Leveraging Technology to Reduce Inactionable Alarms from Bedside Physiologic Monitors

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Alarm Fatigue

- Alarms are intended to alert clinicians to changing conditions and reduce the risk of human error
- Alarms are everywhere! Nurses become desensitized to the alarms and fail to respond to alarms in a timely, appropriate manner
- Alarm fatigue is both auditory and mental
Alarms in the ICU

• Alarms every 19 seconds in a medical intensive care unit 350 alarms per patient per day (Welsh, 2012)

• Decreasing SpO$_2$ lower alarm limit from 90% to 88% resulted in a 45% decrease in alarms (Welsh, 2011)

• Education of nurses regarding alarms important step in addressing alarm fatigue (Graham & Cvach, 2010)

• No reports in literature regarding arrhythmia alarms
Setting

• 166 bed community hospital in Northern Colorado
• Cardiac Intensive Care Unit, Surgical Intensive Care Unit, Progressive Care Unit (12 beds each)
• Since 2009, policy already follows AACN’s guidelines:
  – Change electrodes daily, properly prepare skin, set alarm limits based on patient condition, education for nurses
Quality Improvement Project

• Determine prevalence of alarms from bedside physiologic monitors in the critical care units
• Implement changes to decrease alarms
  – Turn off non-actionable alarms (eg, PVCs)
  – Turn off alarms that signify conditions that are not emergent (eg, fever)
  – Adjust alarms to actionable limits (eg, lower oxygen saturation alarm to 88%)
## Initial State – One Day

<table>
<thead>
<tr>
<th>Unit (Patients)</th>
<th>Alarms</th>
<th>Alarms/Pt</th>
<th>Alarms/Hr</th>
</tr>
</thead>
<tbody>
<tr>
<td>SICU (7)</td>
<td>3661</td>
<td>523</td>
<td>153</td>
</tr>
<tr>
<td>CICU (7)</td>
<td>2521</td>
<td>360</td>
<td>105</td>
</tr>
<tr>
<td>PCU (12)</td>
<td>5923</td>
<td>494</td>
<td>247</td>
</tr>
<tr>
<td>Total (26)</td>
<td>12105</td>
<td>466</td>
<td>504</td>
</tr>
</tbody>
</table>

- Yellow arrhythmia alarms: 7,532 (62%)
- Low oxygen saturation alarms: 1,067 (9%)
Leveraging Technology

- Reprogram monitor defaults
  - Turn off temperature, respiratory rate and CVP alarms (non-emergent alarms)
  - Decrease oxygen saturation alarm from 90% to 88% (actionable limits)
  - Turn off all non-lethal arrhythmia alarms except irregular heart rate (non-actionable alarms)
- Education for nurses
Data

- 3 post-intervention data collection dates
- Goal decrease overall number of alarms, not necessarily per patient
- Per patient alarm results due to variability in number and acuity of patients in the unit
- Individual patient “outliers” included in data analysis
- No statistical difference between units
- ANOVA with post-hoc pairwise comparisons to pre-measures
Alarms per Patient per Day

Average Percent Change Pre-Post: 61%

<table>
<thead>
<tr>
<th></th>
<th>SICU</th>
<th>CICU</th>
<th>PCU</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pre</td>
<td>500</td>
<td>500</td>
<td>500</td>
<td>500</td>
</tr>
<tr>
<td>Post 1</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
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<tr>
<td>Post 2</td>
<td>100</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>Post 3</td>
<td>50</td>
<td>50</td>
<td>50</td>
<td>50</td>
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</tbody>
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<table>
<thead>
<tr>
<th></th>
<th>Post 1</th>
<th>Post 2</th>
<th>Post 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>t*(6)</td>
<td>-3.133</td>
<td>-3.441</td>
<td>-3.292</td>
</tr>
<tr>
<td>p-value</td>
<td>0.010</td>
<td>0.007</td>
<td>0.008</td>
</tr>
</tbody>
</table>
**Alarms per Patient**

Pre to Post 3 | Yellow | Red | SpO2 |
---|---|---|---|
\(t^*(6)\) | -6.282 | -0.297 | -0.297 |
p-value | 0.00038 | 0.7764 | 0.7764 |
% Change | 79% | 30% | 20%
Summary Points

- Nurses always had the ability to turn off or individualize alarms, but were afraid to do so.
- Defaulting alarms off was easier and less distressing to the nurse.
- No increase in Code Blue events or other untoward events after changes implemented.
- Small changes can make a big difference.
- Leverage the technology you have.
Questions?

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Selected References