Enhancing Patient Safety with Appropriate Ventilator Alarm Management

September 25, 2015

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- **Vision:** To drive the safe adoption and use of healthcare technology
- Visit our website to learn more about our alarm initiative – *National Coalition for Alarm Management Safety:*
  - Get involved and consider making a donation to this important national effort!
  - http://www.aami.org/thefoundation/content.aspx?ItemNumber=1494&navItemNumber=672
  - Contact Sarah Lombardi at slombardi@aami.org

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Thank You to Our Industry Partners

This Patient Safety Seminar is offered at no charge thanks to funding from our National Coalition for Alarm Management Safety industry partners. The AAMI Foundation and its co-convening organizations appreciate their generosity. The AAMI Foundation is managing all costs for the series. The seminar does not contain commercial content.

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LinkedIn Questions

Join our group **in** ™

Please post questions about alarms on the

AAMI Foundation's LinkedIn page:

http://www.linkedin.com/groups/Healthcare-Technology-Safety-Institute-HTSI-4284508

Or

Email Sarah Lombardi (slombardi@aami.org)

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Speaker Introductions

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Assistant Professor

Director of Clinical Research

Division of Trauma and Critical Care

Department of Surgery

University of Cincinnati

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Disclosures

- None

University of Cincinnati Medical Center

- Level 1 Tertiary Trauma Center
  - 2.2 million catchment area
- Approximately 4000 trauma alerts per year
  - 72% blunt
  - 28 % penetrating
  - Average ISS 19.17
- 36 bed Surgical/Trauma/Burn ICU
- 20 bed Neurological Sciences Intensive Care Unit
- 6 bed Shock Resuscitation Unit (SRU)/Center for Emergency Care

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Overview

- Prepare to meet goals for alarm management and patient safety

- Establish understanding of what alarms are critical for sustained monitoring
  - Learn how to distinguish between priority/critical and nuisance alarms

- Understand the significance of setting appropriate alarm parameters
  - "Cookie cutter" alarms may not be the answer

- Evaluate how data is presented
  - Assessing the data you see and don't see

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Overview

- What are some of the challenges
  - Getting alarm data
  - No standardized alarm settings parameter specific
  - Managing alarms (patient versus mechanical)
  - Responding to alarms appropriately (addressing technology and/or patient action items)
  - Understanding middleware relative to EHRs and is it possible to integrate elsewhere
- Establishing the RT as THE resource for other clinicians

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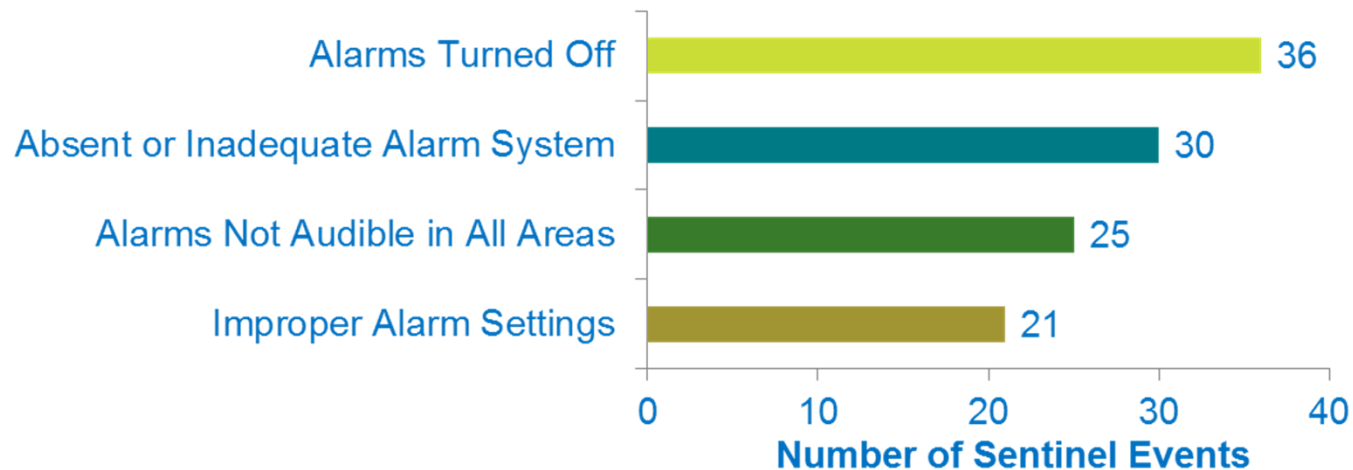
The Environment

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Significance of Vent Alarms

- Life sustaining intervention

- Extremely critical/complex interaction between machine and patient

- Arguably most vital piece of equipment

- Complex variability between various designs/manufacturers

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Why the Emphasis?

- As of July 1, 2014, JCAHO established alarm system safety as a top priority for hospitals seeking to maintain their accreditation[1]

- In a review of sentinel events reported to JCAHO between 2009 and 2012[a], JCAHO found that of the 98 alarm-related events occurring during this period, 80 resulted in death[1,2]

  - Contributing factors included:[1]

Contributing Factor	Number of Sentinel Events
Alarms Turned Off	36
Absent or Inadequate Alarm System	30
Alarms Not Audible in All Areas	25
Improper Alarm Settings	21

[a] The reporting of most sentinel events to The Joint Commission is voluntary and represents only a small portion of actual events. Therefore, these data are not an epidemiologic data set and no conclusion should be drawn about the actual relative frequency of trends in events over time.
[1] Poster available at: http://www.jointcommission.org/sea_issue_50/. Accessed April 13, 2015.
[2] Joint Commission. *Sentinel Event Alert*. 2013;50:1-3.

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Why the Emphasis? (cont.)

- Surveillance evidence
  - JC: 65% of ventilator deaths reported were result of 3 key factors
    - Clinician did not respond
    - Clinician did not hear
    - Incorrect settings
  - ECRI
    - Almost half the cases, clinician did not believe alarm sounded

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Victims of Technology

- Top 10 Health Tech Hazards
  - Inadequate Alarm Policies and Practices
    - Inappropriate alarm limits
    - Misaligned priorities when setting alarms
    - Alarm volume minimized
  - Inappropriate setting of alarms contributing to unrecognized ventilator disconnections
  - Incorrect/missing data
    - Validate alarm data

Health Devices, Nov 2014, ECRI Report

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Regulatory Requirements

- Joint Commission National Patient Safety Goal
  - Phase I: Establish alarms as an institutional priority with a determination of their most critical alarms as the emphasis
    - Pole clinicians for ideas
    - Based on risk to patients
    - Incorporate best practice
  - Phase II: Facilities required to incorporate specific policy/procedural objectives and provide education system wide
    - Establish clinical targets
    - Determine who is permitted to set/change/disable

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Priority Alarms and Alarm Priorities

- What alarms are most critical
    - SpO_2/CO_2?/Low/High pressure/volume/etc.

- When should RTs act
    - Nuisance alarms
    - Balancing urgency to avoid harm

- Auto setting of alarms
    - Not all patients are made the same
    - Can and/or should "cookie cutter" approach apply

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Priority Alarms and Alarm Priorities

- Level 1: Events that are immediately threatening if left unattended for short periods (e.g., power failure, apnea)

- Level 2: Events that are potentially life threatening if left unattended for longer periods (e.g., circuit leak, positive-end expiratory pressure [PEEP] alarms)

- Level 3: Non-ventilator events that are not likely to be life threatening but a possible source of patient harm if not addressed

American Association for Respiratory Care (AARC), Consensus Statement on the Essentials of Mechanical Ventilators. Respir Care. 1992;37(9):1000-8

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Instructive Evidence

- ## Low pressure alarm inadequacy

  - Small diameter tracheostomy tubes generate significant resistance

  - Decannulation may be undetected when low pressure alarm set at 10 cmH2O below PIP

  - Evidence suggest tighter control to mitigate unrecognized events

Kun et al, Feb 2001, Home Vent Low Press Alarms Fail to Detect Accidental Decannulation; Chest, 119(2)

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Examples

- Low pressure alarm set inappropriate
  - Patient spontaneously breathing
  - Increased sedation due to transport/resulted in profound hypercarbia
  - Elevated ICP in TBI patient

- High pressure alarm
  - Initial alarm setting was 80 cmH2O
  - Patient air trapping resulted in pneumothorax

- Minute Volume alarm
  - Set at 2 lpm when actual minute volume was 10 lpm
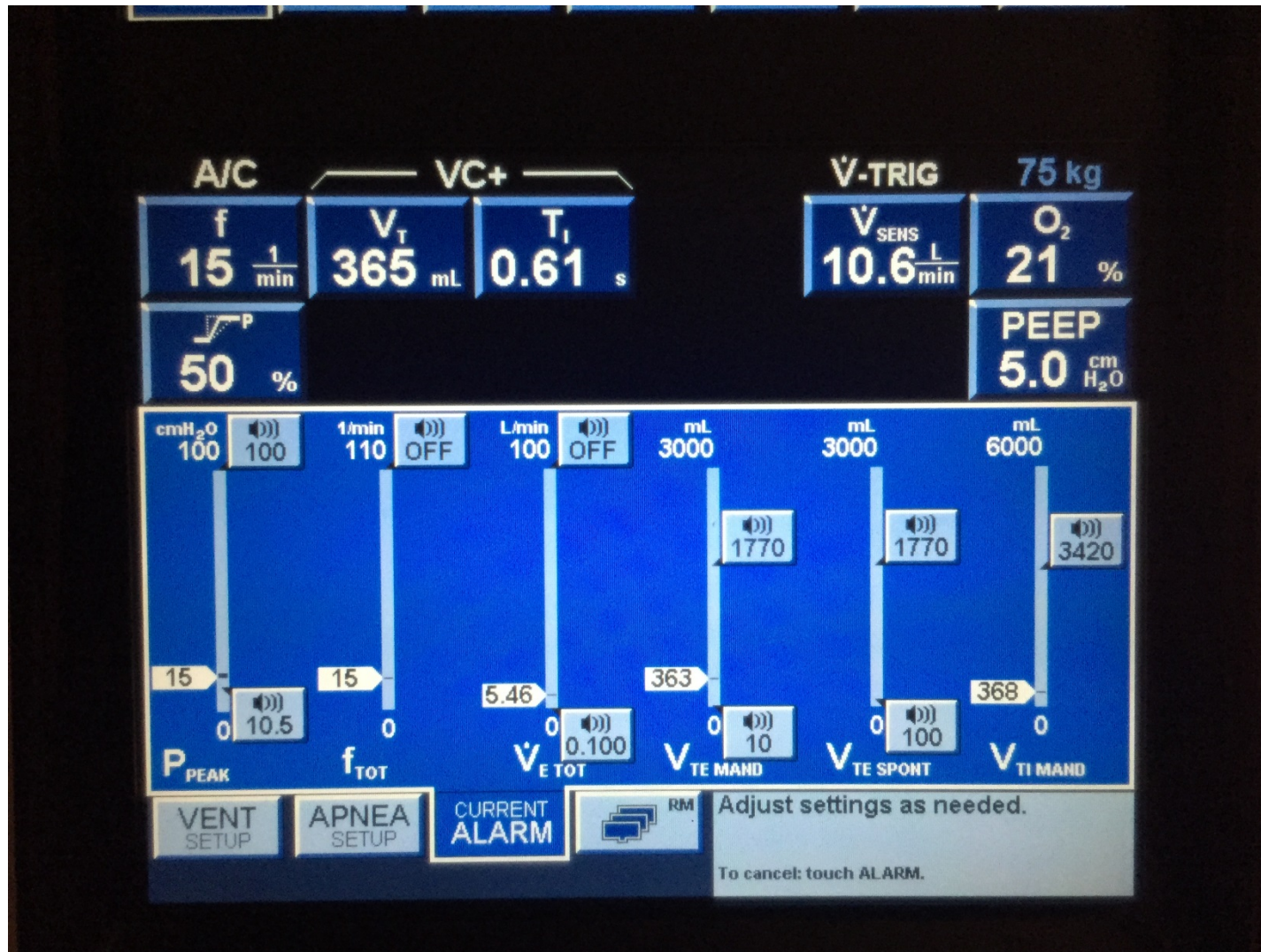 - Patient became hypoxic/hypercarbic leading to arrest

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Evidence

Evidence

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Evidence

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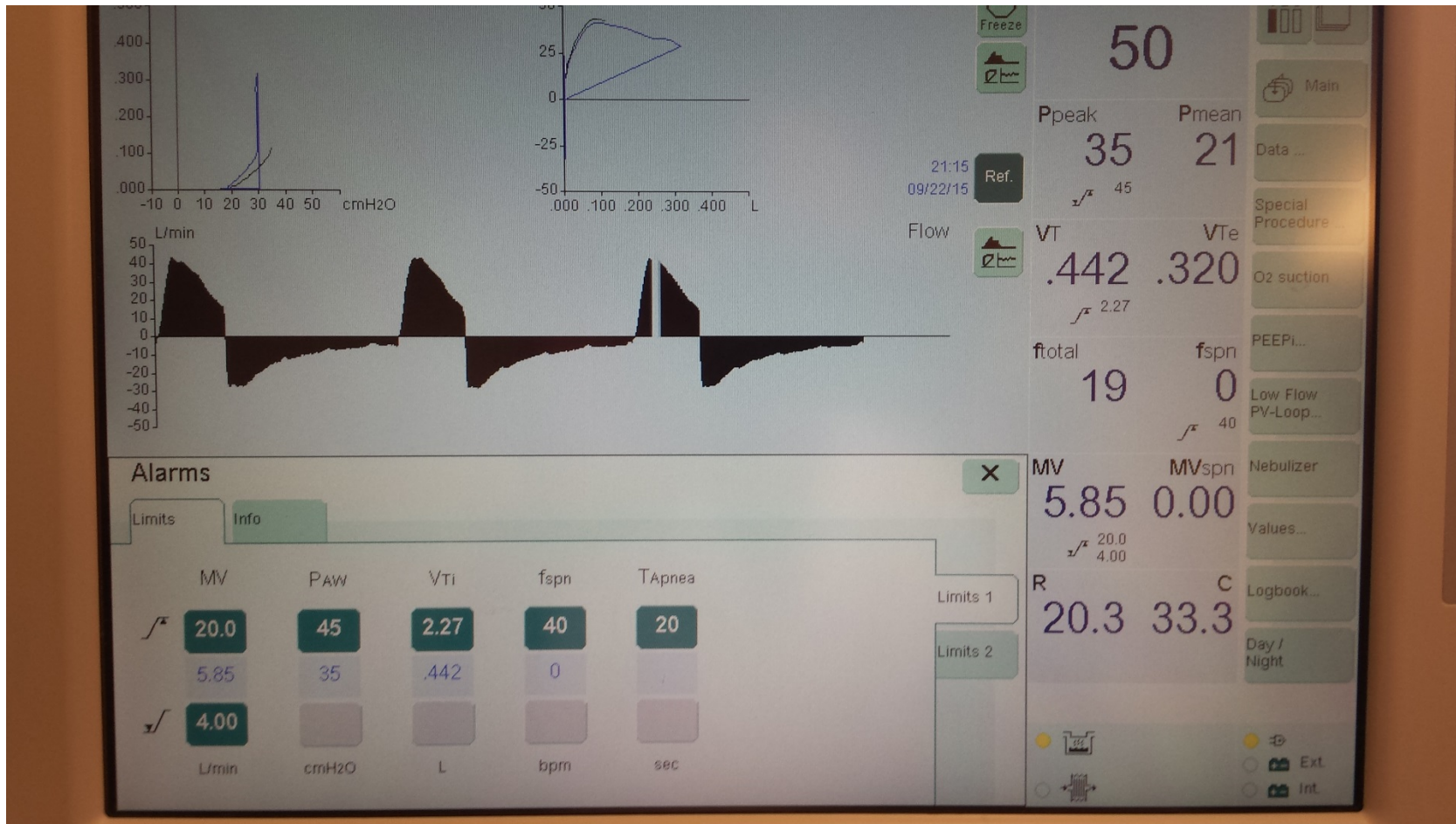
Alarm Fatigue

- What is it?
  - Reducing sense of urgency (persistent coughing triggers high pressure/increasing pressure alarm to avoid alarm/responding when no real problem)
  - Oversaturation of alarm noise/doesn't just affect clinicians
  - 23% determined effective while over 40% ignored in MICU environment[1]
  - 350 alarms per patent per day[2]

- How to combat it
  - Eliminating redundancy
  - Setting parameters appropriately
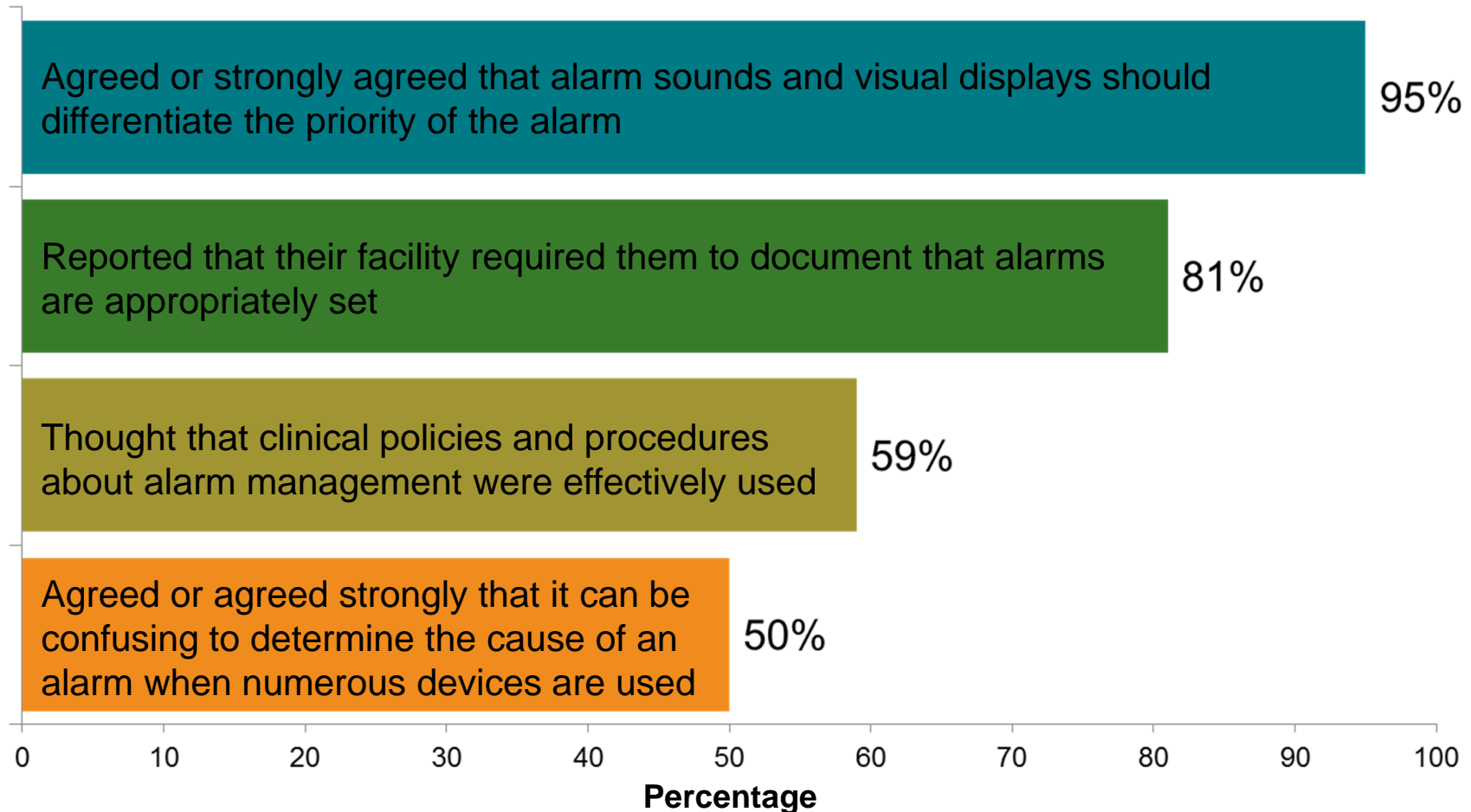 - Avoid complacency

[1]Gorges et al, 2009, Anesth Analg: [2]Sendelbach et al, Oct 2013; Alarm Fatigue; AACN ACC, 24(4)

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Additional Challenges

- Difficulty abstracting data from alarms

- Alarm parameters lack standardization
    - Evidence required to improve compliance/support

- Alarm systems saturation
    - Clinician must navigate myriad of alarm systems should understand who to reach out to for resolution (other clinicians, BMET, etc.)

- Patient versus equipment alarms
    - When and how to respond

- Middleware
    - What is it
    - How can we capitalize on it

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RTs' Perspective

Healthcare Technology Foundation 2011 Survey of Alarm Effectiveness:
2,071 Respiratory Therapists Participated in the Survey

Agreed or strongly agreed that alarm sounds and visual displays should differentiate the priority of the alarm — 95%

Reported that their facility required them to document that alarms are appropriately set — 81%

Thought that clinical policies and procedures about alarm management were effectively used — 59%

Agreed or agreed strongly that it can be confusing to determine the cause of an alarm when numerous devices are used — 50%

Percentage

Dunlevy C and Strickland S. *AARC Times*. 2013;37(11):43-48.

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RTs Must Lead the Way

- Mechanical ventilation experts
- AARC CPG
  - Emphasizes significance of alarms
  - Professional guidance
  - Validates efforts of safe implementation of mechanical ventilation
- Advocate for safer patient environment
  - Establish policy for alarm settings (patient/unit specific)
  - Ensure functionality of equipment
    - Suggest replacing sensors to avoid nuisance

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RTs Must Lead the Way

- Establish multidisciplinary team
- Generate policies standardizing throughout facility
- Practice evidence based strategies
- Incorporate alarm strategies in training; make it a core competency
- Share successes and shortfalls
- **Improve practitioner discipline (mandate confirmation during report)**
- Research areas of alarm concerns

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Recommendations for Alarms

- If using default alarms, make them matter
  - Specific to unit
  - Specific to condition
  - Specific to patient
- Generate policies that address continuity
  - Transports are arguably most hazardous environment
  - New care area requires reassessment of alarm parameters
  - Establish responsibility for attending to alarms/1st, 2nd, 3rd order of escalation

Health Devices, Nov 2104, ECRI Report

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Potential Technical Solutions

- Distributed display for ventilator alarms[1]
  - Elevated audio/video display
  - Must be addressed
  - Software reduced unnecessary response
  - System consolidated ventilator alerts/information
- Establishing appropriate time delays to mitigate "noise"
- Integrating data from different devices

[1]Evans et al, Dec 05; Enhanced Notification of Vent Events; Amer Med Info Assoc, 12(6)

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One Team, One Mission

- Industry Partners
  - Generate systems using clinician feedback/human factors considerations
  - Establish smart alarms
  - Appreciate that patient needs should drive technology development, not the contrary
  - "100+ Alarms" isn't always an improvement in technology
  - Consider standardizing alarm sets across industry, safety should override proprietary (sound, relative to priority, etc.)

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One Team, One Mission

- Hospital leadership on down issue
  - Managing expectations
  - Everyone's issue to solve (management/clinician/patient)
  - Invest in determining root cause
- **Treat the patient, not the machine**

Thank you for attending!

Continuing Respiratory Care Education (CRCE)

- This seminar (course number 145053000) has been approved for 1.0 live CRCE by the American Association for Respiratory Care.

- The link for the test, evaluation form, and certificate will be emailed after the seminar on 9/25/15.

- In the coming days, the slides, recording and Q&A will be available here:
  http://www.aami.org/thefoundation/content.aspx?ItemNumber=1498&navItemNumber=671

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Free Alarm Resources

Safety Innovations Series

- White Papers
- Patient Safety Seminar Recordings

Alarms Management Patient Safety Seminars

- Webinar Recordings
- Webinar Slides
- Key Points Checklists

AAMI/FDA Ventilator Summit Publication

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Mark Your Calendars!

Next Alarm Management Seminar:

- Alarm Safety Update: Are you ready?

- October 5, 2015 (12PM-1PM ET)
  - Ronald M. Wyatt MD, MHA, The Joint Commission
  - Maria Cvach, DNP, RN, FAAN, Johns Hopkins Hospital
  - Sharon H. Allan ACNS-BC, MSN, RN, CCRC, CVSICU, Johns Hopkins Hospital

- Register Today!
  - https://attendee.gotowebinar.com/register/6591392256302918145

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Questions?

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Or you can email your question to: slombardi@aami.org.

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