"It's Alarming"
Simple Steps To Reduce Nuisance Alarms

Lisa Pahl, MSN, Principal, Practice Lead Alarm Management
Healthcare Transformation Services
May, 2017
Objective

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

What will you learn...

You’ll be able to describe how to capture and analyze alarm data and other findings to identify and implement alarm management changes and evaluate their effectiveness.
“Alarming” Personal Stories

Unacknowledged alarms cause patients & families to lose trust in you & your organization

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

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

“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.”

“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?”

Photo courtesy of Lisa Pahl
Some Interesting Dates & Events
A selected review

2003  JCAHO releases NPSG No. 6 “Improve the effectiveness of clinical alarm systems"
  • Part of focus is on assuring alarms are activated with appropriate settings and sufficiently audible

2010  Liz Kowalczyk of the Boston Globe begins series of articles on alarms in hospitals
  • Patient death at UMASS identified alarm fatigue identified as a contributing factor

2011  Association for the Advancement of Medical Instrumentation (AAMI) “Summit On Clinical
       Alarms”
  • 300 multi-disciplinary stakeholders attended to “discuss the hazard of alarm noise” and identified
     seven “Clarion Themes” to focus on

2012  A 17 year old died in an outpatient setting following a routine and uncomplicated tonsillectomy
  • $6M award in part on alarms on the monitor being “muted, ignored and/or not properly set”

2013  TJC Sentinel Event Alert Issue 50 around alarm safety
  • Identified alarm fatigue as one of the most common contributing factors to reported events

2014 & 2016  TJC NPSG.06.01.01 on Clinical Alarm Safety; AAMI National Coalition for Alarm Safety
  • Establish alarm safety as priority, identify most important alarms to manage, establish P&Ps, and
    educate staff and providers; share best practices and improve alarm management
Alarm Management
- Initiative -
What Is Alarm Fatigue?
There is not an agreed upon or standard definition

Large number of frequent alarms or alerts + Sensory overload + Desensitization = Delayed response & missed alarms

“A clinical scenario that may occur when alarms sound so often that responders become desensitized to them and may not respond quickly enough or not at all”

FDA, MedSun: Newsletter #65, October 2011
Actionable vs. Non-Actionable Alarm Signals

Ensure key stakeholders (i.e. providers, nurses, etc.) come to an agreement

**Actionable Alarm Signal**

**REQUIRES** clinical intervention or action

- Life threatening, immediate response & action required
- Change in patient status, requires action to reverse or prevent further deterioration
- Requires action to correct a technical problem to assure proper patient monitoring
  - Ex. leads off, \( \text{SpO}_2 \) sensor disconnected

**Non-Actionable Alarm Signal**

**DOES NOT** require clinical intervention or action

- Short duration, self correcting (ex. \( \text{SpO}_2 \) alarm signal)
- Anticipated (ex. Suctioning or positioning)
- Due to tight limits rather than actionable ones
- False alarm due to:
  - Incorrect identification by system itself
  - Interferes with system (ex. artifact or low voltage triggered asystole)
The Potential Impact of Non-Actionable Alarms on Staff and Patients
Alarm add up, distract, and interrupt

5 ICUs had a total of 2.5 million alarms in a 31-day study period.*

The equivalent of 30 million alarms in a year.

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

A disruption every 1.5 minutes for the nurse and for the patient.

The Potential Impact of Reducing Non-Actionable Alarms

Less interruptions, noise, and stress

<table>
<thead>
<tr>
<th>IMPROVEMENTS</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Improved Quality of Care</td>
<td>▪ 500,000 less interruptions for nursing staff in ICN</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 15,000 more hours each month of time nurses can spend with their patients</td>
<td></td>
</tr>
<tr>
<td>Enhanced Patient and Staff Satisfaction</td>
<td>▪ Decreased noise levels for patients and staff due to decreased alarm and/or alert sounds at bedsides, central stations and on phones</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ Staff awareness of leadership goal to reduce non-actionable alarms</td>
<td></td>
</tr>
<tr>
<td>Increased Efficiency</td>
<td>▪ Less workflow disruptions related to responding to, acknowledging, and reviewing alarms</td>
<td></td>
</tr>
<tr>
<td>Cost Savings</td>
<td>▪ Less time spent responding to non-actionable alarms</td>
<td></td>
</tr>
<tr>
<td></td>
<td>▪ 30% reduction of alarms on Philips units only translates into savings hours equivalent to 46 FTEs or approximately $2.4M in cost savings</td>
<td></td>
</tr>
</tbody>
</table>

A 30% reduction would result in:

~9 million less alarms per year

~300,000 hours of time for value added patient care
Developing An Effective Alarm Management Strategy
Understanding the problem and where to start

The Challenge
More technology often means more alarms, many of which are not actionable or clinically relevant.

These nuisance alarms interrupt work flow and patient care, disrupt patient’s sleep cycles and healing, and creates alarm fatigue for care providers, and can adversely impact patient care.

The Goal
Reduce non-actionable alarms and alarm fatigue:
• Utilize data and other information to modify default setting
• Revise monitoring and alarm management processes, practices, and policies
• Utilize technology to alert care providers to a change in patient status prior to an alarm occurring
• Ensure your culture identifies alarm management as a patient safety priority
Our Approach
Question

Has your unit/organization moved beyond data and have assessed other areas of alarm management, i.e. staff feedback, observation, the monitoring process, etc.?

☐ Yes

☐ No
Alarm Management Evaluation
Using an end-to-end strategy to identify opportunities

Culture

People

Process & Practices

Technology

Data Analysis
Obtain Direct Feedback and Input
From leadership, frontline staff, providers, and patients and families

“The Monitor Techs manage the alarms. They will call us if there is a problem and they silence the alarms, we don’t.”

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

“Alarms are going off all of the time. The patients and even family complain about it.”

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

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

“Patients stay on the monitor right up until they go home.”

“We’re supposed to change the electrodes everyday, but we don’t do that.”

“As long as a doctor writes an order, they can go to tests without their telemetry.”

“We’re not allowed to adjust limits on our own. I would have to get an order.”

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

“Patients stay on the monitor right up until they go home.”

“We’re not allowed to adjust limits on our own. I would have to get an order.”

“I’m not sure what process is used to adjust alarm limits so they are appropriate for the patient.”
Clarify Roles & Responsibilities Through Observation
Can everyone articulate their role in patient monitoring and alarm management?

**NURSING ASSISTANT**
- Connects patient to telemetry device when they are admitted
- Reattaches disconnected leads and electrodes
- Replaces batteries in telemetry

**NURSE**
- Admits their own patients to the central
- Reviews rhythm strips every shift
- Is notified by the Monitor Tech if there is a change in patient rhythm
- Goes with monitored patient to tests
- Contacts physician for changes and to see if alarm settings can be adjusted

**CHARGE NURSE**
- In addition to patient care load, is the backup if the Monitor Tech is unable to reach a nurse
- Verifies that staff have their pagers and have assigned patients at the start of the shift

**MONITOR TECH**
- Continuously monitors between 32 to 48 patients at the central
- Acknowledges alarms when they occur
- Calls primary nurse if there is a change; if no response, calls the Charge Nurse, if no response calls the unit directly
- Makes alarm limit adjusts on their own
Review Your Entire Monitoring and Alarm Process
Assess workflow, patient flow, data flow, environment, and patient safety

Order(s)/Protocols
- Monitoring Initiation - who orders? Use of AHA guidelines?
- Adjusting limits and parameters
- Change in monitoring (tele to bedside or vice versa)
- Transport
- Continuance or discontinuance

Patient and Device
- Patient/family education
- Electrode storage, application, changes
- Device on and functioning correctly
- Right device & settings, on the right patient with right information in the right sector

Arrhythmia Analysis
- Best leads selected
- Settings specific for patient (i.e. pacer)
- Waveform data displayed and learned correctly
- System correctly analyzing and evaluating rhythm

Alarm Generation
- Alarms on, active
- Limits and alarms customized
- Waveform displaying
- Change in patient triggers visual/audible alarm
- Secondary notification system

Response
- Alarm enunciation occurs, is detected
- Patient assessed, treatment initiated if needed
- Alarm silenced and evaluated
- Alarm settings adjusted based on patient status
Technology Assessment
Do staff know how to adjust settings and how to return to defaults?

<table>
<thead>
<tr>
<th>Settings</th>
<th>Tele 1</th>
<th>ICU</th>
<th>MICU</th>
</tr>
</thead>
<tbody>
<tr>
<td>High Limit</td>
<td>120</td>
<td>135</td>
<td>135</td>
</tr>
<tr>
<td>Low Limit</td>
<td>50</td>
<td>50</td>
<td>50</td>
</tr>
<tr>
<td>Extreme Tachy Diff</td>
<td>20</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Tachy Clamp</td>
<td>200</td>
<td>240</td>
<td>240</td>
</tr>
<tr>
<td>Extreme Brady Diff</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
<tr>
<td>Brady Clamp</td>
<td>40</td>
<td>30</td>
<td>30</td>
</tr>
<tr>
<td>Asystole Thresh</td>
<td>4.0 SEC</td>
<td>4.0 SEC</td>
<td>4.0 SEC</td>
</tr>
<tr>
<td>Vtach HR</td>
<td>100</td>
<td>120</td>
<td>120</td>
</tr>
<tr>
<td>Vtach Run</td>
<td>5</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Vent Rhythm</td>
<td>14</td>
<td>14</td>
<td>14</td>
</tr>
<tr>
<td>PVCs/min</td>
<td>10</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Non-Sustain VT</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
</tr>
<tr>
<td>Vent Rhythm</td>
<td>ON</td>
<td>ON</td>
<td>ON</td>
</tr>
</tbody>
</table>
Your Culture
What are your ways of working together?

Who decides and adjusts alarm limits and settings?

What happens if an adverse event occurs?

“Meyer said hospital administrators are not interested in assigning blame to individual staff members because that would be unfair and counterproductive in trying to encourage open reporting and discussion of problems. Rather, he said, hospital officials want to fix the underlying systemic issues with monitoring patients . . .”


What is your on-boarding process?
Is education provided on monitors and alarm management expectations?
Do you currently collect and analyze data about the number and types of monitoring alarms occurring on your unit?

- [ ] Yes
- [ ] No
## Monitoring Alarms: How They Are Classified and Prioritized

Use common terminology rather than vendor specific terminology.

<table>
<thead>
<tr>
<th>High Priority Arrhythmia (***</th>
<th>Medium Priority Arrhythmia (**)</th>
<th>High Priority Parameter (!!!)</th>
<th>Medium Priority Parameter (!!)</th>
<th>Inop/Technical (priority can be changed for some)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asystole</td>
<td>Non-sustained Vtach</td>
<td>Apnea</td>
<td>High or Low Limit Violations:</td>
<td>Leads Off</td>
</tr>
<tr>
<td>Vfib/Tach</td>
<td>Ventricular Rhythm</td>
<td>Spo₂ Desat</td>
<td>SpO₂</td>
<td>Replace Battery</td>
</tr>
<tr>
<td>Extreme Tachycardia</td>
<td>Run PVCs</td>
<td>Invasive Pressure</td>
<td>Respiratory</td>
<td>Cannot analyze ECG</td>
</tr>
<tr>
<td>Extreme Bradycardia</td>
<td>Pair PVCs</td>
<td>Line Disconnect</td>
<td>NBP</td>
<td>Others outlined in IFU; not captured by PIIC IX</td>
</tr>
<tr>
<td>V-Tach</td>
<td>Trigeminy</td>
<td>Invasive Pressure Extreme Limit</td>
<td>Invasive Pressure</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Bigeminy</td>
<td></td>
<td>Temp</td>
<td></td>
</tr>
<tr>
<td></td>
<td>PVCs per minute</td>
<td></td>
<td>CO₂</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Multiform PVCs</td>
<td></td>
<td>Other</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pause</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pacer not capture</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pacer not pace</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Missed beat</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>SVT</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>HR High/Low</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Atrial Fib/Atrial Fib End</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Irregular Heart Rate/Irregular Heart Rate End</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Data Collection: How, What, and Where

At Philips, we use the PIIC iX or the IAR Tool
Monitoring Alarm Data Analysis
Start by comparing totals across units

Number of alarms adding to noise and interruptions on the unit as a whole
Monitoring Alarm Data Analysis
Start by comparing totals and categories across units

Identify areas of focus that could potentially have the largest impact across the organization
Check For Outliers
Deep dive can provide information on customization and practices

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, all of the alarms that occurred were triggered by heart rates between 70 and 74.

Are one or two patients contributing the most to the alarm load? Is it because the alarms are actionable or do they need to be customized?
Data Based Default Settings Improvements
Use data to identify system wide and unit specific opportunities

Who and How
• Alarm Management/Technology Committee
  • Multidisciplinary and key stakeholder representation

• Published Best Practices and other resources
  • Utilize Near Miss, Incident, RRT, and Code Blue reports

• Keep focus on whether an alarm is clinically relevant and/or actionable
  • Based on patient populations, care models, and treatment protocols

Where To Start
• Could some medium priority arrhythmia alarms be safely defaulted off?

• Review all parameters
  • Evaluate limits, balance so not too tight, not too wide
  • Can some parameter alarms be safely defaulted off?
  • Review delay times before an alarm is triggered, e.g., SpO2 low limit, Desat, Apnea

• Identify redundant settings and determine when they should be utilized or eliminated

• Ensure Leads Off & Replace Battery are high priority across all units

Pilot incremental changes on one unit and evaluate results and discuss lessons learned before implementing house wide
Secondary Notification:
Automated Middleware or Central Monitoring Unit
Question

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

- Yes
- No
Alarm/Alert Communication Process
Understand your system: What is being sent, to whom, what are the delay times, escalations patterns, and reminders?

1. **Alarm Data**
   - Alarm data capturing and analysis
   - **Focus:** Baseline alarm data and default settings

2. **Alerts**
   - All 'actionable' alerts
   - Middleware/CMU filter ('Actionable' Alarms)

   - **Alert Communications and analysis**
   - **Focus:** Alert workflow and processes and data

   - **Event notification**
   - Dispatch alert
The Potential Impact of Alerts

If not utilized effectively, staff will also become desensitized to alerts.

Comparison of Number of Asystole and Vfib/Vtach Alarms and Paging Alerts for Critical Care Units
(each over a 30 day period)

This was an automated system. What is the impact on Monitor Watchers?
Other Opportunities
The CoCreate Approach

...The beginning of the journey towards improvements for a better future

Consistent with your Organizations' vision, Philips partnership resolves to discover the gaps and challenges, co-develop solutions with the stakeholders and deliver results.
Understand & Enhance Your Culture
Ensure everyone views alarm management as a patient safety issue that is everyone’s responsibility

Hospital Survey on Patient Safety

Instructions
This survey asks for your opinions about patient safety issues, medical error, and event reporting in your hospital and will take about 10 to 15 minutes to complete.

If you do not wish to answer a question, or if a question does not apply to you, you may leave your answer blank.

- An "error" is defined as any type of error, mistake, accident, accident, or deviation, regardless of whether or not it results in patient harm.
- "Patient safety" is defined as the avoidance and prevention of patient injuries or adverse events resulting from the processes of health care delivery.

Near Miss Reporting

AACN Standards for Establishing and Sustaining Healthy Work Environments

Critical Thinking Skills

CUSP Toolkit

The Comprehensive Unit-based Safety Program (CUSP) toolkit includes training tools to make care safer by improving the foundation of how your physicians, nurses, and other clinical team members work together. It builds the capacity to address safety issues by combining clinical best practices and the science of safety.
Start With Basic Process and Move to Advanced Processes
Often a lack of clarity and wide variation in practice

Artifact Prevention
- Skin prep prior to electrode attachment
- Electrode storage & placement
- Lead wire inspection
- Electrode evaluation for daily use and special needs
- Replace electrodes q24 hours
  - This is an AACN recommendation
  - One study showed daily electrocardiogram electrode change reduced the average alarms per bed per day by 46% on two Critical Care units.

Alarm Customization
- Use Alarm Committee and other internal experts to develop a consistent customization process
- Identify which settings nurses can individually adjust versus which require further input from others (physicians, charge, manager, etc.)
  - Limit adjustments
  - Turning individual alarms off
  - Changing alarm criteria (e.g. increasing pause trigger from > 2 seconds to > 3 seconds or Vtach rate trigger from 100 bpm to 120 bpm)
- Update policies and procedures so they align with the process
- Establish alarm settings review process as part of hand-offs and rounds
- Consider incorporating alarm review and actionable settings as part of patient rounds

Perform random audits related to processes to ensure practice aligns

## Results
Some other examples

<table>
<thead>
<tr>
<th>Hospital A</th>
<th>Type</th>
<th>Total Alarms Per Patient Bed Per Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital A</td>
<td><strong>Lead</strong> Changes Q24 hours &amp; obtaining appropriate lead set sizes</td>
<td>-60%</td>
</tr>
<tr>
<td></td>
<td><strong>Default Changes: Arrhythmia Settings</strong></td>
<td>-41%</td>
</tr>
<tr>
<td></td>
<td><strong>Default Changes: SpO2 Low Limit Decrease</strong></td>
<td>-39%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hospital B</th>
<th>Type</th>
<th>Total Alarms Per Patient Bed Per Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital B</td>
<td><strong>Default Changes: Arrhythmia &amp; Parameter Settings</strong>&lt;br&gt;(Unit 1)</td>
<td>-36%</td>
</tr>
<tr>
<td></td>
<td><strong>Default Changes: arrhythmia Settings</strong>&lt;br&gt;(2 Units)</td>
<td>-42%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hospital C</th>
<th>Type</th>
<th>Total Alarms Per Patient Bed Per Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital C</td>
<td><strong>Default Changes: Arrhythmia Settings</strong>&lt;br&gt;(Unit 1)</td>
<td>-30%</td>
</tr>
<tr>
<td></td>
<td><strong>Default Changes: Parameter Settings</strong>&lt;br&gt;(Unit 2)</td>
<td>-19%</td>
</tr>
<tr>
<td></td>
<td><strong>Customization Guidelines Only</strong>&lt;br&gt;(Unit 3)</td>
<td>-26%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Hospital D</th>
<th>Type</th>
<th>Total Alarms Per Patient Bed Per Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hospital D</td>
<td><strong>Default Setting Changes</strong>&lt;br&gt;(Unit 1)</td>
<td>-28%</td>
</tr>
<tr>
<td></td>
<td><strong>Default Setting Changes</strong>&lt;br&gt;(Unit 2)</td>
<td>-33%</td>
</tr>
</tbody>
</table>
Results

Some other examples
Results

Some other examples
Technology Optimization

What can you use to alert you to a change in patient status?

SpO₂ Smart Alarm

Smart Alarm Delay Dynamics

% SpO₂

low limit

desat limit

time (s)
Right Size Your Monitoring Solution

The Right Monitor

For The Right Patient

At The Right Time

Christiana Care used the AHA Guidelines and reduced their telemetry use by 70% and estimate they saved $4.8M in a year

At The Right Place

“Our survey revealed that the use of monitor watchers is prevalent, but the efficacy of monitor watchers in improving patient outcomes has never been established.”*

*Citation: Funk, Marjorie et al. Use of Monitor Watchers in Hospitals: Characteristics, Training, and Practices, Biomedical Instrumentation and Technology. Nov/Dec 016
The Process is Cyclic
Alarm Management isn’t a one and done initiative

- Alarm Management Committee
- Data and Information
- Key Stakeholder Input
- Experts and Best Practices
- Patient Populations, Treatment, & Care Delivery
- Right Technology, Defaults & Customization
- Education & Competency
- Communication
- Near Miss Reports/Staff Concerns
- RRT and Code Blue Reviews
“There is no one-size-fits-all, institution-wide solution to addressing alarm hazards. Because the needs of each care area are unique, the team will need to understand the particular risks present in each and develop strategies that address those risks.”

ECRI Institute, “The Path To Alarm Safety,” TechNation, March, 2014 p. 33
Thank you!