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Can Alarm Fatigue be Conquered? Yes, Say Hospitals Cutting the Noise

The problem of alarm fatigue has gained attention in recent years, with evidence showing that it can threaten patient safety. Now hospitals are finding ways to effectively address the problem by minimizing the number of alarms and prioritizing the rest, and they also are finding that something as simple as a trash can lid can play a role in alarm fatigue.

Alarm fatigue has risen to the level of a recognized safety risk that must be addressed. The Joint Commission (TJC) found 98 alarm-related instances of patient harm, including 80 deaths and 13 cases of permanent disability between January 2009 and June 2012. As of January 2016, TJC's National Patient Safety Goals (NPSGs) mandate that hospitals take definitive steps to implement policies and procedures to safely reduce and prioritize the number of primary and secondary alarms. The ECRI Institute ranked alarm proliferation as the second top technology hazard in 2016, and an investigation by the *The Boston Globe* found more than 200 deaths nationally related to alarm problems. (To access the TJC report, go to <http://bit.ly/1PI4ilQ>. You can access the NPSG related to alarm fatigue at <http://bit.ly/1qYEnL6>. Readers can access ECRI's technol-

ogy hazards at <http://bit.ly/1WQJIUM>. Access the report from The Boston Globe online at <http://bit.ly/1MWEX7Q>.)

Several hospitals are reporting success with their efforts

to reduce alarm fatigue. Boston Medical Center recently reported that its analysis showed the vast majority of warning alarms at the hospital don't need an audible signal, so the hospital decided it was safe to switch them off. At the same time, the hospital also upgraded some low-level warning alarms to a higher level that signifies a crisis. Boston Medical also gave nurses authority to change alarm settings to account for the differences among patients. As a result, just one division of the hospital went from 90,000 alarms a week to 10,000.

(The hospital's experience with addressing alarm fatigue is described in the *Journal of Cardiovascular Nursing*, which readers can access online at <http://bit.ly/1RPVulq>.)

Texas Children's Hospital (TCH) in Houston addressed alarm fatigue with multiple strategies. Hospital leaders wanted to create a safer patient environment by making alarms more meaningful and useful to clinicians, explains **Jennifer Sanders**, MSN, RN, NEA-BC, director of clinical support operations at the hospital. Initial efforts focused on gathering data to quan-



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SPECIAL CARE

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tify what clinicians knew anecdotally: that there were too many alarms going off too often, and they had a detrimental effect on patient care. TCH worked with an outside clinical decision technology vendor, Medical Informatics Corporation in Houston, TX, to develop an alarm dashboard that provided a patient-level analytics platform the care team could use to make decisions about alarm settings.

The hospital also formed a multidisciplinary team with membership from the medical staff, nursing staff, clinical informatics, biomedical engineering, information services, and the vendor. TCH chose the Progressive Care Unit (PCU), a step-down intensive care unit, as an early adopter unit because it was known anecdotally to have a high number of alarms. The team began collecting data from the electronic medical record, cardiac monitoring system, and nurse staff assignments.

The team made recommendations based on a 53-day data analysis, which included an onsite environmental analysis, multiple staff interviews, and a comprehensive analysis of the alarm and patient data collected in the PCU. Based on these findings, the team decided to use a Plan-Do-Study-Act (PDSA) approach, a four-stage problem-solving model used for improving a process or carrying out change. The hospital started with simple changes and progressed to the introduction of patient-specific

alarm dashboards. For example, some of the first changes involved simple environmental improvements such as changing trash and linen bins so that they would not make as much noise.

“We realized that every time a nurse would wash her hands and throw the paper towel away in the trash bin, the lid would make a very loud noise, and all the patient alarms would go off because they were startled and their heart rates went up,” Sanders explains. “The simple fix was putting silent closing lids on the trash cans, and that alone produced an almost 3% reduction in alarms on those units.”

Alarm threshold changed

The team went on to adopt a new alarm threshold for low peripheral capillary oxygen saturation (SpO₂), an estimate of the amount of oxygen in the blood. The standard alarm threshold was changed from 93% to 90%, though physicians can set it differently for individual patients. This change in the standard threshold resulted in a 10% reduction in SpO₂ alarms per bed per day, a 13% reduction SpO₂ as a percentage of total alarms in the unit, and a 15% reduction in SpO₂ alarms that lasted fewer than 10 seconds, also known as chattering alarms and consid-

ered one of the most annoying.

The next step was educating the staff about alarm management and the proper way to use silence and suspend functions. Nursing education resulted in an additional 11% reduction in SpO₂ alarms per bed per day.

Finally TCH introduced the patient-specific dashboards that can be reviewed during rounds, which enabled physicians to engage in the alarm management improvement process and evaluate alarm settings for specific high alarming patients. The process takes an average of less than two minutes per patient during rounds, Sanders says. Presented graphically, the patient dashboard shows, for example, that the patient experienced 122 SpO₂ alarms in the past 24 hours. This information means that the patient’s “time in alarm” or amount of time alarms sounded in the room was 52 minutes and 27 seconds over the last 24 hours. The data also show that compared to the prior day, the alarm count is greatly reduced. A plot shows alarms aggregated by time of day. Currently, the patient’s SpO₂ limit is set to 90%, but this patient’s 95% confidence limit of observed vitals are between 81% and 96%. A table also provides data to the care team regarding the potential impact of changing the patient’s SpO₂ threshold.

“They have real-time conversations about this particular patient and how the alarms are sounding,” Sanders explains. “They can discuss whether the patient really was decompensating and needed intervention, or whether we need to change the alarm parameters to avoid nuisance alarms.”

Rather than focusing on alarm fatigue as a technology problem

EXECUTIVE SUMMARY

The Joint Commission’s National Patient Safety Goals require hospitals to address alarm fatigue.

- At least 80 deaths have been tied to the problem.
- One hospital division reduced alarms from 90,000 per week to 10,000.

or a nursing problem, the multi-disciplinary team considered it a patient care issue and sought ways to improve the patient experience, she says. Assessing the data from different perspectives was important, Sanders says. The unit level data showing the alarms by bed can help identify the patients frequently in alarm status, and the nurse-level information depicts the alarm load by nurse, which allows nursing leaders to review patient assignments for appropriateness of total alarm volume by staff nurse. The patient view shows the alarms by patient for the past 24 hours and provides data and recommendations on changes to alarm limits to reduce alarm fatigue.

“This was a project that brought almost instant gratification,” Sanders says. “You could look at the data, make a change, and almost immediately see a change in the alarms and the noise on the unit.”

Alarms cause fatigue

The Hospital for Special Care (HSC) in New Britain, CT, also has taken aim at alarm fatigue and reduced ventilator alarms by 80%, says **Donna M. Reinholdt**, MHL, MM, RN, LNC, director of corporate risk management and compliance.

The hospital formed an alarm committee a year in advance of TJC’s implementation of the alarm safety NPSG. It included the chief of pulmonary medicine, leaders from respiratory medicine, and respiratory therapists, who are responsible for responding to most alarms. The committee identified all high-risk clinical alarms, assessed device-specific alarms, and prioritized both the devices and specific alarms on

each device. The goal was to differentiate which alarms were immediately actionable from those that were non-emergent, Reinholdt explains.

“The committee continues to meet on a regular basis and reviews any risk-related concerns regarding alarm device volume and audibility,” Reinholdt says. “The committee utilizes a true risk management strategy in coping with potential alarm device fatigue by implementing monitors that measure response time and volume, as in the number of alarm conditions occurring.”

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Most of the patient population at HSC is mechanically ventilated, so the threat of alarm fatigue stemmed primarily from those devices, Reinholdt notes. The Respiratory Therapy Department at HSC manages more than 100 ventilators, each with its own set of alarms, at patients’ bedsides across the hospital. In addition to the ventilator alarms, staff still had to deal with alarms from the usual mix of devices found in any hospital, such as pumps and physiological monitors.

For many years the number of

ventilators and the complicated layout of the units forced the hospital’s respiratory therapists to spend much of their shifts racing from room to room responding to hundreds of non-actionable alarms, says **Connie Dills**, MBA, RRT, RPFT, respiratory practice manager at HSC. Most of the alarms were for events that, while noteworthy, did not require immediate intervention, she explains. Not only did the repeated alarms distract staff and take them away from other duties, but the noise also disturbed patients who were trying to recover.

“Alarm fatigue was a huge problem for us,” Dills says. “A lot of the fatigue was from everyone getting every alarm all the time. We wanted to put the right alarm with the right person at the right time.”

Alarms prioritized

With mechanical ventilation, the most critical alarm is for low exhaled minute volume, which indicates too little gas exhaled from a person’s lungs per minute.

That alarm can mean the patient is not being ventilated because there is a mechanical malfunction, a leak, or some other problem, Dills explains. However, the ventilators also can alert therapists to conditions such as high pressures and low respiratory rates, which are not critical but can lead to low exhaled minute volume if they persist. Those alarms could be triggered by something benign such as the patient coughing or talking and did not indicate a persistent condition that would become critical, Dills explains.

“In most cases there was no need to respond, and in fact, there often was someone with the patient,

and that's why they were talking and setting off that alarm," Dills says. "But if you don't have volume coming back to the ventilator, that's a big indicator that they're not being ventilated, and someone needs to respond right away."

One of the first improvements was to route ventilator alarms through pagers to the specific respiratory therapist assigned to each patient. The hospital also changed how alarms were transmitted.

The critical alarms, such as low exhaled minute volume and patient disconnect, are routed to the handheld paging system as well as the overhead alarm system so a therapist can respond promptly. The non-critical alarms — those for conditions that are not immediately threatening — do not go through the handheld paging system, and they are not broadcast on the unit. The computer system tracks those alarms, however, and a non-critical alarm that does not self-correct will result in an actionable/critical alarm that will go into the paging system and overhead system.

That change greatly reduced the cacophony of alarms in the hospital, Dills says. To enable the alarm filtering and prioritization, HSC used the Bernoulli One software system that provides continuous surveillance and alarm monitoring, manufactured by Bernoulli, a company based in Milford, CT, that provides device and software products for healthcare facilities. *(In addition to Medical Informatics and Bernoulli, products for medical device integration are available from other companies such as Capsule in Andover, MA, Excel Medical in Jupiter, FL, and Iatric Systems in Uxbridge, MA.)*

The system first was implemented in the Pediatric Unit, which has

the most complex layout, making it difficult for clinical staff to move quickly from patient to patient. The unit utilizes three types of ventilators from different manufacturers, so a vendor-neutral approach was critical, Dills explains.

The software system also allowed the hospital to provide networked laptop and desktop computers with scrolling message bars at key locations. These computer stations provide the respiratory therapists with access to data and alarms from all ventilated patients so that when they receive alarms on their pagers, they quickly can assess the patient's status without having to go to the bedside immediately.

Real-time data from the networked system also enabled the respiratory therapists and the alarm committee to start identifying non-actionable alarms that could be adjusted or eliminated entirely, which contributed to the 80% reduction in ventilator alarms in the Pediatric Unit. After successful implementation in the Pediatric Unit, the system was expanded to the Respiratory Care and Respiratory Step-Down units as well, with similar results.

The change in alarm procedures was welcomed by the respiratory therapists and nursing staff, Dills says. The units are much quieter than before the alarm fatigue initia-

tive. Rather than worrying that downgrading some alarms would threaten patient safety, the respiratory therapists are more confident that they know when to respond quickly to an emergency, she says.

"We recently had a server upgrade that took the system down for a while, and the therapists were just beside themselves that they were going to miss an alarm," Dills says. "They know now that they can trust the alarms and really respond when necessary. Previously there were so many alarms that nurses and therapists sometimes stopped hearing them, and that was scary. ■"

SOURCES

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