

## Patient Safety Tip of the Week

February 4, 2014

### But What If the Battery Runs Low?

It's a question we often find ourselves asking during FMEA's (Failure Mode and Effects Analyses) or RCA's (root cause analyses). We put so many redundancies into our systems to try to ensure that nothing can go wrong. Then we get a bad outcome because we neglected to remember a simple battery system might go dead.

You just revised your alarm safety policies and procedures as you prepare for the new Joint Commission NPSG on alarm management and safety. As part of your project you implemented middleware that transmits the alarm alerts to your nurses (or others) via their cell phone or pager. A patient event triggers an alarm that is sent to the primary nurse expected to respond. Unfortunately, the battery in her cell phone has failed and she never receives the alert. Fortunately, the escalation procedure you built into your system sends the alert to a secondary nurse who responds to the patient and no harm comes to the patient.

You implemented a "panic button" system to protect your behavioral health workers from assaults by patients on your locked behavioral health unit. The worker is in a situation where she fears potential harm from a patient and presses the panic button. However, the battery in the panic button is dead. Fortunately, other staff were within audible range of her shouts for help and responded before she was assaulted.

A patient is being monitored by remote telemetry ([CDPH 2014](#)). The battery charge on the 9-volt battery on the remote unit is running low. The audible alarms for low battery status had been turned off and the only ones working were the visual ones. A low battery warning appears as a yellow alarm on the screen. It later turns red but once the battery is dead no tracing at all appears on the remote monitor screen. The nurse who was manning the remote monitoring station (because no monitor tech was available) has multiple other distractions and does not see the yellow or red low battery alerts. The patient has a fatal event not picked up by monitoring.

A patient is on a portable ventilator in the ED while awaiting a bed in the ICU (see our April 2, 2007 Patient Safety Tip of the Week "[More Alarm Issues](#)"). The portable ventilator has a dual power supply (AC from wall sockets and a battery on the unit). Unbeknownst to staff the circuit breaker for the wall socket into which the AC cord was

connected had tripped and the ventilator was running on battery power. When the battery charge ran out several hours later the patient had a cardiopulmonary arrest.

You have an alarm that responds to the temperature in a refrigerator dropping below a set value to protect against loss of the medical products inside. You took great care to make sure the thermometer was not on the same electrical supply as the refrigerator. However, the battery on the thermometer had not been checked recently and had no charge when the refrigerator actually lost power. All the medical products in the refrigerator are lost.

A power failure ([Hazlett 2013](#)) at a hospital occurs. The emergency generator comes on after 5-6 seconds but the memory battery does not back up the temperature setting on an infant isolette temperature setting. The temperature setting reverts to the manufacturer default setting and the isolette becomes too hot for the baby.

An infusion pump ([MHRA 2005](#)) was used when transporting a patient between hospitals. Staff checked that the display on the pump said that the battery would last 4 hours (longer than the expected journey time), but the pump batteries expired after 90 minutes. On investigation it was found that the manufacturer's instructions stated that the battery indication was not reliable until 5 minutes after switch on. This had not been noted in training.

These are just a few examples of cases where batteries running low impacted or had the potential to impact patient outcomes. The problem is prevalent enough and significant enough that the FDA convened a special 2-day public workshop last year to begin to address the issue ([FDA 2013a](#)).

A survey of providers done before the conference in 2013 ([FDA 2013b](#), [Hazlett 2013](#)) identified multiple devices that are battery-powered: a whole host of physiological monitors, automated blood pressure recording devices, telemetry packs and boxes, electrocardiograms, pulse oximeters, thermometers, glucose meters, infusion pumps (large volume infusion pumps, syringe pumps, patient-controlled analgesia pumps, etc.), portable computer stations (eg. computers on wheels), sequential compression devices, patient lifts, ventilators, defibrillators, CPAP/BiPAP machines, patient beds, and many others.

The following specific problems were noted in the survey: failure to plug-in device when not in use, overcharging, undercharging, inaccessible plugs/outlets, battery leakage, battery swelling, confusion with on/off button on pump, loose connections, and incorrect battery replacement by staff.

But most hospitals do not have an organized centralized program for battery maintenance. In the survey above most hospitals noted that nursing staff is responsible for charging battery-powered medical devices on the units where they are used but that staff often forget to plug in the devices or outlets are not available when needed. They note this is especially problematic when portable devices are moved from one unit to

another. Often batteries are undercharged. An example given is a device charged for only 15 minutes when a full charge would require several hours. They also note that not all devices have low battery alerts. In many, such as pulse oximeters, error codes just display when the battery is low. And don't forget that some batteries have "memory" and if frequently charged will only charge to the last level, which may be low.

But overcharging can also be a problem. Overcharged batteries can swell, overheat, explode or cause fires.

Sometimes design issues are the problem. In the portable ventilator case note earlier there was a light that indicated whether the ventilator was on AC current or battery but that indicator light was on the back of the unit where it was not readily visible.

The issues noted related to portable devices that are used during patient transports are of particular interest. We've often talked about items to include in your "Ticket to Ride" communication tools that should be used during patient transports (see our Patient Safety Tips of the Week for April 8, 2008 "[Oxygen as a Medication](#)" and November 18, 2008 "[Ticket to Ride: Checklist, Form, or Decision Scorecard?](#)"). But we've never included a specific area to comment about battery life issues for portable equipment. You learn something new every day!

Another problem is that the instructional manuals for the device or batteries are often not available at the point of care where the information is needed.

There's also often poor communication between staff purchasing batteries and those using them so that problematic batteries simply get reordered over and over.

Issues related to storage, maintenance, sterilization, and proper disposal of batteries are beyond the scope of today's column but are important considerations for your overall battery management initiative. Information on such issues is available at other sites ([MHRA 2005](#)).

Battery maintenance, replacement, service calls, disposal, etc. can also be quite expensive. So your CFO should have an interest in getting your battery management program in order.

Does your facility have a battery management policy and procedure? We'll bet not. So while you are doing your alarm inventory as part of your activities to meet NPSG 06.01.01 (see our July 2, 2013 Patient Safety Tip of the Week "[Issues in Alarm Management](#)" and our What's New in the Patient Safety World columns for February 2013 "[Joint Commission Proposes New 2014 National Patient Safety Goal](#)", May 2013 "[Joint Commission Sentinel Event Alert: Alarm Safety](#)" and August 2013 "[Joint Commission Formalizes 2014 NPSG on Alarm Management](#)") you should be doing a related inventory of all your systems that utilize batteries. The sorts of questions you should be asking are:

- What items use batteries?
- What would be the patient (or facility) risk if the battery failed?
- What type of battery does this equipment use?
- How do you know how much battery life is left?
- Is there a way the battery warns when charge is low?  
Is it audible? Is it visible?
- Who checks the status of the battery?
- How often do they check the status?
- Are there recommended replacement times?
- Is the battery rechargeable?
- If so, is there a memory? (could the battery life diminish with frequent charging?)
- How are various devices recharged on the units where they are used?
- Is the correct charger used with this battery? (use of the wrong charger can result in undercharging)
- If the device this battery is in loses all power does it reset to prior settings or to default settings when power is restored?
- Who keeps track of all our battery-related issues?
- Are there battery-related issues in any of our root cause analyses (RCA's) or incident investigations?
- How is our staff educated on use of this device and battery issues?
- Do we survey end-users or check service log issues before we reorder batteries for this device?
- Does your "Ticket to Ride" patient transport communication tool have an item for discussion of battery life issues on any transported devices?
- Do you include looking at battery charging/recharging issues when you do your Patient Safety Walk Rounds?

And if you are using cell phones or pagers for alerting staff to various alarms, consider doing a FMEA (failure mode and effects analysis) and ask not only what would happen if the primary responder's battery is low but also what would happen if more than one responders' battery is low.

When you do your inservices and staff education on battery-related issues don't forget to include some of the examples at the beginning of today's article. A session titled "Battery Management Issues" is guaranteed to be a "snoozer". So you need to spice up that talk by showing them some real life cases with unfortunate outcomes to get and keep their attention. Remember – "stories, not statistics".

Lastly, don't forget that there are battery-related issues with some of the equipment your patients may be using at home. Don't forget to discuss these as part of your discharge process.

Batteries may sound like a mundane issue. But you can see from today's column that battery-related issues are real patient safety concerns. Make sure you develop an

organizational battery management program in conjunction with your alarm safety and management program.

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