BOSTON MEDICAL CENTER

Clinical Alarm
TASK FORCE

Alarm Management at Boston Medical Center
A Roadmap to Safe Silence

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This presentation is a view into the process we undertake at Boston Medical Center for managing alarms. We are a member of the National Coalition for Alarm Management Safety.

Much of this presentation covers some preliminary work done on managing pulse oximetry alarms.

Check out the work of the Foundation!   http://www.aami.org/thefoundation/

AAMIFOUNDATION

AAMI Foundation's National Coalition for Alarm Management Safety

2008 - 2011 Identify Risk

71% Growth in capacity + staff education

Geography of Medical~Surgical telemetry units

Lack of monitoring at bedside

Defaults – standardize + some incremental changes

Review External Sentinel Events

Created multi-disciplinary team [governance]

Created mandatory Arrhythmia competency examination

Created self contained Telemetry System

2011 - 2012 Gap Analysis + Process Design

Identify gaps in technology use and perception of capabilities

No new investments – leverage human capital

Extract and evaluate alarm data – identify alarm change goal

Observe staff in environment and assess workflow

Identify support model + education needs

EMR Order set changes

Held Quality Summits

Alarm Settings Default Changes established for Pilot

Patient Status Arrhythmia Alarms	Prepilot	Pilot
Asystole	Crisis	Crisis
Ventricular fibrillation/ ventricular tachycardia	Crisis	Crisis
Ventricular tachycardia (VT >6)	Crisis	Crisis
VT >2 (VT > 2 < 6)	Crisis	Crisis
Very bradycardia	Crisis	Crisis
Accelerated ventricular rhythm	Warning	**Crisis**
Pause	Crisis	Crisis
Tachycardia	Warning	**Crisis**
Bradycardia	Warning	**Crisis**
R on T	Message	Message
Couplet	Message	Message
Bigeminy	Message	Message
Trigeminy	Message	Message
PVC	Message	Message
Irregular	Message	Message
Atrial fibrillation	Message	**Advisory**

Distribution of Alarm Types for 2011 Defaults

Patient Status Parameter Limit Alarms	Prepilot	Pilot
HR	50l120lWarning	45l130lCrisis
PVC/min	10lAdvisory	10lMessage
BP	Warning	Warning
Spo₂	Warning	Warning
System Status Alarms	**BMC 2011**	**BMC 2011**
No telemetrry, lead fail, probe off	Warning	Warning
Arrhythmia suspend	Warning	Warning

2012 - 2013 Pilot + Results

Educate organization on effort

Create environment where ALL alarms are actionable

Remove audible alerts for clinically insignificant alarms (self resetting)

Change Arrhythmia and parameter defaults

Slightly widen Heart Rate limits

Create ownership locally

Support process and staff 24/7

In the Moment Training

Educate staff on technology and process

Leverage analytics to facilitate change

Create buy-in through transparency

Understand that it is marathon not a sprint

	Area	Crisis	Warning	Advisory	Message	Total/Wk
Pre - 1	7N	851	72,730	170	7,341	81,092
Pre - 2	7N	2,836	65,092	67	26,558	94,553
Total		3,687	137,822	237	33,899	175,645

Total Audible Alarms

87,823

89% Reduction

9,967

Pre-Pilot   Pilot

	Area	Crisis	Warning	Advisory	Message	Total/Wk
Post 1	7N	6,611	3,666	50	1,471	11,798
Post 2	7N	4,926	2,477	733	0	8,136
Total		11,537	6,143	783	1,471	19,934

Bradycardia, Tachycardia and HR Limit Alarms

62,793

LARGEST CONTRIBUTOR

93% Reduction

3,970

Average Alarms per Week

Pre-Pilot   Pilot

Noise

Collaboration

One warning alarm generates 2 beeps. Before our changes, the staff had to listen to an average of 175,646 beeps per week. These alarms were clinically insignificant.
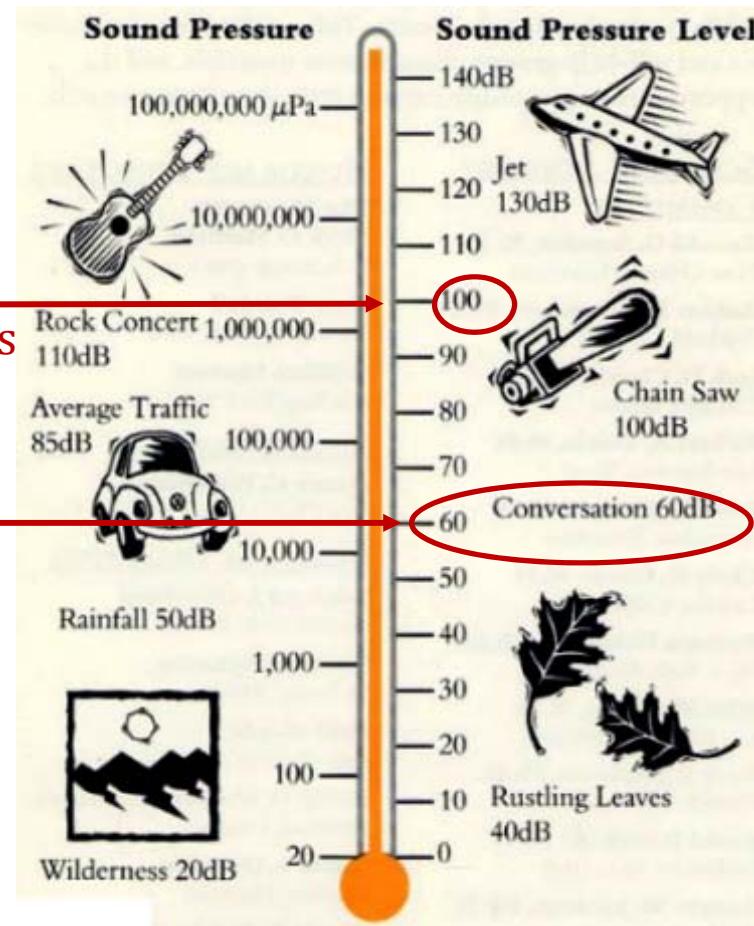
Before changes

After changes

The resulting alarms on the unit were more meaningful because they were actionable and could be clearly heard.

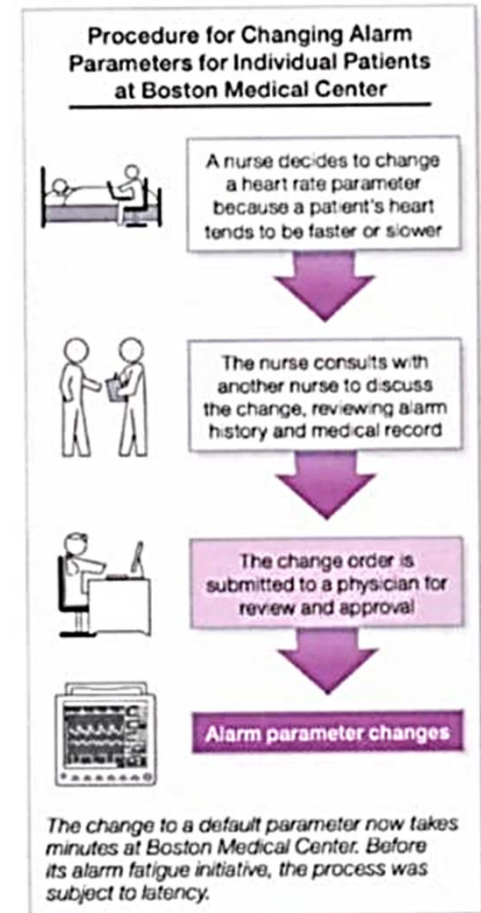**Sound Pressure**

100,000,000 μPa — 140dB
130
10,000,000 — 120 Jet 130dB
110
1,000,000 — 100
Rock Concert 90
110dB
Chain Saw 100dB
Average Traffic 80
85dB 100,000 — 70
60 Conversation 60dB
10,000 — 50
Rainfall 50dB 40
1,000 — 30
20
100 — 10 Rustling Leaves 40dB
20 — 0
Wilderness 20dB

Sound Pressure Level

chart source: hearos.com

Procedure for Changing Alarm Parameters for Individual Patients at Boston Medical Center

A nurse decides to change a heart rate parameter because a patient's heart tends to be faster or slower

The nurse consults with another nurse to discuss the change, reviewing alarm history and medical record

The change order is submitted to a physician for review and approval

Alarm parameter changes

The change to a default parameter now takes minutes at Boston Medical Center. Before its alarm fatigue initiative, the process was subject to latency.

2013 - ......

Received $25,000 BMC quality grant to create Support model for full hospital conversion

Expanded changes to all ten telemetry units

Reduced overall alarms by **60%**

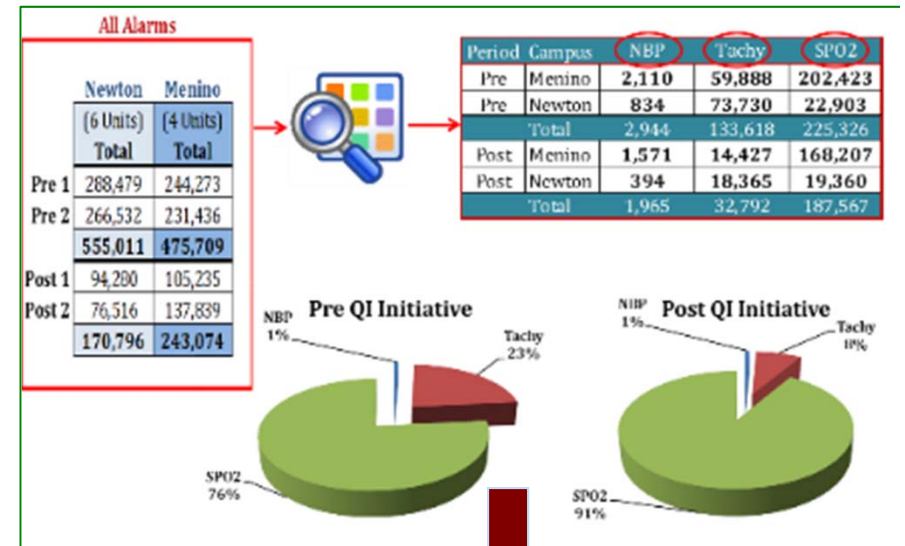Found opportunities for further alarm reduction

Sustainability efforts

Continue to monitor, measure and observe

Success also found opportunities

Utilize the same process

Understand the change and the impact

Solicit subject matter experts as champions

All Alarms	Newton (6 Units) Total	Menino (4 Units) Total
Pre 1	288,479	244,273
Pre 2	266,532	231,436
	555,011	475,709
Post 1	94,280	105,235
Post 2	76,516	137,839
	170,796	243,074

Period	Campus	NBP	Tachy	SPO2
Pre	Menino	2,110	59,888	202,423
Pre	Newton	834	73,730	22,903
	Total	2,944	133,618	225,326
Post	Menino	1,571	14,427	168,207
Post	Newton	394	18,365	19,360
	Total	1,965	32,792	187,567

Pre QI Initiative
NBP 1%
Tachy 23%
SPO2 76%

Post QI Initiative
NBP 1%
Tachy 1%
SPO2 91%

Tachycardia Alarms +Pulse Oximetry

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GO LIVE Week of December 8, 2014

Currently either Tachycardia or High Heart Rate triggers a Crisis Alarm

To reduce nuisance alarms the "Tachycardia" Alarm (not the high HR alarm) will be downgraded from a Crisis Alarm to an Advisory Alarm.

Alarm Definitions

1. TACHYCARDIA: 4 consecutive beats above the upper rate alarm [>130]
   Examples:
   - Short beat run SVT
   - AF briefly accelerates >than 130 more than 4 beats in a row
   - Brief artifact that looks like fast HR
     - Note: These alarms are frequent and usually do not need immediate response
2. HR High: 5 seconds above the set upper heart rate [>130]
   - Sustained HR increase 5 or more seconds above upper limit of HR is a true Crisis Alarm.

Summary of Changes:

- The Crisis Alarm for Tachycardia will be eliminated. (Short 4 beat or more rate increase)
- Instead Tachycardia will be an Advisory Alarm so Alarm History still captures brief increases in rate such as SVT.
- Crisis Alarm for HR High (sustained rate increase >130 for 5 sec) will be maintained to appropriately create an alarm requiring immediate response.

Positive Effect:

- Creates appropriate alert for alarm requiring immediate response (HR High)
- Still captures brief increase in rate in patient history
- Eliminates several thousand nuisance alarms/week

Phase II - Tachycardia

Pre-Pilot	MP5W	MP 6W	MP 6E	MP7E	MP7W		E8W	E8E	E7W	E7N	E7E	E6W
Alarm	Total	Total	Total	Total	Total		Total	Total	Total	Total	Total	Total
HR High	6,966	3,468	1,202	1,096	784		500	3,211	784	1,456	1,148	1,462
Tachycardia *	3,093	3,806	1,298	652	994		146	1,189	994	1,413	925	862

Post Pilot	MP5W	MP 6W	MP 6E	MP7E	MP7W		E8W	E8E	E7W	E7N	E7E	E6W
Alarm	Total	Total	Total	Total	Total		Total	Total	Total	Total	Total	Total
HR High	2,308	2,513	2,909	234	974		729	7,250	2,449	3,614	1,230	2,169
Tachycardia *	2,396	2,482	2,271	206	1,011		126	1,230	856	2,810	1,611	849

* Note:

Moving level from Crisis to Advisory made each unit *quieter* while capturing alarms in alarm history for review.

	Newton	Menino
■	8,561	13,516
■	5,529	9,843

HR High and Tachycardia
Pre Pilot
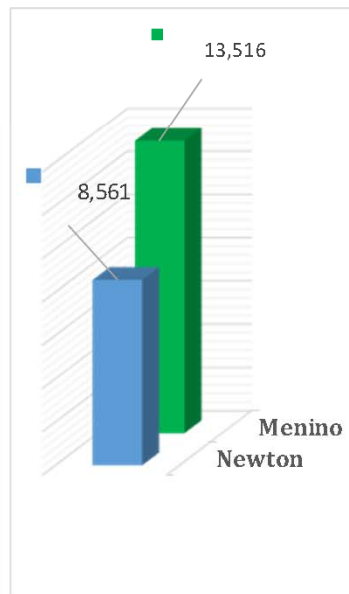
Crisis Alarms
Post Pilot

Advisory Alarms
Post Pilot

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EXCEPTIONAL CARE. WITHOUT EXCEPTION.

QUEST — Quality Efficiency Satisfaction Total Revenue

Two Week Data collected from alarm logs [10 Telemetry Units]

Area/Campus	SPO2 Lo	SPO2 Rate Lo	SPO2 Rate Hi	SPO2 Probe	SPO2 Sensor	Pulse Search	Total
Week	Warning	Warning	Warning	Warning	Warning	Message	
Menino Units	283,776	25,170	682	42,467	269	18,266	370,630
Newton Units	148,069	932	2,163	26,705	1,623	2,903	182,805

553,435 Alarms !

Data and workflow and Education suggest there are opportunities to improve Recipient 2nd Patient Safety Grant 2015

Define the current problem/ reason for action	Following the successful implementation of the cardiac monitor alarm reduction project we found that there remained a significant number of alarms contributing to alarm fatigue that stemmed from SpO2 alarms (O2 Sat alarms). On further review we found that standard policies, procedures and order sets governing application of this technology are lacking and there is significant opportunity for improvement in application of this technology across the organization.
Provide baseline data to support the problem statement	Currently SpO2 alarms constitute over 1/3rd (39%) of all audible alarms on our medical surgical units. On Newton 8E our Pilot Unit again over 1/3 rd (32%) of all alarms comes from SpO2 alarms
Discuss any potential barriers to success	Achieving interdisciplinary consensus on application of O2 sat monitoring technology .

- Created a Multidisciplinary Pulse Oximetry Task Force that included as its members nurses, physicians, respiratory therapists, biomedical engineers, IT analysts representing every level of staff from direct care givers to quality leads and departmental leadership.
- Extracted alarm data to assess pulse oximetry alarms and determine how they contributed to alarm fatigue.
- Evaluated actual practices of clinical staff in ordering and using continuous pulse oximetry technology including interviews and focus groups across services as well as "secret shopper" observations of nursing staff responding to pulse oximetry alarms.
- Created policy, procedure and EMR order sets for governing continuous pulse oximetry use for adult non-ICU settings,
- Determined defaults and alarm levels for pulse oximetry that signaled meaningful clinical alarms and would bring clinical staff to view and manage these alarms in real time.
- Made necessary default changes to monitors and developed probe troubleshooting guidelines that would improve acquisition of pulse oximetry signal minimizing false alarms.

Educational Initiatives

Emphasized the new clinical indications for continuous pulse oximetry.

Established continuous pulse oximetry would require an EPIC order.

Established intermittent pulse oximetry with routine vital signs as a standard of care for all patients not on continuous pulse oximetry.

Required continuous pulse oximetry waveform be displayed on central monitor.

Provided tips for troubleshooting poor waveform signal from pulse oximetry probes.

Alarm Changes

SpO2≤88% (rather than 90%) became a CRISIS alarm
>> For Bariatric, COPD or Pulmonary Hypertension Patients
>> SpO2≤85%

15 second delay replaced a previous 5 second delay increasing sensitivity of monitor before signaling SpO2 low or probe off alarm.

Duplicate alarms such as SpO2-HR alarm were moved to a MESSAGE non-audible alarm but able to changed to a CRISIS Alarm by staff when patient not on simultaneous Telemetry.
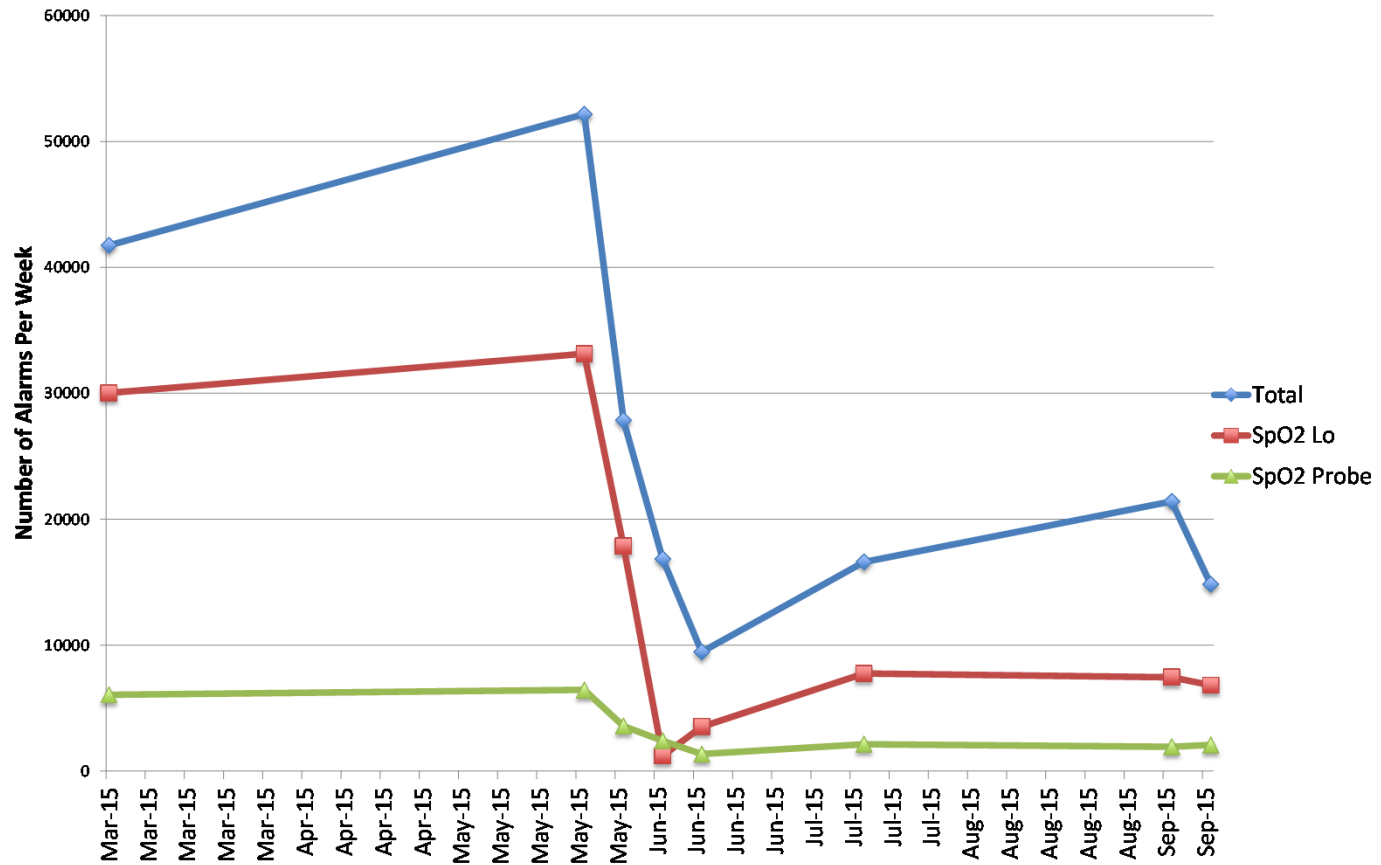
- Data from the week preceding Go Live showed 80-90% of 5W IMCU patients on continuous pulse oximetry most without an order.

- Audits during the Pilot showed 25-35% patients on continuous pulse oximetry all but one patient had orders.

- Total audible alarms reduction during the Pilot was 82% driven primarily by an 89% reduction in SpO2 low alarms.

- Change sustained with most recent data from Pilot unit showing 72% reduction in total alarms driven again by a 57% reduction in SpO2 low alarms

- Review of Code Blues, RRTs and ICU transfers documented no adverse outcomes related to pulse oximetry monitoring changes made during the Pilot with roll out to all units planned this Fall.

Conclusions

- Establishing indications for continuous pulse oximetry and requiring an EPIC order for use of this technology led to a significant reduction in pulse oximetry alarms during the Pilot on 5W IMCU.

- Reducing the limit for SpO2 low alarm from 90% to 88% (or 85% in specific situations) reduced SpO2 alarms without adverse events such as Code Blue, RRT or transfer to the ICU for pulmonary care.

- Delaying the time to alarm sounding from 5 seconds to 15 seconds improved sensitivity of the monitor decreasing false SpO2 low alarms while expanding probe type choices decreased frequency of probe off alarms.

- Using a stepwise approach that included development of specific guidelines for use of continuous pulse oximetry, educated all stakeholders, set defaults to minimize clinically insignificant alarms and required an immediate response by staff to SpO2 low alarm made possible the significant reduction in alarms on the Pilot Unit.

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Summary

www.youtube.com/watch?v=nVbBpsSTAbU

Key Elements to Success Has Been

See more about BMC and the alarm project

Data is a powerful tool to start the discussion of alarm changes

- Establish a broad-base multidisciplinary alarm work group
- Understand their current manufacturer alarm defaults
- Extract and evaluate their alarm data
- Observe staff response to alarms, looking for the barriers to timely response
- Identify with clinician stakeholders clinically insignificant alarms
- Remove audible notification for clinically insignificant alarms
- Choose an alarm setting that requires staff response for all clinically significant alarms
- Standardize alarm defaults across patient care units wherever possible
- Empower nursing staff to eliminate false alarms, appropriately adjusting alarm in real time after validation with second registered nurse

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