Evaluation of Telemetry Utilization on Medical Surgical Floors

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Co-chair, Alarm Safety Committee
The Hospital of the University of Pennsylvania
Session Objectives

- Understand the concept of alarm fatigue
- Review the process for understanding the use of telemetry on medical surgical floors
- Discuss the data obtained by evaluating the use of telemetry on medical surgical floors
- What did I learn that will help to improve alarm safety at my organization?
The Hospital of the University of Pennsylvania

Located in Philadelphia, PA

Part of the University of Pennsylvania Health System

789 bed quaternary academic medical center

Adult Admissions 36,737
Outpatient Visits 1,515,612
ED Visits 63,365
Births 4,221
Professional Nurses 1,880
The Hospital of the University of Pennsylvania

- Telemetry model
  - Nurse accountability model
    - Telemetry on every unit (except post partum)
- Perception
  - Overuse of telemetry
  - Non-value added care
  - Truth or perception?
No EB indication for monitoring
Alarms not customized
Poor electrode adherence
Wires disconnected
Inadequate staffing
Inadequate education

Non-actionable alarms

Physiologic Consequences:
- ↑ Heart rate
- ↑ Blood pressure
- Dyspnea
- ↑ Gastric acid
- ↑ Anxiety
- ↑ Cardiac dysrhythmias

Alarm Fatigue

Impact on Staff:
- Anxiety
- Negative job performance
- Burn out
- Annoyance
- Frustration
- Impatience

Alarm Safety – Focus?
Alarm Fatigue

Alarm fatigue:
“limited capacity to identify and prioritize alarm signals, which has led to delayed or failed alarm responses and deliberate alarm deactivations”

Ryher, Okcu, Ackerman, Zimring, & Persson, 2012
Problem Statement

Telemetry not based on EBP guidelines

Alarm Fatigue

- Disabling
- Silencing
- Ignoring
Purpose

• To promote an evidence based approach to telemetry utilization in a medical-surgical setting

Aims

• Examine practice patterns for the ordering and discontinuation of telemetry monitoring on two medical-surgical units at a university medical center

• Examine nurses’ attitudes and practices related to alarm safety on two medical-surgical units at a university medical center
Background

○ Evidence Based Indications for Telemetry

○ American Heart Association (AHA) guidelines for telemetry:
  ○ Recommend telemetry use for defined patient populations
  ○ Recommend the duration of time on telemetry based on the clinical scenario

Drew, et al., 2004
Impact: Population and System

**Population**
- Patients on medical-surgical floors on telemetry that do not have an evidence based indication receiving potentially non-value added care

**System**
- Evaluation of practice patterns on the use of telemetry
  - Telemetry not supported by the AHA guidelines will impact
    - Nursing care time
    - Transport resources
    - Supplies
- Other organizations
  - Patient flow
Significance

- Overuse of telemetry may contribute to nuisance alarms
- Noise from nuisance alarms can overwhelm caregivers
- Potentially true alarms will be missed

Nurses could spend 16 to 35% of their time responding to alarms

Synthesis of the Evidence

- Database searches
  - Pub Med; CINAHL; Ovid

- Key search terms
  - Alarm fatigue; cardiac telemetry; alarm safety; clinical alarms
## Synthesis of the Evidence

### Telemetry Use Outside the AHA Guidelines
- Feder & Funk, 2013
- Benjamin, et al., 2013
- Dressler, et al., 2014;
- Henriques-Forsythe, et al., 2009
- Kanwar, et al., 2008
- Schull, & Redelmeier, 2000

### Telemetry for Patients in the ED with Chest Pain
- Dhillon, et al., 2009
- Gatien, et al., 2007
- Grossman, et al., 2011
- Henriques-Forsythe, et. al., 2009
- Hollander, Sites, Pollack, & Shofer, 2004
- Leighton, Kianfar, Serynek, & Kerwin, 2013
- Perkins, McCurdy, Vilke, Al-Marshad, 2013
Synthesis of the Evidence

**Strengths**

- Four studies **brought telemetry use to within the guidelines** with no adverse outcomes (Benjamin, et al., 2013; Dressler, et. al., 2014, Kansara, 2015; and Kanwar, et. al., 2008)
- Five studies have suggested **that telemetry monitoring does not contribute to early detection of critical arrhythmias or clinical deterioration** (Feder & Funk, 2013; Gazarian, 2014; Kansara, et al., 2015; Kanwar, et al., 2008)

**Weaknesses**

- The evidence based practice guidelines (Drew, et. al., 2004)
  - Guidelines based on expert opinion
  - 10 years old
  - Only guideline available
Gaps in the Evidence

Telemetry Utilization
- Guidelines based on expert opinion, are mainly for cardiology patients, and are out of date

Attitudes & practices r/t alarms
- Study did not aggregate nurse’s responses

Theoretical Framework

- Theory of Planned Behavior (TPB)
  - Social cognitive theory
  - **Behavior intention is the most important determinant of behavior**
  - Influenced by
    - Attitudes
    - Subjective / social norms
    - Behavioral control

- The stronger the attitudes and social norms, the greater the perceived behavioral control, and the more likely the person is to perform a particular behavior.

- Application of TPB
  - Why might a provider order telemetry or not discontinue it if it is not indicated by the EBP guidelines?
  - Nurse’s attitudes toward alarm response

**Project Design: Process Improvement**

**DMAIC Methodology**

- **Define**: Problem identification and benefit analysis
- **Measure**: Translation of the problem into a measurable form and assess the current status
- **Analyze**: Understand root causes of why defects occur; identify key process variables that cause defects
- **Improve**: Design and implement adjustments to the process to improve the critical issues
- **Control**: Desired improvements have been made, a system needs to be put in place to ensure sustainability

*American Society for Quality, 2012*
Project Design

- One 40 bed medical unit; one 32 bed surgical unit
- All beds are able to accommodate telemetry
  - Nurse accountability model of telemetry
- Unit Based Clinical Leadership (UBCL)
  - Clinical leadership team on each unit
- All registered nurses were invited to participate in the survey on attitudes and practices related to clinical alarms
Established a team
- Stakeholder Analysis
- Assigned roles on the team

Created a charter
- Defined the problem, business case, & scope
- Defined the goal statement and success metrics

Work plan
- Defined timelines and milestones
The American Heart Association has EBP guidelines for the use of telemetry. Telemetry use outside the guidelines may result in excessive alarms, leading to alarm fatigue. This project will examine practice patterns for telemetry utilization on 2 medical surgical floors to determine if they are congruent with the EBP guidelines.

**Goal Statement/Success Metrics**
1. Analyze telemetry practice patterns related to EBP guidelines
2. Review results of HTF survey on attitudes and practices related to alarm safety
3. Use both sets of data to develop countermeasures

**Business Impact**
- The evidence suggests a 35% overutilization of telemetry on medical surgical floors.
- By decreasing telemetry overutilization by 25% on one medical surgical floor at HUP could save an estimated $85,532 in non-capital expenses

**Project Scope**
This project will examine telemetry utilization practice patterns on one medicine floor (Silverstein 11) and one surgical floor (Ravdin 9). To understand staff attitudes and practices with alarms, the Health Care Technology Foundation survey will be administered to all registered nurses on both floors.

**Project Milestones**
1. Results of HTF survey on alarm attitudes and practices
2. Completion of 4 weeks of data collection on ordering and discontinuation practices for telemetry

**Team (Please Place Initials by Name)**
- Executive Sponsor(s): Regina Cunningham, PhD, RN AOCN
- Champion(s): Kate Fitzpatrick, DNP, RN;
  - Betty Ann Boczar, MSN, RN
- Clinical Leader(s): JoAnne Phillips
- Process Owner(s): Nicole Pavone / Janelle Harris
- Team Leader(s): UBCL Physician Leads
- Mentor/Facilitator(s): JoAnne Phillips
- Team Members: Nicole Pavone, Diana Santangelo, Melissa Trolene, Sitha Dy, Alexandra Rineer, Janelle Harris, Adriana Boyle

**Subject Matter Experts(s):**
Define

Control

Measure

Improve

Analyze

Created a high level process map
• Workflow for telemetry ordering / discontinuation

Discussed metrics
• Predicted length of monitoring versus actual monitoring

• Assess practice patterns for telemetry ordering
Telemetry Utilization

Data were collected daily for 4 weeks – 94 patients

• Evaluation of each telemetry order
• Data collected from the EMR

All data were de-identified
Data Points Collected

- Subject ID
  - All data were de-identified
- Age
- Gender
- AHA Class I, II, or III
- Indication from the EMR
- Primary diagnosis
- Congruence between primary diagnosis and order
- Discipline who ordered
- Predicted length of monitoring
- Date / time of original order
- Date / time of discontinuation order
- Actual hours on telemetry
- Non-indicated hours of telemetry
Attitudes and Practices related to Alarms

- All registered nurse staff were invited to take the online survey
- 66 RNs (60%) participation

All data were de-identified
All data were de-identified

Telemetry Utilization

Define
Control

Measure

Improve

Analyze

- Descriptive data were analyzed
  - Age, gender, primary diagnosis, class of telemetry order based on the AHA guidelines (class I, II, III), discipline that ordered telemetry

- Congruence of order with the clinical status

- Telemetry hours of monitoring
  - Predicted number of hours on telemetry
  - Actual number of hours on telemetry

- Gap: non-indicated time on telemetry
<table>
<thead>
<tr>
<th>Age</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Mean: 59.8 years</td>
<td>SD 14.4 years</td>
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</table>

<table>
<thead>
<tr>
<th>Gender</th>
<th></th>
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<tbody>
<tr>
<td>Male 58.5%</td>
<td>Female 41.5%</td>
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</table>

<table>
<thead>
<tr>
<th>Class</th>
<th>Number</th>
</tr>
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<tbody>
<tr>
<td>Not AHA indication</td>
<td>64</td>
</tr>
<tr>
<td>Class I</td>
<td>8</td>
</tr>
<tr>
<td>Class II</td>
<td>22</td>
</tr>
<tr>
<td>Class III</td>
<td>3</td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Congruence</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Yes – 42.8%</td>
<td>No – 57.1%</td>
</tr>
</tbody>
</table>
Provider Role for Telemetry Order

- Physician: 69
- Nurse Practitioner: 17
- Physician's Assistant: 8
<table>
<thead>
<tr>
<th>Telemetry Orders</th>
<th>Number of patients</th>
<th>AHA Class</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrolytes</td>
<td>20</td>
<td>None</td>
</tr>
<tr>
<td>Post operative</td>
<td>16</td>
<td>None</td>
</tr>
<tr>
<td>Palpitations</td>
<td>16</td>
<td>None</td>
</tr>
<tr>
<td>QT prolonging medications</td>
<td>7</td>
<td>II</td>
</tr>
<tr>
<td>Atrial tachyarrhythmias</td>
<td>6</td>
<td>None</td>
</tr>
<tr>
<td>CHF – Active</td>
<td>4</td>
<td>II</td>
</tr>
<tr>
<td>Syncope</td>
<td>4</td>
<td>II</td>
</tr>
<tr>
<td>Intermediate/high risk chest pain</td>
<td>4</td>
<td>II</td>
</tr>
<tr>
<td>Stroke</td>
<td>3</td>
<td>None</td>
</tr>
<tr>
<td>Low risk chest pain</td>
<td>3</td>
<td>II</td>
</tr>
<tr>
<td>Arrhythmias with unstable hemodynamics</td>
<td>3</td>
<td>I</td>
</tr>
<tr>
<td>Unrestricted</td>
<td>3</td>
<td>None</td>
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<tr>
<td>Unstable hemodynamics</td>
<td>2</td>
<td>I</td>
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<tr>
<td>Acute coronary syndrome</td>
<td>2</td>
<td>II</td>
</tr>
<tr>
<td>Critical care patient</td>
<td>1</td>
<td>I</td>
</tr>
<tr>
<td>Electrolytes</td>
<td>Analysis</td>
<td></td>
</tr>
<tr>
<td>------------------------------------</td>
<td>-----------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Magnesium 1.7</td>
<td>Oral magnesium; IV potassium</td>
<td></td>
</tr>
<tr>
<td>Potassium, calcium and magnesium normal</td>
<td>No repletion</td>
<td></td>
</tr>
<tr>
<td>Calcium 8.8</td>
<td>Calcium ordered</td>
<td></td>
</tr>
<tr>
<td>Calcium 8.8</td>
<td>No repletion / changes</td>
<td></td>
</tr>
<tr>
<td>Calcium 8.2</td>
<td>Calcium and magnesium ordered</td>
<td></td>
</tr>
<tr>
<td>Magnesium 1.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcium 7.3</td>
<td>Potassium and magnesium ordered</td>
<td></td>
</tr>
<tr>
<td>Magnesium 1.5 - 1.7; potassium 3.6-3.9</td>
<td>No repletion / changes</td>
<td></td>
</tr>
<tr>
<td>Calcium 10.5</td>
<td>(renal failure)</td>
<td></td>
</tr>
<tr>
<td>Potassium normal</td>
<td>No repletion / repletion</td>
<td></td>
</tr>
<tr>
<td>Calcium 7.7</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potassium 5.4</td>
<td>Potassium ordered</td>
<td></td>
</tr>
<tr>
<td>Potassium 2.8</td>
<td>Lactulose ordered</td>
<td></td>
</tr>
<tr>
<td>Calcium 8.4</td>
<td>Potassium ordered</td>
<td></td>
</tr>
<tr>
<td>Potassium</td>
<td>No repletion / changes</td>
<td></td>
</tr>
<tr>
<td>Calcium and magnesium normal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potassium ordered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No electrolytes ordered</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potassium 3.4</td>
<td>No repletion / changes</td>
<td></td>
</tr>
<tr>
<td>Calcium 8.4; Magnesium 1.3</td>
<td>Magnesium and potassium ordered</td>
<td></td>
</tr>
<tr>
<td>calcium and magnesium normal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Potassium 3.4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcium 8.4;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Magnesium 1.3</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcium 7.5</td>
<td>No repletion / changes</td>
<td></td>
</tr>
<tr>
<td>Potassium 5.4; Calcium 8.2</td>
<td>No repletion / changes</td>
<td></td>
</tr>
<tr>
<td>Potassium 3.6</td>
<td>No repletion / changes</td>
<td></td>
</tr>
<tr>
<td>Potassium 3.5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Calcium 7.7</td>
<td>No repletion / changes</td>
<td></td>
</tr>
<tr>
<td>Potassium 3.6</td>
<td>No repletion / changes</td>
<td></td>
</tr>
</tbody>
</table>
68% of the telemetry orders were not supported by the AHA guidelines

42.8% of the orders demonstrated congruence with the patient’s clinical status

The mean time difference between the predicted and actual length of monitoring was over 43 hours

- Pts monitored longer than predicted, gap was 58 hours
- Pts monitored shorter than predicted, gap was -13 hours
What did we learn from tele data?

- Electrolyte imbalance was the most frequent reason for ordering tele –
  - Only 1 pt had critical values
- QTc prolongation
  - Meds and pre-existing QTc prolongation
  - Only 1 of 8 pts

All data were de-identified
All data were de-identified

What does it mean?

- The electronic order set needs to be reviewed
- Lack of congruence – Need better understanding why
- Patients monitored significantly longer than is supported by the evidence
Healthcare Technology Foundation Survey

- Administered to staff on both units via survey monkey
- 67 participants (60%)
  - All but 1 respondent RN
### Alarm Safety Issue

<table>
<thead>
<tr>
<th>Alarm Safety Issue</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequent false alarms, which lead to reduced attention or response to alarms when they occur</td>
<td>3.45</td>
</tr>
<tr>
<td>Difficulty in hearing alarms when they occur</td>
<td>4.46</td>
</tr>
<tr>
<td>Difficulty in identifying the source of an alarm</td>
<td>4.76</td>
</tr>
<tr>
<td>Difficulty in understanding the priority of an alarm</td>
<td>4.88</td>
</tr>
<tr>
<td>Inadequate staff to respond to alarms as they occur</td>
<td>5</td>
</tr>
<tr>
<td>Difficulty in understanding the priority of an alarm</td>
<td>5.14</td>
</tr>
<tr>
<td>Noise competition from non-clinical alarms and pages</td>
<td>5.3</td>
</tr>
<tr>
<td>Difficulty in setting alarms properly</td>
<td>5.74</td>
</tr>
<tr>
<td>Lack of training on alarm systems</td>
<td>6.19</td>
</tr>
</tbody>
</table>
What did we learn from the Alarm Survey?

- Nuisance alarms occur frequently, disrupt patient care and reduce trust
- Frequent false alarms are the most important alarm safety issue
- The data on both units were similar

Define

Control

Measure

Improve

Analyze

All data were de-identified
What did the survey tell us?

• Strategies to minimize nuisance alarms need to be developed
• Need to identify the barriers to safe alarm management

All data were de-identified
Improve and Control

- Outside the scope of this project
- Collaborate with teams on those floors to develop countermeasures
Impact of Results on Practice

Follow the EBP guidelines

- ↓ Number of pts on telemetry
- ↓ Time / # of pts on telemetry
- ↓ Nuisance alarms
- ↓ Alarm Fatigue
## Strengths and Limitations

### Strengths
- 60% response to the survey
- Strong staff involvement
- Data collected over 4 weeks by one data collector
- Data collected will help to inform initiatives to decrease telemetry utilization

### Weaknesses
- One hospital; two units
- Telemetry delivery model
- Congruence is based on documentation in the EMR
- Unable to complete the improve and control aspects of the project
Improve and Control

- Beyond the scope of this project
  - Collaborate with UBCL to plan next steps
  - Transition leadership on next steps in process improvement methodology
Alarm Fatigue: Brought on by...

Clinical deficiencies

Evidence based indications
- Nurse’s Knowledge
- Nursing Practice standards:
  - Electrode management
  - Customization
  - Alarm response
  - Handoffs

Technical Deficiencies

Unreliable process for RN notification
- Monitor safety features not optimized
- Monitor set ups not standardized
- Defaults not customized

Standards of Practice / Education: Nurses, respiratory therapists, engineers
- Competency Assessment
- Technology standardization

Resolved Through:

Actionable alarms

Resulting In:

Bringing it Together.....

- Alarm Fatigue ✓
- Review the process for understanding the use of telemetry on medical surgical floors ✓
- Discuss the data obtained by evaluating the use of telemetry on medical surgical floors ✓
- What did I learn that will help to improve alarm safety at my organization?
What Can You do?

- Resources available
  - NACNS Toolkit
  - AAMI Website
  - AACN Website
- Identify barriers to success!
Questions?

Thank you!

Joanne.phillips@uphs.upenn.edu
References


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