Medical Device Alerting

Industry Overview
The existence of medical device alarms within health care organizations reflects the many safety enhancements and advances made throughout the industry over the last several decades. As medical equipment became more complex, the demand for proper management protocols to show deviations from “normal” device activity rose steadily. Once the manufacturing of built-in alarms within medical devices became standard across the industry, the standardization of alarms and alerting rules among manufacturers consequently became virtually non-existent, resulting in the redundancy and overuse of alarms within clinical environments. As the volume of alarms continued to increase, so did the need for alarm monitoring to ensure the appropriate alarms were being relayed to the appropriate caregivers when necessary.

Alarm fatigue is a major problem plaguing health care organizations today. While alarms are intended to alert caregivers of deviations from a predetermined “normal” patient status, the actual percentages of alarms which bear critical importance are low. Caregivers reliant upon medical device alarms to alert when a serious problem has occurred often respond to a normal patient situation, increasing clinical inefficiencies. As the volume of alarms continues to steadily increase throughout a shift, the noise can become overwhelming to caregivers and result in alarms being disabled, silenced, or even ignored all together.

This desensitization of device alarms comes with an unfortunate price. The ECRI Institute, an independent nonprofit health care research and consulting organization, currently ranks alarm hazards as #2 in the “ECRI Institute’s Top Ten List of Health Technology Hazards for 2011”. The institute reported that nine deaths involving physiologic monitor alarm fatigue have occurred since June 2004 in Pennsylvania alone. Additionally, device manufacturers nationwide filed 216 reports with the FDA on monitor alarm-related deaths between January 2005 and June 2010.¹ Likewise, using information provided by the Department of Health and the Centers for Medicare and Medicaid Services, the Boston Globe reported that there were at least 15 deaths during a six-year span in Massachusetts related to missed alarms or physiologic monitor problems.² In addition to alarm fatigue, many health care organizations experience inefficiencies with how alarms are relayed to caregivers, often resulting in delayed response times. Without an alerting system in place to send alerts directly to caregivers’ mobile devices, technicians are required to monitor alarms from a central location, and manually notify a caregiver when a response is needed. This inefficient process can also result in adverse consequences if a critical alarm or an emergency code is not responded to in a timely manner.

The statistics around patient mortalities are staggering, and present a clear example of the dangers resulting from alarm fatigue. Likewise, the issues with monitoring and manually relaying alarms add to these dangers, as the chance of delayed response to critical situations is heightened. Without an alarm management and secondary alerting system in place, caregivers will continue to be overwhelmed by the vast number of medical device alarms constantly sounding, and health care organizations will continue to be subjected to inefficient workflows and decreasing levels of patient safety.

Alarm Management & Secondary Alerting
In order to help combat the issues of alarm fatigue and manual alert notification, Cerner developed a secondary alerting solution, CareAware AlertLink™. The solution routes alerts from the EMR, medical devices and nurse call systems directly to a caregiver’s mobile device. CareAware AlertLink also offers a way to escalate alarms between clinicians when a patient’s primary caregiver is not available. By using the solution’s rules engine, health care organizations can decide which alarms are critical and should be routed to caregivers for a response, as well as which alarms are

Alarm Fatigue:
- ECRI Institute’s #2 Health Technology Hazard for 2011
- 216 reports on monitor alarm-related deaths filed with the FDA in five years

¹ CareAware AlertLink

² CareAware AlertLink
Medical Device Alerting

CareAware AlertLink routes secondary alerts from medical devices or nurse call systems directly to a clinician’s mobile device, helping to improve response times and increase workload visibility, as well as reduce alarm fatigue through a customizable rules engine.

informational and do not require an immediate reaction. Additionally, health care organizations can set up CareAware AlertLink to alert Biomedical engineers when a device has gone offline to improve system uptime.

CareAware AlertLink runs on Cerner’s device connectivity architecture, CareAware®. This workflow-driven platform enables device and system interoperability with a focus on transforming workflow and improving patient safety. Devices are connected through the core component of the architecture, the Care Aware iBus™. Once connected, medical devices can communicate bi-directionally with the EMR, as well as with mobile devices, and information can flow seamlessly between the systems.

The routing of alerts directly to mobile devices allows caregivers to respond more quickly to critical alarms. Once a caregiver is associated to a mobile device, he or she can begin to receive alerts. Upon receiving alerts, a caregiver can respond to the alarm or press “decline” on the device to immediately forward the alert to the secondary caregiver. Caregivers can also use CareAware AlertLink to receive alerts from nurse call and further increase efficiencies by calling back to the room.

To help reduce alarm fatigue, caregivers may control the devices and treatment of patients by tailoring the settings of the patients’ physiologic monitors. CareAware AlertLink uses customizable rules to build action-based alarms, filtering out much of the noise that would otherwise interrupt nursing workflows. Most alarms coming from Nurse Call systems, for example, are not considered critical, and can be routed to a nursing assistant’s device to take action. This way, the primary nurse can continue

Figure 1 - CareAware AlertLink architecture
focusing on patient care by only responding to high-priority alerts. The rules engine within CareAware AlertLink allows health care organizations to customize alarm notifications to the workflows and processes already in place, increasing efficiencies and enhancing patient safety.

To make the most optimal staff assignment decisions, Cerner offers CareAware StaffLink™, a staffing assignment utility designed to provide efficient scheduling and improved workflow. The solution offers the ability to make several assignments within one system, and push those assignments to disparate systems. The ease of integration with CareAware AlertLink creates a patient-to-staff relationship for medical device alerting. CareAware StaffLink communicates with the EMR, sending information about a patient’s primary, secondary and tertiary care caregivers, which in turn is used for alert escalation within CareAware AlertLink.

**Workflow Analysis & Benefits**

As the fatal consequences of alarm fatigue continue to make headlines, the factors contributing to these adverse outcomes are being examined. A research study presented by the International Anesthesia Research Society measured the volume of alarms coming from devices within the University of Utah Hospital’s medical ICU. After over 200 hours of observation was completed, the study found that only 5.3 percent of alarms were effective and patient-related, and 17.7 percent were effective and technically-related. Over 36 percent of alarms were deemed ineffective and over 40 percent were altogether ignored by caregivers. These findings show the inefficiencies and potential dangers stemming from the lack of an alarm management system.

By using the rules engine within CareAware AlertLink, users can customize alarm management by selecting which alerts should be sent to which caregivers and how the alerts should be sent. Since going live in December 2008, Cerner’s development partner, a 540-bed adult specialty health care hospital, has had over 6.97 million medical device alarms processed. Of these, only 81,256 (1.12 percent) were sent to the mobile phones of caregivers. This use of customizable rules has allowed the hospital to greatly decrease the risks associated with alarm fatigue.

At another facility using CareAware AlertLink, onsite time and motion studies measuring the effect of secondary alerting have found that approximately 30 percent of all alarms are escalated by caregivers via the mobile devices. This improved escalation capability within the 300-bed acute-care medical center has led to response times to alarms improving by 45 seconds. For critical alarms and emergency codes, this improved response time could mean the difference in saving a patient’s life.

**Conclusion**

As innovative technology continues to redefine health care processes, the industry is challenged with properly managing and using new technology to enhance workflows and ultimately provide a higher standard of care. Recent discussions around the perils of alarm fatigue and other medical device alarming issues have opened the eyes of the health care industry to the need for proper alarm management and secondary alerting protocols. Cerner’s CareAware AlertLink and CareAware StaffLink solutions helps organizations address these needs through the customization of alarming rules and the integration with third-party health care systems. By appropriately connecting technology to workflows, caregivers can begin to use the efficiencies gained to enhance the way care is given, positively impacting patient outcomes.
