Inadvertent Mix-Up of Morphine and Hydromorphone: A Potent Error

Morphine is the quintessential opioid agonist and the accepted standard against which other opioids are tested in controlled clinical trials. However, because some patients cannot tolerate morphine or have conditions such as renal or hepatic impairment that may impact its use, another opioid may be needed as a replacement drug. Hydromorphone (Dilaudid®) is a common alternative to morphine for treating pain. When a patient requires an alternative to morphine, the analgesic equivalence between morphine and the alternative needs to be considered. The most common hospital-based source of medication errors involving potency is when a patient is switched from morphine to hydromorphone.

Hydromorphone by any route is significantly more potent than morphine, as indicated by the following:

- **Oral** hydromorphone is approximately four times more potent than **oral** morphine.
  - For example, 7.5 mg hydromorphone per os (PO) = 30 mg morphine PO.
- **Parenteral** hydromorphone is approximately **seven** times more potent than **parenteral** morphine.
  - For example, 1.5 mg hydromorphone intravenous (IV) = 10 mg morphine IV.
- **Parenteral** hydromorphone is approximately **20** times more potent than **oral** morphine:
  - For example, 1.5 mg hydromorphone IV = 30 mg morphine PO.

In addition, name similarities have led to inadvertent mix-ups between morphine and hydromorphone, or the mistaken belief that hydromorphone is the generic name for morphine. Analysis of wrong drug errors submitted to PA-PSRS shows that mix-ups between these two medications outnumber all other pairs of medications (see “Common Medication Pairs that Contribute to Wrong Drug Errors” elsewhere in the September 2007 issue of the PA-PSRS Patient Safety Advisory Advisory). When errors occur with these two medications and the same milligram dose is given (e.g., hydromorphone 5 mg IV given instead of morphine 5 mg IV), the potential for harm exists. In the previous example, 5 mg of parenteral hydromorphone is equivalent to 35 mg of parenteral morphine.

A few reports submitted to PA-PSRS involved breakdowns in the communication of drug orders, such as the following:

A doctor and nurse were at the patient’s bedside. The doctor spoke about considering Dilaudid, but at the command post the doctor gave a verbal and written order for morphine. The nurse stated that she did not hear the verbal order and Dilaudid had been given. The patient became lethargic and diaphoretic, and the rapid response team was called. Narcan was given and patient improved within a few minutes.

A patient’s pre-op orders were continued along with the post-op orders which were written. The patient had been ordered Dilaudid IV pre-op and morphine IM post op. A nurse continued to give Dilaudid IV. The patient developed respiratory distress and was transferred to the telemetry unit.

Some of the errors reported to PA-PSRS, such as the following, occurred when the pharmacy department dispensed the wrong medication or replenished an automated dispensing cabinet (ADC) or unit stock with the wrong medication:

A patient was ordered morphine for pain. There was a possibility that the patient received Dilaudid instead of morphine. Morphine and Dilaudid were later found mixed in the morphine drawer in the ADC. No injury to patient.

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The unit’s ADC was restocked with morphine 4 mg injection instead of Dilaudid 4 mg injection. A patient received two doses of morphine instead of the ordered medication of Dilaudid.

Seventy-one percent of reports of mix-ups between morphine and hydromorphone indicate that the errors occurred when these medications were obtained from unit stock (i.e., ADCs, medication carts), prior to administration. Examples include the following:

During the 3-11 shift change report, the oncoming nurse was told that a patient was receiving morphine [patient-controlled analgesia (PCA)]. Upon checking the PCA settings, the patient asked why he was now on morphine, as he was getting no relief. The nurse checked orders and found that the patient should have been on Dilaudid PCA. The incorrect medication had been removed from the ADC and had been infusing for approximately five hours.

Dilaudid 4 mg was removed from narcotic drawer instead of morphine 4 mg. The nurse attempted to scan the drug but aborted the effort when the computer did not accept the scan and thought it was a malfunction. The patient received the medication but remained stable.

In the emergency room, a physician ordered Dilaudid for the patient. Upon discharge, the nurse removed the medication from the automated dispensing cabinet and unknowingly gave the patient morphine to take home, thinking it was Dilaudid. After completing a discrepancy check with Pyxis, the error was discovered. The patient was called at home, but the patient had already taken the medication. There were no complications per the patient.

Further analysis of these wrong drug reports involving either morphine or hydromorphone shows that:

- The most common care areas where this mix-up occurred were medical/surgical units, medical/oncology units, emergency departments (EDs), and telemetry units.

- Elderly patients (patients 65 years and older) were involved in 34% of the reports.

Adverse events related to inadvertent mix-up of these two medications have occurred elsewhere. In a tragic event that took place in Canada, a 69-year-old patient was given 10 mg of hydromorphone IM instead of 10 mg of morphine. The patient presented to the ED with a chest injury sustained while horseback riding. Prior to discharge, the ED physician wrote an order for morphine 10 mg IM for pain, but hydromorphone was mistakenly selected from the narcotic drawer. Both hydromorphone and morphine were stocked in 1 mL, 10 mg/mL ampuls. Based on equianalgesic dose conversion charts, the patient, who was likely opiate-naïve, received an equivalent dose of about 60 to 70 mg of morphine. Shortly after the patient was discharged, the nurse discovered the error after a scheduled narcotic count showed a discrepancy between the two drugs. Hospital staff immediately tried to contact the patient and finally located him in a rural hospital close to his home. The patient’s condition had rapidly deteriorated until he arrested. Despite rescue efforts, the patient died.

Another example includes an error in a hospital, where the darkness of the room during laser surgery (i.e., all lights were off except a spotlight) contributed to mix-ups between look-alike, prefilled syringes of morphine and hydromorphone. (See photos of look-alike syringes.) In a third case, hydromorphone 4 mg cartridges were mixed in with similar looking morphine 4 mg cartridges in the floor stock narcotic cabinet. The hydromorphone was administered instead of morphine for postoperative pain control. Unfortunately, two hours later the patient was found dead.

The Joint Commission has turned its attention to the confusion between these names and the potential harm that can occur, as is reflected in its National Patient Safety Goal 3C, which states that organizations, in order to improve the safety of using medications, “identify and, at a minimum, annually review a list of look-alike/sound-alike drugs used in the organization, and take action to prevent errors involving the interchange of these drugs.” The Joint Commission has included morphine and hydromorphone as a name pair that both acute care and ambulatory care sites should consider adding to their look-alike/sound-alike lists.
Safe Practices
Mix-ups between morphine and hydromorphone are the most common and potentially serious errors that can occur involving two high-alert drugs. This risk exists in almost every facility in Pennsylvania. Assume that this error will eventually happen in your facility, and consider the following steps to reduce the risk of patient harm.\(^7\)

**Limit access.** Reduce stock amounts of hydromorphone wherever possible, and eliminate it from floor stock if usage is low. For example, some health systems where this type of error occurred removed all hydromorphone from every ED in the health region. If the drug is needed on patient care units, only the 2 mg/mL strength is available, except in palliative care units. The pharmacies in these health systems continue to stock hydromorphone for compounding PCA or continuous infusions.

**Reduce options.** If both drugs are available in patient care units, avoid stocking morphine and hydromorphone in the same strength. For example, since both drugs are available in 2 mg and 4 mg prefilled syringes, stock 2 mg of hydromorphone and 4 mg of morphine (but not vice versa, since 4 mg of hydromorphone could be an excessive dose). If the drugs are stored in an ADC, consider allowing access to morphine via an override function in emergencies, but require pharmacy order review before removing a first dose of hydromorphone. Also, be sure to store each medication in a separate, individual bin or drawer in the ADC or unit-stock to help prevent drug selection errors. In the pharmacy, segregate prefilled syringes and vials of these drugs, especially if they contain the same concentration.

**Reduce “look-alike” potential.** When possible, use tall man lettering to emphasize the lettering, like “HYDRO” or “PHONE” on pharmacy labels, auxiliary labels, medication administration records, preprinted orders and drug listings on prescriber and pharmacy order entry screens or ADCs. Consider adding label reminders on hydromorphone indicating the brand name equivalent, “DILAUDID,” to help prevent confusion. Some ADCs may also offer the capability of asking “This is DILAUDID. Is that correct?” when nurses retrieve hydromorphone.\(^10\)

**Employ technology.** Technological solutions (e.g., bar coding, automated dispensing technology that requires pharmacy order screening prior to dose retrieval) may reduce, but not eliminate, the risk of mix-ups.

**Require redundancies.** Require an independent double check before administering IV narcotic doses. Since nurses routinely obtain narcotics from floor stock, the typical pharmacist-nurse double check is not in place (as it is with patient-specific doses dispensed from the pharmacy). Some ADCs can be programmed to require a licensed “witness” when selected narcotics are removed, or when the override feature is used to access selected narcotics. Reminders can also appear on the screen.

**Monitor patients.** Implement policies that specify the scope, frequency, and duration of monitoring that should occur before discharging patients who have just received a parenteral narcotic.

**Educate staff.** Provide safety information on the use of potent narcotics via newsletters and in-service meetings. Educate staff about the differences between hydromorphone and morphine, as some of the reported mix-ups have been due to the mistaken belief that hydromorphone is the generic name for morphine.

**Educate patients.** Prior to administration of a narcotic, repeat the name of the medication out loud to the patient as another source of confirmation.

**Notes**
Inadvertent Mix-Up of Morphine and Hydromorphone: A Potent Error (Continued)


Self-Assessment Questions

1. The approximate equianalgesic dose of oral hydromorphone is which one of the following?
   A. One-tenth the dose of oral morphine
   B. One-fourth the dose of oral morphine
   C. Equal to the dose of oral morphine
   D. Twice the dose of oral morphine
   E. Ten times the dose of oral morphine

2. The approximate equianalgesic dose of parenteral hydromorphone is which one of the following?
   A. One-tenth the dose of parenteral morphine
   B. One-fourth the dose of parenteral morphine
   C. Equal to the dose of parenteral morphine
   D. Twice the dose of parenteral morphine
   E. Seven times the dose of parenteral morphine

3. Conditions that may contribute to harm from mix-ups between morphine and hydromorphone include all EXCEPT which one of the following?
   A. The more potent morphine is given instead of hydromorphone
   B. The location of care areas (e.g., the emergency department)
   C. The similarity in the names of the medications
   D. Breakdown in the communication of drug orders

4. Which of the following steps would not help to reduce the risk of patient harm with the use of morphine and hydromorphone?
   A. Reducing the number of available concentrations of both drugs
   B. Allowing unlimited stock of these medications
   C. Using tall man lettering to differentiate hydromorphone from morphine
   D. Learning about the differences between both medications

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Selected articles in previous issues include:

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- “Bone Cement Implantation Syndrome” (December 2006)
- “Delays in the OR: Stress between ‘Running Two Rooms’ and ‘Time Outs’” (September 2006)
- “Doing the ‘Right’ Things to Correct Wrong-Site Surgery” (June 2007)
- “I’m Stuck and I Can’t Get Out! Hospital Bed Entrapment” (December 2006)
- “Improving Safety of Telephone or Verbal Orders” (June 2006)
- “Mismanagement of Expressed Breast Milk” (June 2007)
- “Safety in Using Promethazine (Phenergan)” (March 2007)
- “Skin Tears: The Clinical Challenge” (September 2006)
- “Who Administers Propofol in Your Organization?” (March 2006)
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The Institute for Safe Medication Practices (ISMP) is an independent, nonprofit organization dedicated solely to medication error prevention and safe medication use. ISMP provides recommendations for the safe use of medications to the healthcare community including healthcare professionals, government agencies, accrediting organizations, and consumers. ISMP’s efforts are built on a non-punitive approach and systems-based solutions.