Clinical Alarms: 
Risk or Benefit to Patient Safety?

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Clinical Alarms: Risk or Benefit to Patient Safety?

- Overview of alarms and alarm management
- Alarm management survey
- The perfect alarm
- Alarm fatigue
- National Patient Safety Goal
- 2011 Alarm Summit recommendations
- Alarm study
- Ventilator alarms

What is an Alarm?

- An audible and/or visible means of indicating an equipment malfunction, process deviation, or abnormal condition requiring a response
- Not a substitute for constant surveillance/assessment of patients

STOP EVERYTHING! Needs immediate attention
PAY ATTENTION. Investigate what is happening
Everything is good
**Purpose of Alarms**

- Influence operator’s ability to reduce consequences of serious situations
- Improve patient safety and quality
- Prevent untoward events

**Current State of Clinical Alarms**

- Medical alarm systems are out of control
  - Hundreds of auditory alarm signals
  - Thousands of alarms sound daily in patient care areas
  - Estimated 150-400 alarms per patient day in critical care
- ECRI Top Health Technology Hazard since 2010
- FDA report
  - 500 patient deaths over four years
  - In 2010, 2,500 adverse events with ventilators
  - 1/3 alarm related
**Alarm Management (cont.)**

- Other contributing factors:
  - Alarm fatigue
  - Alarm settings not customized
  - Inadequate staff training on use and function of equipment
  - Inadequate staffing to respond to alarms
  - Alarms not integrated with other medical devices
  - Equipment malfunctions and failures

**Northeast Blackout of 2003**

- Failure of the control computers and alarm system
- Failed Alarm Tools were a major factor in the blackout.
- The primary server hosting the alarm processing application failed, due either to the stalling of the alarm application, “queuing” to the remote EMS terminals, or some combination of the two.
Deepwater Horizon Oil Spill

- Vital warning systems on the oil rig were switched off in order to spare workers being woken by false alarms
- The revelation that alarm systems were at the center of the disaster were disabled came in testimony by a chief technician
- “It appears that the medical equipment industry is traversing the same ground with regards to audible alarms as the military and space industries crossed decades ago.” - Rochelle Grober, 1995

Alarm Management

- Alarm summit held in 2011
  - ECRI, TJC, AAMI, FDA, ACCE
  - Serious event data significantly under-reported
- Greater than 85% of clinical alarms require no clinical intervention
- TJC Sentinel Event database
  - Majority of events in Telemetry, ICU, ED
  - Major contributing factors:
    - Absent or inadequate alarm systems
    - Improper alarm settings
    - Alarm signals not audible in all areas
    - Alarm settings inappropriately turned off
Alarm Management (cont.)

Association for the Advancement of Medical Instrumentation
Healthcare Technology Safety Institute

Alarm Management Survey

2011 Clinical Alarms Survey, over 4,000 clinicians responded to survey.

Response by Hospital Department
**Alarm Management Survey (cont.)**

2011 Clinical Alarms Survey, over 4,000 clinicians responded to survey.

**Response by Job Title**

- Respiratory Therapist: 2,071
- RN: 276
- Clinical Manager: 251
- Other: 201
- BMET: 202
- Admin/Non-clinical Manager: 198
- Clinical Engineer: 182
- Monitor Technician: 152
- Nurse’s Aide/Orderly: 74
- LPN: 39
- Physician: 30
- Paramedic: 30

**Alarm Management Survey (cont.)**

Has your institution experienced adverse patient events in the last two years related to clinical alarm problems? 

- Yes: 49.5%
- No: 46.5%
- Not sure: 4.0%

The results show almost 1 in 5 institutions experiencing adverse patient events over the last two years with a large percentage unsure if events had occurred.
Alarm Management Survey (cont.)

Has your institution developed clinical alarm improvement initiatives over the past two years?

#31

Clinical alarm improvement initiatives were reported to have taken place in a little more than 20% of the responders healthcare institutions with a large percentage unsure of this activity.

The Perfect Alarm

• 100% Specificity

• 100% Sensitivity
The Perfect Alarm

• Appropriate settings
• Effective staff training
• Clear alarm information
• Effective notification channels
• Clear response protocols

Alarms are Not Perfect

• If the fire alarm went off in this room right now, what would be your initial thought?
  • Fire drill
  • False alarm
  • Testing the system
  • The building is on fire
Alarms are Not Perfect

Alarm Condition Activated

- Actionable
  - Intervention required to resolve alarm condition
- Non Actionable
  - Intervention NOT required to resolve alarm condition
Alarm Fatigue

• Too many devices with alarms
• Alarms limits not set to actionable levels
• Alarms limits set too tight
• Alarm systems too sensitive
• Too many false positive alarm conditions
• Duplicate alarm conditions
• Unit/department culture

Alarm Fatigue

• Clinicians desensitized or immune to sounds
• Overwhelmed by information
• Ineffective response by staff
  • Delay in response
  • Turn volume down
  • Turn alarm off
  • Adjust settings outside safe parameters
National Patient Safety Goal (NPSG)

- Issued by The Joint Commission (TJC) in 2003
- Retired in 2005
- Continued to be surveyed under medical equipment standards
- TJC decided to develop new NPSG after Alarm Summit 2011
- Phased in process
  - Initial actions effective July 1, 2014
  - Second phase effective January 1, 2016
TJC Sentinel Event database

- June 2009 – June 2012
  - 98 alarm related events reported
  - 80 resulted in death
  - 13 resulted in permanent loss of function
  - 5 resulted in unexpected additional care or extended stay

National Patient Safety Goal (NPSG)

EFFECTIVE JULY 1, 2014

- Leaders establish alarm safety as a critical hospital priority
- Identify most important alarm signals to manage, based on:
  - Input from medical staff and clinical departments
  - Risk to patients if alarm not attended to or malfunctions
  - Whether specific alarms are needed or unnecessarily contribute to noise/alarm fatigue
  - Potential for patient harm (based on incident history)
  - Published best practices/guidelines
National Patient Safety Goal (NPSG)

EFFECTIVE JANUARY 1, 2016
• Develop policies and procedures for managing alarms identified as most important
  • Clinically appropriate settings for alarm signals
  • When alarm signals can be disabled
  • When alarm parameters can be changed
  • Who has authority:
    • To change parameters
    • To set parameters
    • To turn off parameters

National Patient Safety Goal (NPSG)

EFFECTIVE JANUARY 1, 2016
• Develop policies and procedures for managing alarms identified as most important
  • Alarms should be relevant
  • Alarms should be timely
  • Alarms should be actionable
  • Alarms should be addressed immediately
**National Patient Safety Goal (NPSG)**

**EFFECTIVE JANUARY 1, 2016**

- Develop policies and procedures for managing alarms identified as most important
  - Monitoring and responding to alarm signals
  - Checking individual alarm settings for:
    - Accurate settings
    - Proper operation
    - Detectability

**EFFECTIVE JANUARY 1, 2016**

- Educate staff and physicians about the purpose and proper operation of alarm systems for which they are responsible
- Data collection
National Patient Safety Goal (NPSG)

EFFECTIVE JANUARY 1, 2016

• Establish an interdisciplinary team
  • Clinicians (Nursing, Respiratory therapy)
  • Medical staff
  • Risk management
  • Information technology
  • Biomedical engineering
  • Facilities management

2011 Summit Recommendations

1. Gain cross-disciplinary leadership support
2. Establish a cross-functional team with clinical leadership to address alarm fatigue across environments of care
3. Re-establish priorities: Process should drive technology adoption rather than allowing technology to drive process
4. Develop a continuous improvement process for constantly optimizing alarm system policies and configurations
5. Conduct clinical testing and analyze alarm data to implement optimized alarm limits and delays and reduce clinically non-actionable alarm conditions
2011 Summit Recommendations (cont.)

6. Test acoustics on clinical floors: Environmental noise impacts patient and staff well-being and patient safety
7. Implement an alarm system configuration policy based on clinical evidence
8. Change single-use sensors more frequently to reduce nuisance alarm conditions (except pediatric units)
9. Mandate alarm system management training for all clinical operators
10. Share experiences with AAMI, FDA, TJC, ECRI, and others with problem reporting systems so everyone can benefit from your efforts

Alarm Management

- Clinical policies and procedures regarding alarm management are effectively used in my facility
  - Strongly agree
  - Agree
  - Neutral
  - Disagree
  - Strongly disagree
Clinical policies and procedures regarding alarm management are effectively used in my facility.

- There is a requirement in my institution to document that the alarms are set appropriately for each patient.
  - Strongly agree
  - Agree
  - Neutral
  - Disagree
  - Strongly disagree
Alarm Management

There is a requirement in my institution to document that the alarms are set appropriately for each patient.

Alarm Study

• Study of ventilator alarms at The Johns Hopkins Hospital (Baltimore, MD)
  • 10 week study in Medical, Surgical, and Neuro ICUs
  • Average of 173 ventilator alarms/day/unit
  • Duration of alarms
    • Mean: 4.32 seconds
    • % greater than 5 seconds: 36%
    • % greater than 10 seconds: 7%
    • % greater than 20 seconds: 1.7%
    • % greater than 30 seconds: 0.49%
    • 93% of ventilator alarms were less than 10 seconds
Alarm Study

- Study of cardiac monitors at Boston Medical Center
  - Initiated as a pilot on one unit
  - Focused on reducing audible warning and advisory alarms
  - Readjusted alarm parameters for “crisis” alarms only
  - Reduced audible telemetry alarms from 12,546/day to 1,424/day
  - 89% reduction in audible alarms
  - Transformed into hospital-wide initiative
  - Reduced decibel level from 90 decibels (heavy traffic) to 72 decibels (normal conversation)

Management of Ventilator Alarms

- Evaluate your hospital’s current vent alarm management
  - Understand RT’s practice on vent alarm settings
  - Other disciplines involved in alarm management

- Respiratory Therapist’s responsibilities
  - Set alarm limits based on individual patient condition and assessment
  - Designated primary responder for all vent alarms
  - Determines the most important vent alarm and expected response
  - Shared sense of responsibility with nursing and other clinicians
  - Best practice in alarm management
Challenges with Ventilator Alarms

• Alarm settings too broad or too narrow
• Inconsistent and complicated alarm packages with different ventilators
• Variation in available alarm settings
• Inconsistent nomenclature
• Limited autonomy allowed to customize algorithms and delays
• Inconsistent ability to transmit alarm data to third party (EMR, secondary alarm notification)

Challenges with Ventilator Alarms (cont.)

• Lack of research to determine best practice for vent alarm settings
• Need more options for secondary alarm notification
• Customizing alarm limits for individual patients
• Determine primary responder for all ventilator alarms
• Need data prior to changing current practice
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