Alarm Safety and Alarm Fatigue

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KEYWORDS

• Clinical alarms • Alarm fatigue • Alarm safety • Quality improvement
• Neonatal intensive care

KEY POINTS

- The proliferation of alarming devices in neonatal intensive care (NICU) has created significant risk of patient harm due to alarm desensitization and missed alarms.
- A large proportion of clinical alarms in NICUs are nonactionable, creating a cry wolf phenomenon that promotes alarm fatigue.
- Safe alarm practices require attention to device functionality, alarm settings, staff operating the devices, patient condition, and environment of care.
- Sound quality improvement methods can significantly reduce clinical alarm burden and enhance alarm safety.

THE ALARM SAFETY PROBLEM

Medical device alarms present care providers with a dilemma: they contribute crucially to effective patient care; however, they may also cause unintended adverse consequences. Safe and effective use of device alarms requires an understanding of the technology sufficiently clear to balance inherent benefits and risks. For some patients in intensive care settings, the number of alarm signals may reach several hundred per day, creating such a high alarm burden that desensitized staff may miss, devalue, ignore, or disable alarm signals.[1] Alarm desensitization, or alarm fatigue, is a multifactorial problem related to the rapid proliferation of alarming devices, use of alarm limits that are unnecessarily narrow or not standardized, and exacerbated by high rates of false or nonactionable alarms.[2] Many organizations have called attention to alarm safety as an important issue, including the Joint Commission, the Emergency Care Research Institute, and the Association for the Advancement of Medical

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Instrumentation.[1,3,4] In June 2013, The Joint Commission approved a new National Patient Safety Goal on clinical alarm safety for hospitals (**Box 1**). This safety goal was prompted by a series of 98 alarm-related sentinel events reported to The Joint Commission from 2009 to 2012. Eighty of these events resulted in death, 13 in permanent loss of function, and 5 in unexpected additional care or extended hospitalizations.

Medical Device Alarms in the Neonatal Intensive Care Unit

In neonatal intensive care units (NICUs), cardiorespiratory events with vital sign fluctuation, especially in preterm infants, contribute significantly to alarm burden. Alarm fatigue or desensitization may develop when frequent oxygen saturation (SpO_2) or heart rate alarms sound, yet the events self-resolve before clinical action is needed. In a 2002 study of nurse responses to NICU cardiorespiratory alarms, each monitor alerted 16.7 times per hour and most were SpO_2 alarms.[5] In baseline measures in Connecticut Children's NICUs, staff experienced 11.9 SpO_2 alarms per very low birth weight (VLBW; <1500g) infant per hour. Based on typical nurse assignments in the open bay NICU rooms, the authors estimate each of our nurses was exposed to an SpO_2 alarm nearly every minute of their shift. This estimate did not include other cardiorespiratory alarms or alarms from other devices, such as pumps or ventilators.

MONITORED SYSTEMS AND ALARM RESPONSE

Human Factors and Alarms

Human response to clinical alarms has correlates in other fields, including aviation, nuclear power, and many others. A significant body of human factors research exists related to alarms. Binary alarm systems are automated decision aids that classify current condition into either normal or critical. The positive predictive value (PPV) of an

Box 1
Elements of performance for the Joint Commission's 2014 National Patient Safety Goal 06.01.01

1. As of July 1, 2014, leaders establish alarm system safety as a hospital priority.
2. During 2014, identify the most important alarm signals to manage based on the following:
   - Input from the medical staff and clinical departments
   - Risk to patients if the alarm signal is not attended to or if it malfunctions
   - Whether specific alarm signals are needed or unnecessarily contribute to alarm noise and alarm fatigue
   - Potential for patient harm based on internal incident history
   - Published best practices and guidelines.
3. As of January 1, 2016, establish policies and procedures for managing the alarms identified in 2 (above) that, at a minimum, address the following:
   - Clinically appropriate settings for alarm signals
   - When alarm signals can be disabled
   - When alarm parameters can be changed
   - Who in the organization has the authority to set alarm parameters
   - Who in the organization has the authority to change alarm parameters
   - Who in the organization has the authority to set alarm parameters to the off setting
   - Monitoring and responding to alarm signals
   - Checking individual alarm signals for accurate settings, proper operation, and detectability.
4. As of January 1, 2016, educate staff and licensed independent practitioners about the purpose and proper operation of alarm systems for which they are responsible.