inpatients
## Alarm Default Changes

<table>
<thead>
<tr>
<th>Alarm</th>
<th>2004</th>
<th>New</th>
</tr>
</thead>
<tbody>
<tr>
<td>High heart rate</td>
<td>➤120</td>
<td>➤130</td>
</tr>
<tr>
<td>Low heart rate</td>
<td>&lt;40</td>
<td>&lt;35</td>
</tr>
<tr>
<td>Pair PVCs</td>
<td>Off</td>
<td>Off</td>
</tr>
<tr>
<td>Missed beat</td>
<td>Off</td>
<td>Off</td>
</tr>
<tr>
<td>Vent bigeminy</td>
<td>Off</td>
<td>Off</td>
</tr>
<tr>
<td>Vent trigeminy</td>
<td>Off</td>
<td>Off</td>
</tr>
</tbody>
</table>
# Alarm Default Changes

<table>
<thead>
<tr>
<th>Yellow Alarm</th>
<th>2004</th>
<th>New</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non-sustained VT</td>
<td>On</td>
<td>Off</td>
</tr>
<tr>
<td>Run PVCs</td>
<td>&gt;2</td>
<td>Off</td>
</tr>
<tr>
<td>PVC rate</td>
<td>&gt;10 PVCs/min</td>
<td>&gt;15 PVCs/min</td>
</tr>
<tr>
<td>Pause</td>
<td>&gt;2.0 sec</td>
<td>&gt;2.5 sec</td>
</tr>
<tr>
<td>SVT</td>
<td>&gt;180 b/min</td>
<td>&gt;180 b/min</td>
</tr>
</tbody>
</table>
### Alarm Default Changes

<table>
<thead>
<tr>
<th>Red Alarm</th>
<th>2004</th>
<th>New</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asystole</td>
<td>&gt;4.0 sec</td>
<td>&gt;4.0 sec</td>
</tr>
<tr>
<td>Vfib / Vtach</td>
<td>&gt;100 b/min</td>
<td>&gt;120 b/min</td>
</tr>
<tr>
<td>Extreme Tachy</td>
<td>&gt;140 b/min</td>
<td>&gt;150 b/min</td>
</tr>
<tr>
<td>Extreme Brady</td>
<td>&lt;40 b/min</td>
<td>&lt;35 b/min</td>
</tr>
</tbody>
</table>
Reviewed consensus guidelines for appropriate indications for cardiac telemetry

Recognized that high proportion of telemetry monitoring inadvertently continued after “high-risk” condition had excluded or resolved

• Re-designed electronic order for telemetry to include:
  • Required clinical indication
  • Daily re-order or discontinuation of telemetry
Recognized that telemetry monitoring occasionally suspended for “high-risk” patients when travelling off-unit

- Re-designed electronic order for telemetry to include:
  - No option to suspend telemetry for “high-risk” indications
  - Telemetry suspension (for non-high risk patients) through structured order
Enhanced competency for response to Actionable Alarms

- Developed and implemented baseline competency for cardiac telemetry interpretation
- Developed tiered competencies for units with higher acuity
- Reorganized committee structure to ensure collaboration among engineering team and clinical team members
- Developed ongoing performance metrics for alarm response
- Enhanced review of all cardiac/respiratory events to include intensive review of monitoring history/oversight
## Summary of 2012

<table>
<thead>
<tr>
<th>MEASURE</th>
<th>GOAL</th>
<th>FY 2012 QUARTER</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telemetry: Response to “Leads Off” Alarms within 3 minutes</td>
<td>100.0%</td>
<td>95.6% 93.5% 96.6% 97.9%</td>
</tr>
</tbody>
</table>
Ongoing Challenges

• Recent 30 minute Observation
  – Medical Unit
    • 100% of the time an alarm was sounding
  – Surgical Unit
    • 50% of the time an alarm was sounding
Next Steps

- Equipment Upgrade
  - Improved accessibility of data
  - Enhanced ability to customize alarm settings

- Increase Number of Remote Displays

- Continue to Refine Algorithms/Indications for use
Questions? Comments?

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