

## Alarm Management

### Scope and Impact of the Problem

Alarm fatigue develops when a person is exposed to an excessive number of alarms. This situation can result in sensory overload, which may cause the person to become desensitized to the alarms. Consequently, the response to alarms may be delayed, or alarms may be missed altogether.<sup>1</sup> Although studies show it is difficult for humans to differentiate among more than 6 different alarm sounds,<sup>2,3</sup> the average number of alarms in an ICU has increased from 6 in 1983 to more than 40 different alarms in 2011.<sup>4,5</sup> Patient deaths have been attributed to alarm fatigue.<sup>6,7</sup> In addition, 80% to 99% of electrocardiographic (ECG) monitor alarms are false or clinically insignificant.<sup>8-13</sup> Several strategies for alarm management have been suggested to reduce alarm fatigue and improve patient safety.

### Expected Practice and Nursing Actions\*

- ☑ *Provide proper skin preparation for ECG electrodes.* (Level B)
  - Wash the isolated electrode area with soap and water, wipe the electrode area with a rough washcloth or gauze, and/or use the sandpaper on the electrode to roughen a small area of the skin.
  - Do not use alcohol for skin preparation; it can dry out the skin.
- ☑ *Change ECG electrodes daily.* (Level E)
  - Change daily or more often if needed.
- ☑ *Customize alarm parameters and levels on ECG monitors.* (Level E)
  - Customize the alarms to meet the needs of individual patients.
  - Set customized alarms within 1 hour of assuming care of a patient and as the patient's condition changes.
- ☑ *Customize delay and threshold settings on oxygen saturation via pulse oximetry (SpO<sub>2</sub>) monitors.* (Level E)
  - Collaborate with an interprofessional team, including biomedical engineering, to determine the best delay and threshold settings.
  - Use disposable, adhesive pulse oximetry sensors, and replace the sensors when they no longer adhere properly to the patient's skin.
- ☑ *Provide initial and ongoing education about devices with alarms.* (Level E)
  - Provide education on monitoring systems and alarms, as well as operational effectiveness, to new nurses and all other health care staff on a periodic basis.
  - Budget for ongoing education when purchasing monitoring systems.

- ☑ *Establish interprofessional teams to address issues related to alarms, such as the development of policies and procedures. (Level E)*
  - Determine the default alarms for the equipment being used.
  - Evaluate the need to upgrade to next-generation pulse oximetry.
  - Consider developing a culture of suspending alarms when nurses perform patient care that may produce false alarms.
  - Standardize monitoring practices across clinical environments.
  
- ☑ *Monitor only those patients with clinical indications for monitoring. (Level C)*
  - Collaborate with an interprofessional team to determine those patients in a population or care unit who should be monitored and what parameters to use.
  - Use the American Heart Association's *Practice Standards for ECG Monitoring in Hospital Settings: Executive Summary and Guide for Implementation*.<sup>14</sup>

## Supporting Evidence

### **Provide proper skin preparation for ECG electrodes.**

Expert opinion<sup>15-17</sup> and research<sup>18,19</sup> support proper skin preparation to decrease the number of false alarms. Proper skin preparation before ECG electrodes are placed decreases skin impedance and signal noise, thereby enhancing conductivity.<sup>16</sup> Spurious signals are recorded when there is poor electrode contact.<sup>1,20</sup> Washing the electrode area with soap and water, wiping with a rough washcloth or gauze, or using the sandpaper on the electrode to roughen the skin (which helps remove part of the *stratum corneum* or epidermis outer layer to allow the electrical signals to travel) is the recommended skin preparation.<sup>14,18,19,21</sup> Excessive hair at the electrode site should be clipped.<sup>21</sup> Research has demonstrated that one stroke of an abrasive surface can reduce artifacts caused by the electrode-skin interface.<sup>18</sup>

### **Change electrodes daily.**

Evidence suggests that changing ECG electrodes daily decreases the number of false alarms. In a quality improvement project, the average percentage of alarms per bed per day decreased by 46% by changing ECG electrodes daily.<sup>21</sup> Although not confirmed through research, this intervention has reduced the number of alarms.

### **Customize alarm parameters and levels on ECG monitors.**

Changing alarm default settings and customizing alarms according to patient need, including parameters and levels, have decreased the number of false alarms.<sup>22-25</sup> A 43% reduction in critical monitor alarms was observed in a critical care setting when default alarm parameters were changed (including customization of the alarms) and registered nurses were educated about the change.<sup>23</sup> Similarly, in a medical-surgical unit with telemetry monitoring, changing the high heart rate alarm from 120 beats per minute (bpm) to 130 bpm resulted in a 50% decrease in the number of alarms.<sup>24</sup>

## **Customize delay settings and threshold settings on SpO<sub>2</sub> monitors.**

The combination of both customized alarm delay and threshold settings optimizes the SpO<sub>2</sub> monitor to its highest potential, producing an alarm when action is required.

Despite new technology that allows for improved measurement through low-perfusion states and periods of movement, pulse oximeters typically measure oxygen saturation best in patients who have adequate peripheral perfusion and are not moving.<sup>26</sup> The newest technologies in both disposable, adhesive pulse oximetry sensors and next-generation monitoring systems improve accuracy in states of low perfusion and increased motion.<sup>15,26</sup>

Delaying a setting (eg, from the time the event initially occurs to when an alarm is triggered<sup>27</sup>) on the SpO<sub>2</sub> alarm to 15 seconds<sup>26</sup> or 19 seconds<sup>28</sup> can reduce the frequency of alarms by 50% and 70%, respectively; most desaturations recover within a short period. Setting the alarm threshold based on each patient's condition also can reduce the frequency of alarms, thus decreasing alarm fatigue.<sup>26</sup> When the SpO<sub>2</sub> alarm threshold was reduced from 90% to 88%, the number of alarms decreased by 45%.<sup>26</sup> When both a 15-second delay and an alarm threshold of 88% were applied, a “six-fold reduction” was demonstrated in the number of SpO<sub>2</sub> alarms.<sup>26</sup>

## **Provide initial and ongoing education on devices with alarms.**

Education is an intervention that increases the understanding of how monitoring systems and their alarms should be managed.<sup>2,5,22,29</sup> Education should address operational effectiveness in addition to providing knowledge about the system and its alarms.<sup>2</sup> In a quality improvement project, retraining nurses was the first step in a multipronged approach to reduce the number of false alarms.<sup>23</sup>

This project demonstrated that after receiving education and retraining, nurses individualized alarm settings at the outset, instead of adjusting settings in response to continual activation of an alarm. The cost for educating the users of technology, including those who manage alarms, should be included in the budgeting and implementation processes.<sup>2</sup>

## **Establish interprofessional teams to address issues related to alarms, such as the development of policies and procedures.**

Using an interprofessional team approach with stakeholders from the clinical, technical, and information technology communities to address alarm-related issues, such as policy development and response algorithms, has reduced the number of false alarms.<sup>21,26,30</sup> Policies should provide direction on which patients to monitor and on appropriate alarm parameters to optimize alarm systems and reduce false alarms.

For example, the policy should include appropriate suspension of alarms during patient care, which can decrease the number of audible alarms by 20%.<sup>9</sup> Incorporating this practice into nursing standards of care and unit orientation fosters a culture of appropriate alarm use, leading to safer environments for patients.<sup>26,30</sup>

## **Monitor only those patients with clinical indications for monitoring.**

Expert opinion and research recommend monitoring only those patients with clinical indications for monitoring, which can significantly decrease the number of false alarms.<sup>5,25,31</sup> An example of a false alarm is the alarming of “irregular rhythm” on the cardiac monitor for a patient who has chronic atrial fibrillation. Because the patient’s baseline rhythm is irregular, this alarm has no clinical relevance.<sup>25</sup>

In 2004, the American Heart Association (AHA) developed guidelines for ECG monitoring in hospitalized patients, specifying who should be monitored and for how long.<sup>32</sup> However, when examining 1816 patients in cardiac units—using AHA standards as the criteria—85% of patients with no indication for monitoring had cardiac monitoring.<sup>31</sup> Developing an alarm safety program helps identify the appropriate patients to monitor and helps standardize the practice across clinical environments.<sup>25</sup>

### **\*AACN Levels of Evidence**

**Level A** Meta-analysis of quantitative studies or meta-synthesis of qualitative studies with results that consistently support a specific action, intervention, or treatment (includes systematic review of randomized controlled trials)

**Level B** Well-designed, controlled studies with results that consistently support a specific action, intervention, or treatment

**Level C** Evidence from qualitative, systematic reviews of qualitative, descriptive, or correlational studies, or randomized controlled trials with inconsistent results

**Level D** Peer-reviewed professional organizational standards with clinical studies to support recommendations

**Level E** Multiple case reports, theory-based evidence from expert opinions, or peer-reviewed professional organizational standards without clinical studies to support recommendations

**Level M** Manufacturer’s recommendations only

### **Need More Information and Help?**

Contact a clinical practice specialist for additional information at ([www.aacn.org](http://www.aacn.org)) > Clinical Practice > Practice Resource Network > Ask the Clinical Practice Team.

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