

# Patient Safety Strategies and Tactics

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## PCA Pump Alarm Safety Concerns

The AMC PSO recently reviewed a case involving an ambulatory pump, which is used to administer patient controlled analgesia. The analysis revealed a number of important safety issues.

### Air in line alarms

In the course of working with new PCA pumps, PACU staff have frequently noticed that the “air in line” alarm frequently sounds shortly after set up. This occurs only when the medication, in these cases PCA, is administered via cassette. This alarm does not occur when medication is administered by bag for epidurals or peripheral nerve blocks. Alarm activation halts the delivery of pain medication to these mostly postoperative patients. Upon examination, no air is noted in the cassette. In rare instances, tiny “champagne bubbles” are noted but they are much too small to cause the alarm to sound. The problem is often ascribed to user error caused by unfamiliarity with new equipment. When this alarm problem persists a review is conducted by a trans-disciplinary committee including biomedical and clinical engineers as well as pharmacy staff. It is not uncommon, after several rounds of testing and analysis, to determine no clear cause for an apparent alarm malfunction. Lot numbers do not seem to play a role, because the pre-filled medication cassettes are supplied by different manufacturers. Engineers often create pristine, bubble free saline cassettes which, when tested, still activate the air in line alarms. Pump manufacturers indicate that most users did not use the pump’s highly sensitive air sensor because even the tiniest bubble could trigger an alarm. Since no air was visible and an air filter was in place, providers believed that they had met a sufficient level of patient safety.

### Safety Strategies

Since many organizations experience similar alarm issues, the following safety strategies for PCA pump use will prove useful:

When using pumps for both IV administered medications (e.g., PCA) and non-IV administered medications (e.g., epidurals or peripheral nerve blocks):

- Reduce the risk of confusing these two by using cassettes for the IV route (PCA) and bags for the non-IV route (epidurals or peripheral nerve blocks).
- Use color-coded tubing to distinguish epidurals and peripheral nerve blocks from PCA’s.
- Use a color-coded lockbox to deliver the epidural and peripheral nerve block doses.
- Treat epidurals and peripheral nerve blocks as controlled substances to separate these non-IV bags from IV bags.
- Use different cassettes for different PCA drugs. (e.g., 50 ml cassettes for Dilaudid and 100 ml cassettes for Morphine).
- Program PCA pumps so that a security code is required to disable the air in line alarm. This code would be held by a senior pharmacist or equivalent.
- Be aware that distractions caused by PCA pump troubleshooting, particularly when combined with the pressure to provide prompt pain relief, increase the risk of medical error.

### Dose changing and volume memory deletion

The AMC PSO’s analysis also considered a second safety concern related to the same PCA pump. Pump parameter changes (e.g. dose, infusion rate, lockout interval) are considered to be “tasks.” When selecting certain tasks, clinicians were not alerted

that this selection would restore the pump's default settings. Restoration of default settings would also eliminate the stored volume total from the pump's memory and return it to full volume. Stored volume information is needed for the pump to correctly calculate when to activate the "cassette empty" alarm. Incorrect volume information would cause the PCA pump to continue running while the soft plastic bag within the cassette case simply collapsed upon itself. The air in line alarm would not sound because no air was being pumped into the tubing. An occlusion alarm would not be generated because the tubing pressure would not be changed.

The most common result of this human-pump interface error would be a cassette that was out of medication for a period of time without alerting the clinician. Unbeknownst to staff, the patient would not receive pain medication while the empty pump continued to operate and record that doses were being administered. Consequently, staff would increase doses, infusion rates, and hourly limits to provide additional medication and improve pain control. When the cassette was eventually replaced, the PCA pump would then deliver pain medication at these higher doses. This sudden increase could potentially overwhelm the patient.

### **Safety Strategies**

Concerns related to screen selection and dose changes will also be reviewed with the manufacturer. Recommendations include building prompts and alerts into the screen selection menu. Additional strategies that can be incorporated into pump-user education and troubleshooting guides include:

- Emphasizing vigilance when entering dose changes into the PCA pump menu.
- Considering an empty medication cassette as a possible reason for pain that does not respond to increased doses of PCA medication.

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[amcpso@rmf.harvard.edu](mailto:amcpso@rmf.harvard.edu)