Ensuring Remote Telemetry Monitoring Patient Safety

IIE/Society for Health Systems
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Session Objectives

You will learn...

1. How to create a specific and meaningful definition of safety.

2. How to build an FMEA consistent with JCAHO requirements.

3. How to measure performance against the safety definition.

4. How to select and pilot safety solutions.

5. How to include, promote, and educate stakeholders to ensure buy-in.
Overview

• Defining Safety
• FMEA’s & JCAHO
• Measuring Safety Performance
• Selecting & Piloting Solutions
• Strategies to Effect Change
• Summary
Overview

- Defining Safety
- FMEA’s & JCAHO
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Feb 2006
**Background**

- Numerous studies prove: respiratory & cardiac failure is almost always presaged by observable physiologic changes 6-8 hours before the event, which can be detected for most patients by monitoring of heart rate & O2 saturation levels.

- Effective interventions for cardiac and respiratory failures must begin within 3-5 minutes to prevent long-term negative outcomes:
  - Death
  - Brain damage
  - Other systemic injury

- House-wide telemetry eases bed assignments
- Centralized (vs. unit-based) model less costly
• National Patient Safety Goals (2004)
  – Improve effectiveness of patient care alarms
    • Assure alarm systems that monitor patients are regularly tested and adjusted, if needed, to prevent any problems.
    • Alarms are turned on with the correct settings and are loud enough to be heard within the patient unit.

• IHI 100,000 Lives Campaign
  – Rapid Response Teams – monitoring a signal when RR appropriate!
The Problem at University

- Vendor’s alpha site for centralized system—no up-front expectation of potential failures & no support to identify benchmarks

- Nurses at the hospital were often not responding to alerts AT ALL, let alone in a timely manner...
  - Patient deaths had occurred (though fortunately not recently!)
  - Near misses were occurring regularly...

- Because of preventable system failures, some clinical events were not being detected

- Repeated examination of the problem had surfaced numerous root causes, but without significant, widespread, or lasting impact

- Project chartered under recommendations of the Board to fulfill JCAHO requirements
Defining “Safety”

- Who?
- What?
- When?
- Where?
- SO WHAT?
- Why?
- What can we do about it?

Tips for Success:
- Use brainstorming & fishbone diagrams to build consensus
- Good “starters”:
  - What does “safe” look like?
  - What has to happen to ensure safety?
- Watch out for hidden agendas!!
- Keep the focus on safety, NOT on feelings & grudges…
Think Systems!

Technology

Processes

Communication

Hand-offs

Shared Understanding & Common Vision

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Defining Safety:
To optimize the safety of patients monitored by CMU, we must ensure:

(1) the right patients are monitored
(2) using individualized parameters
(3) by a reliable system to whose alerts
(4) we respond in a timely and
(5) clinically appropriate manner.

Safety starts with a focused assessment, properly maintaining the equipment, and effectively communicating alerts and responses.

Note that this assumes a far more comprehensive definition of “system” than the 2004 National Patient Safety Goals!

Objectives/Goal Statements:
By June 15, 2005:

1. Reduce technical alerts by 70%.
2. Reduce acknowledgement defect rate by 70%.
Overview

- Defining Safety

- **FMEA’s & JCAHO**

  - Measuring Safety Performance
  - Selecting & Piloting Solutions

- Strategies to Effect Change

- Summary

Feb 2006
An ongoing, proactive program for identifying unanticipated adverse events and safety risks to patients is defined and implemented.

- **Rationale:** Hospitals should proactively seek to identify and reduce risks to the safety of patients. Such initiatives have the obvious advantage of preventing adverse events rather than simply reacting when they occur. This approach also avoids the barriers to understanding created by hindsight bias and the fear of disclosure, embarrassment, blame, and punishment that can happen after an event.

**References:**
1. JCAHO CAMH Update 3, Aug 2005
JCAHO Standard PI.3.10

• Elements of Performance:

1. Select a high-risk process to be analyzed
   • At least one high-risk process is chosen annually—the choice should be based in part on information published periodically by the Joint Commission about the most frequent sentinel events and risks

2. Describe the chosen process (for example through the use of a flow chart)

3. Identify the ways in which the process could break down or fail to perform its desired function (i.e., what engineers call potential “failure modes”)

4. Identify the possible effects each failure mode could have on patients and the seriousness of those effects
JCAHO Standard PI.3.10

• Elements of Performance: (continued)

5. Prioritize the potential failure modes

6. Determine why the potential failure modes could occur

7. Redesign the process and/or underlying systems to minimize the risk of the effects on patients

8. Test and implement the redesigned process

9. Monitor the effectiveness of the redesigned process

Comments:
1. Note that it never says “FMEA”, but it describes the process!
2. When you speak to JCAHO representatives, they can’t offer any examples other than FMEA’s!
High Risk Processes

- Processes that involve risks or may result in sentinel events
  - Medication use
  - Operative and other procedures
  - Use of blood and blood components
  - Restraint use
  - Seclusion, when a part of care
  - Care/services provided to high-risk populations
  - Resuscitation
Constructing an FMEA Table

1. Flow-chart the process

2. Identify actual AND potential failure points in the process

3. Document each failure point
   • What failure can/does occur ("mode")
   • Each separate effect resulting from the failure ("effects")

4. Evaluate each mode/effect pair
   • S = Severity of effect
   • F = Approximate frequency
   • D = Ability of system to prevent, control, or detect the failure

5. Calculate Risk Priority Number: $RPN = S \times F \times D$
Chart 0.0 - High Level Flow Chart of TUH CMU Telemetry Monitoring Process

**Doctor**
- Order Telemetry

**Nursing Unit**
- Call CMU
  - Respond to Alerts (See Chart 1.3)
  - Maintain Transmitter (See Chart 1.2)*

**CMU**
- Initiate Monitoring (See Chart 1.1)
  - Monitor Telemetry (See Chart 1.3)

- Review Reports?
  - Discontinue Order
  - Call CMU & Remove Transmitter
    - Pick-up Transmitter*/**
      - Log patient out
        - Clean Transmitter

* END 0.0

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* When CMU staff are on a nursing unit, they are supposed to check monitor & attend to any technical problems detected for all monitored pts on that unit.

** CMU staff are not supposed to remove a transmitter from a patient--only a nurse on the floor should do so.

Complete order should include pt ID, type of monitoring, and parameters/ranges to be maintained (Parameters sometimes are not specified--use standard ranges.)

Sometimes not until pt discharged...
Kinds of Monitoring Alerts

Observations:

- Only 1 out of 7 alerts is a clinical issue—and some of these are actually erroneous due to technical problems.

- Battery alerts (28%) are completely predictable & thus preventable.

- Probably ½ or more of the Leads Off alerts (48% of total) are preventable.

- Nearly all of the Other (10%) category are preventable.

- Not shown: 17% of alerts—1 of every 6!—are repeats of previous alerts not addressed!!
Cause & Effect: Potential Causes Brainstorming

**Wrong Patients**
- Pt noncompliant/uncooperative
- Parameters not specific for pt needs
- Not ordered for patient

**Poor Info**
- Phone doesn't work
- Pager doesn't work
- Pager not worn
- Wrong pt listed for transmitter
- Wrong RN listed for pager
- Nursing assignment not known

**Unsafe Condition**

**Equipment Problems**
- Transmitter lost
- Transmitter not available
- Wrong transmitter placed on patient
- Delay in placing transmitter on patient
- Order missed/lost

**Poor Response**
- Monitoring system fails
- Pt moves to non-monitored area
- Nurse not available to respond
- Too many alarms = nothing important
- Proper response for pt not known
- Don't know how to acknowledge CMU
- Response req'mts not known

**Wrong Patients**
- Pt's awaiting discharge
- Pt's condition doesn't warrant

**Poor Info**
- Transmittor not available
- Wrong transmitter placed on patient
- Delay in placing transmitter on patient
- Order missed/lost

**Equipment Problems**
- Attached incorrectly to pt
-低 signal
clearance
- Ignored
time

**Poor Response**
- Too many leads
-fell off
- Too many alarms = nothing important
- Proper response for pt not known
- Don't know how to acknowledge CMU
- Response req'mts not known

**Wrong Patients**
- Batteries
- Batteries

**Equipment Problems**
- Patient incorrectly placed on pt
- Ignored
time

**Poor Response**
- Batteries
- Batteries

**Wrong Patients**
- Batteries
- Batteries

**Equipment Problems**
- Patient incorrectly placed on pt
- Ignored
time

**Poor Response**
- Batteries
- Batteries
1. Rate each impact/result of failure for its severity. The following scale is suggested, the any number between 1 and 10 is fine. If uncertain about an item, choose a higher number.

2. Rate each potential failure for (a) the frequency with which it occurs and (b) the system's ability to detect or prevent or control that failure. The following scales are suggested, though any number from 1 to 10 is acceptable. If uncertain about an item, choose a higher number.

<table>
<thead>
<tr>
<th>Rate</th>
<th>Frequency</th>
<th>Ability to Detect/Prevent/Control</th>
<th>Severity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Very rare - 1/year or less</td>
<td>Almost always caught - &quot;99% predictable&quot;</td>
<td>No consequence to pt or staff; nuisance</td>
</tr>
<tr>
<td>2</td>
<td>Unusual - 1/month</td>
<td>Usually detected/acted upon - &quot;85% +&quot;</td>
<td>No consequence to pt but added work</td>
</tr>
<tr>
<td>3</td>
<td>&quot;A few times&quot; per month</td>
<td></td>
<td>Potential of missing more critical indications</td>
</tr>
<tr>
<td>4</td>
<td>Infrequent - 1/week</td>
<td>Sometimes missed</td>
<td>Potential acute injury</td>
</tr>
<tr>
<td>5</td>
<td>&quot;A few times&quot; per week</td>
<td>50/50 detected/acted upon</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>Multiple times weekly</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Common - daily</td>
<td>Easily missed; requires attention to detail</td>
<td>Potential permanent injury</td>
</tr>
<tr>
<td>8</td>
<td>&quot;A few times&quot; per day</td>
<td>Hard to detect - &quot; &lt; 10% &quot;</td>
<td>Potentially life-threatening</td>
</tr>
<tr>
<td>9</td>
<td>Several times daily</td>
<td>Almost never recognized until too late - &quot;1%&quot;</td>
<td>Immediate risk of death</td>
</tr>
<tr>
<td>10</td>
<td>Multiple times daily</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**KEY:** Higher number = higher risk = bigger issue. If in doubt, be conservative and pick a higher number.

Assigning three scales of 1-10 results in each M/E pair Risk Priority Number (RPN) ranging from 1 (=1x1x1) to 1,000 (=10x10x10)
### FMEA: Failure Modes & Effects Analysis

<table>
<thead>
<tr>
<th>Attribute of Safety</th>
<th>Potential Failure</th>
<th>Impact/Result</th>
<th>Severity</th>
<th>Freq'cy</th>
<th>Ability to Detect or Prevent</th>
<th>Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td>Awareness of patient condition</td>
<td>RN not available when alert issued (in procedure or personal needs)</td>
<td>Potentially miss critical clinical indications</td>
<td>4</td>
<td>7</td>
<td>7</td>
<td>196.0</td>
</tr>
<tr>
<td>Right patients on Telemetry</td>
<td>Monitoring parameters not individualized to patient's specific needs/condition</td>
<td>Alarms not indicative of patient need</td>
<td>4</td>
<td>8</td>
<td>6</td>
<td>192.0</td>
</tr>
<tr>
<td>Right patients on Telemetry</td>
<td>No beds available on units trained to care for patients with dysrhythmia</td>
<td>Patient placed on unit designated for &quot;telemetry&quot;, though staff may be unprepared for patient's needs</td>
<td>4</td>
<td>8</td>
<td>5</td>
<td>160.0</td>
</tr>
<tr>
<td>Trust/Communication</td>
<td>No/slow response to alerts; Nursing staff unaware of potential problem</td>
<td>Pt not monitored; potentially miss critical clinical indications</td>
<td>5</td>
<td>6</td>
<td>5</td>
<td>150.0</td>
</tr>
<tr>
<td>Trust/Communication</td>
<td>Too many non-lethal alerts; Nurses feel CMU irritating</td>
<td>No slow/response = multiple calls &amp; increasing frustration; Potentially ignore or miss critical clinical indications</td>
<td>3</td>
<td>8</td>
<td>6</td>
<td>144.0</td>
</tr>
<tr>
<td>Trust/Communication</td>
<td>Patient off unit &amp; system shows “failure”</td>
<td>Pt not monitored; potentially miss critical clinical indications</td>
<td>4</td>
<td>8</td>
<td>4</td>
<td>128.0</td>
</tr>
<tr>
<td>Right patients on Telemetry</td>
<td>Units trained to care for patients with dysrhythmia may be not have enough staff to take a new patient.</td>
<td>Patient placed on unit designated for &quot;telemetry&quot; because they have more staff available, though staff may be unprepared for patient's needs</td>
<td>4</td>
<td>6</td>
<td>5</td>
<td>120.0</td>
</tr>
<tr>
<td>Awareness of patient condition</td>
<td>Staff/patients not trained in how to replace probes or leads removed temporarily</td>
<td>Pt not monitored; potentially miss critical clinical indications</td>
<td>3.5</td>
<td>7</td>
<td>4.5</td>
<td>110.3</td>
</tr>
<tr>
<td>Trust/Communication</td>
<td>No/slow response to alerts; CMU feels nurses don't care</td>
<td>Multiple calls &amp; increasing frustration</td>
<td>3</td>
<td>7</td>
<td>5</td>
<td>105.0</td>
</tr>
<tr>
<td>Trust/Communication</td>
<td>No response, leading to escalation</td>
<td>Multiple calls &amp; increasing frustration</td>
<td>3</td>
<td>7</td>
<td>5</td>
<td>105.0</td>
</tr>
<tr>
<td>Awareness of patient condition</td>
<td>System crash</td>
<td>Potentially miss critical clinical indications</td>
<td>10</td>
<td>1</td>
<td>10</td>
<td>100.0</td>
</tr>
</tbody>
</table>

Identified 42 possible risks, spanning severity from “annoying” to “immediate risk of death”
Another look at the RPN scoring…

Pareto Chart of TUH CMU Failure Risks - Baseline FMEA

Project will address factors accounting for 96% of estimated risk

Though some pairs had low RPN’s, they would be addressed because solutions targeting specific types of failures would reduce or eliminate them. One type of failure was determined to be outside the scope of this project, accounting for the “lost” 4%.
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Feb 2006
Critical to Quality (CTQ) Project Requirements
- 100% detection of unsafe events
- High confidence in validity of alerts
- Timely response to alerts
- No rework

Operational Metrics Defined:
- Business Metrics
  - Volume of codes
  - Volume of deaths related to codes
- Process Metrics
  - Technical alerts per monitored patient day
  - Acknowledgement defects (i.e., no or slow responses) as % of alerts
- Financial Metrics
  - No significant cost or revenue changes anticipated
- Consequential Metrics
  - None identified
• Nearly 90% of telemetry alerts are not acknowledged in a timely manner, as outlined by hospital policy
  – Over 1/2 of alerts receive no acknowledgement *
  – Over 30% receive acknowledgements outside of specified times
  – Acknowledgement of lethal rhythms only slightly lower defect rate than other: 84% defective vs. 91%

• 10 telemetry transmitters lost (@ $2,500 each)

Can we be sure a patient is safe if we’re not sure anyone checks & resolves a detected problem?

* This is not saying “patient need not addressed”. Rather, CMU had no feedback from the nurse.
Overview

- Defining Safety
- FMEA’s & JCAHO
- Measuring Safety Performance
- **Selecting & Piloting Solutions**
- Strategies to Effect Change
- Summary

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Conclusions: Key Drivers of Defects

- “Noise” overload: Too many non-critical pages & possible misuse of red phones

- Knowledge deficits:
  - Transmitters are tied to specific units, programmed for specific patients
  - Acknowledging alerts *much* easier than most realize!

- Missing/broken processes:
  - Transmitter maintenance
  - Return of transmitters to CMU at discontinuation
  - Transport of monitored patients
  - Back-up coverage when nurse temporarily not available
  - Back-up coverage for system failure
  - Incomplete data
  - Communication system failure

- Incomplete/unclear orders for telemetry

Feb 2006
Solutions target 3 separate groups:

- CMU
- Physicians
- Nursing Unit Staff
Reducing measurement error

• Analysis of log data revealed incomplete recording of alerts & times

• Appeared defects might have been overstated...

• ...but retesting suggested the severity of the problem was actually underestimated!!

• New checklist-based logs implemented to simplify recording & summarization/analysis
Other CMU Department Changes

- Established on each unit a **single location to collect transmitters** removed from patients when telemetry discontinued

- Began **writing patient name on transmitter pouches**, and instituted “double check” procedures to verify **new patient set-up**

- Developed new orientation & annual competency **educational materials for nurses**

- Developed departmental **procedure for routinely testing red phones**

- **Discontinuing daily pager tests**
  - Inconsistent use & response
  - Duplicates diagnostic analysis available from paging system
### Ordering practices

- **New order form**
  - Specification of type of monitoring needed
  - Specification of parameters

- **New order process**
  - Form faxed to CMU
  - Scheduled for conversion to CPOE

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**ORDCHK**

**UNIVERSITY HOSPITAL, INC.**

**PHYSICIAN’S CHECKLIST/ ORDER SHEET**

All applicable orders have been checked. ORDERS NOT CHECKED ARE NOT TO BE FOLLOWED.

Orders are modified according to the medical condition of the patient. All orders are to be dated, timed, and signed by a physician. Additional orders may be entered at the end of the order set. If the orders are transcribed in sessions, the transcriber must date, time, and initial in the section marked order noted. If the entire set of orders is transcribed at one time, make a single slash across the page and enter the date, time, and your initials.

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### ALLERGIES:

- **None Known**
- **Yes, Drug/Reaction:** ________________________________________

### ORDER NUMBER

#### TELEMETRY ORDERS FOR CENTRALIZED MONITORING UNIT

- **Reason for CMU Monitoring:**
  - **Patient's Baseline Vitals:** HR ____________ O2 Sat's ____________
  - Oxygen saturation monitoring - Call for saturation less than ____________
  - Heart rate monitoring - Call for heart rate less than ____________ or greater than ____________
  - Discontinue telemetry monitoring after 72 hours.

- **IF PATIENT REQUIRES MONITORING BEYOND 72 HOURS, YOU MUST REORDER!!**
  - Please fax these orders to the CMU, 584-6681.

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### CMU Standard Monitoring Parameters (to be used if inclusive of patient’s baseline):

- **HR Less Than 50:**
- **HR Greater Than 135:**
- **Oxygen Saturation Less Than 90:**

---

**White–Chart**  **Yellow–Pharmacy**  **Pink–Floor Copy**

---

**Physician Signature**

<table>
<thead>
<tr>
<th>Date</th>
<th>Time</th>
</tr>
</thead>
</table>

---

**Developed by Andy Crawford, RN, BSN**

<table>
<thead>
<tr>
<th>Date</th>
<th>Review Date</th>
</tr>
</thead>
<tbody>
<tr>
<td>04/2005</td>
<td>04/2006</td>
</tr>
</tbody>
</table>
Routine Maintenance Critical!!

One unit piloted regular daily battery changes for telemetry transmitters. Immediately the volume of low battery alerts from CMU dropped from ~5 to <1 per day!
Acknowledgement & Maintenance

- “Just press the button” to acknowledge an alert
- Institute “preventive maintenance” routines
  - Anticipate electrode gel drying out; replace leads Q48
  - Anticipate battery depletion:
    - Q24 change for cardiac-only monitoring
    - Q8 when monitoring SpO2
- Increase awareness/“WIIFM” among nurses
  - Posters
  - Staff communication
  - Revamped training
    - Orientation
    - Intranet-based annual competencies

“How can I get CMU to quit bugging me?!”

To minimize CMU pages & alerts:

1. Fresh batteries in the transmitter
   - Change q24 for patients on cardiac-only monitoring
   - Change q8 for patients on SpO2 monitoring
2. Good lead contact, with proper lead placement
   - Electrode gel dries out. Check during AM care & replace PRN, at least q48. Initial & date at least one electrode when replacing the set.
   - ALWAYS replace electrodes if pulled off or fallen off.
   - Refer to the lead placement diagram on transmitter.
   - Remember to put transmitters back on patients returning from tests/other areas.
3. Acknowledge an alert as quickly as you can!
   - Lethal rhythm/red phone alerts in 1 minute
   - Pages in 3 minutes
   - To acknowledge a page, just push the button so CMU knows you’re with the patient!

Press & hold the black button for count of 3 to send acknowledgement signal—NO NEED TO TELEPHONE!!
Transport & Back-up

- Drafted new policy outlining procedure for transporting monitored patients
  - Transporters reminded that they must check-in with patients’ nurses before taking a patient
  - Reflects community standards Codifies intended (but currently not standard) practice at University
  - Will be incorporated into education for nurses, HUC’s, and transporters

- Drafted policy outlining back-up procedures for system failure
  - Will be incorporated into education for nurses, HUC’s, and other Patient Care Services personnel
CALL TO ACTION – July 2005

What unit managers/leaders need to do NOW

- Incorporate battery & lead changes into routine shift vitals
- Remind staff:
  - All alerts & responses are logged, including who was alerted
  - Get a “buddy” to hold your pager when you won’t be available (off unit, break, in procedure, etc.)
  - “Just push the button” to acknowledge an alert
  - Put discontinued transmitters & logs in the return boxes
- Look for news of next steps:
  - Policy & procedure updates
  - New ordering process
  - New educational materials
  - Results of remeasurement

What we asked of managers in July…
## Baseline Capability

After Implementing New Data Collection Forms

<table>
<thead>
<tr>
<th>Metric</th>
<th>Original</th>
<th>New Target*</th>
<th>New Baseline</th>
<th>Z-score **</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alerts per Monitored Patient per Day</td>
<td>Not Available</td>
<td>Not Available</td>
<td>2.63</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>Technical Alerts per Monitored Patient per Day</td>
<td>Not Available</td>
<td>0.68</td>
<td>2.27</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>% Alerts Not Acknowledged</td>
<td>50%</td>
<td>15%</td>
<td>44.3%</td>
<td>0.14</td>
</tr>
<tr>
<td>% Alerts Not Acknowledged in Timely Manner</td>
<td>90%</td>
<td>27%</td>
<td>77.6%</td>
<td>-0.76</td>
</tr>
<tr>
<td>Defective Alerts per Monitored Patient per Day</td>
<td>Not Available</td>
<td>0.60</td>
<td>2.01</td>
<td>&lt;0</td>
</tr>
</tbody>
</table>

* Target: “...70% Reduction...” of original for responses, of new baseline for per-monitored-patient-day statistics

** Z-score: >50% defect, Z <0. “Near perfect” z=6.

Some “organic” improvement was expected, as educational posters & communications were in place before “new baseline” was taken...
Results of Communication Audit

- Overall, 90% of questions asked were answered correctly!!

- Of missed answers, 80% from 3 questions:
  - #18 – Transmitters can be matched to the patient by comparing the name on the pouch to the patient’s ID
  - #19/20 – Deals with transportation. If going to Dialysis, nurse should call CMU to get a transmitter that will work in Dialysis. Otherwise, the nurse should notify CMU the patient will be off-unit, and leave the transmitter in the patient’s room.

Conclusion: Communication was received—**staff know what to do!**
Results of Communication Audit

CMU: Knowledge Audit of Units Served
Findings by Unit & Position

Manager reported no communication had occurred

Percent Correct

Unit : Position
Results of Communication Audit

CMU: Knowledge Audit of Units Served
Analysis of Responses by Question

Question

Attempted
Correct
% Correct
Results of Communication Audit

- **Wrong Answers**
  - Staff were immediately coached/corrected when they provided an incorrect answer

- **Comments/Concerns from staff**
  - Clarity re: responsibilities/assignments
    - “Anybody can change the batteries and leads…”
    - “Whoever is available changes the batteries and checks the leads.”
  - Limited staffing
    - “Sometimes CMU says we have to pick up the transmitter, but we only have 2 staff ourselves!”
    - “If we have to escort a monitored patient, we’ll leave too many patients on the unit for the rest of the staff…”

Recommendations:
1. Regular transmitter maintenance MUST be defined as part of the daily routine on all units.
2. Transport can be called to get a transmitter picked up.
3. The Nursing Supervisor can advise on options—another unit may be able to spare some help to escort or fill-in.
## Results of Remeasure

<table>
<thead>
<tr>
<th>Metric</th>
<th>New Baseline</th>
<th>Remeasure</th>
<th>Change</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Alerts per Monitored Patient per Day</td>
<td>2.63</td>
<td>1.89</td>
<td>Improved 28%!! (p=0.036)</td>
<td>Very good!!</td>
</tr>
<tr>
<td>Technical Alerts per Monitored Patient per Day</td>
<td>2.27</td>
<td>1.68</td>
<td>Improved 26% (p=0.05)</td>
<td>Very good!!</td>
</tr>
<tr>
<td>% Alerts Not Acknowledged</td>
<td>44.3%</td>
<td>48.7%</td>
<td>No change (p=0.10)</td>
<td>We can do better!</td>
</tr>
<tr>
<td>% Alerts Not Acknowledged in Timely Manner</td>
<td>77.6%</td>
<td>68.5%</td>
<td>Improved 9% (p=0.01)</td>
<td>Good..we can still do better!</td>
</tr>
<tr>
<td>Defective Alerts per Monitored Patient per Day</td>
<td>2.01</td>
<td>1.36</td>
<td>Improved 32%!! (p=0.015)</td>
<td>Very good!!</td>
</tr>
</tbody>
</table>
Other than the reduced number of alerts per patient, what changes occurred in types of alerts?

The Chi-square test for independence is used to compare distributions. A p-value < 0.05 indicates the distributions are different (i.e., independent of one another). For the before & after samples, p = 0.99—the distributions are statistically the same!
Results of Remeasure

Nearly every unit showed improvement!!

CMU Alert Acknowledgement Defects per Patient per Day by Unit, Before & After

Improvement can be seen when “After” has either:
1. Lower midline/crosshairs.
2. Smaller box.
Results of Remeasure

Observations from data:

- 17% of alerts were repeats/escalations
  - Repeats were NOT occurring in 5-minute intervals—15-60 minutes passed between attempts

- Documented incidents:
  - Nurses took their pagers with them off-unit & did not respond for hours
  - Missed red phone alert (phone tested by communications and no operational problems found)
  - Abusive & avoidance behaviors toward CMU when non-acknowledgement followed-up by telephone calls to unit

- Results varied by individuals on same units: some always responded on time, others in same area never responded.

This variability points to individual non-compliance and management practice rather than system flaws. Incidents of neglect, abuse, and habitual noncompliance are reported to unit managers and ACNO’s via e-mail, to facilitate individual coaching...
What might be happening?

- If folks know what they’re supposed to do & how, but aren’t doing it, why?
  - Simply forget/make mistake (why CMU tries multiple times)

- Can’t
  - More pressing priorities (happens/understandable)
  - Patient or nurse off-unit (preventable, with communication)

- Won’t (resistance due to misunderstanding or attitude)
  - Don’t accept responsibility for taking appropriate action—”...not my problem...”
  - Don’t appreciate potential risks
  - Don’t understand accountability
  - Don’t recognize that CMU isn’t aware of what’s happening on unit—only what the monitor says...

This variability points to individual non-compliance and management practice rather than system flaws. Incidents of neglect, abuse, and habitual noncompliance are reported to unit managers and ACNO’s via e-mail, to facilitate individual coaching...
Overall Conclusions

- Staff generally know what to do.

- Specifics of how maintenance is completed not clearly defined on every unit (when audited).

- Marked improvement in performance!

- Still some way to go toward goal...

- Still a gap between knowledge and behavior...

Feb 2006
**2nd Remeasure** (Alerts per Patient)

<table>
<thead>
<tr>
<th></th>
<th>0-Before</th>
<th>1-After</th>
<th>2-After</th>
</tr>
</thead>
<tbody>
<tr>
<td>Leads</td>
<td>1.26</td>
<td>0.85</td>
<td>1.58</td>
</tr>
<tr>
<td>Other</td>
<td>0.27</td>
<td>0.36</td>
<td>0.72</td>
</tr>
<tr>
<td>Battery</td>
<td>0.74</td>
<td>0.47</td>
<td>0.62</td>
</tr>
<tr>
<td>Clinical</td>
<td>0.36</td>
<td>0.21</td>
<td></td>
</tr>
</tbody>
</table>

Alerts/patient increased considerably—even exceeding baseline! Most significant growth in lead-related alerts & in “Other”, which is a non-specific “no signal” alert.
Drill-Down: Variability in Alerts per Patient

- Closer review of the data revealed special cause variation:
  - 8CCP experienced an exceptionally high volume of SpO2-related calls on Thursday, Friday, and Saturday of the data period. This suggests at least one patient during this time was very non-compliant in wearing the SpO2 lead correctly, or at all! This is further evidenced by the high number of repeat alerts.
  - SpO2 usage was much higher toward the end of the week, driving up:
    - Battery alerts (SpO2 drains batteries 3 times faster!)
    - Lead alerts (which includes patients taking off the finger probe)
  - Total patients on CMU telemetry does not vary significantly from day to day, but admissions & discharges both peak on Friday, increasing opportunities for errors. E.g., removing a transmitter to discharge a patient without first notifying CMU would drive up:
    - Lead-related alerts
    - “No signal”/other alerts
Peak Alerts/Patient

Types of Alerts per Patient, by Day of Week

- **Variable**
  - No Sig/Pt
  - Battery/Pt
  - SpO2 Lead/Pt
  - EKG Lead/Pt

<table>
<thead>
<tr>
<th>Data</th>
<th>1-Mon</th>
<th>2-Tue</th>
<th>3-Wed</th>
<th>4-Thu</th>
<th>5-Fri</th>
<th>6-Sat</th>
<th>7-Sun</th>
</tr>
</thead>
<tbody>
<tr>
<td>DoW</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
An unexpected new problem…

“How can I get CMU to quit bugging me?!”

To minimize CMU pages & alerts:

1. Fresh batteries in the transmitter
   - Change q24 for patients on cardiac-only monitoring
   - Change q8 for patients on SpO2 monitoring

2. Good lead contact, with proper lead placement
   - Electrode gel dries out. Check during AM care & replace PRN, at least q48. Initial & date at least one electrode when replacing the set.
   - **ALWAYS** replace electrodes if pulled off or fallen off.
   - Refer to the lead placement diagram on transmitter.
   - Remember to put transmitters back on patients returning from tests/other areas.

3. Acknowledge an alert as quickly as you can!
   - Lethal rhythm/red phone alerts in 1 minute
   - Pages in 3 minutes
   - To acknowledge a page, **just push the button** so CMU knows you’re with the patient!

Some staff (willfully?) misinterpreted this to mean “I never have to call CMU…”

Press & hold the black button for count of 3 to send acknowledgement signal—NO NEED TO TELEPHONE!!
Some Good News...

Acknowledgement rate at 58%--new high!

Timely response at new high of 37%, vs. original of only 21%!
• Standardize battery policy, on every unit CMU supports:
  – Stock 9V batteries on the vitals checking devices.
  – All CMU transmitter batteries to be changed when AM vitals check.
  – For any patient with SpO2 monitoring, batteries must be changed when vitals checked on every shift.

• At discharge or when removing transmitter: CALL CMU first!

• Explore IS&T support in “automatically signaling” needs:
  – Battery & lead change requirements print on MAR or other nursing patient care “checklists” (e.g., “pending orders”)?
  – Discharges print to CMU?

• Emphasize to patients and families that wearing the SpO2 finger probe continuously & correctly is a responsibility in participating in their care/recovery.
  – Get orders to remove non-compliant patients from telemetry.

• Consider 48-hour automatic discontinuation to reduce opportunity for errors.
Radically Rethinking “Central” Monitoring

• Human Nature
  – What gets measured...
  – Out of sight = out of mind
  – Everyone’s responsibility = nobody’s job
  – Non-clinical (85%+ of alarms) = non-priority

• New experiment: What if responsibility were consolidated to one person per unit?
  – Advantages
    • Local, & closer personal relationship to nurses
    • Defined priority; doesn’t have to be a nurse!
    • Less “noise” bothering nurses
  – Disadvantages
    • Other tasks competing for attention

“If you always do what you’ve always done, you’ll always get what you always got.” - unknown

“Systems deliver exactly the results they are designed to produce” – D. Berwick

“The significant problems we have cannot be solved at the same level of thinking with which we created them.” - Einstein

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The “Radical” Experiment

Concerns

• Competing priorities
• Disruptive to nursing unit
• Resistance from CMU
• Decentralizing Centralization?!!

Strategies

• Dedicated/only assignment
• “Watch” as well as “do”
• Volunteer unit
• Short pilot
• Emphasize benefits to RN’s
• Paint picture of success
• “Let’s try it and see...”
• Recognize “safety net”
• If it’s the wrong thing, we need to fix it!

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Results

Results of "Radical" Experiment

- PCA identified & resolved 92% of “alert conditions” without having to be notified by CMU.
  - Of those missed, the PCA was with another patient or at lunch.
  - PCA addressed missed alerts upon notification
  - Because PCA did not perform “preventive maintenance” in changing batteries & leads, volume of alerts was higher than necessary.

- Of all the alert conditions, 35 were clinical: 28* low SpO2 and 7 rhythm.
  - Of these, the PCA checked the patient and resolved the issue before CMU called 31 of the 35 times (89%)
  - Of CMU’s calls, 3 were low SpO2 & 1 was for heart rate

* This number is somewhat higher than usual, as CMU often waits until a definite pattern of low SpO2 emerges, as patient behaviors can lead to false alarms or temporary drops that resolve themselves.
Interpreting the Results

Results of "Radical" Experiment

- **More responsive:** Consolidating responsibility to a single individual increased acknowledgement/resolution rate to 100%

- **Faster response:** Consolidating responsibility & watching the monitor increased timeliness of response to 100%

- **Less “noise”:** Watching the monitor reduced CMU call volumes 87% (using normalized SpO2 alert volumes—not the total the PCA acted on).

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### Opportunities

#### Results of "Radical" Experiment

<table>
<thead>
<tr>
<th>Description</th>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
</table>
| **Advantages** | • Day shift only  
• Assign CMU maintenance & response accountability to one person (who could be a HUC!), who then carries a reduced direct pt care load.  
• Augment CMU monitoring by having HUC watch monitors when not otherwise occupied. | • Assign “watching” & “doing” responsibility to an individual person, who could have minimal patient care training and who has basically no additional direct patient care load. | • Decentralize monitoring back to nursing units |
| **Disadvantages/Risks/Barriers** | • Resistance from PCA’s & HUC’s | • Resistance from PCA’s & HUC’s | • Low utilization  
• Increased training/competency costs  
• Increased technology costs |

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As CPOE implementation progresses, HUC role will change dramatically, but still be needed. This function has been designated a priority as the new job description is developed and piloted.

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Overview

• Defining Safety

• FMEA’s & JCAHO

• Measuring Safety Performance

• Selecting & Piloting Solutions

• Strategies to Effect Change

• Summary

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Getting & Maintaining Support

- Mandated from the top
- Team-based: CMU + Nursing Units
- Regular progress reporting to unit managers
- Frequent outreach to nurses
  - Promotional
  - Educational
  - One-on-one
- Pilots with results reporting
- Process for ongoing monitoring & feedback

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Overview

- Defining Safety
- FMEA’s & JCAHO
- Measuring Safety Performance
- Selecting & Piloting Solutions
- Strategies to Effect Change

- Summary

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Summary: The Actual Process

1. Define “safety”: what are the observable signs?
2. Determine metrics
3. Establish baseline performance
4. Document & analyze process
   - Flow charts
   - Cause & Effect brainstorming (Fishbone)
   - FMEA to prioritize
5. Identify solutions
   - Focused brainstorming on FMEA priorities
   - Data-driven imperatives—”reap what you sow”
   - Ensure behavior changes hold
6. Pilot & re-measure
7. Feedback mechanisms
Questions?

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Feb 2006