Patient Safety Tip of the Week

July 2, 2013

Issues in Alarm Management

Since Joint Commission published its Sentinel Event Alert on alarm safety and developed the new national patient safety goal (NPSG) on alarm management (see our What's New in the Patient Safety World columns for February 2013 "Joint Commission Proposes New 2014 National Patient Safety Goal" and May 2013 "Joint Commission Sentinel Event Alert: Alarm Safety") healthcare organizations have been frantically working to develop programs that will comply with the new NPSG.

But it shouldn't have required actions by TJC to get healthcare organizations to pay more attention to alarm management and alarm safety issues. Issues with alarms in healthcare have been one of our dominant themes since we began publishing Tip of the Week back in 2007. Faulty response to alarms is one of the "big 3" problems encountered in many root cause analyses of sentinel events (the other 2 are communication failures and failure to buck the authority gradient). We've mentioned before that we often make amicable bets with CEO's when we enter their facilities that we will find within a specified timeframe some alarms that have been disabled or otherwise manipulated. That's a bet we win every time (but we don't actually make them pay up!).

One of the best ways to understand the issues related to alarms is to go to a clinical area where alarms are prevalent (eg. ICU, OR/PACU, dialysis unit, ER, etc.) and **sit and watch what goes on**. The first thing you'll probably notice is the ubiquity of alarms and the extreme frequency with which they go off. You'll notice that the alarms will interrupt nurses and other staff from other activities. You'll also notice that how fast someone responds to an alarm is extremely variable. And you'll wonder how any patient could ever sleep with so many alarms going off. Then you'll also notice the likely first action taken by the person responding to the alarm – they'll probably turn off the alarm. Don't be shocked! That's human nature and we need to take that into account when we design alarm systems (see below).

Your organization needs to **make alarm safety an organizational priority**. It should be a topic that your Board and both your medical staff and administrative **leadership** hear about regularly in their meetings. **Tying quality improvement goals to incentives** at various levels may also be a way to emphasize that the organization is serious about alarm safety.

One of the Joint Commission recommendations is that each organization have a **multidisciplinary team that addresses and oversees alarm safety**. That team should include not only physicians and nurses, but also administrators, quality improvement personnel, respiratory therapists, monitoring technicians, biomedical engineers, and IT personnel amongst others. But you really **need to address alarm management and safety on a unit-by-unit basis**. You'll find that the specific alarm issues as well as the culture and workaround issues differ on every unit. And don't just include people in leadership roles. Make sure that **front-line staff** are included.

First and foremost, **take an inventory of all your alarm systems**. Then **determine which ones are not necessary**. In our February 23, 2010 "Alarm Issues in the News Again" where we discussed **alarm fatigue** we noted a study by Siebig and colleagues (Siebig et al 2010) in medical intensive care units that found **only 15% of alarms were considered clinically relevant**. Our November 2010 What's New in the Patient Safety World column "Alarms in the Operating Room" noted another study (Schmid 2010) on 25 consecutive cardiac surgery cases. They noted an average of 1.2 alarms per minute and noted that approximately 80% of the alarms had no therapeutic consequences, a figure remarkably similar to that found in the Siebig study mentioned above. The new Joint Commission sentinel event alert cites the statistic that between 85% and 99% of alarm signals do not require clinical intervention.

The Joint Commission Alarm Safety Webinar in May 2013 included description of a Boston Medical Center initiative that did an alarm inventory and categorization of alarm types (eg. warning alarms vs. crisis alarms) and significantly reduced the overall number of audible alarms on cardiac patients. They achieved **an 89% decrease in audible alarms!** The major impact was on telemetry monitoring. It's really worth your while listening to this webinar (or reading the transcript) to see how they went about this incredibly successful initiative. They describe the multidisciplinary team that developed the initiative, categorized the alarms, got buy-in from all stakeholders, developed standardized order sets, and got feedback. Staff and patient satisfaction also improved dramatically.

Telemetry is one technology we often see overutilized in many hospitals. The American Heart Association and American College of Cardiology (AHA/ACC) have published **guidelines on telemetry monitoring and suggested criteria**. Yet many hospitals have never developed local guidelines to help identify which patients should be monitored (and which should not). Moreover, criteria for continued monitoring are extremely important because all too often a physician orders telemetry and it gets continued indefinitely. Getting your physician staff involved early in developing your telemetry criteria is the key.

Alarm hazards have been a perennial topic on **ECRI Institute's Annual Top 10 Health Technology Hazards** list and headed the list for 2013 (ECRI 2013). ECRI Institute, which has a great alarm management resources web page, has a poster that includes strategies you might use in your approach to improve alarm safety. It reminds you not to

forget you probably already have many lessons learned pertaining to alarms in root cause analyses (RCA's) of previous incidents or near-misses in your organization (or other organizations).

A timely new practice alert from the American Association of Critical-Care Nurses (AACN 2013) provides some good recommendations for alarm management but also shows that the evidence grades for most recommendations are those based on case reports, consensus opinions, expert opinions, etc. rather than being based on well-designed controlled trials. Nevertheless the recommendations make a great deal of sense:

- Provide proper skin preparation for ECG electrodes.
- Change ECG electrodes daily.
- Customize alarm parameters and levels on ECG monitors.
- Customize delay and threshold settings on oxygen saturation via pulse oximetry (SpO2) monitors.
- Provide initial and ongoing education about devices with alarms.
- Establish interprofessional teams to address issues related to alarms, such as the development of policies and procedures.
- Monitor only those patients with clinical indications for monitoring.

Our February 23, 2010 Patient Safety Tip of the Week "Alarm Issues in the News Again") discussed the excellent Boston Globe series (Kowalczyk 2011a, Kowalczyk 2011b) on problems related to alarms and especially the problem of **alarm fatigue** and efforts to develop alarm systems **("smart" alarms**) that integrate multiple types of physiologic measurements to help better differentiate true emergencies from artifact. However, the problem of alarm fatigue is also deeply rooted in **faulty design of alarm systems**. In our April 2, 2007 Patient Safety Tip of the Week "More Alarm Issues" we pointed out the classic example (with a disastrous outcome) in which alarm volumes had been intentionally reduced because the noise was interfering with other activities. The fact that multiple providers turned down the volumes on one particular set of alarms belied the flawed design nature of the unit involved.

Delineation of responsibility for responding to alarms is important. A 2011 Pennsylvania Patient Safety Authority advisory noted multiple cases of inadequate responses to alarms (Lacker 2011). All too often staff, who may be busy with other activities, assume someone else will respond. Your policies and protocols should have mechanisms for escalating responses. Particularly in areas like ICU's you can "partner" nurses and have tiers of responsibility for backup coverage (TJC 2011). So when you are sitting in an area observing all alarm-related activities, measure how long it takes for responses. One hospital found it took an average of 9.5 minutes for a clinician to respond to high-priority alarms. It implemented better communications systems to dramatically improve the response times (TJC 2011).

Checking alarms should be a regular component of your Patient Safety Walk Rounds. More importantly, it should be something your staff does daily on every unit that utilizes alarms of any type. Some units even do it on every shift. And when you find

alarms that have been disabled or otherwise manipulated make sure you **find out why**. Such actions always have an **underlying root cause that must be addressed**.

You should **include alarm status as part of your structured handoff tool** used at changes of shift. And **alarm status must be included in your "Ticket to Ride" tool** for in-hospital transports (eg. to radiology). The 2011 PPSA Patient Safety Advisory (Lacker 2011) cited six fatal cases in which monitors were disconnected either while in radiology or were not reconnected upon return to the floor from diagnostic testing. A Joint Commission Perspectives on Patient Safety article in 2011 done in conjunction with the ECRI institute includes a sample "Ticket to Ride" form that includes comments on cardiac monitoring (TJC 2011).

You must also be able to **recognize when a "false alarm" is, in fact, a true alarm**. The most important example we have provided on numerous occasions is that which occurs in patients with obstructive sleep apnea (OSA) who are monitored only with pulse oximetry. In such patients the apnea occurs when they fall asleep. If the apnea is sufficiently long they develop hypoxemia and the pulse oximeter alarms once the oxygen saturation falls below the set threshold. However, when the nurse or other person responds they typically wake the patient and begin looking to see if there is something wrong with the sensor. Now the patient is awake and no longer apneic and, hence, no longer hypoxemic. So the alarm often gets written off as a "false" alarm. And since the majority of patients with OSA are undiagnosed that is the reason we recommend use of capnography and apnea monitoring universally in patients receiving opiate therapy or other potential respiratory depressants. If you do a failure mode and effects analysis (FMEA) or other sort of assessment of your alarm systems to determine your potential vulnerabilities, consideration of the diagnosed or undiagnosed OSA patient should be at the top of your list of potential gaps.

Alarms should be designed to point the responder to the problem at hand. In our March 26, 2007 Patient Safety Tip of the Week "Alarms Should Point to the Problem" we described an incident where a low pressure dialysis alarm went off (designed to alert staff that a needle may have come out of an access site). The nurse turned off the alarm and eyeballed the patient and saw no blood. Nothing further was done. Soon thereafter the low pressure alarm triggered again. This time it was recognized that the dialysis catheter had indeed become dislodged and the patient had, in fact, had considerable blood loss. It had not been appreciated immediately because a blanket had been covering up the catheter site and the blood, rather than being visible on the floor, had been pooling in the webbing of the lounge chair in which the patient was reclining. The equipment and alarm were on the side of the patient opposite from the involved limb so that the visual attention of the responder was not directed immediately to the site the alarm was drawing attention to. If we can make copy machines that tell us exactly where to look when the alarm goes off that there is a paper jam, why can't critical medical monitoring devices do the same thing?!!! Proper design of medical equipment necessitates seeing how humans will respond to it in the typical medical setting. When Microsoft develops new software, it puts real people in a real-life setting and sees exactly how people are likely to respond to various scenarios. Why can't all medical device manufacturers learn from this?

In our June 19, 2007 Patient Safety Tip of the Week "Unintended Consequences of Technological Solutons" we described a case in which **telemetry transmitters were transposed** on two patients, leading to an erroneous response to one patient's room while the patient in true ventricular fibrillation down the hall died. That illustrates a principle that must be strictly adhered to: never allow anyone to take out two transmitters at the same time. Each hookup should be handled independently and completed before the next is done.

Another important lesson was in our March 5, 2007 Patient Safety Tip of the Week "Disabled Alarms" where we described a case in which a piece of tape had been placed over the blender alarm on a ventilator, presumably to prevent the alarm from alarming while the machine was being serviced without use of oxygen. One of the lessons from that case is that any time you set up a new piece of equipment on a patient you **use a checklist specific to that piece of equipment** that forces you to verify that all alarms are appropriately set and functional and that parameters chosen are appropriate. We also recommend you review some of the useful tips we've included in our February 23, 2010 Patient Safety Tip of the Week "Alarm Issues in the News Again" and the several other columns noted below.

Don't forget to include alarm considerations in some of your financial decisions as well. **When purchasing new equipment, consider how alarms differ from old equipment**.

Education of staff on all levels is critical to maintaining high levels of alarm safety. And we are not talking about just physicians and nurses. Even your non-clinical staff need this education. The receptionist on the floor needs to know to immediately call a nurse when the transport team brings that patient back up from radiology without his monitor hooked up! And don't forget **patient and family education**. ECRI Institute has a short video on the Four "A's" for Alarms (Advocate, Active, Ask, Alert) that is quite useful.

Developing a **culture of patient safety** is critical. When you use multidisciplinary teams, keep all stakeholders informed, focus on a unit level, and get regular feedback from frontline staff you'll start to see that culture develop. Transparency and participation are key to success.

Our alarm systems still leave a lot to be desired. Most are threshold-based and there are significant theoretical and practical considerations regarding the utility of any threshold-based alarms. Those discussions are beyond the scope of today's column but those who are interested should read our Patient Safety Tips of the Week for March 2, 2010 "Alarm Sensitivity: Early Detection vs. Alarm Fatigue" and February 22, 2011 "Rethinking Alarms". In particular, we've often mentioned the provocative article by Lynn and Curry (Lynn 2011) on alarms and their failure to identify deteriorating patients early.

The Physician-Patient Alliance for Health & Safety, which has done such a great job promoting safe practices for patient-controlled analgesia (PCA) and other narcotic safety

issues has also begun to focus on alarm safety issues and we expect to see more from them in the future.

Prior Patient Safety Tips of the Week pertaining to alarm-related issues:

- March 5, 2007 "Disabled Alarms"
- March 26, 2007 "Alarms Should Point to the Problem"
- April 2, 2007 "More Alarm Issues"
- June 19, 2007 "Unintended Consequences of Technological Solutons"
- April 1, 2008 "Pennsylvania PSA's FMEA on Telemetry Alarm Interventions"
- February 23, 2010 "Alarm Issues in the News Again"
- March 2, 2010 "Alarm Sensitivity: Early Detection vs. Alarm Fatigue"
- March 16, 2010 "A Patient Safety Scavenger Hunt"
- November 2010 "Alarms in the Operating Room"
- February 22, 2011 "Rethinking Alarms"
- February 2013 "Joint Commission Proposes New 2014 National Patient Safety Goal"
- May 2013 "Joint Commission Sentinel Event Alert: Alarm Safety"

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Physician-Patient Alliance for Health & Safety
http://ppahs.org/

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