ALARM SOUNDS THAT MEAN SOMETHING

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DISCLOSURE

• Co-PI on grants from the Australian Research Council to develop new auditory alarms and displays
• Member of the Masimo Scientific Advisory Board

OVERVIEW OF MEDICAL DEVICE ALARM SOUNDS

• Medical device alarm sound problems
• Past – Proprietary alarm sounds
• Current – Standard Melodic alarms
• Proposed – Standard Icon alarms
• Future? – Speech and Speecon displays
MEDICAL DEVICE ALARM SOUND PROBLEMS

- Perceivability
- Background Sound Masking
- Recognizability
- Localizability
- Urgency mapping
- Distraction
- Alarm fatigue and “The alarm problem”

PAST – PROPRIETARY ALARM SOUNDS

- 1991: No correlation between clinicians’ ratings of alarm sound urgency and ratings of clinical situation urgency
- 1992: Clinicians correctly identified the source of an alarm sound 34% of the time

CURRENT – STANDARDIZED MELODIC ALARMS

- IEC 60601-1-8 (2003): General requirements, tests and guidance for alarm systems in medical electrical equipment and medical electrical systems
- Philosophy described by Herr: 6 categories with 2 priority levels plus one low-priority (17 total)
- 2008: Critical care nurses taught to recognize 16 sounds achieved 68% recognition accuracy immediately after 2nd day of training
PROPOSED – STANDARDIZED ICON ALARMS

- IEC 60601-1-8 (2020)
- Same underlying philosophy and number of alarm sounds
- 2018: Anesthesiologists taught to recognize 8 alarm sounds achieved 88% recognition accuracy after 5-10 minutes of training

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<th>Medium priority</th>
<th>General</th>
<th>Oxygen</th>
<th>Ventilation</th>
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<td>High priority</td>
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STANDARDIZED ICON ALARMS

POTENTIAL PROBLEMS/LIMITATIONS

- Are the icons intuitive (i.e., is training still necessary)?
- Localizability
- Masking
- Each medical device makes only one category of sound, even if it measures or provides multiple categories
- Some categories encompass very many alarm types
- Non-icon alarm sounds (e.g., proprietary, melodic) still allowed
- New sounds may do little to decrease “alarm fatigue”

SPEECH AND SPEARCON DISPLAYS

- Investigations ongoing to evaluate the potential of spearcon continuous-informing and alarm displays
- Spearcons (time-compressed speech phrases) more easily learned and can provide a much larger range of messages
- Spearcon accuracy with training > 85%, but much lower without training (accuracy < 10%)

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<th>Alarm style</th>
<th>Continuous informing</th>
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REFERENCES

• Loeb KG. Recognition accuracy of current operating room alarms. Anesth Analg 75:499; 1992
• Wee AH. Are melodic medical equipment alarms easily learned? Anesth Analg 106:501; 2008
• McNeil RR. Auditory icon alarms are more accurately and quickly identified than current standard melodic alarms in a simulated clinical setting. Anesthesiology 129:58; 2018