Misprogram a PCA Pump? It's Easy!

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PROBLEM: One patient died and another recovered after two nurses accidentally misprogrammed a Deltec CADD-Prizm PCS Pain Control System pump (Model 6101), used for patient-controlled analgesia (PCA). Even though human error played a role in these events, the culprit is more likely a combination of problems, including the pump's automatic capability of defaulting to a previous setting.

The errors were first recognized when a postoperative patient became unresponsive after a bolus of fentanyl. The physician had ordered fentanyl PCA "per protocol," which called for a 50-mcg/mL concentration, a 10-mcg demand dose, a 6-minute "lockout," and clinician-administered boluses of 20 mcg every 5 minutes for three doses, repeated every four hours as needed.

To program the pump, the nurse first scrolled through a wide range of numbers to select the correct concentration. However, she accidentally programmed *1* mcg/mL instead of the desired concentration of *50* mcg/mL. Next, she programmed the demand dose as *0.10* mcg instead of *10* mcg.

Two nurses were initially present when the pump was being programmed, but one left the room. When she returned, she asked the other nurse to read the settings to her for verification, but the programming errors were missed. Because the pump had been programmed to deliver fentanyl in a 1-mcg/mL concentration, each demand dose delivered only 0.1 mL. As a result, despite an actual concentration of 50 mcg/mL, the patient received only half of the intended dose (0.1 mL of 50 mcg/mL, or 5 mcg). When the patient continued to complain of severe pain, a nurse on the next shift gave the patient a 20-mcg bolus. She correctly programmed the bolus dose, but because the pump had been set incorrectly at a 1-mcg/mL of the 50-mcg/mL concentration, or 1,000 mcg! About 15 minutes later, the patient was found to be unresponsive and was quickly transferred to the intensive-care unit. The patient died three days later.

In this fatal event, the two nurses had been familiar with fentanyl and were well aware of the correct concentration and demand dose that should have been entered into the pump. In fact, the nurse who verified the pump settings mentioned the need for "extra care with fentanyl" to the programming nurse. Both nurses felt certain that the fentanyl concentration had been set at 50 mcg/mL and the demand dose at 10 mcg. This might well have been the case initially, at least for the concentration.

During an investigation of these events, the hospital was informed that the pumps could automatically default to an earlier setting if no one confirmed the current setting by pressing "enter" within a short period of time. As such, the nurse could have initially entered the correct concentration but then neglected to press the "enter" key within the allotted time. As a consequence, the setting could have returned to a prior setting on the scroll of numbers—1 mcg/mL for the concentration.

Failures in the system of double-checks also played a role in both fatalities. Even though the hospital required two nurses to confirm PCA pump settings, the policy did not clarify that the double-checks should be performed independently, with one nurse setting the pump and another nurse independently checking the patient, drug, and settings against the orders.

Finally, the pump manufacturer had not alerted hospital staff personnel that they could set default values for PCA drugs by locking out the unused range of numbers available.

SAFE PRACTICE RECOMMENDATION: Errors associated with PCA can be deadly, and special precautions are needed when patients receive narcotics via this method of drug delivery. Here are some strategies to help avoid these mistakes:

1. The variety of medications used for PCA should be limited. Fentanyl PCA should be restricted to anesthesiologists or pain-management team members only.
2. Access to information about PCA procedures should be improved. A quick reference sheet should be developed for nurses and should include programming tips and maximum dose warnings for each PCA medication used.
3. For improved labeling, the sequence of information on PCA medication labels and order sets should be matched with the sequence of information to be entered into the PCA pump, the PCA protocols, or any other relevant documents. PCA concentrations on drug labels should be highlighted with bold lettering or other methods.
4. Default settings should be programmed. The staff should contact the pump manufacturer to learn about any safety features available with the PCA pumps and should utilize them fully.
5. Concentrations of PCA medications should be standardized. When possible, default values should be set for each concentration, or inappropriate ranges for the concentrations that are not used should be locked out.
6. If a single option exists for default settings, "zero" should be selected to force an entry.
7. The staff should conduct periodic biomedical checks on the pumps to ensure proper default settings.
8. All staff members should be alerted to situations in which the pump might default to a standard setting.
9. If the patient is not responding to the PCA doses as anticipated, an error should be suspected. The drug, its concentration, the pump settings, and the line attachment should be reverified and compared against the original order, es-

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pecially before a clinician administers a bolus dose.

10. A system of independent double-checks should be instituted. A manual double-check process should be created for clinicians to follow when they are verifying PCA medications, pump settings, the patient's identity, and the line attachments.

11. When possible, bar-coding technology and "smart" PCA pumps should be used to alert clinicians to potential programming errors. However, until newer pumps are adapted for bar-coding, it should be noted that automated checks do not entirely replace manual, independent double-checks to verify other dimensions not covered by the automation, such as patient identification with current smart pumps or pump settings with current bar-code systems.

The reports described in this column were received through the USP–ISMP Medication Errors Reporting Program (MERP). Errors, close calls, or hazardous conditions may be reported on the ISMP (www. ismp.org) or the USP (www.usp.org) Web site or communicated directly to ISMP by calling 1-800-FAILSAFE or via e-mail at ismpinfo@ismp.org. ■