How To Identify The Most Important Alarm Signals To Manage: A Holistic Approach

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Trust And The Impact of Non-Actionable Alarms

Patients and their families want to know care providers are focused on what is important and relevant to their care and recovery.

“The nurse told me it wasn’t anything important and I could just silence it any time it went off. What if I hit the wrong button or did it for the wrong thing?”

“They said it didn’t mean anything. Then why is it going off?”

“The alarms go off and on all the time and nobody seems to notice or to care.”

“I waited and waited, but nobody came in to see what the alarm was for. It eventually went off on its own.”

“When my mom was in the ICU, it seemed like alarms were going non-stop.”

These are representative comments from patients and family members in discussing the need for improved noise and alarm management.

Photos courtesy of Lisa Pahl
Learning Outcomes

• Primary:
  – Discuss how to capture, analyze, and utilize data to identify performance improvement opportunities to decrease non-actionable alarms.

• Additional:
  – Differentiate actionable versus non-actionable alarm signals as part of an evidence-based approach to reduce alarm fatigue.

  – Describe the components of a successful alarm management strategy and how they interact to improve clinical care and operational effectiveness.
Presentation Outline

- Alarm Overview
- Georgia Regents Initiative
- Initial Data Collection & Analysis
- Georgia Regents Changes & Process
- Post Change Data Results
- Next Steps
How Many Potential Alarms Can You Identify?
Why Alarm Management Should be a Priority for You

• There is clear evidence that alarm frequency in many clinical environments is *excessive*

• *Literature review, site audits, web surveys and anecdotal reports all indicate that the absolute quantity of patient alarms is becoming problematic*

• Most alarm signals are *NOT actionable* – 50-80% according to published literature

• Alarms cause *stress for healthcare professionals*, with sound levels of 80 decibels common in clinical units

• Alarms *stress patients* and interrupt sleep. Stress and poor sleep can impact recovery, extend length of stay and result in worse long term function

• Alarm fatigue results in *depression and reduced productivity* in nursing staff. More than 50% of nursing staff identify themselves as affected by alarm fatigue

*See Bibliography Slide*
Alarm Management Strategy And Goals

Use a comprehensive, multi-faceted approach to incorporate experts and best practices.

- Reduce non-actionable alarms and alarm fatigue
- Ensure staff accountability and responsiveness to alarms
- Enhance patient care, patient safety, and patient experience
- Create a quieter, more healing environment
- Evaluate and optimize technology
- Improve productivity and work flow
- Increase patient and staff satisfaction
- Promote and model a culture of safety
- Enhance patient and family trust
- Align/meet TJC NPSG on Alarm Management
Actionable vs. Non-Actionable Alarm Signals
Use key stakeholders (i.e. physicians, nurses, etc.) to define and come to an agreement.

**Actionable alarm signal** – Requires clinical intervention or some type of action
• Life threatening, immediate response and action required
• Change in patient status, requires action to reverse or prevent further deterioration
• Requires action to prevent harm
• Requires action to correct a technical problem to assure proper patient monitoring (e.g., leads off, SpO₂ sensor disconnected)

**Non-actionable alarm signal** – Does not require a clinical intervention or action
• Short duration, self correcting (e.g., SpO₂ alarm signal)
• Intentional (e.g., suctioning or positioning/moving a patient)
• Triggered due to tight limits rather than actionable ones
• False alarm
  – System itself incorrectly identifies an alarm condition
  – Something interferes with system causing it to detect an alarm, e.g., artifact or low voltage triggered asystole
Alarm Management Current State Assessment
A comprehensive, holistic approach to provide sustainable solutions
Georgia Regents Health System
Academic Health Center in Augusta, Georgia

- 478 bed Georgia Regents Medical Center
- 154 bed Children’s Hospital of Georgia, including the region’s only Level IV NICU
- Critical Care Center, housing a regional Level I Trauma Center
- GR Health ⇔ Philips formed a 15-year business Alliance in 2014
Response to TJC National Patient Safety Goal

*Leadership* chartered a multidisciplinary Clinical Alarm Management Work Group

By October 31, 2014, identify the most important alarm signals to manage based on the following:

1. Input from the medical staff and clinical departments
2. Risk to patients if the alarm signal is not attended to or if it malfunctions
3. Whether specific alarm signals are needed or unnecessarily contribute to alarm noise and alarm fatigue
4. Potential for patient harm based on internal incident history
5. Published best practices and guidelines

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Unit Clinical Alarm Inventory*

- Clinical equipment with alarms
- Typical usage:
  - Constantly, Regularly, or Infrequently
- Is it centrally monitored?
- Priority
  - A = Highest – Could result in death
  - B = High – May lead to unintended consequences
  - C = Low – Little risk
- Level of oversight typically available adequate?

*Association for the Advancement of Medical Instrumentation (AAMI) website
Monitoring Process Mapping
Many sources of non-actionable alarms exist due to monitoring process complexity.

One piece of an extensive process mapping
“The Monitor Techs manage the alarms. They will call us if there is a problem and they silence the alarms, we don’t.”

“We can adjust limits but we can’t turn any alarms off. Not even irregular heart rate.”

“I’m not sure how you get the alarm settings back to the defaults.”

“It can be hard to get someone to respond and to change the batteries.”

“I hear alarms going off all the time and it seems as if nobody pays attention to them or tries to adjust them.”

“We did do education on changing the electrodes everyday, but I’m not sure everyone does that.”

“We don’t currently have a policy for who gets monitored but we are looking at developing one using the AHA guidelines.”

“I’m not sure what process is used to adjust alarm limits so they are appropriate for the patient.”

“I know people don’t always discharge between patients since I have seen data in there from before the patient was admitted.”
Data Collection: What Are Your Options?

**PIIC iX (Central Station)**
- Audit log is incorporated into the product
- Can review alarm data directly at any time
- Can export data onto a thumb drive or obtain remotely
- Data is available for any PIIC iX device attached to the server
- Includes data for selected Inop alarms
- Can download up to 90 days of alarm data

**IntelliSpace Alarm Reporting (IAR) Tool**
- SW on a separate PC that pulls data from either the PIIC or the PIIC iX
- Can collect data from either the PIIC or the PIIC iX
- Can export data onto a thumb drive or obtain remotely
- Provides data on all monitoring alarms, including all inop/technical alarm signals
- Expanded storage capabilities of up to 15 months of alarm data
Question

Do you currently collect and analyze data about the number and types of monitoring alarms occurring on your unit?

1. Yes

2. No
Initial Alarm Data For MICU and 6N (Telemetry)

Collected over a two-week time period

- MICU: 52,729
- 6N: 46,358

Total Alarms

<table>
<thead>
<tr>
<th>MICU</th>
<th>6N</th>
</tr>
</thead>
<tbody>
<tr>
<td>52,729</td>
<td>46,358</td>
</tr>
</tbody>
</table>

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Initial Alarm Data For MICU & 6N
Alarms totals per category can help prioritize focus areas.

<table>
<thead>
<tr>
<th>Category</th>
<th>MICU</th>
<th>6N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Red Arrhythmia</td>
<td>764</td>
<td>1004</td>
</tr>
<tr>
<td>Yellow Arrhythmia</td>
<td>13252</td>
<td>38218</td>
</tr>
<tr>
<td>Red Parameter</td>
<td>4166</td>
<td>487</td>
</tr>
<tr>
<td>Yellow Parameter</td>
<td>33073</td>
<td>3457</td>
</tr>
<tr>
<td>Inop/Technical</td>
<td>1474</td>
<td>3192</td>
</tr>
</tbody>
</table>

Number of Alarms Over 2 Weeks

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Alarm Data By Each Type Of Alarm: MICU
Can identify specific alarms to address

MICU Red Arrhythmia Alarm Totals

<table>
<thead>
<tr>
<th>Alarm Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asystole</td>
<td>130</td>
</tr>
<tr>
<td>Vfib/Vtach</td>
<td>78</td>
</tr>
<tr>
<td>Vtach</td>
<td>252</td>
</tr>
<tr>
<td>Extreme Tachy</td>
<td>194</td>
</tr>
<tr>
<td>Extreme Brady</td>
<td>110</td>
</tr>
</tbody>
</table>

MICU Yellow Arrhythmia Alarm Totals

<table>
<thead>
<tr>
<th>Alarm Type</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR High</td>
<td>1567</td>
</tr>
<tr>
<td>HR Low</td>
<td>658</td>
</tr>
<tr>
<td>Nonsus VT</td>
<td>773</td>
</tr>
<tr>
<td>Vent Rhythm</td>
<td>3097</td>
</tr>
<tr>
<td>Run</td>
<td>454</td>
</tr>
<tr>
<td>Par PVCs</td>
<td>75</td>
</tr>
<tr>
<td>R on T PVC</td>
<td>34</td>
</tr>
<tr>
<td>Bigem</td>
<td>100</td>
</tr>
<tr>
<td>Trigem</td>
<td>152</td>
</tr>
<tr>
<td>PVC Rate</td>
<td>1026</td>
</tr>
<tr>
<td>Multiform PVC</td>
<td>1804</td>
</tr>
<tr>
<td>PVC Not Capture</td>
<td>57</td>
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<tr>
<td>Pacer Not Pace</td>
<td>18</td>
</tr>
<tr>
<td>Pause</td>
<td>231</td>
</tr>
<tr>
<td>Missed Beat</td>
<td>12</td>
</tr>
<tr>
<td>SYT</td>
<td>284</td>
</tr>
<tr>
<td>Atib</td>
<td>184</td>
</tr>
<tr>
<td>Inspec HR</td>
<td>681</td>
</tr>
</tbody>
</table>
Alarms Per Patient: Patient Outliers?

Deep dives can provide information on process and customization.

Summary
A total of 1,947 alarms were generated by one patient and the majority of the alarms for Low Heart Rate. The low limit was set at 75. Except for 12 of the alarm signals, all of the alarms that occurred were triggered by heart rates between 70 and 74.
Evaluating The Potential Impact Of Alarms
It is not just alarm fatigue for the nurses.

One patient in an ICU had a total of **907 alarms** in a 24-hour time period.

**A disruption every 1.5 minutes for the nurse and for the patient!**

Impacts patient care, patient and staff satisfaction and workflow

This does not include all of the other alarms going off in the patient room (i.e. ventilators, IV pumps, etc.)
Intervention 1: Adjust Yellow Arrhythmia Defaults

Total 68,924 yellow arrhythmia alarm signals generated. New default would have eliminated 21,088 alarms.

30% reduction
Alarm Management Communication *Example*
This communication was distributed and posted on the unit.

**The Following Changes Will Be Made On 6N**
On February 19th we will initiate our first intervention to address the issue of Alarm Fatigue at our institution. The following alarms will be defaulted to OFF:

1. Non-sustained ventricular tachycardia (which only applies to 3 and 4 beat runs)
2. Run PVCs (redundant with #1)
3. Pair PVCs
4. Ventricular Bigeminy
5. Ventricular Trigeminy
6. Multiform PVCs
7. Pause (currently set greater than 2 seconds)

In addition, the red alarm default for asystole will be changed from 4 seconds to 3 seconds.

**Notifications**
The physicians have been notified by the physician Co-Chair that these changes are being made

The 6N nursing staff has been notified by the Nurse Manager that these changes are being made

**Assessing The Impact**
- Alarm data was collected and analyzed for two weeks previously
- Alarm data will be collected and analyzed for two weeks following the configuration changes in order to evaluate the impact on the total number of alarms occurring

**Expectations**
- Any of the above alarms may be turned back on if deemed clinically appropriate, and the physicians and nurses may coordinate with the 6N alarm techs to do this
- The plan is to keep a close record of any possible negative outcomes related to these changes, including any near-misses, Rapid Response calls, or Code Blue events
- If you perceive any near miss events, please document and notify the Nurse Manager of 6N
- If you have any other questions or concerns, please contact your Nurse Manager
Post-Change Alarm Data Comparisons

<table>
<thead>
<tr>
<th>MICU Pre</th>
<th>6N Pre</th>
<th>MICU Post</th>
<th>6N Post</th>
</tr>
</thead>
<tbody>
<tr>
<td>52,729</td>
<td>46,358</td>
<td>56,069</td>
<td>31,576</td>
</tr>
</tbody>
</table>

6% Increase
32% Reduction
Assessing Pre and Post Change Data MICU
Yellow arrhythmia category only a small portion of MICU alarms

MICU Alarm Category Pre-Change

- Red Arrhythmia: 764 (1%)
- Yellow Arrhythmia: 13252 (25%)
- Red Parameter: 7076 (13%)
- Yellow Parameter: 41992 (75%)
- Inop/Technical: 33073 (8%)
- Total: 4166 (3%)
- Total: 1014 (2%)
- Total: 1474 (3%)
- Total: 4706 (8%)
- Total: 33073 (63%)
- Total: 41992 (75%)

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Assessing Pre and Post Change Data 6N

Yellow arrhythmia category a large portion of the 6N alarms

6N Alarm Category Pre-Change

- Red Arrhythmia: 487, 1%
- Red Parameter: 3457, 8%
- Yellow Arrhythmia: 3192, 7%
- Yellow Parameter: 1004, 2%
- Inop/Technical: 38218, 82%

6N Alarm Category Post-Change

- Red Arrhythmia: 802, 2%
- Red Parameter: 4372, 14%
- Yellow Arrhythmia: 18533, 59%
- Yellow Parameter: 6819, 22%
- Inop/Technical: 1050, 3%
Yellow Arrhythmia Alarms Per Patient Bed Per Day

- MICU Pre-Change: 39, Post-Change: 21
  - 46% Reduction

- 6N Pre-Change: 114, Post-Change: 46
  - 60% Reduction
Total Alarms Per Patient Bed Per Day for 6N
Comparing pre- and post-change data
Impact On Total Alarms Per Patient Bed Per Day
Comparing MICU and 6N

- 6% Increase from MICU to 6N (Pre-Change: 157, Post-Change: 167)
- 41% Decrease from MICU to 6N (Pre-Change: 132, Post-Change: 78)
Next Steps

• Continue faculty and staff education on clinical alarm management
  – Grand rounds and section meetings
  – Nursing skills fair
  – Online training (Future)

• Educational program for lead placement
  – Skin prep and proper electrode placement
  – Routine battery replacement
  – Routine change of electrodes

• New clinical alarm management policy

• Telemetry order set based on AHA Telemetry Practice Standards

• CHOG pilot units

• MICU default parameter settings
Starting Point For MICU Parameter Focus
Top five alarms measured pre- and post-changes
Alarms Per Limit Trigger
Assessing the potential impact of limits settings

Total SpO2 Alarms MICU (Default Low Limit <94)
Clinical Alarm Management Work Group Charter - Part II

By October 31, 2015, establish policies and procedures for managing the priority alarms identified and at a minimum, address the following:

1. Clinically appropriate settings for alarm signals
2. When alarm signals can be disabled
3. When alarm parameters can be changed
4. Who in the organization has the authority to set alarm parameters
5. Who in the organization has the authority to change alarm parameters
6. Who in the organization has the authority to set alarm parameters to “off”
7. Monitoring and responding to alarm signals
8. Checking individual alarm signals for accurate settings, proper operation, and detectability
Next Steps

• Partner with Philips on creation of an alarm reporting dashboard.

• Continue with incremental changes and measure the results.

• Consider Alarm Champions (staff) to partner with Alarm Committee to roll out changes and be change agents.

• Explore technology optimization and use of IntelliSpace Event Management (IEM).
  – Evaluate use model
  – Identify ROI
Question

Does your institution use any type of automated secondary notification system for clinical alarms?

1. Yes

2. No
Looking At Alarm/Alert communication

Alarms (all PMD alarms)

- Reports to help identify 'actionable' alarms

IEM filter ('Actionable' Alarms)

Alerts (all 'actionable' IEM alerts)

Alarm data output

1. Alarm Data
   - Alarm data capturing and analysis
     - Focus: Baseline alarm data
     - Addresses: TJC 2014 NPSG 06.01.01
     - Delivers: Pre-filtered Alarm reports data

2. Event solution
   - Alert Communications and analysis
     - Focus: Alert workflow and processes
     - Addresses: TJC 2016 NPSG 06.01.01
     - Delivers: Alert communications + alert workflow reporting data

Comprehensive ‘end-to-end’ Alarm/Alert communications solution from Philips
Technology Optimization

Utilize other tools to analyze trends and changes in patient status in conjunction with alarms.
In Summary

Any Alarm Management Strategy must be carefully thought out, tested, and continuously evaluated to assure achieving the right balance of patient safety and quality of care with the reduction of alarm fatigue.

Photo courtesy of Lisa Pahl
Thank you!