Patient-Centric Alarm Management for Improving Care Quality

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Speaker Introduction

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Conflict of Interest and Disclosures

The authors declare they do not have any relevant or material financial interests that relate to the material described in this presentation.

All data in this presentation acquired from Texas Children’s Hospital data management.
Agenda

• History of monitoring and patient alarms

• Iterative improvements and understanding through Plan-Do-Study-Act (PDSA) cycles

• Improving alarm management with patient-centric alarms and additional PDSA cycles

• Conclusion: data makes communication possible, communication improves care
Learning Objectives

• Evaluate the role of patient monitoring and alarms in the modern critical care unit
• Show how PDSA cycles lead to ongoing alarm management improvement
• Identify how patient-centric alarm management and analytics improves care and outcomes
• Explain why opening communication channels among clinicians is a key to successful alarm management
An introduction to the benefits realized for the value of Health IT

- **S** - SATISFACTION
  - Patients, nurses

- **T** - TREATMENT/CLINICAL
  - Efficiency, quality of care, safety

- **E** - ELECTRONIC SECURE DATA
  - Enhanced, communication, data reporting, data sharing

- **P** - PATIENT ENGAGEMENT AND POPULATION MANAGEMENT
  - Prevention benefits, patient education

- **S** - SAVINGS
  - Efficiency, operations
Five Principles of Leadership

1. Challenge the Process
2. Inspire a Shared Vision
3. Enable Others to Act
4. Model the Way
5. Encourage the Heart

Kouzes and Posner
Part 1: History and Background
Mother falling asleep after watching her sick daughter all night...

“Vigil”: The act of keeping awake at times when sleeping is customary.

Act or period of time of watching or surveillance. (Webster)
Diana Cooper De Bakey
1909-1972
Old Monitor

New Monitor
54 Potential Alarm Sounds: Many Equal
The Illusion Of Monitoring

- It tells us that something DID happen
- It is after the fact information
- It can be distracting
- Occasionally useful
Status Quo

Total number of alarms per occupied bed in a 24 hr. period

Average Alarms in the PCU per Day = 5776
Stdev = 1029

Average Alarms per Bed per Day = 182
Stdev = 28
Too Many Alarms for Nurses

Average Alarms per nurse per shift: **over 250**

Or: 1 alarm every 3 minutes for 12 hours
Alarm floods: over 10 alarms in 10 minutes!

Average 87 floods per day
Experiments in Multitasking

“If you throw too much at a person at once, the person cannot possibly process all the input in real time”

-Emma Fauss
Consequences

ALARM FATIGUE

Desensitization to alarms due to overexposure
Desensitization can lead to longer response times or missing critical alarms.
Alarms become meaningless!
Effects of Alarm Fatigue

• Alarms contribute to distraction and not to better monitoring
• Nursing work flow is disrupted
• Increase in patient family anxiety and dissatisfaction
• Increase in provider anxiety and dissatisfaction
Part 2: PDSA Cycles for improving Alarm Management
Approach

- TCH formed Alarm Management Steering Committee
- Chose Progressive Care Unit (PCU) for study
- “How can alarms be used best within a hospital unit?”
- Initial data collected through technical partnership with Medical Informatics Corp (MIC) to understand alarm environment quantitatively
- Partnership maintained and changes made through series of Plan-Do-Study-Act (PDSA) cycles
Each PDSA cycle reduced Alarms
Baseline PDSA: Measure alarms in Unit

During baseline study, 230,000 alarms recorded in 60 days

Nurses averaged 250 alarms per shift, compared to a recommended 150 alarms

Dashboard used for on-demand daily summary of alarms
Baseline PDSA: Drill into the Data

Dashboard used to “drill-down” into alarms, by bed, nurse, or specific alarm.

One nurse spent 11 hours out of a 12 hour shift in alarm flood.

One patient experienced 600 alarms in 24 hours.
Quick Win: Garbage cans

Noise will wake babies and cause alarms

Change garbage cans so the lids close quietly

<table>
<thead>
<tr>
<th></th>
<th>Old Bins</th>
<th>New Bins</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Noise (average)</td>
<td>31.5 dB</td>
<td>30.4 dB</td>
<td>-3.44%</td>
</tr>
<tr>
<td>Number of alarms</td>
<td>570</td>
<td>289</td>
<td>-49.30%</td>
</tr>
<tr>
<td>Hours in alarm</td>
<td>2.83</td>
<td>2.46</td>
<td>-13.23%</td>
</tr>
<tr>
<td>Average Beds Used</td>
<td>3.99</td>
<td>5.06</td>
<td>26.89%</td>
</tr>
<tr>
<td>% time in alarm</td>
<td>5.07%</td>
<td>3.47%</td>
<td>-31.62%</td>
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</table>
Quiet Rooms at Night Mean Better Sleep

Room is 19% quieter between midnight and 7:00 AM
PDSA: Analyze The Alarm Data

Only 15 types of alarms caused almost 98% of all alarms

SpO₂ Lo is a particular offender

TCH policy: SpO₂ Lo Alarm limit at 93%

So let’s revisit the policy, and set a new SpO₂ Lo Alarm limit at 90%...
PDSA: Make Needed Policy Changes

10% reduction in alarms per bed per day
13% reduction of total alarms in unit
15% reduction in alarms less than 10 seconds long

No Adverse Effects
Part 3: Patient-Centric Alarms
Policy is set for population averages

- Traditional alarm settings → “one-size-fits-all”, population-based approach
- Alarms should be customized on patient-by-patient basis
One-Size-Fits-Some

- Identified four types of alarming patients

<table>
<thead>
<tr>
<th>Type</th>
<th>Description</th>
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<tbody>
<tr>
<td>Outside of population normal, but clinically stable</td>
<td>Outside of desired physiological bounds, clinically unstable or in transition</td>
</tr>
<tr>
<td>Clinically stable and highly active</td>
<td>Injury or physical abnormality resulting in continuous monitoring artifacts</td>
</tr>
</tbody>
</table>
Development of Patient-Specific Alarm Rounding Protocol

Physicians engaged during rounds

Under 2 minutes per patient

39 patients observed with high alarms, 10 limit orders were changed

Positive response to use of data and patient analytics
Managing alarms – Nurse’s Stories

• Used during rounding
  – Brady alarm limits changed after 56 alarms in 3 hours

• Used for critical thinking
  – 6 month old with SpO₂ low, HR high, RR high alarms found to be well out of range due to intolerance from ventilator weaning

• Used for unique patients
  – 19-year-old had pediatric settings on monitor, needed adult settings

“Data changed the conversation from alarms to improved patient care.”
Results

• Physicians engaged
  – Less than 2 minutes per patient
  – 39 patients with high alarms were observed: 10 times the alarm limit orders were changed
  – Example: Patient Alarm Data dashboard used to reduce time in alarm by 4 hours per day for a single patient
  – Dashboard used to address changing limits for patient with over 500 alarms in a single night
• Positive response to use of data and patient analytics
Part 4: Leverage of Technology—the recent PDSA Cycles
Sat Seconds

![SatSeconds Graph](image-url)
Implementation and Results

• Trial on several patients at 30 Sat-Seconds
• Reset all monitors
• Decrease in SpO₂ alarms by 25% and overall alarms by 14.99% with a reduction of time in alarm by 21.43%
• Benchmarked with other like organizations and consulted with vendor
• Reset all monitors to 50 Sat-Seconds
• Further decrease in SpO₂ alarms by 17.2% and overall alarms by 12.37% with a reduction of time in alarm by 11.8%
3 to 5-Lead EKG Cables

- More accurate readings of rhythms
  - The 3-lead monitors the lateral and inferior portions of the heart whereas the 5-lead adds the anterior
  - The 3-lead monitors 3 vectors while the 5-lead monitors 7
- Decrease lead EKG alarm fail
- Decrease respiratory lead alarm fails

Implementation and Results

• Purchased new cables and switched out throughout the unit

• Decrease in EKG fail alarms by 38% and overall alarms by 4.03% with a slight increase in time in alarm by 1.9% likely due to more accurate readings
**Alarms/Bed/Day in the PCU**

<table>
<thead>
<tr>
<th>Changes</th>
<th>Alarms/bed/day</th>
<th>Reduction</th>
<th>Time in Alarm</th>
<th>Reduction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>216.1</td>
<td></td>
<td>6.02</td>
<td></td>
</tr>
<tr>
<td>Sat seconds (30)</td>
<td>183.7</td>
<td>14.99%</td>
<td>4.73</td>
<td>21.43%</td>
</tr>
<tr>
<td>5 Lead</td>
<td>176.3</td>
<td>4.03%</td>
<td>4.82</td>
<td>-1.9%</td>
</tr>
<tr>
<td>Sat seconds (50)</td>
<td>154.5</td>
<td>12.37%</td>
<td>4.25</td>
<td>11.8%</td>
</tr>
<tr>
<td>Overall reduction</td>
<td></td>
<td>28.51%</td>
<td></td>
<td>29.40%</td>
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Part 5: Lessons Learned
Lessons Learned

• Alarm fatigue interferes with patient safety
• People should guide policy and not the other way
• Policy is not always practice
• Every alarm should be actionable
• Data makes communication, communication makes better care
• Use the power of technology
Challenges

• Governance, and enabling shared leadership
  – Alarm fatigue is a “nurse’s problem”, but alarm policy is set at the hospital level
  – Bring all care providers into conversation

• Changing the conversation
  – Physicians had little knowledge of the impact of alarms on nurse staff
  – Nurses allowed to own issue of alarm management, suggest changes with data as evidence

• Making the right tools for the right people
  – Head nurses used unit-wide Alarm Analytics Dashboard
  – Nurses advising physicians on specific patients used a Patient Alarm Data tool
  • Education is key
Conclusions and Outcomes

• Daily dashboards are used by both TCH administrators and care staff to improve the alarm environment in the PCU

• Patient care is emphasized
  – One patient saw an **88% decrease in all alarms** with a personalized limit change
  – One patient saw **a complete elimination** of PVC HI alarms after adjusting limits based on patient condition
  – One patient saw a **63% decrease** in RR HI Alarms after they were found to alarm frequently only at night

**Patient-Centric and Real-Time analytics can change the conversation, empower hospital staff, and improve patient care.**
Conclusions and Outcomes

• TCH has become a national thought leader in alarm management
  - TCH was selected to present at the AAMI workshop in 2015
  - TCH was given the ECRI Health Devices Achievement Award for the project
  - The project has been tapped for support of the hospital’s MAGNET status

• Overall reduction of alarms in the PCU by 28.51% and decreased time in alarm by 29.40% - alarms reaching bedside staff are meaningful
Broader Impact

- SpO₂ Lo Alarm limit reset to 90% **house-wide** on monitors and order sets
- Additional units to adopt Sat-Seconds on bedside monitors
- Plan to introduce contextual alarms
- Deeper focus on nurse-led alarm management
Recommendations

• Perform a baseline analysis of alarms in the unit
• Continue measuring alarms, and empower nurses with this data
• Identify the most frequent alarms, and act
• Encourage further communication through physician engagement
• Investigate technology options
• Keep the "big picture" of noise reduction in mind
Benefits realized for the value of Health IT

- **Satisfaction (S)**: Patients, nurses
- **Treatment/Clinical (T)**: Efficiency, quality of care, safety
- **Electronic Secure Data (E)**: Enhanced, communication, data reporting, data sharing
- **Patient Engagement and Population Management (P)**: Prevention benefits, patient education
- **Savings (S)**: Efficiency, operations
Questions

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• Please complete online session evaluation