



Nurse Advise-ERR®

Educating the healthcare community about safe medication practices

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Beware of basal opioid infusions with PCA therapy

A 63-year-old, 109 kg, opioid-naïve patient (one who has not recently received regular daily doses of opioids) was admitted to a hospital with fractures sustained in a fall. She was given two doses of morphine 4 mg and one dose of **HYDRO**morphine 1 mg in the emergency department prior to admission. Upon arrival to the inpatient unit, she was started on **HYDRO**morphine via patient controlled analgesia (PCA), which included a continuous basal infusion of 0.5 mg per hour, an on-demand dose of 0.2 mg with a lockout interval of 10 minutes, and a 4-hour dose limit of 6 mg. Continuous pulse oximetry was not in use. About 5 hours later, the patient was found unresponsive. She was breathing six times a minute, and her nail beds were turning blue. Oxygen saturation was checked with pulse oximetry and found to be 44%.

The rapid response team was called, oxygen was started, and two doses of naloxone were administered to the patient. Less than 15 minutes later, she was alert and talking. The patient then told a nurse she has sleep apnea and sometimes uses a *continuous positive airway pressure* (CPAP) machine at home. She hadn't been using the CPAP machine recently, so she had

not told the admitting nurse about her condition. Another key factor not considered was that the patient's body mass index (BMI) was 38.6; a BMI of 40 or more is considered morbid obesity. Obese patients often experience hypoxemia and are at risk for sleep apnea during PCA use.

Although no permanent harm ensued, the hospital's medication safety team used this case as a learning opportunity. Three contributing factors associated with the event were identified, as described below.

Dosing guidance. The PCA standard order form did not guide prescribers to appropriate doses, but instead provided a broad range of doses. The suggested **HYDRO**morphine continuous basal infusion dose was 0.1 to 0.5 mg/hour, without guidance for selecting appropriate candidates. Many prescribers routinely selected a 0.5 mg/hour basal infusion, regardless of patient characteristics. However, a basal opioid infusion dose was not appropriate for this opioid-naïve patient.

Several studies have shown that patients with basal opioid infusions are five times as likely to experience respiratory depression.¹⁻⁴ The Anesthesia Patient Safety Foundation (APSF) recently published an editorial about opioid-induced respiratory depression stating, "It is critically important to emphasize the need to individualize postoperative pain management and to insist that continuous monitoring of oxygenation be the routine."⁵

Patient screening. The patient was not sufficiently screened for obstructive sleep apnea (OSA) and other risk factors for PCA-induced respiratory depression. The facility had an OSA screening process in place for preoper-

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safetywires

⚡ Too much **HYDRO**morphine.

A 40-year-old, healthy man visited a hospital emergency department for severe throat pain. At the hospital, staff administered 2 mg of IV **HYDRO**morphine (**DILAUDID**) around 8 a.m. The patient was later transferred to a nursing unit in the hospital. The nurses gave two additional doses of IV **HYDRO**morphine 2 mg prior to 5 p.m. The patient had rarely taken opioids before admission except **VICODIN** (acetaminophen and **HYDRO**codone), which had not been tolerated well. The patient's wife mentioned this information, which was noted in the patient's chart. Unfortunately, the patient suffered respiratory arrest. He was resuscitated but sustained permanent CNS impairment and died. The death was reportedly related to the **HYDRO**morphine dosing. The question must be asked whether **HYDRO**morphine was an appropriate analgesic for throat pain. Even if it is, patients should not receive high initial doses of opiates, especially **HYDRO**morphine; 2 mg IV is equivalent to approximately 12 to 14 mg of IV morphine, an extremely large dose for anyone who has not been on opiates in the past. Another analgesic, even non-narcotic, may have been a safer choice and adequate to relieve the patient's throat pain.

⚡ Lab test, not medication.

When a pharmacist was reconciling medication orders on one of the nursing units, he found a transcription on the MAR that caused him to pause (Figure 1 on page 2). After trying to figure out what was intended, he went back to the original order (Figure 2 on page 2). The original order was also confusing except for some additional clues. The pharmacist recognized the signature (not shown) as one of the infectious disease (ID) physicians and then checked the chart for a progress note or consultation.

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Table 1. Risk factors for respiratory depression in PCA patients

Use of basal infusion
Advanced age
Obesity
Upper abdominal surgery
Obstructive sleep apnea
Concurrent use of CNS depressants
Renal, cardiopulmonary, or hepatic impairment
Pump programming errors
Families pushing PCA buttons (PCA by proxy)
Lack of opioid tolerance (opioid-naïve)

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 ative patients, but screening did not occur because this patient was not a surgical candidate. The incidence of respiratory depression in PCA patients ranges from 0.19 to 5.2 percent, depending on how it is measured.¹⁻⁴ Table 1 (on page 1) includes risk factors for respiratory depression in PCA patients.

Patient monitoring. No process was in place to trigger an evaluation for continuous pulse oximetry (a non-invasive method of measuring blood oxygenation) or capnography (the measurement of the concentration of exhaled carbon dioxide) monitoring when using PCA. While continuous pulse oximetry is helpful, capnography is a better monitoring device for obese patients or those with obstructive sleep apnea.¹⁻⁴ These patients are driven to breathe by their oxygen levels; if they are given supplemental oxygen, they might not be hypoxic but will develop high levels of carbon dioxide and suffer the resultant side effects.

Reporting Hospital's Recommendations

The hospital's medication safety team decided to address these contributing factors by standardizing the PCA dosing process and revising the standard PCA order form, as described below.

- A guide for prescribers was developed indicating an appropriate opioid dose based on the patient's age and opioid tolerance (see

Table 2 below).

- The basal infusion component was eliminated except in opioid-tolerant patients.
- The opioid order set was rearranged to match the sequence in which the medications appear on the facility's smart IV pumps.
- A registered nurse is required to screen patients for OSA before PCA initiation, with further assessment by a respiratory therapist if the screening shows two or more risk factors (see Table 3 on page 3).
- Continuous pulse oximetry is required (capnography preferred if available) while on PCA therapy if the patient has a continuous basal infusion, has sleep apnea, is over 64 years of age, or is morbidly obese.
- Patient education is required and must include instructing the patient's family members not to push the PCA button for the patient (PCA by proxy).

The hospital also uses smart pumps for PCA therapy, with one standardized concentration for each drug and dose limits set in the pump library. Before converting to smart pumps, two PCA programming errors had occurred in recent years leading to serious respiratory depression. Since switching to smart pumps, no programming errors have been reported at the hospital.

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Table 2. Recommended opioid doses on facility's new PCA order form.

HYDROMorphone	Most patients	Over 64 yrs or sleep apnea	Opioid-tolerant
PCA dose	0.3 mg	0.2 mg	0.4 mg
Lockout interval	10 minutes	10 minutes	10 minutes
Continuous dose	none	none	0.3 mg/hr (with pulse ox)
Maximum limit in 4 hrs	4 mg	3 mg	6 mg
Loading dose	0.6 mg	0.4 mg	1 mg
Morphine	Most patients	Over 64 yrs or sleep apnea	Opioid-tolerant
PCA dose	1 mg	0.7 mg	1.2 mg
Lockout interval	10 minutes	10 minutes	10 minutes
Continuous dose	None	None	2 mg/hr (with pulse ox)
Maximum limit in 4 hrs	20 mg	15 mg	30 mg
Loading dose	3 mg	2 mg	4 mg

Repeat loading dose IV every 4 hours if needed for breakthrough pain.

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There he found the physician suspected mycoplasma pneumonia, and to make the diagnosis, he ordered a mycoplasma IgM titer, which is found in 80% of *M. pneumoniae* cases within 1 week of infection. Mystery solved, but it does point out potential dangers of incomplete nomenclature. Had the ID physician written "mycoplasma IgM titer," the order would have been less confusing. There is also danger when using improper abbreviations. People get used to them, which could eventually lead to confusion, as happened here. Although "gm" is

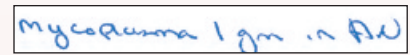


Figure 1: Transcription on nurse's MAR.

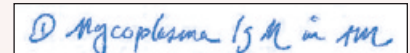


Figure 2: Original physician order.

commonly seen as an abbreviation for grams, the USP approved abbreviation for gram is a lower case letter "g" only.

Fatal sound-alike. Here's a sound-alike situation we haven't previously run across. A pharmacist from Ireland told us about a patient who was given parenteral morphine. The patient was quite sensitive to the drug and developed respiratory depression. The patient's physician called in an order for an ampul of naloxone to be given. A dose was prepared and given but there was no response. A repeat order for a second ampul of naloxone was given and again the patient didn't respond. The nurse questioned the physician, "How much of this Lanoxin do you want me to give?" This type of error is a *metathesis*, or transposition of speech sounds or syllables, like saying TRADEGY instead of TRAGEDY. Instead of NaLoxone, the nurse heard LaNoxin. The patient subsequently died. Contributing to the error, the nurse had not read back (or at least repeated back) the telephone order and the physician had prescribed an ampul of the drug rather than a metric weight dose. The nurse accepted the incomplete order and administered an ampul of **LANOXIN** (digoxin) both times.

ISMP survey helps define near miss and close call

We extend our sincere thanks to more than 3,800 readers who participated in our survey regarding the definition of a near miss! ISMP agrees with the vast majority of respondents (88%) who defined a near miss as **an error that happened but did not reach the patient**. These errors are captured and corrected before reaching the patient, either through chance or purposefully designed system controls that have been put in place. Thus, reporting near misses can help to evaluate whether capture opportunities are functioning poorly or functioning well.

Only 3% of respondents defined a near miss as **an error that reached the patient but did not result in harm**. Yet, this is closer to how a near miss is defined by some state reporting programs and the Agency for Healthcare Research and Quality (AHRQ) (www.psnnet.ahrq.gov/glossary.aspx).

According to the AHRQ definition, a near miss is an “event or situation that did not produce patient injury, but only because of chance.” Thus, the good fortune of not harming a patient might reflect how robust the patient is or how fortuitous a timely intervention by the provider may be. The problem with the AHRQ definition is twofold: 1) It does not clarify whether the harmless error reached the patient; and 2) It fails to foster ongoing evaluation of system controls that can help capture errors or prevent patient harm once the error has reached the patient. Instead, it implies that patient harm was avoided purely by chance, giving little

credence to capture and recovery opportunities that may be working well or in need of improvement.

Several respondents suggested that the term near miss is a confusing misnomer, and that a near miss is really a near “hit” or near “error.” A near “miss” is more applicable when trying to “hit” something, not avoid something. They suggested “close call” as a better term, and we agree. Although near miss appears to be well entrenched in healthcare terminology, we will try to refer to near misses as close calls when feasible in the future (see Table 1).

Table 1. Definition of a Close Call (Near Miss)

Close call (near miss): An event, situation, or error that took place but was captured before reaching the patient. For example, penicillin was ordered for a patient allergic to the drug; however, the pharmacist was alerted to the allergy during computer order entry, the prescriber was called, and the penicillin was not dispensed or administered to the patient. Or the wrong drug was dispensed by pharmacy, and a nurse caught the error before it was administered to the patient.

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Additional ISMP Recommendations

Basal infusions are not recommended unless the patient is *opioid-tolerant*. *Opioid-tolerant* patients are ones who have received opioids regularly for approximately 7 days or longer. *Opioid-naïve* patients who present with high opioid requirements may be an exception and require a basal infusion, but additional safety steps (e.g., capnography) should be instituted.

Listed below are additional PCA recommendations for consideration.

- Evaluate the level of pain, alertness, and vital signs, including rate and respiration quality, every 2-4 hours.
- Evaluate all patients with minimal

verbal and tactile stimulation to obtain an accurate assessment of their level of sedation.

- Monitor patients more frequently during the first 24 hours and at night, when hypoventilation and nocturnal hypoxia may occur.
- Employ early warning devices such as apnea alarms at night and capnography, which can alert practitioners to respiratory insufficiency.

More recommendations related to PCA can be found in our January and February 2005 newsletters at: www.ismp.org/Newsletters/nursing/Issues/NurseAdviseERR200501.pdf and www.ismp.org/Newsletters/nursing/Issues/NurseAdviseERR200502.pdf.

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Table 3. RN screening for sleep apnea

- Is the patient's body mass index greater than 25?
- Does the patient have a history of excessive daytime sedation?
- Does the patient have a history of snoring?
- Does the patient have a history of hypertension?

If two of the factors are positive, consult respiratory therapy for a modified Berlin sleepiness screening.

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Please join ISMP in acknowledging the invaluable contributions that pharmacists and technicians make to patient care in our nation's healthcare institutions. **Pharmacy Week** is an ideal time for nurses and other healthcare professionals to let pharmacists and technicians know how much their efforts to promote safe and effective medication use have contributed to patient safety!

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