

Risk of Mix-ups between Ephedrine and Epinephrine

As a vasoconstrictor, epinephrine is 100 to 1,000 times more potent than ephedrine.¹ Mix-ups between these two drugs have resulted in serious patient harm. The Closed Claims Project of the American Society of Anesthesiologists found that errors involving epinephrine are particularly dangerous.² Among the 205 medication incidents in this review, epinephrine was identified as a drug of top concern: 11 of the 17 incidents with epinephrine resulted in death or major morbidity.² Six of these 17 cases involved mix-ups between epinephrine and the intended drug, and two of these involved ephedrine (the other mix-ups involved oxytocin or hydralazine). This bulletin highlights a report received by ISMP Canada involving a critical incident with a mix-up between ephedrine and epinephrine.

The drug names “ephedrine” and “epinephrine” look-alike. The problem of look-alike names is compounded by the fact that both names start with the letter “e” and the drugs are therefore likely to be stored in close proximity in medication storage areas that are arranged in alphabetical order by generic name. Even in storage areas where drugs are organized by pharmacological class or action, these two drugs may be stored near one another because both are vasopressors (i.e., vasoconstricting agents). The products may also be similarly packaged (in 1 mL ampoules) (Figure 1).



Figure 1. Examples of ephedrine and epinephrine packaging (all are 1 mL ampoules). From left to right: ephedrine 50 mg/mL, epinephrine 1 mg/mL, (one manufacturer) and epinephrine 1 mg/mL (another manufacturer).

A Canadian hospital reported the following incident to ISMP Canada, along with lessons learned, in an effort to help other facilities to prevent similar events:

A patient in labour (full-term pregnancy) was admitted to a labour and delivery unit. Epidural anesthesia with fentanyl and bupivacaine was initiated. The patient experienced a feeling of weakness and became

hypotensive shortly after the epidural infusion was started. Oxygen and a plain intravenous fluid bolus were ordered by the anesthesiologist. The patient’s blood pressure remained low, and the anesthesiologist was called. The anesthesiologist provided a telephone order to stop the epidural infusion and administer one dose of ephedrine 5 mg IV. The nurse drew up 5 mL of epinephrine 1 mg/mL (a total of 5 mg) instead of ephedrine. As the nurse began to administer what she thought was ephedrine by direct IV injection, the patient experienced severe hypertension (blood pressure approximately 190/130 mm Hg), tachycardia (heart rate approximately 135 beats per minute), and nausea. The nurse stopped administration of the drug, and the anesthesiologist and obstetrician were called stat. When the anesthesiologist arrived a few minutes later, the patient was vomiting and was experiencing blurred vision. It was discovered that a total of 1.3 mg of epinephrine had been administered instead of ephedrine.

After delivery, the infant was examined by the pediatrician, who determined that the newborn was healthy. The mother was transferred to the intensive care unit for continued close monitoring and observation. Approximately one day later, she was transferred to the postpartum unit. Both the mother and the infant were discharged home several days later. A cardiology follow-up indicated that the mother had probably experienced a subendocardial myocardial infarction.

The hospital identified a number of factors contributing to this incident, including the following:

- The nurse believed that epinephrine was another name for ephedrine.
- Ephedrine 50 mg/mL and epinephrine 1 mg/mL ampoules were stored side by side on the epidural cart.
- Because of the perceived urgency of the situation, drug information was not checked before administration.

A number of recommendations and actions were taken by the hospital to reduce the likelihood of a similar event, including the following:

- Re-evaluate the need to have both products stocked in patient care areas (i.e., ensure that each item is available only where needed).
- Physically separate ephedrine and epinephrine.
- Implement TALLman lettering on labels used in the drug storage area.

- Restrict the authority to administer ephedrine to the anesthesiologist in the labour and delivery unit.
- Review and update current policies, and revise the drug information available in patient care areas (e.g., in the medication administration manual).
- Ensure the competency of all nursing staff involved in the medication use process for these medications.

The accidental administration of epinephrine instead of ephedrine has been highlighted in other published reports,^{3,4,5} including those of the Institute for Safe Medication Practices in the United States (ISMP).^{6,7,8} In one case, the administration of epinephrine 5 mg IV instead of ephedrine 5 mg IV was averted when only three ampoules of epinephrine 1 mg/mL were available in an automated dispensing cabinet; this led the nurse to call the pharmacy, at which point the potential error was discovered.⁷ In another case, a nurse was able to borrow additional epinephrine from the nursery (a 30 mL vial of epinephrine 1 mg/mL), and the error was not averted.^{7,8} It is noteworthy that reverse mix-ups have also been reported.⁸ In one case, ephedrine was inadvertently used to admix an epinephrine infusion. In another case, an irrigation solution was prepared with ephedrine rather than epinephrine and was used for irrigation during an orthopedic procedure. In both cases, the patients experienced minor complications; serious harm was averted because the patients were being monitored closely.

A number of recommendations to reduce the potential for confusion between ephedrine and epinephrine, including those previously made by ISMP US, are provided here for additional consideration:

- **Review.** Review all areas where ephedrine and epinephrine are stored to determine that they are both required in those locations. For instance, epinephrine 1 mg/mL ampoules may be stocked outside of a “crash cart” for administration in case of anaphylaxis or anaphylactoid reactions (e.g., adult dose: epinephrine 0.2 mg to 1 mg, given subcutaneously or intramuscularly).⁹ Ephedrine is less widely required in patient care areas as its use is most common in the treatment of drug-induced hypotension from anesthesia (e.g., maternal hypotension during epidural anesthesia).¹⁰ When either or both are required in a patient care area, ensure optimal amounts and optimal storage (e.g., assess storage risks associated with availability, restricted availability or removal from patient care area locations). Avoid stocking these medications side by side. In addition, the 30 mL multi-dose vial of epinephrine 1 mg/mL presents a particular hazard and should not be stored in patient care areas. If a 30 mL vial must be stored outside the pharmacy, multiple strategies must be employed to prevent its inadvertent use (e.g., alert staff about the potential problem, use auxiliary warning labels).

- **Differentiate.** Ask the pharmacy to assist in differentiating the appearance of these look-alike drug names throughout the medication use process (e.g., on computer screens, pharmacy and nursing unit shelves, and bins [including automated dispensing cabinets], pharmacy product labels, and medication administration records) by use of highlighting, boldface, colour, or TALLman lettering (e.g., ePHEDrine, EPInephrine).
- **Ensure that essential drug information is readily available.** Ensure that essential drug information is readily available and accessible in a useful format to practitioners, wherever these drugs are prescribed, dispensed, or administered.
- **“More than two, call pharmacy.”** Because typically only one ampoule or single use vial is required when a dose of a medication is given by direct IV injection (“IV push”), staff should be on the alert to question a dose and call pharmacy whenever more than two ampoules or vials are required to administer a single dose.
- **Alert practitioners.** Alert practitioners to the potential confusion between the names of these drugs by widely sharing this bulletin with staff (e.g., nurses, physicians, pharmacists). Consider highlighting information related to drug name confusion as part of staff training and communications.

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National Survey: Concentrated Potassium Chloride. Deadline Extended until May 25, 2007.

As part of a knowledge translation research project to evaluate the practices for handling concentrated potassium chloride, ISMP Canada in partnership with a patient safety research team, has asked Canadian Directors of Pharmacy to complete a survey. The purpose of the survey is to identify the barriers to removal of concentrated potassium chloride from all patient care areas. The deadline for hospitals to complete this survey has been extended to May 25, 2007. Your participation in this survey is very important and greatly appreciated. For further information, please visit ISMP Canada's website: www.ismp-canada.org/kclsurvey.

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ISMP Canada is a national voluntary medication incident and 'near miss' reporting program founded for the purpose of sharing the learning experiences from medication errors. Implementation of preventative strategies and system safeguards to decrease the risk for error-induced injury and thereby promote medication safety in healthcare is our collaborative goal.

Medication Incidents (including near misses) can be reported to ISMP Canada:

- (i) through the website http://www.ismp-canada.org/err_report.htm or
- (ii) by phone: 416-733-3131 or toll free: 1-866-544-7672.

ISMP Canada can also be contacted by e-mail: cmirps@ismp-canada.org. ISMP Canada guarantees confidentiality and security of information received, and respects the wishes of the reporter as to the level of detail to be included in publications.

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