Alarm management through rule based middleware and smart phones

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What's happened in our institution
University of Maryland Medical Center

- **"We didn't hear it"**
- "We couldn't tell what was alarming"
- "We just got too busy"
- "Things were just crazy that day"
- "The place is like a casino with so many bells and whistles"

What HTM professionals can do to solve alarm problems?

Implement the right technology for change management of alarms

Alarm Management

- ## University of Maryland Medical Center
  - ### We took a two step approach to reach the goal
    - #### Clinical ownership
      - Defaults
      - Understanding their environment
      - Committees on defining alarm parameters
      - Level 2: pilot in Neuro ICU

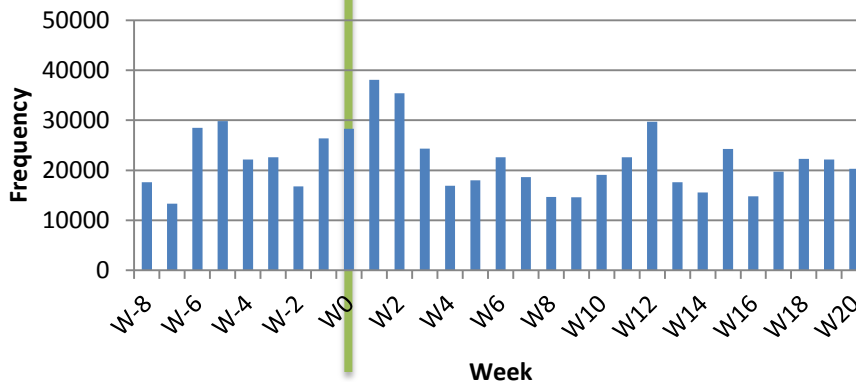Framework for alarm management process maturity. BI&T May/June2016

Total

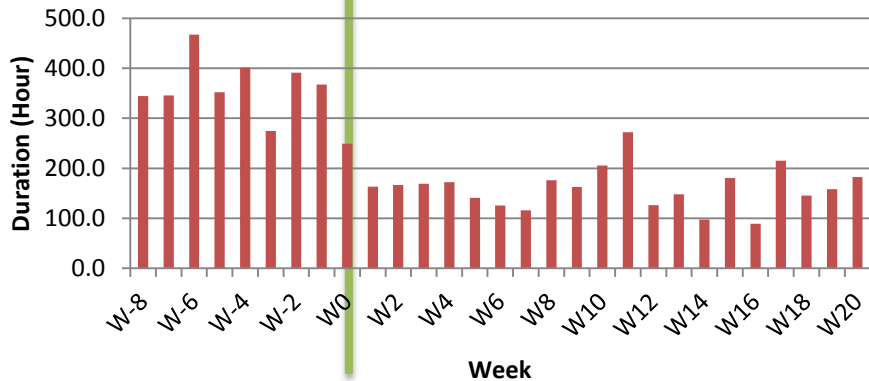

Before settings changed ⟵ ⟶ After settings changed

West - Total Frequency
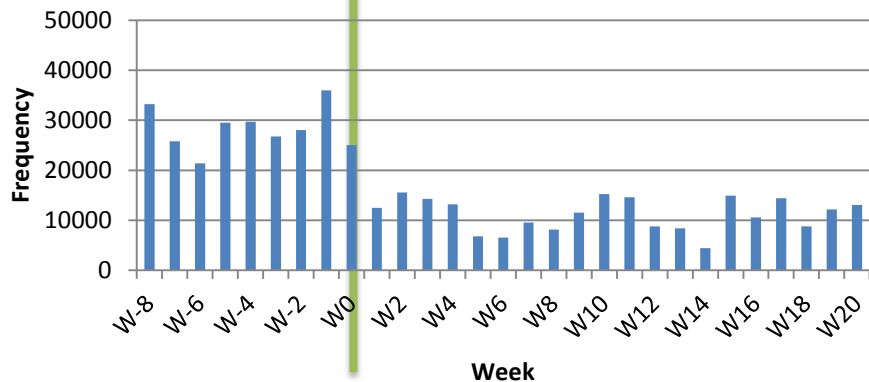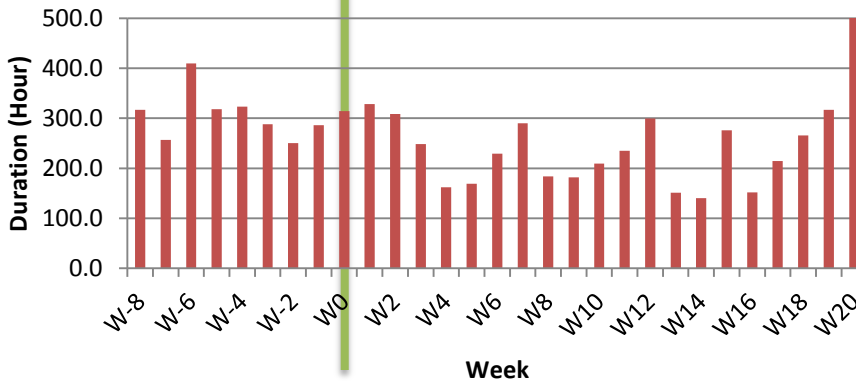
No setting changed

East - Total Frequency

Before settings changed ⟵ ⟶ After settings changed

No setting changed

West - Total Duration

East - Total Duration

– Middleware
  - We looked for a middleware that we control
    - Vendor agnostic
    - Define the rule to limit the number of non actionable alarms sent to the provider

- Why alarm middleware and integration with smart phones is important?
- Elements to consider for successful implementation
- Lessons learned
- Improvement of care at UMMC

Total 610,569 Alarms (3588 types of Alarm messages) in 3 Month in 22 Bed Neuro ICU
Top 10 Reasons for Alarm in each of 4 Categories

Level	Alarm Categories	N	1	2	3	4	5	6	7	8	9	10
3	System Alarms	39102 (6.4%)	SPO2 PROBE	CONNECT PROBE	ARRHY SUSPEND	LEADS FAIL	NO ECG	RR LEADS FAIL	NBP MAX TIME	SENSOR	SPO2 SENSOR	WRONG CABLE
			43.6%	18.2%	14.8%	13.1%	2.8%	2.5%	2.5%	1.6%	0.6%	0.3%
5	Patient Advisory	541991 (88.8%)	CHECK ADAPTER	RSP HI	TACHY	SPO2 LO	ART S HI	NO BREATH	RSP LO	ART D LO	ART S LO	EXP CO2 LO
			18.3%	18.0%	10.0%	7.5%	6.9%	4.6%	3.6%	3.2%	2.5%	2.4%
6	Patient Warning	27675 (4.5%)	HR HI	VT>2	HR LO	ART DISCONN	PVC	BRADY	ART D HI	ART S HI	ART M HI	V BRADY
			38.1%	29.7%	23.0%	4.6%	2.3%	0.7%	0.5%	0.4%	0.3%	0.2%
7	Patient Crisis	1801 **(0.3%)**	ASYSTOLE	V TACH	VFIB/VTAC							
			20.9%	69.5%	9.6%							

Can we wait
2s to reduce **45%**
Or **4s** to reduce **56%**
of alarms?

Level	Alarm Categories	N	2s	4s	6s	8s	10s	1min
3	System Warning	39102 (6.4%)	15.82%	31.08%	39.45%	44.18%	47.86%	76.14%
5	Patient Advisory	541991 (88.8%)	46.60%	57.55%	64.03%	68.94%	72.72%	93.66%
6	Patient Warning	27675 (4.5%)	61.47%	70.70%	76.64%	80.73%	83.60%	97.20%
7	Patient Crisis	1801 (0.3%)	17.49%	29.43%	38.76%	46.03%	52.36%	93.56%
All	All Alarms	610,569 (100%)	45.22%	56.37%	62.96%	67.82%	71.56%	92.70%

Why implement alarm middleware?

Defining most important alarms to manage

A secondary notification for alarms

Delaying alarms before reaching the caregiver

Alarm middleware and integration with smart phones

- Reducing the noise and visual alarm fatigue in the unit
- Limit the number or removal of secondary monitors
- Reduce over head paging or sound speakers
- Secure text messaging between clinicians

Important elements of design

- Understand the environment (all systems that need to be integrated) and customize your solution to it
- NICU staged approach (patient monitor alarms only in Phase I, Phase II nurse call integration)
- Nurse call integration with phones through middleware which will handle escalation of nurse call
- Consider the version of nurse call and its ability to fully integrate with your middleware (cancel calls from the phones or room only)
- Our CSSTEP will do a full integration with nurse call:
  - Nurse call calls are sent to the unit secretary first
- NICU will only send code blue and vent alarms through the middleware

Important elements of design

- Staff assignment (nurse call, EMR, middleware)
- Active directory integration not available (manually entering the users into middleware and staff assignment client)
- Ask for a test environment and go through all the scenarios including escalation patterns, alerts and alarms that you will manage through the middleware and smart phones prior to go live with your technical ressources

Lessons learned

- Have the whole team (clinical team, CE, Biomed and IT) involved during the entire project

- Have end user training and not super user training

- Nurse managers and Biomed need to be present for all training (assignment training and end user training prior and after the go live)

Lessons learned

- Ask for additional support by the vendor during not only the go live but the entire week of the go life to insure effective training and to correct any user errors
- Plan for technical resources to be available to support the unit during the go live and 1 month after the go live.
- Plan for any software and hardware support you need for your solution

Lessons learned

- Expect that the go live will not be as smooth as you expected and have a back up plan in place
- If possible start getting acclimated to the technology before hand (phones, staff assignment)
- Plan ahead of time for you alarm notification downtime (have a back up plan implemented in place)

Obstacles in adopting the new technology

- Phone implementation required some setting adjustments
  - Allowed channels
- Human errors and providing adequate training
  - Messages not received (Provider was off duty, 2 providers are assigned in the same slots)
  - Redefined the assignment workflow after the go live
  - Additional training
- Resistance to change

If you don't fail it's because you didn't risk enough, and if you didn't risk enough it's because you didn't risk enough it's because you didn't put your whole self out there. Carols Barrabes

Improvement of care at UMMC

- Won IHA award in two categories:
  - Improving patient care and Health delivery
  - 2016 Intelligent Health Grand Award
- Transitioned from a bay unit model with no nurse call – to new 52 single bed model
- Messaging between L&D and NICU
  - Replaced the old middleware and the 7925 Cisco phone with smart phones
  - UMMC requirement 15-20 people needed to be on the message for urgent delivery and the sender need to have a confirmation
- Issues with old technology:
  - Message were sent to inbox to review later. Need to scroll to find it (can be missed)
  - Messages time out and nurses were unaware that messages weren't sent
  - No confirmation that the message was sent and single sign on
  - Not user friendly (drop down menu of 15 items)and nurse weren't entering all the information needed to NICU recess team

A wireless text messaging system improves communication for neonatal resuscitation. Colleen A Hughes Driscoll and al. American journal of Medical Quality:1-6.2016.

Improvement of care at UMMC

- Implementing a desktop application using the new middleware:
  - Individual sign on
  - Built in prompt for CDI (critical delivery information)
  - Easy to use interface allowing quick data entry
  - Acknowledgement of send and receive

- Results:
  - 95% improvement in content and reliability of critical delivery information expect (indication 93%)
  - The new middleware improved communication of information needed to implement evidence based practice

Next steps

- Waveform application implementation in CSSTEP

- Implement alarm reporting

- Expand the implementation of alarm middleware and smart phones to all telemetry units