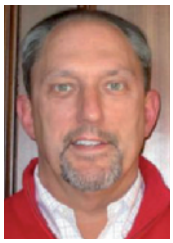
Taking Alarm Standardization to The Floors with A Telemetry Training System

James Piepenbrink

About the Author



James Piepenbrink, BS, is director of the department of clinical engineering at Boston Medical Center. Email: jim.piepenbrink@bmc.org

"If you build it, he will come." (*Field of Dreams,* 1989). Certainly, this is what hospitals envision when creating clinical simulation centers to help train staff on a variety of procedures and processes. There is tremendous value in these centers, but part of the challenge is outfitting them with the technology that staff use in the care of patients. In addition, getting staff to these centers can be problematic, since they are often not close to inpatient areas.

Such simulation labs are valuable in training staff on such items as changing alarm parameters. Managing alarms is a daunting task, given the number of devices and the varied tones and alerts of devices used in a typical clinical setting. Competing alarms present an aural challenge to staff, and erroneous alarms add greatly to noise pollution on the unit.

To reduce nuisance alarms and fine-tune alarm parameters and defaults so that true alarms are presented, the clinical engineering department at Boston Medical Center (BMC) took on the standardization of telemetry alarms and portable monitor alarms. As we investigated, reviewed, and discussed alarms, we found that adjusting parameter defaults was essential in managing patients on telemetry devices. With the introduction of standardized defaults and alerts across care areas, the issue of educating staff about the changes presented a challenge. Many of the changes were subtle and did not translate well through emails, posters, or other non-auditory means. And, as mentioned, getting staff to simulation centers presents challenges.

This article describes how the clinical engineering and nursing education departments at BMC took on the task of creating a portable, self-contained telemetry system to educate staff about changes in telemetry alarms and portable monitor alarms. The system enabled us to demonstrate current alarms (both visually and audibly), and show staff the changes. This system greatly enhanced the educational experience.

Telemetry Growth and Challenges

The use of telemetry afforded BMC more bed space, providing monitoring of patients without under-utilizing critical care beds. With sicker patients came the need to rapidly deploy additional telemetry capacity, and with this came increased challenges in staff training, the variety of areas (surgical versus medical),

and differing views on unit standards. Also, the increased number of monitored beds exposed us to the potential for more events and near misses.

It was apparent that addressing these challenges, coupled with undefined device standards, required a team-based approach. A joint effort was undertaken by the chief medical officer, several key physicians, nursing educators, nurse managers, and clinical engineers to provide a stable basis for setting alarm expectations so that consistent specificity of alarms could be achieved.

Improvement Initiative

Nursing and Cardiology established new telemetry standards to better define candidates for telemetry, the duration for use, and what to do with patients who leave the floor while on telemetry. The process for managing the telemetry patient required enhanced systems review, addressing education of both the nursing and house officer staff, tempered by the limitations of the telemetry system.

Despite many technical advances, alarms frequently go off, mostly due to rate violations, artifact, or insignificant arrhythmias. The fine-tuning of an alarm system is limited, and the ability to specifically detect and alarm only significant arrhythmias is currently an unattainable goal. To further exacerbate this problem, training a large number of staff is difficult in a classroom setting. Arrhythmia detection is challenging, and filtering through the very large number of alarms on a busy unit is extremely difficult.

One particular challenge physicians face is fine-tuning parameters for individual patients, rather than using default settings. A review of system capabilities showed that our current system could be modified in a clinically useful way, but that the system was not widely used. This collaborative approach proved to have some tangible benefits through the transfer of knowledge, the increased utility of the telemetry system, and the creation of focused discussions between physicians, nurses, and engineers.

Taking into account what was identified, the committee agreed to shift priorities to address the following short- and long-term priorities to improve telemetry utilization:

- Nurse orientation and education
- Attending and house officer education and oversight
- Order sets to optimize settings for individuals
- Review of alarm settings, clearing of inappropriate/erroneous alarms
- Improved training

The committee undertook a concerted effort to address issues with education, utilization, and alarm management. One of the first actions was to review the vast list of parameter alarm defaults, and create consistent definitions of alarms and the associated warnings across the 12 telemetry areas. The monitoring system we use has 16 arrhythmia alarm levels and three levels of associated warnings. Creating a unified list to be formatted across the campus was an important first step.

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The next aspect of the changes included the creation of standardized premature ventricular contraction (PVC) thresholds as well as high and low heart rate (HR) limits (both electrocardiogram [ECG] and pulse oximetry

[SpO_2]). This first phase of standards was intended to ensure that all units categorize arrhythmias consistently, reducing the quantity of low acuity, low HR limit violations and alarms for PVC counts. Computerized physician order entry (CPOE) systems offer a great benefit because rules and stops can be integrated into the system across the enterprise, which can help normalize practices. Nursing and Cardiology, after reviewing the policies and investigating other institutions' practices, engaged the help of the information technology analysts who manage the CPOE to create an enhanced order set for telemetry. Now, all attending physicians and house officers are using a more robust and defined order set that addresses utilization and parameter defaults with the intent of improving communication about telemetry patients and promoting discussion between the nursing staff and physicians. Moreover, the appropriateness of utilization was included to better define candidates for telemetry and to provide reminders about the duration of the orders.

Another benefit of the multidisciplinary group was to have subject matter experts available to discuss issues and arrive at strategies to transfer the information to all parties associated with the efforts. With more defined alarm parameters and order sets, a reduction of low-level and nuisance alarms was noticed, but the issue of other parameter alarms and the filling of alarm histories required review and cleaning up so that the true alarms were part of the patient's data. Cardiology worked with Nursing to review the process and to identify the best way to manage these per patient. From this, an action list of alarms and issues was identified to be reviewed by the committee as needed.

Another benefit of this group was the recommendation and creation of a full-scale telemetry training course that was ultimately provided to more than 700 nurses on medical-surgical floors with telemetry. The online course covered orientation, education about telemetry policies, and arrhythmia detection/interpretation. The test requires a 100% score and annual accreditation is expected. Additional aspects of the training included crisis alarm protocols to notify physicians, alarm review, and the creation of a simulation area where staff can go through the process of admitting a patient to the telemetry system. On the physician side, we have instituted an orientation program on the telemetry system for incoming interns that includes:

- How to do telemetry review—both checking events and graphic trends
- How to open from events or graphic trends to full disclosure to see more detail
- How to print alarms and full disclosure
- How to remove alarms from history
- What alarms sound like, from Advisory to Crisis
- Accountability when silencing alarms

To solve these problems, clinical engineering, in partnership with the nursing education staff, designed and built a portable, self-contained telemetry system that can be rolled around campus to demonstrate the different changes in alarms, and allow staff to interact with the system without involving live patients.

These strategies for orientation, order sets, and default standards proved to be beneficial in 2009 as we added nearly 100 beds of telemetry capacity to the institution in just two months. Having a defined education and systems process made the expansion progress much more efficient and safe, as many previous issues were identified and built into the program standards. The clinical staff was oriented to the telemetry process and the technology prior to installation, which made for a better transition into clinical use.

Portable Training System

The orientation process for cardiac competence was an obvious focal point for improvement efforts. Unfortunately, it became difficult to share the system overview with staff due to the configuration of the simulation lab, as well as the limited times available to provide this training.

In the simulation center, we found it difficult to teach staff about changes in alarms due to the lack of technology dedicated to telemetry. However, it was also difficult to relay this

information in the unit, because many of the default changes were time-consuming, and created a disruption there.

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Design criteria

As we began to develop the system, several key design criteria became apparent. For it to be most effective, we had to ensure it would meet not only the functional requirements for training, but also the ergonomic requirements of educators, so they would use the system. We identified several criteria for the system, and built it utilizing existing monitoring hardware and some "found" items. The following were paramount:

- The system had to exactly create the experience of managing a patient on telemetry, including admission/discharge process;

Figure 1. View of cart.

Figure 2. This rear view of the opened system shows components used to run the self-contained system

alarm setting; alarm annunciation; event review; and storage of patient data.
- The system had to withstand rolling across a large, urban campus with the following issues addressed: size and weight of the system; stability; portability; security of devices during transportation—mounting limitations and requirements; adequate storage to contain all components necessary to operate, including batteries and simulators; cables and leads; operating manuals and educational materials.
- The system had to be easy to set up, so that users could move it from area to area without a great deal of effort.
- A detailed power on-off instruction sheet was developed to ensure the system would operate as required.

The cart (Figures 1 and 2) is comprised of a telemetry server, receiver cabinet, patient monitor, central station, network switch, antenna system, display, keyboard, and mouse and simulators.

Introduction of the training cart

The use of the cart came into play in fall 2010 during a two-day educational blitz we set up with our patient monitoring system vendor partner. The goal of the education program was to provide an on-site educator from the monitoring company to answer user questions, handle orientation of new staff, and work with our educators to enhance their understanding of the system capabilities. We wanted the educator to visit each of the care areas so he or she could answer questions on the fly, see what the use models looked like, and afford more users access to this resource, since they would not have to leave the floor.

The cart accompanied the team (vendor educator and nurse educators) so they could see what changes had occurred to the system, and could transfer knowledge using the actual system. We found this to be a truly effective method of orienting staff, and it provided a real-time method of system utilization.

Examples of use

As we continue to assess and make changes to device and alarm defaults in an effort to ensure maximum patient safety, the cart has proven to be invaluable in demonstrating what current defaults entail and what changes will result. This approach provides a way to demonstrate the cause and effect of these changes, and enhances any written or course material that may accompany the changes.

Recently, we recommended a change in one of the network alert alarms. We were able to demonstrate this to the Code Committee and Nursing Executive Committee by showing the current alarm, what the new alarm would look and sound like, and the benefits of the change. It proved to be an effective way to transfer knowledge in a real-time environment. The changes were evident, and prompted good discussion. We foresee that this will be a good system to test changes as they arise, and then demonstrate to users what they entail and what the end result will be.

Summary

The cart, while relatively new, has proven to be an extremely effective means to demonstrate the capabilities of the telemetry system. It allows clinical users a hands-on, real-time means of reviewing the system and changes in use. User feedback has prompted us to make minor modifications in a couple of areas including securing the bottom drawers so they do not open during transport and changing the height of the central station display so it does not compete with the patient monitor display. The cart has proven to be a valuable teaching and system utilization tool. It has also bolstered the partnership we have with our colleagues in nursing and medicine. ■