



Nurse Advise-ERR®

Educating the healthcare community about safe medication practices

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Independent double-checks are vital, not perfect

Double-checks for certain high-alert medications help prevent errors from reaching a patient, but the following scenarios show why they are not always foolproof.

Heparin error. A physician ordered a heparin infusion with directions to follow a weight-based nomogram for lab monitoring and dose adjustments. Based on results of the patient's APTT level, the nomogram indicated the patient should get a bolus dose of heparin 1,700 units IV. The nurse removed a 10 mL vial of heparin (1,000 units/mL) from an automated dispensing cabinet (ADC) to prepare the dose, but she miscalculated the volume needed as 17 mL, not 1.7 mL. Concerned that she would have to use a second vial to prepare the bolus, she asked another nurse to "look at my math" to make sure she had not made an error. But the other nurse didn't actually recalculate the volume needed, so she made the same error when "looking over" her colleague's work. The patient received 17,000 units of heparin and developed severe epistaxis.

Morphine error. An epidural infusion of fentaNYL (2 mcg/mL) with bupivacaine (0.125%) was started on a 62-year-old man who had just undergone a lobectomy for lung cancer. An outside company the pharmacy used to supply pain control infusions had prepared the bag of fentaNYL with bupivacaine. Several nights later, a supervisor went to retrieve a replacement bag from an ADC and accidentally picked up a premixed bag of morphine (1 mg/mL) intended for IV use. Both the IV morphine and epidural fentaNYL/bupivacaine bags were located in the same drawer, both were prepared by the same outside

company, and both were packaged in identical brown plastic overwraps to shield the solutions from light. The labels, located on one side of the overwraps, looked similar, and each product was supplied as 100 mL in a 150 mL bag. The supervisor brought the bag to the nursing unit. A second nurse double-checked the product but also failed to notice the mistake because the bag was packaged in the brown overwrap, as she had come to expect. The morphine was hung and the patient's respiratory status began to deteriorate. The epidural infusion was temporarily turned off, but no one noticed the error. It finally became evident when a nurse was documenting the waste after the epidural catheter was removed.

You can't rely on manual double-check systems alone to catch all errors.

Although multiple system failures contributed to these errors, in both cases, failed double-checks allowed the errors reach the patients. By understanding how the double-checks were done and the differences between endogenous (caused by internal factors) and exogenous (caused by external factors) errors, you can help avoid making similar mistakes.¹

Endogenous errors

An endogenous error arises within an individual who makes a random error such as making a mental slip and prescribing an incorrect dose, or making a math error and miscalculating a dose. In the heparin overdose, the nurse made an endogenous error when calculating the volume needed from the vial. Because endogenous errors arise within one person, a second person performing an independent double-check may not follow the same faulty thinking and is likely to detect the error.

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Alcohol abuse and hand sanitizers. Readily available dispensers of alcohol-based hand sanitizers may be a bit too inviting for patients prone to severe alcohol abuse, according to a letter in the *American Journal of Health-System Pharmacy* (Bookstaver PB, Norris LB, Michels JE. Ingestion of hand sanitizer by a hospitalized patient with a history of alcohol abuse. 65: 2203-4). The authors reported a case in which a hospitalized patient with a known history of ingesting rubbing alcohol and alcohol-containing hand sanitizer and mouthwash was witnessed on two occasions ingesting **AVAGARD** foam hand antiseptic from a wall dispenser. Avagard contains 62% alcohol. After the second occurrence, staff removed the hand sanitizer from the wall. The authors pointed out that patients with a history of nonpotable alcohol ingestion require careful assessment of abuse patterns in light of the availability of alcohol-based hand sanitizers in hospitals. Their presence increases the risk of alcohol intoxication, falls, and drug interactions. The authors recommended temporary removal of alcohol-based hand sanitizers from wall dispensers when high-risk patients are present.

Unintended consequences of high-alert stickers. Some hospitals and pharmacies are labeling high-alert medications with special "high-alert drug" stickers sold by various vendors. This practice might be detrimental to your safety efforts if you apply these stickers to too many drugs or if you forget to apply them to a targeted drug, as in the following example. At change of shift, a nurse checked a patient's blood sugar with a point-of-care blood glucose meter and saw that

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Benzocaine spray and methemoglobinemia

Before placing a nasogastric tube in a 74-year-old man, a physician administered three sprays of **HURRICAINÉ** (20% benzocaine), 1-2 seconds each, to numb the patient's throat. An hour later, the patient became hypoxic and did not improve despite receiving oxygen. A blood gas was drawn, which had a chocolate appearance, prompting an order for a methemoglobin level. The result was 46% (normal is less than 1%). Methylene blue was infused and 2 hours later, the patient's methemoglobin level was normal at 0.9%.

Hurricane spray contains benzocaine which is known to cause methemoglobinemia, a condition evidenced by abnormal levels of oxidized hemoglobin. The oxidized hemoglobin binds so firmly with oxygen that little oxygen is available to tissues. When induced by benzocaine, methemoglobinemia can result in life-threatening conditions. Normally, methemoglobin is 1% of circulating hemoglobin. Cyanosis occurs as the level rises above 10%. Anxiety, fatigue, and tachycardia appear at 20% to 50%, and from 50% to 70%, coma and death may result.

The risk of methemoglobinemia due to benzocaine increases with the number and duration of sprays administered. According to the Hurricane package insert, a ½ second spray should be administered, which may be repeated once. However, acknowledging human performance limitations, no one can reliably estimate fractions of seconds or visualize how thickly the spray coats the throat. Due to the risk of adverse events, the hospital where the event occurred removed benzocaine sprays from its formulary.

Four years ago, the Institute for Safe Medication Practices (ISMP) identified and analyzed 132 cases of life-threatening benzocaine-induced methemoglobinemia¹ from reports submitted to ISMP and the US Food and Drug Administration (FDA). The cases included 107 serious adverse events (81.1%) and 2 deaths (1.5%).

Topical benzocaine has also been linked to Sudden Infant Death Syndrome (SIDS). A case reported in the literature involved the death of a 4-month-old infant that was classified as SIDS but later found to be benzocaine toxicity and methemoglobinemia.² Postmortem toxicology showed a methemoglobin level of 36%. The child received three times more **ALLERGEN Ear Drops** (5.4% antipyrine, 1.4% benzocaine) than prescribed on the day prior to his death.

Not all clinicians realize benzocaine in topical sprays is absorbed systemically. In most cases of methemoglobinemia, clinicians used multiple sprays of benzocaine-containing products, or sprays of longer duration than recommended. Some products that contain benzocaine are available without a prescription, so patients could also use too much spray, gargle too often with a liquid form, or even swallow it.

Prompt recognition and treatment can be challenging because elevations of methemoglobin can produce normal pulse oximetry readings. Drawing arterial blood for co-oximetry, to directly measure methemoglobin levels, is needed. The brown appearance of arterial blood is another clue.

Some patients may be predisposed to methemoglobinemia:

- Infants less than 6 months of age
- The elderly with cardiac problems
- Patients with altered hemoglobin, such as G6PD deficiency or methemoglobin reductase enzyme deficiency.

Application of benzocaine products to inflamed areas, which absorb more drug, can also contribute to the problem. See **checkitout!** for recommendations on how to reduce the risk of harm from methemoglobinemia.

References: 1) Moore TJ, Walsh CS, Cohen MR. Reported adverse event cases of methemoglobinemia associated with benzocaine products. *Arch Intern Med* 2004;164:1192-1196. 2) Logan BK, Gordon AM. Death of an infant involving benzocaine. *J Forensic Sci* 2005;50(6):1486-8).

checkitout! ✓✓✓✓

To reduce the risk of harm from methemoglobinemia when using benzocaine topical anesthetics:

- ✓ **Ask patients** who may receive topical anesthetics about their medical history to determine if risk factors for methemoglobinemia (e.g., G6PD deficiency) are present.
- ✓ **Stock just one** topical anesthetic spray to enhance staff familiarity with the product and its proper dosing, and limit areas where it is stocked (e.g. ICU, OR, where patients are intubated).
- ✓ **Have pharmacy apply warning labels** to remind nurses to avoid sprays of longer duration than recommended.
- ✓ **Use a metered-dose spray** product of 20% benzocaine if possible (check with pharmacy for availability), and avoid multiple sprays.
- ✓ **Document** the number and duration of sprays applied to keep track of the amount of drug administered.
- ✓ **Consider methemoglobinemia** if cyanosis develops after application of topical anesthetics, even if pulse oximetry readings are normal.
- ✓ **Become familiar** with treating methemoglobinemia if you administer topical benzocaine.
- ✓ **Have supplemental oxygen** and methylene blue (given 1 to 2 mg/kg IV to enhance the oxygen-carrying capacity of hemoglobin) available where benzocaine sprays are used.
- ✓ **Warn patients** who use topical anesthetics at home (e.g., oncology patients, parents of teething infants and children) about methemoglobinemia.
- ✓ **Consider alternatives** to benzocaine spray, such as viscous lidocaine, lidocaine jelly, or lidocaine preservative-free ampuls (maximum recommended dose of 200 mg), which should be used with an atomization device.



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Had the second nurse done the math calculations herself without prior knowledge of the first nurse's work, she would have been far more likely to detect the error.

Exogenous errors

An exogenous error arises from external conditions such as poor product labeling, illegible handwriting, or unclear information. In the epidural error, the nurse made an exogenous error related to the look-alike packaging of the IV bags provided by the outside company. Although the second nurse performed an independent check, she failed to uncover the error. Double-checks, even when performed independently, are less successful in detecting exogenous errors because some of the external factors that initially led to the error are still present, and people with similar training may make the same mistake.

Although double-check systems sometimes fail, they still play a vital role in error detection when used at the most vulnerable points of the medication use system and when performed *independently*. But you can't rely on manual double-check systems alone to catch all errors.

System changes are necessary to reduce error frequency.

For example, better labeling of IV and epidural products would have helped prevent the morphine error. The hospital that reported this error now applies large yellow "FENTANYL/BUPIVACAINE For Epidural Use Only" labels (to match the yellow stripe in the epidural tubing) or blue "CONTAINS MORPHINE For IV Use Only" labels on the bags and the overwraps. Labels are applied to both sides of the bags and overwraps so they are visible regardless of the bag's orientation on the IV pole or storage area. These labels are also applied to the cartons stocked in the pharmacy and the products are now stored separately in both the pharmacy and ADCs. Bedside bar-coding systems can also help prevent product mix-ups.

In a case like the heparin overdose, system-based error-reduction strategies can be used to prevent further calculation errors. Dosing charts that eliminate the need for calculations and pharmacy preparation of all non-emergency drugs are two examples.

Reference: 1) Senders J. Essays on human error in medicine. October 2000; ISMP Canada. Accessed at: www.ismp-canada.org/smp0010.htm.

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it registered under 10 mg/dL! The patient's doctor was contacted, and the patient, who was hardly arousable, was given 50% dextrose IV push and started on a dextrose infusion. Upon checking the patient's IV infusions, the nurse noticed that, instead of hanging a 100 mL fluconazole IV piggyback as prescribed, another nurse had hung insulin 100 units in 100 mL by mistake. In this hospital, it was standard practice to label high-alert drugs like IV insulin with a high-alert sticker, but pharmacy staff had inadvertently omitted the sticker. Without the sticker, the 100 mL bags looked similar, and the nurse, who was accustomed to high-alert stickers on insulin bags, picked up the wrong one and hung it. While the failure to place a required warning label on a targeted product is a proximate cause of this error, sometimes "warnings" can be too numerous to be effective. For example, computer order-entry alerts are beneficial when used selectively, but they sometimes result in "alert fatigue" whereby the provider, after receiving too many alerts, ignores and/or overrides them, rendering the alerts useless. Placing high-alert stickers on all or most high-alert drugs may similarly dilute your efforts to make items stand out. ISMP encourages selective use of auxiliary labels to call attention to very specific product problems. Once a drug has been designated to receive an auxiliary label, a process should be established to ensure that the label is applied consistently.

Special Announcements

Patient Safety Awareness Week.

March 8-14, 2009, is the time established by the National Patient Safety Foundation to celebrate **Patient Safety Awareness Week** (www.npsf.org/hp/psaw/). To help celebrate this year's theme—*A Prescription for Safety; One Partnership, One Team*—ISMP is offering a **40% discount** (while supplies last) on two videos you can broadcast in your facility for patients, visitors, and staff to view:

- Patients Play a Vital Role in Patient Safety
- Patient Safety Requires a Team Effort.

To place an order, visit: <http://onlinestore.ismp.org/>. We also encourage you to invite your patients, visitors, and staff to visit **ConsumerMedSafety.org**, our new consumer website (www.consumermedsafety.org), and to sign up for free, personalized drug safety alerts.

ISMP Fellowship. ISMP is now accepting applications for its 2009-2010 **Safe Medication Management Fellowship**.

This yearlong learning opportunity, funded by Cardinal Health Foundation, offers practitioners interested in patient safety a challenging and rewarding experience that will enhance their career growth. Fellows have the unique opportunity to make a real difference in medication safety. To learn more about the fellowship and submit an application by the **March 31 deadline**, visit: www.ismp.org/profdevelopment/managementfellowship.asp.

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Report medication errors to ISMP at 1-800-FAIL-SAF(E).



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Medication Safety Intensive

A unique 2-day workshop that will arm you with the tools you need to establish an aggressive, focused medication safety program

Program Overview

This intensive workshop will help you look at your organization “through the eyes of ISMP” medication safety experts, who will take you through their real-world experiences in establishing and evaluating medication safety programs.

During The Workshop, You Will:

- Engage in group discussions
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For more information about the program and to register, please visit: www.ismp.org/educational/MSI.

Fees and Registration

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