



Errors involving PCA pumps

To prevent the administration of excessive amounts of analgesia medication, patient-controlled analgesia (PCA) pumps offer several safety features (e.g., a “lockout interval” specifies both the minimum amount of time between each dose and an established maximum allowable amount of drug during a predefined time period). Despite such advantages, medication errors involving PCA pumps continue to occur.

USP examined the medication errors submitted to its MEDMARX and USP Medication Errors Reporting (MER) Program from Sept. 1, 1998, through Aug. 31, 2003. To obtain PCA errors in MEDMARX, a text search for “PCA” in the *Error Description* field was conducted. Together, both programs yielded a total of 5,377 records. Of these, 425 records (7.9%) were categorized as harmful.

Given that the average overall harm rate for error reports submitted to MEDMARX over the past several years has been approximately 2%, it appears that when PCA pumps are involved, the chance for patient harm increases more than 3.5 times. The most common types of error involving PCA pumps were *improper dose/quantity* (38.9%), *unauthorized drug* (18.4%), and *omission error* (17.6%) (see table on page 29).

Selected cases from the MER program

1. Settings and concentrations for morphine PCA were ordered per standard protocol. In 1.5 hours, the patient received four doses of morphine via the PCA device and was noted as being “talkative,

eating, and drinking.” Three hours later, a second nurse noted the patient was unresponsive but did not contact the physician. Over the course of the night, the patient received three more doses of morphine via the PCA device. Toward the end of the night shift, a third nurse noted that the patient was unresponsive and “gurgling” with lung crackles. The physician was contacted and ordered suctioning, naloxone, and furosemide. The patient’s condition improved but again deteriorated later in the day. The patient later expired.

When the nurse was cleaning the room, she turned off the PCA device and removed the morphine solution. She noted that the solution in the IV bag did not correlate to the pump. The pump indicated the bag should contain 20 ml with a dose of 8 mg delivered. The nurse calculated that the bag should contain at least 80 ml. The nurse contacted a supervisor, who reviewed the pump settings and discovered that the pump had been incorrectly programmed to deliver 1 mg/ml instead of 0.1 mg/ml.

2. A PCA-related error occurred in a hospital and it was discovered that the error was not due to a wrong drug, dose, or programming error, but to the overdosage of an opioid as a result of a practice-related error. The nurse, when assessing the patient’s pain, would wake the patient to perform the assessment and then would push the PCA pump button on behalf of the patient. The nurse was attempting to assist the patient but in reality was causing extreme oversedation and the patient died.

by

John P. Santell, M.S., R.Ph.;
Diane D. Cousins, R.Ph.; and
Rodney Hicks, R.N., M.S.N., M.P.A.

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Recommendations to prevent PCA errors

General

•Conduct a Failure Modes & Effects Analysis (FMEA) for existing pumps, as well as for new pumps that are brought into the facility. Consider what default settings are preprogrammed. Consider whether the pumps can be programmed by drug (e.g., morphine PCA versus hydromorphone PCA). Consider if the pump resets to a default (other than "000," which would require active entry) after it turns off.

•STAFF: Require proper and complete training and demonstration of

competency before staff members are permitted to work with pumps.

•PATIENTS AND FAMILY MEMBERS: Written instructions should be provided to patients. Instruct family members *not* to administer PCA doses—PCA by definition should be administered at the patient's perception of need. Document education of patient and family members. For issues related to PCA by proxy, visit www.ismp.org/msaarticles/issue2.htm.

•Dosing errors are usually by a factor of 10. Errors include the following:

◆Underdoses when lockout is at four hours (default) instead of one hour.

◆Order calls for 1 mg/hour, but the pump is set at 0.1 mg/hour.

◆Order calls for 0.05 mg, but the pump is set at 0.5 mg.

◆Other errors include insertion

of the wrong drug or wrong concentration in the PCA device.

•Pumps should have upstream occlusion alarms.

•Educate staff on sound-alike and look-alike drugs, especially when bar-code technology is not part of

Types of error*

Types of errors	Count	Percent
Improper dose/quantity	1,873	38.9%
Unauthorized drug	887	18.4
Omission error	846	17.6
Prescribing error	443	9.2
Wrong administration technique	230	4.8
Extra dose	227	4.7
Wrong drug preparation	203	4.2
Wrong time	160	3.3
Wrong patient	118	2.5
Wrong dosage form	79	1.6
Wrong route	29	0.6
Deteriorated/expired product	15	0.3

Total **5,110**

*Based on 4,812 records, making 5,110 selections for Types of Error
Source: USP MEDMARX

the existing system. Many wrong drug errors with PCA pumps are due to name confusion (e.g., morphine versus hydromorphone versus meperidine). Auxiliary labeling or posted warnings could be used to highlight differences. Limit the number of products and strengths used/stocked in the facility. Create alerts in computer systems with dosing limits specific to the drug being selected. Do not store sound-alike or look-alike drugs together in a single drawer of the dispensing cabinet on the floor. To view USP's list of similar drug names, visit www.usp.org/patientSafety/briefsArticlesReports/qualityReview/qr792004-04-01.

USP also has a list of tips for using this resource at www.usp.org/patientSafety/briefsArticlesReports/practitionerReportingNews/prn1182004-09-10.html.

Dispensing

•Standardize the strengths/concentrations available in your facility. Be sure physicians are aware of the standard concentrations in use. If higher concentrations are needed for a particular patient or settings, conduct an FMEA to ensure additional safeguards are in place.

•Separate PCA syringe locations in automated dispensing systems to prevent selection of the wrong drug.

Administering

•Double-check clamp (to open position) before closing the pump.

•Check for kinks in the tubing in the pump door. Despite a kink in the tubing, at

times no alarm may sound and the volume could be counting down.

•Check whether connections are to IV or epidural lines to prevent wrong-route errors.

•Set pumps to be programmed in mg, *not* ml.

•Pumps should be assessed on a regular basis.

Monitoring

If patient complains of pain, reassess pump settings. Check that the basal rate has been entered. Also check that the tubing is not kinked.

John P. Santell is Director of Educational Program Initiatives; **Diane D. Cousins** is VP; and **Rodney Hicks** is Research Coordinator, USP Center for the Advancement of Patient Safety, U.S. Pharmacopeia.

USP operates two complementary reporting programs: the Medication Error Reporting Program, presented in cooperation with the Institute for Safe Medication Practices, and MEDMARX. For more information on how to report errors, visit: www.usp.org/patientsafety.