ALARM MANAGEMENT SYSTEMS – ARE YOU AND YOUR HOSPITAL READY?

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ABSTRACT

Patient generated monitor alarms have been a concern for health care providers for years. Initiatives to ensure that clinicians hear an alarm or a warning signal when a patient's condition is deteriorating include: louder tones at the patients' bedside with concomitant warning lights outside of the patient room; centralized monitoring of the patient's conditions at the nursing station to name a few. Another initiative includes patient alarms generated at the bedside sent to dedicated pagers. Nursing personnel assigned to care for a monitored patient carry the pager and receive the alarms when their patient's condition is deteriorating (complementary alarm notification). The Joint Commission on Hospital Accreditation published a Prepublication Standards document establishing alarm management as a 2014 National Patient Safety Goal[1]. The Safety goal was to be introduced in two phases culminating in the implementation of clinical alarm management policies and procedures by 2016. Manufacturers have developed systems that replace the older pager technology with smart phone technology, leveraging existing hospital's infrastructure such as WIFI to transmit the alarm conditions. Hospitals interested in implementing such Alarm Management strategies, find themselves overwhelmed by the complexities of the systems and the dependence on robust infrastructures to support clinical care. Similarly, close collaboration within Nursing, Medical Engineering and IS is imperative.

INTRODUCTION

In 2002 the hospital acquired patient monitors for the inpatient units (372 beds). The rational was to have a patient monitor at each bedside to ensure proper patient monitoring when needed. The monitoring system has the capability of displaying all monitored beds centrally at the nursing station. In addition, the hospital acquired a Secondary Alarm Notification system. The Secondary alarm system used a wireless transmitter system that sent bedside alarms to a dedicated alphanumeric pager. With this secondary alarm system, nurses received the bed side alarms for patients assigned specifically to the nurse. On the pager, the nurse was able to see the bed number, the type of alarm generated at the bedside, the waveform of the parameters monitored, and the numeric data. The nurse would then be able to attend to the alarm by going directly to the room. One of the many advantages of the secondary alarm notification system was that there was no need to have a person monitoring the alarms centrally. If the nurse did not respond to the alarm within a certain time, the alarm was escalated to other pagers to ensure that other nurses would attend to the patient alarm. Figure one, shows a typical display on the pager.

Figure 1: Secondary Alarm notification pager with ECG signal

The manufacturer of the secondary alarm notification system, indicated that as of Dec 2010, the company was not going to be able to provide support for the system.

The hospital established a multidisciplinary group to develop an RFP for the replacement of the secondary alarm notification system. The group's membership consisted of Nursing practice leaders including frontline Nursing staff, Nursing Informatics, Medical Engineering, IT personnel, procurement and legal services.

The task group agreed that the monitoring system was still meeting the clinical needs and the manufacturer will be continuing the support for few more years.

HOSPITAL READINESS

Replacement of the secondary alarm system provided the hospital with the opportunity to review the literature and the market for available systems. A common theme in the literature is that Hospitals need to develop a strategy for Alarm Management to avoid/reduce clinician's alarm fatigue. ECRI has listed Alarm Management as one of the Top ten risks that hospitals are facing in the past three years [2] [3] [4]. Product reviews revealed that systems were no longer using alphanumeric pagers but rather a smart device.

While the initial intent of the task group was to write the RPF document, after reviewing the literature it was clear that there were additional issues that needed to be addressed. In particular the following:

- Review the existing monitoring policy and practices to ensure it met current standards of practice;

- Develop alarm management strategies for the new proposed system;

- Ensure the policies and strategies will support patient care by optimizing alarm notification and response, while at the same time maximizing patient safety and reducing alarm fatigue.

The group developed the following guiding principles that were important when selecting the new Alarm Management system:

- Alarms should be clearly displayed in the device including numeric values and waveforms;

- System to use smart phone technology

- System to have the ability to integrate other alarms such as Code Blue, Code Red and others

- Where possible leverage existing systems/infrastructure

The RFP was issued and responses were reviewed for final selection. Some of the lessons learnt through the process were as follows:

- Companies should demonstrate their proposed systems prior to final selection;

- Front line staff should be involved in the demonstrations;

- Where possible, have the proponent simulate a nursing floor set up including transmission of alarms to the smart phone;

Clinical readiness for Alarm Management

Implementing new technology provides an excellent opportunity to review and revise clinical practices. In the case of transitioning from older pager Alarm Management technology to newer technology, nursing leadership and front-line nursing staff reviewed existing practices, identified gaps and determined new practices and system configurations that would result in safer alarm management practices. Key changes were focused on ensuring that alarms that reached the nurse were of value – with a desire to decrease false alarms that can lead to alarm fatigue, complacency and ultimately a potential for missing real patient alarm events. Configurations were aimed at:

- Setting an escalation time (the time from when the nurse does not respond to/acknowledge the alarm to the time it triggers the alarm to the next person/people in line to receive it) to allow the primary nurse time to attend to the patient.

- Minimizing the escalation path to prevent too many nurses from receiving the alarm.

Although it was expected that the majority of nursing staff would have experience with cell phones/smart devices, plans should be made to support nursing whose experience might be minimal. It was also considered essential to provide additional functionality to ensure that alarm management was not just transitioning from a single-focus alarm pager to a single-focus smart device. To that end talk/text capabilities were included, as were a variety of mobile resource apps that the nursing staff had previously used frequently.

Of particular importance was preparing the clinical managers and nursing staff for the accountabilities of maintaining the inventory of phones and ensuring they were in good working order for each subsequent shift.

Clinical Engineering

Clinical Engineering (CE) personnel have been great partners with clinical personnel in assisting them in acquiring patient care technology. CE personnel are also very knowledgeable on the setting and management of the monitoring systems employed by the hospital. This knowledge assures that any Alarm Management system company is able to interface their system with the monitoring system while at the same time not interfering with the patient care system. CE personnel is well positioned to facilitate the resolution of any possible issues that might arise while connecting the monitor's alarms to the proposed alarm Management System. CE when considering the new Alarm Management Systems, needs to ensure that when it comes to using the Hospital's IT infrastructure, they need to collaborate very closely with the IT/IS personnel. CE personnel could also play a pivotal role in communicating with IT/IS and also supporting them when dealing with the Alarm Management Company and the technical people of the patient Monitoring System.

IT Infrastructure

Alarm Management systems are becoming more sophisticated than previous generations. It is no longer a simple system having a RF transmitter and computer that could be placed in the network closet of the nursing floor. It is now a full computerized system that integrates with the IT infrastructure and uses the hospital's WiFi and centralized servers. Our team soon learnt that it was important to ensure that IT personnel was a full partner in the selection and evaluation of systems. Items that can be highlighted are as follows:

- Physical and technical requirements to host the servers needed for the application;

- High Availability system and architecture design principles;

- Knowledge of and hardware availability in case of virtual system;

- Interfacing of the alarm system with ADT where possible;

- Integration of the system with existing mobile technology (smart phones, iPads, etc.);

- Cybersecurity and protection of the various system components of the proposed system against malware and other threats;

- Compliance with hospital's and industry WiFi standards;

- WiFi coverage, Signal to Noise Ratio(SNR) and RF interference in the areas of deployment;

- Integration of proposed system with existing middleware hardware and software for integration of other alarms (Code Blue, Code Red, etc.).

Company Readiness

Alarm integration for display into a single device is not new to some industries. Companies have developed systems that integrate the Building automation systems and sends alarms/pages to a Plant Operations person for attention to the reported alarm. However, Patient Alarm Management has added a level of complexity and rigor that might have not existed in other systems. Companies need to get approval of their Alarm Management as a medical device concomitant with this is the demonstration of the safety and compliance of the system to more strict standards. Companies offering Alarm Management systems need to work with Clinical Engineering and IT/IS personnel to ensure their system integrates with the monitoring system, while at the same time not affecting the systems. Some issues that companies need to address are follows:

- How to acquire physiological signals and alarms from the monitoring system;

- Alarm Management configuration to support a high availability environment;

- System configuration to support any size hospitals;

- System redundancy;

- Compliance with current WiFi standards;

- System protection against Cyber-attacks;

- Clinical knowledge and support to understand Clinical workflows;

- Local support with knowledge of the proposed product.

CONCLUSIONS

The replacement of the Secondary Alarm Management system provided us an opportunity to update our Clinical practices for patient monitoring and alarm management to improve patient safety. A multidisciplinary team needs to work together for a successful implementation of an Alarm Management system. The outcome of the new Alarm Management system enhanced the alarm notification, and reduced clinicians' alarm fatigue. Clinical Engineering and IS/IT need to work together to ensure a robust implementation of the system from the system's point of view, high availability and meeting Cybersecurity standards. The hospital's infrastructure should be robust with good WiFi coverage in areas where the Alarm Management system will be deployed.

ACKNOWLEDGEMENTS

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