

High-alert drugs:

Strategies for safe I.V. infusions

PURPOSE/GOAL

To provide registered nurses with evidence-based strategies for preventing errors when infusing drugs, particularly high-alert drugs.



OBJECTIVES

- State how medication errors meet the criteria for improvement in healthcare quality.
- Describe the relationship between medication errors and I.V. infusions.
- Discuss how to use evidence-based strategies to prevent infusion-related medication errors.

To prevent medication errors with the most dangerous drugs, use these evidenced-based strategies.

By Robin Donohoe Dennison, RN, DNP, CCNS

IMAGINE COMING TO WORK one evening and hearing that after your shift the night before, another nurse discovered one of your patients was receiving an infusion of dobutamine at *244 ml/hour*. It should have been infusing at 24 ml/hour to deliver the prescribed dose of 5 mcg/kg/minute. Immediately, you would question how you made such an error with a potentially fatal drug infusion, and then you would seek safe processes and practices to make sure you never repeat it.

About 80% of all deaths from medication errors are caused by some 20 drugs, and dobutamine is one of them. Even when errors with these dangerous drugs aren't fatal, outcomes are poor. According to the Institute for Safe Medication Practices (ISMP), who identified these drugs as *high-alert*, they require special safeguards to reduce the risk of patient harm. (See *Identifying High-alert drugs*.)

Most attempts to create safeguards against medication errors take a systems approach. That is, they address problems globally and try to perfect the process of drug administration. Such a global approach is necessary, of course, but it's not the whole answer.



Ultimately, every system relies on something that's less than perfect: human performance.

As a nurse, you're in an ideal position to improve the safety of high-alert drug administration. After all, you're at the center of activity: Nurses administer nearly all drugs, and about 40% of a hospital nurse's time is spent giving drugs. Also, consider this: Nurses intercept about 85% of all potential medication errors, whether they are made by physicians, pharmacists, or nurses.

Dangers of I.V. infusions

All medication errors are serious, but I.V. infusion errors pose the greatest risk of patient harm. About 60% of all life-threatening errors occur with I.V. therapy.

One reason for I.V. infusion errors is the complexity of infusion pumps. Often, the error is a failure to properly program the drug dosage.

Such errors frequently go undetected because the patient's physiologic response to the wrong dosage is misinterpreted as a change in his condition. In critical care areas, many drug dosages are titrated based on the patient's changing condition, and the more dosage changes a nurse keys in, the greater the risk of error and patient harm.

Today, smart pumps have customizable software to create libraries for specific hospital and patient care areas. The drugs, concentrations, doses, and dosage limits can be tailored to a hospital's specifications. If a nurse programs the pump with an infusion rate that would deliver a dose outside the established limits, the pump provides a warning.

Of course, system-wide improvements and better equipment can help ensure safety, but the real responsibility rests with you, the nurse who administers high-alert drugs to your patients. Here are 13 evidence-based strategies you can use to meet that responsibility and keep your patients safe. (See *The route to I.V. infusion safety*.)



Identifying high-alert drugs

The Institute for Safe Medication Practices, a nonprofit research group that advocates patient safety, developed this list of high-alert drugs, which are defined as drugs that have a heightened risk of causing significant patient harm when used in error. These drugs contribute to a large number of medication errors and, when improperly administered, produce poor outcomes.

- Adrenergic agonists—such as epinephrine, norepinephrine, dopamine, dobutamine
- Adrenergic antagonists—such as esmolol
- Anesthetics—such as propofol
- Antiarrhythmics—such as amiodarone, lidocaine
- Anticoagulants—such as heparin, bivalirudin, argatroban, lepirudin
- Antineoplastics
- Dextrose, hypertonic, 20% or greater
- Electrolyte solutions—such as potassium chloride, potassium phosphate, magnesium sulfate, hypertonic sodium chloride
- Fibrinolytics—such as streptokinase, anistreplase, alteplase, tenecteplase
- Glycoprotein IIb/IIIa inhibitors—such as eptifibatid
- Inotropics—such as milrinone
- Insulin
- Liposomal forms of drugs—such as liposomal amphotericin B
- Moderate sedatives—such as midazolam, lorazepam, diazepam
- Neuromuscular blockers—such as atracurium, vecuronium, cisatracurium, pancuronium
- Opiates
- Total parenteral nutrition solutions
- Vasodilators—such as nitroglycerin, nitroprusside, nesiritide

Follow policies, procedures, and protocols

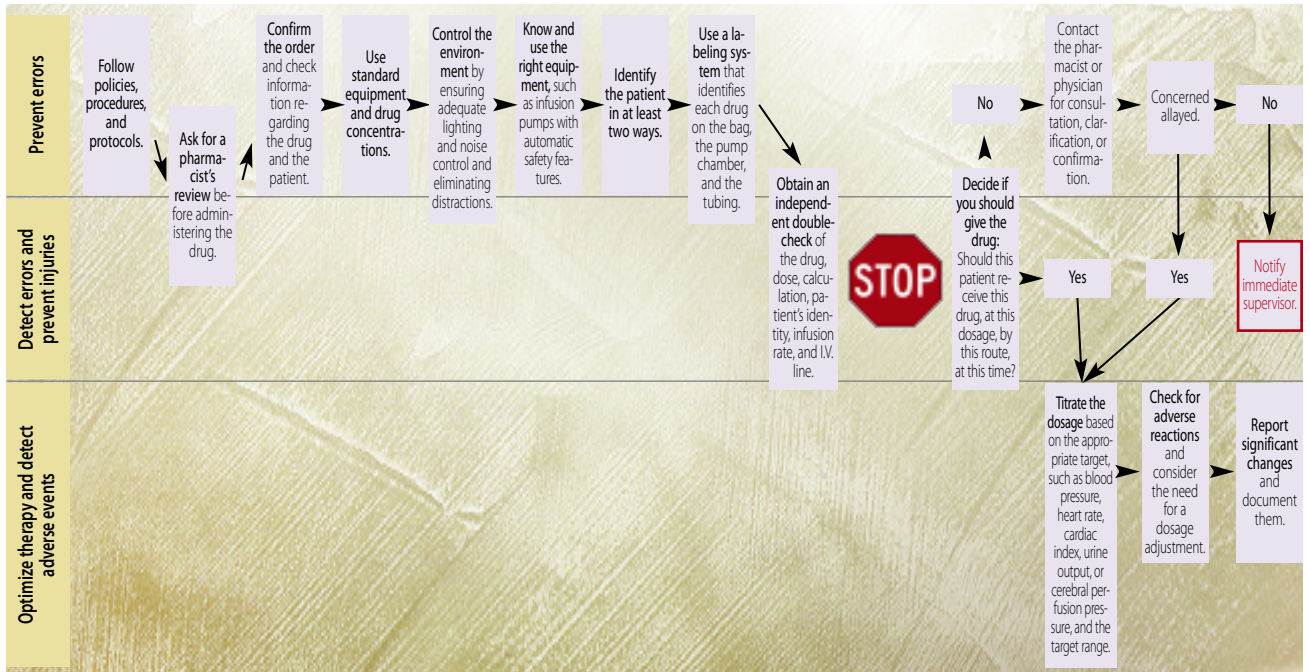
Following evidence-based policies, guidelines, and protocols encourages communication among the disciplines and reduces medication errors. Putting these written guides into practice can help ensure that you take critical steps, such as obtaining the patient's body weight, complying with automatic stop orders, and verifying that standing orders are individualized.

One way to help ensure that everyone follows the guides is to include all relevant staff members in the process of creating them. Also, regularly update policies, guidelines, and protocols to make sure they're consistent with current, evidence-based best practices.

Establishing a nonpunitive reporting process can help ensure that all errors and near-misses (also called *good catches*) are reported. Such a process provides valuable information for systems analyses, so changes can be made to the drug delivery system to prevent recurring errors.

The route to I.V. infusion safety

This flowchart summarizes the progression of the 13 strategies for infusion safety. As shown, the strategies attack the problem in three ways: by preventing the error, by detecting the error, and by detecting adverse effects.



Adapted from Robin Donohoe Dennison, "Safe Administration of High-alert Medication Infusion."

Ask for a pharmacist's review

Have a pharmacist review the prescription before you administer the drug. Remember, between 48% and 70% of errors made during the ordering phase are caught. Bypassing the pharmacist's check for ordering errors increases the chance that the patient will receive the wrong drug, a drug to which the patient is allergic, or a drug that interacts with another drug he's receiving.

Confirm the order

Whenever a prescription for an I.V. infusion of a high-alert drug is written or entered into the computerized provider order entry system, confirm the order and access information about the patient and the drug. If you're administering high-alert drugs, you need not only information about the patient and the drug but also knowledge of pharmacology. With such knowledge, you can understand the correlations between the drug's action and the patient's condition, the results of his diagnostic tests, and his current status. A knowledge of pharmacology also improves the chances that you'll detect contraindications, adverse effects, and medication errors. The Joint Commission on Accreditation of Healthcare Or-

ganizations (JCAHO) recommends that before administering a drug, a nurse know at least the patient's age, sex, current medications, diagnosis, comorbidities, other conditions, laboratory values, allergies, and sensitivities. An electronic patient record, which allows many healthcare providers simultaneous access to patient data, is recommended.

Today, some 10,000 drugs are available, so no one can have a comprehensive working knowledge of all drugs and their effects. But you can have a working knowledge of the drugs you commonly give, especially the high-alert drugs you commonly give. Because of on-going education on new drugs, the restrictions of an institution's formulary, and readily available drug references, nurses can know or quickly find the information they need to minimize medication errors and improve drug safety. Nurses can easily find information on infrequently used drugs and nonformulary drugs in reference books, of course, but these print products quickly go out of date. For up-to-date information, you may want to use personal digital assistant software that has frequent updates (such as ePocrates Rx) or electronic reference programs on unit computers (such as Micromedex).

Use standard equipment and drug concentrations

When patterns of care vary widely, safety can be compromised. By standardizing equipment and processes, an institution can eliminate unnecessary complexity and thus improve safety. For example, having everyone in an institution use the same type of infusion pump simplifies a critical process—administering I.V. drugs—and boosts patient safety. JCAHO recommends such standardizing of equipment across the hospital.

Restricting the number of drugs on the formulary also helps reduce complexity. No one needs to know about all of the glycoprotein IIb/IIIa inhibitors if only one is prescribed most of the time. Off-formulary drugs can still be available for special circumstances. Using generic names also helps avoid errors.

Both JACHO and ISMP recommend limiting the number of drug concentrations available in the hospital. They also recommend keeping drugs on the nursing units in forms that are ready-to-use, such as manufacturer's premixed solutions or pharmacy-prepared admixtures.

Control the environment

Cluttered work spaces, noise, frequent interruptions, and distractions contribute to medication errors. The National Quality Forum recommends a dedicated work space for drug preparation. The work space, which should have an area for hand washing, must be clean, orderly, well lit, and free of clutter, distraction, and noise.

On your unit, you should help establish an area free of distractions and excessive noise that allows you to concentrate on calculating doses and preparing and administering drugs. For your part, don't accept distractions when preparing and administering drugs. Make it clear that you are not to be disturbed. One way to communicate this message is to establish a signal on your unit. If everyone knows that a nurse wearing a blue vest, for example, is not to be disturbed, nurses will be able to concentrate on preparing and giving drugs safely.

Know and use the right equipment

To safely administer I.V. infusions of high-alert drugs, you must understand how equipment such as infusion pumps work, and you must use the equipment as it was made to be used. Though it

An I.V. infusion of a high-alert drug poses significant risks to a patient and requires special knowledge and diligence.

may seem hard to believe, the second most common cause of drug errors during administration is the *misuse* of infusion pumps and other parenteral device systems.

Whenever possible, use equipment with automatic safety features—such as smart pumps—to reduce the risk of human error. As mentioned, a smart I.V. pump warns you if you program it with an infusion rate that would result in a dosage outside the safe limits for the drug concentration. To give the excessive dose, you would have to override the warning. Other technologic advances that make drug administration safer include barcode point-of-care systems and computerized order entry systems.

Of course, technology can't protect you and your patients from harm if you work around the safety features. A recent study found that nurses bypass the drug library—and thus, the safety features—of the smart pump 25% of the time. Without preparation, planning, and staff education, technology intended to protect the patient may actually increase the risk of harm. Also, keep in mind that when people start using a new technology, two things tend to happen: the types of errors change, and the error rate goes up—at least initially.

Identify the patient in at least two ways

Giving a drug to the wrong patient accounts for about 5% of all medication errors. To prevent this error, JCAHO now requires that patients be identified by at least two patient identifiers. Acceptable identifiers include name, hospital identification number, social security number, phone number, and address.

Don't use the error-prone practice of identifying patients by room number. Do use barcodes on armbands. Barcodes have great potential for reducing medication errors, but if you don't use them, the potential won't be realized. One study showed that barcode point-of-entry technology failed to lower the number of wrong-patient errors because nurses seldom scanned the barcode on the patient's identification wristband. Instead, they selected the patient's name on the



Labeling for safety

Many patients have more than one I.V. access site, several tubings, and multiple-chamber infusion pumps. Labeling the bag, the infusion pump chamber, and the tubings reduces the risk of a medication error:

- Label the I.V. bag with the patient's name, the drug, the amount of drug added, the date, and the time.
- Label the pump chamber with the drug, the concentration, and the rate.
- Label the distal tubing with the drug and the I.V. site.

touch-screen terminals in the patient's room or in the hallway.

Use a labeling system

Because many patients have more than one I.V. access site, several tubings, and multiple-chamber infusion pumps, you should use a labeling system that identifies the bag, infusion pump chambers, and tubing. (See *Labeling for safety*.)

If an infusion is a premixed solution or admixed in the pharmacy, it will be labeled with the solution, the drug dose, and the concentration. Add to the bag the date and time that the infusion is hung. The pump chamber is easy to label if you're using a smart pump: The screen displays the admixture information. If your pump doesn't allow this labeling, write the solution name, drug name, and concentration on a tape strip, and put the strip on the pump. Label the tubing with the drug name and the I.V. site.

Color-matching the pump and tubing labels may help. However, this approach raises the risk that you rely on the colors and not read the labels or follow the tube.

Obtain an independent double-check

An independent double-check can detect a medication error before it harms a patient. In fact, such manual redundancy detects about 95% of errors.

An independent double-check means that two licensed personnel *independently* check the accuracy of the drug, the dose, any calculations, the patient's identity, the infusion rate setting, and the selection of the tubing. Sharing calculations or performing a double-check together is more likely to perpetuate an error. That's because such an approach contributes to confirmation bias.

Because real independent double-checks can

significantly affect workloads, they should be required only when the situation warrants the extra time and attention, such as when administering high-alert drugs. No matter how much experience you have, you need a double-check when giving these drugs. Selecting the wrong drug or drug concentration, programming an incorrect flow rate, or using the wrong tubing is just too easy, and

with high-alert drugs, the potential for patient harm is just too high.

Decide if you should give the drug

Ask yourself if there's any reason that your patient should not get this drug, at this time, at this dose, by this route? Patient information plays a crucial role in answering this question. A particular drug may be appropriate for most patients with heart failure, but it may not be appropriate for your patient because of other medical conditions and current health status. Also, a drug may have been appropriate for your patient 4 hours ago, but because of a change in his condition—the development of hemodynamic instability, for instance—the drug may not be appropriate now.

If you doubt that you should give the drug, contact the pharmacist or physician for consultation, clarification, and confirmation. Remember, medication errors usually result from a chain of events. Teams who work together, have mutual respect, and monitor each other have a better chance of detecting and intercepting an error before it causes patient harm. Unfortunately, this atmosphere doesn't exist in all settings, as a recent ISMP survey of more than 2,000 healthcare providers revealed. About 40% said that when they have a question about an order, they either ask a colleague to talk to the prescriber or simply assume the order is correct rather than interact with an intimidating prescriber.

Open communication leads to a safer environment, and every team member should be encouraged to identify potential errors and to ask questions if something doesn't seem right. But whether you're in such a situation or not, one consideration trumps all others: Never administer a drug that you believe is unsafe for a patient. (See *To err...is expensive*.)

Titrate the dosage

You may need to titrate the dosage of a high-alert drug based on the patient's response. If so, you need to know which measure to use—for instance, blood pressure, heart rate, cardiac index, urine output, or cerebral perfusion pressure—and what the target range is. Safe titration of I.V. infusions requires considerable clinical decision-making capability and knowledge of the drug's effects. You also need to know the drug's common adverse effects and to closely monitor the patient for them.

With many critically ill patients, you'll use invasive or noninvasive hemodynamic monitoring values to titrate the infusion rate of high-alert drugs. In these cases, use the monitoring system's alarms to indicate when a measure of hemodynamic function is outside the target range.

Check for adverse reactions

As the number of drugs has grown, so too has the number of adverse reactions. Monitor your patient for the adverse reactions the prescribed high-alert drug can cause. Also, tell the patient and his family about signs and symptoms they should report.

Report significant changes

To protect your patient, stay vigilant. Assess the patient for changes in physiologic status, evaluate the patient's response to drug therapy, and document any adverse drug events. If you note significant changes, document them and communicate them promptly to appropriate members of the healthcare team.

Remember, clear, appropriate documentation is part of an important communication process among members of the healthcare team.

Your patient's safety

An I.V. infusion of a high-alert drug poses significant risks to a patient and requires special knowledge and diligence on your part. System-wide safeguards play an important role in preventing dangerous medication errors. But in the end, a system doesn't protect patients from harm; nurses who use system safeguards properly and who apply practical strategies protect patients from harm. ★

To err...is expensive

Medication errors cause temporary harm, permanent disability, and death. The cost in terms of patient suffering is incalculable. But the cost in dollars isn't.

Medication errors cost hospitals more than \$3.5 billion every year. That's about \$5,000 *per error*, or \$2.8 million a year for a 700-bed teaching hospital.

As you may know, medication errors are the most common reason for malpractice lawsuits against hospitals and nurses. The average amount awarded by the courts for serious errors is \$3.1 million.

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