



What's my line?

Multiple-channel IV pumps accomplish several important functions when numerous solutions are being infused into a patient. To name a few, they conserve precious space around the patient, allowing more room to provide care, and facilitate the transport of patients who have several solutions infusing. However, nurses have sometimes mixed up the infusion lines or pump channels while setting up or programming these pumps.

In one case, a nurse was using a dual-channel pump to infuse **AGGRASTAT** (tirofiban) through one channel and heparin through the other. While hanging a new bag for each solution, she inadvertently threaded the Aggrastat tubing through the channel already programmed for heparin, and vice versa. Luckily, another nurse noticed the error before patient harm occurred.

Another mix-up occurred during an IV tubing change. Heparin (13 mL/hour) and normal saline

(125 mL/hour) were infusing through a dual-channel IV pump. The nurse accidentally reversed the tubing and the patient received heparin at 125 mL/hour for nearly 4 hours. An invasive procedure scheduled for the next day was cancelled due to an elevated aPTT. Nurses have also changed the infusion rate on the wrong channel when dosing or fluid adjustments have been prescribed.

Nurses have sometimes mixed up pump channels while setting up multiple-channel pumps.

While these errors could occur if using two single-channel pumps on the same IV pole, the tubing's close proximity on the multiple-channel pump might facilitate this error. Also, current technology may not offer much help. For example, bar coding could verify the solution being hung, but if the tubing had been switched with another solution during pump set-up, the incorrect rate of infusion would not be detected. Likewise, "smart pumps" that alert nurses to pump setting errors would not detect a line mix-up. See **Check it out!** for some practical suggestions to decrease the risk of these errors.

safetywire

⚡ Check your route. A patient was transferred from the intensive care unit (ICU) to the medical unit with an unneeded intra-arterial line in place. When the patient requested pain medication, the nurse prepared an IV dose of meperidine 25 mg. Since the IV line had infiltrated, she administered the meperidine into the intra-arterial line, which she thought was another venous line. The patient suffered extreme pain and flushing during administration, but fortunately, no permanent harm resulted. Clearly labeled access lines could have helped prevent this error, as could removal of the unnecessary line before the patient was transferred from the ICU. The nurse's unfamiliarity with intra-arterial lines also contributed to the error. Stopcock ports on intra-arterial lines may have male adapters, allowing easy access for blood draws. The nurse may have assumed the male adapter was an access site, since this type of adapter is often present on central venous lines used to monitor pressures.

check it out! ✓✓✓✓

To reduce the risk of harmful errors when using multiple-channel pumps:

- ✓ **Handle one IV solution** at a time.
- ✓ **Always physically trace the line** from the solution, through the pump, and to the patient (insertion site) to validate that the correct channel has been used to program the infusion. Do this with each new infusion, bag change, and tubing change.
- ✓ **For selected high-alert drug infusions** (see page 2 for a list), have one clinician hang the solution and ready it for infusion, and another clinician independently validate the original order, correct patient, dose/concentration, insertion site (route), and pump/channel settings.
- ✓ **Affix the name of the drug** being infused on each IV line (at the end closest to the patient) and above each channel on the pump. However, do not rely on the label alone to select the proper channel, and be sure to remove the label when the drug is discontinued.
- ✓ **Conduct patient rounds** several times each shift to double-check all IV solutions. Take the time to trace each line from the solution to the patient to validate proper channel selection.
- ✓ **Don't improperly use a multiple-channel pump** to infuse solutions into two different patients at the same time. (Yes, we've seen this in both inpatient and outpatient settings.)
- ✓ **Before the purchase** or use of multiple-channel pumps, conduct a failure mode and effects analysis to identify possible risks and take action to reduce the probability of errors. See page 3 for more information.

ISMP issues list of high-alert medications

High-alert medications are drugs that pose a heightened risk of causing significant patient harm when they are used in error. Although mistakes may or may not be more common with these drugs, the consequences of an error are clearly more devastating to patients. Based on error reports submitted to the USP-ISMP Medication Errors Reporting Program and reports of harmful errors in the literature, ISMP has created a list of potential high-alert medications. During August and September of 2003, more than 350 practitioners responded to an ISMP survey designed to identify which of these medications were most frequently considered high alert by individuals and organizations. Further, to assure relevance and completeness, the clinical staff at ISMP, members of our advisory board, and safety experts throughout the US were asked to review the potential list.

The following list of 33 drugs and drug categories reflects the collective thinking of all who provided input. We hope you will use this list to determine the medications that require special safeguards to reduce the risk of errors. This may include strategies like limiting access; using auxiliary labels and automated alerts; standardizing the ordering, concentrations, preparation, and administration of these products; using premixed solutions; and employing automated or independent double-checks when necessary. (Note: manual double-checks are not always the optimal error reduction strategy and may not be practical for a few of the medications on the list.) During 2004, we plan to issue a series of surveys to learn more about the special precautions healthcare organizations have in place for several of these medications.

Class/Category of Medications

- adrenergic agonists, IV (e.g., epinephrine)
- adrenergic antagonists, IV (e.g., propranolol)
- anesthetic agents, general, inhaled and IV (e.g., propofol)
- cardioplegic solutions (used to induce cardiac arrest in open heart surgery)
- chemotherapeutic agents, parenteral and oral
- dextrose, hypertonic, 20% or greater
- dialysis solutions, peritoneal and hemodialysis
- epidural or intrathecal medications
- glycoprotein IIb/IIIa inhibitors (e.g., eptifibatide)
- hypoglycemics, oral (e.g., glyburide)
- inotropic medications, IV (e.g., digoxin, milrinone)
- liposomal forms of drugs (e.g., liposomal amphotericin B)
- moderate sedation agents, IV (e.g., midazolam)
- moderate sedation agents, oral, for children (e.g., chloral hydrate)
- narcotics/opiates, IV and oral liquid concentrates (immediate- and sustained-release)
- neuromuscular blocking agents (e.g., vecuronium)
- radiocontrast agents, IV
- thrombolytics/fibrinolytics, IV (e.g., tenecteplase)
- total parenteral nutrition solutions

Specific Medications

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| ● amiodarone, IV | ● nesiritide, IV |
| ● colchicine injection | ● nitroprusside, sodium, for injection |
| ● heparin, low molecular weight, injection | ● potassium chloride for injection concentrate |
| ● heparin, unfractionated, IV | ● potassium phosphates injection |
| ● insulin, subcutaneous and IV | ● sodium chloride injection, hypertonic (more than 0.9% concentration) |
| ● lidocaine, IV | ● warfarin |
| ● magnesium sulfate injection | |
| ● methotrexate, oral, non-oncologic use | |

► Special Announcement

ISMP Patient Safety Contest

Help us celebrate **National Patient Safety Awareness Week**, March 7-13, 2004, by participating in our annual Patient Safety Contest. This year, we're seeking entries in the following three categories:

(1) Failure mode and effects analysis (FMEA). Submit an interdisciplinary FMEA, completed in the past year, related to a critical aspect of medication use. Describe what you learned from the process, as well as actions that were taken to reduce the risk of a harmful error.

(2) Preventing Intimidation. Describe the steps your organization has undertaken to reduce intimidation among healthcare providers. Include supporting materials such as policies, procedures, role-playing exercises, presentations, minutes of discussions, and measurements (e.g., pre/post surveys) that demonstrate a reduction in intimidating behavior.

(3) Timely delivery of medications. Submit a description of your efforts to improve the timely delivery of medications to patient care units in response to new medication orders. Provide information on how you identified the problem, how an interdisciplinary team addressed the issue, and how you measured your success.

Entries should be faxed (215-914-1492), emailed (ismpinfo@ismp.org), or mailed to ISMP (address appears in credit box on page 3) by **March 3, 2004**, and should include your name, organization, address, and phone number. One winner in each category will receive a new videotape entitled *Patients Play a Vital Role in Patient Safety*, and \$500 to use toward a patient safety activity. "Honorable mention" submissions will receive a \$50 gift certificate to be used toward ISMP products or services. We will post the winning entries on our website and provide national recognition if desired.

For more information on National Patient Safety Awareness Week, please visit: www.npsf.org/html/psaw.html.

Thanks to **2096** clinicians (including **1327** nurses) who completed our **survey on workplace intimidation**.

Look for the results in the next edition of the newsletter.

Using FMEA to predict failures with infusion pumps

Healthcare providers can predict how and when errors and other failures with infusion pumps may occur by using a process known as failure mode and effects analysis (FMEA). Anticipating that errors *will* happen, healthcare providers should use this process to predict and prevent serious failures *before* they occur. It works by gathering an interdisciplinary team (e.g., nurses, physicians, pharmacists, engineering staff, risk and quality staff) to identify as many errors and other failures that could possibly occur when using the pump, and to predict how harmful these failures could be. The goal is to prevent poor results so, of course, the process includes taking action to eliminate, or at least reduce, the risk of failures that could harm patients. The following questions (modified from a collaborative list compiled by ISMP, ECRI, and the Delaware Valley Healthcare Council) can be used to begin discussions about the potential sources of failure with infusion pumps. Visit www.patientsafety.gov/HFMEA.html to learn more about FMEA.

1 Basic Functionality - How well does the pump perform the required task?

- ✓ Is this the correct pump to perform the desired task(s)?
- ✓ Can the pump deliver the volume/increments needed under the correct pressure?
- ✓ Are any features incompatible with the environment where it'll be used (weight, size, number of channels)?
- ✓ Will the pump deliver medications in the concentrations most typically used?
- ✓ What tubing and other supplies are required for the pump to perform effectively and safely? Are they interchangeable with other pumps? Could interchangeable tubing be used for this pump, rendering it unsafe?
- ✓ Are users alerted to pump-setting errors? Wrong patient errors? Wrong channel errors? Wrong medication/solution errors? Mechanical failure?
- ✓ Does the pump have memory functions for settings and alarms with an easily retrievable log? If the pump is turned off, does it retain settings for a period of time?

2 User-Machine Interface - How easy and intuitive is it for people to use the pump?

- ✓ What functionalities do users *expect* the pump to have?
- ✓ Is the number of steps for programming minimal?
- ✓ Are the touch buttons used for programming clearly labeled, logically positioned, and the proper size?
- ✓ Are the screens readable with proper font size, lighting, contrast, and other cues to enhance performance?

- ✓ Do the units of medication delivery (e.g., mcg/kg, mcg/kg/min) match current practices?
- ✓ Do the medications, units of delivery, and strengths appear in a logical sequence for selection?
- ✓ Is there any information that defaults to a pre-determined value? If yes, is it safe?
- ✓ Is it easy to install and prime administration sets, and remove air in the line?
- ✓ Are any special features such as drug/dose calculations and dose alerts helpful and easy to use?
- ✓ Are the screens free of abbreviations, trailing zeros (e.g., 1.0 mg), and naked decimal points (e.g., .1 mg)?
- ✓ Do the alarms clearly guide staff to the problem? Is it possible to permanently disable audible alarms, or set them too low to be heard?
- ✓ If the infusion rate is changed, but not confirmed, does the device continuously alert the user that the solution is infusing at the old rate?
- ✓ Could the administration sets be mispositioned during installation, or accidentally dislodged, separated, or removed by patients?
- ✓ Does the administration set prevent gravity free-flow of the solution when it's removed from the pump?
- ✓ Is the device tamper resistant?
- ✓ Does the pump fit into the typical workflow?
- ✓ How does the pump compare to the pumps now in use?

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