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ISMP
An ECRI Affiliate

Nurse AdviseERR®

Educating the Healthcare Community About Safe Medication Practices

Prevent uncontrolled, rapid infusion rates:

Confirm infusions are connected to pumps before opening the clamp!

PROBLEM: Within several weeks, an organization experienced three errors in which patients received uncontrolled intravenous (IV) infusions at rapid rates. As noted in the event descriptions that follow, the infusions were all associated with high-alert medications—heparin, propofol, and phenylephrine—that should have been administered at a controlled rate via a smart infusion pump. However, each infusion was found to be mistakenly administered via gravity at a rapid rate of infusion, rather than connected to a programmed infusion pump with a defined rate of infusion. The patients required treatment after the events, but were not permanently harmed.

Event #1

A patient inadvertently received an entire 500 mL infusion of heparin (25,000 units/500 mL) within 1 hour. The error began when a nurse was to administer an intermittent antibiotic and heparin infusion to the patient. The hospital did not have enough infusion pumps for all infusions and did not require the use of an infusion pump for organization-defined "low risk" medications, including intermittent antibiotics. When starting the antibiotic and heparin infusions, the nurse confused the antibiotic and heparin lines, resulting in slow antibiotic administration through the infusion pump programmed to infuse the heparin, and rapid heparin administration via gravity. The patient received protamine to reduce the risk of bleeding from the rapid heparin infusion and recovered without incident.

Event #2

A patient received a rapid dose of propofol (500 mg/50 mL) that was intended to be administered as a continuous infusion at a much slower rate. A nurse had unclamped the IV administration set for the propofol infusion without noticing that the infusion was never connected to the programmed infusion pump. The entire propofol infusion was administered within minutes. The distracted and hurried nurse who made the error while preparing the patient to leave for a computed tomography (CT) scan had been assisting the patient's primary nurse, who was caring for multiple trauma patients. After the error was discovered, the nurse acknowledged that the required safety steps for setting up the infusion, including tracing the IV tubing from the source infusion, through the pump, and to the patient, had not been followed.

Event #3

A patient accidentally received a bolus dose of phenylephrine (20 mg/250 mL) in the operating room (OR). An anesthesiologist noted a sudden increase in the patient's blood pressure during the procedure, which helped identify the error. The phenylephrine should have been administered more slowly via an infusion pump. However, the pump had been alarming "air in line," and to clear the alarm, the infusion was removed from the pump and the free-flow protection clamp was opened to remove the air in the line and to reprime the line. The infusion was never reconnected to the pump to re-engage the free-flow protection clamp after clearing the alarm, and the phenylephrine infused rapidly via gravity, causing the patient's blood pressure to increase.

While each error has unique root causes, there were several contributing factors identified during investigation of the events:

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Worth repeating...

Norepinephrine left in a discontinued IV line administered as a bolus

Residual norepinephrine (16 mg/250 mL) remained in a patient's intravenous (IV) line after the infusion was discontinued. The nurse was unable to aspirate the medication out of the line, so it was slowly flushed. The patient quickly experienced a pounding headache, flushing, increased heart rate, and elevated blood pressure. The nurse was prepared to administer an antihypertensive medication, but fortunately, the patient's symptoms subsided in a few minutes.

Since most IV medications are colorless, residual medication left in the IV line may not be apparent to nurses and could be a danger. Similar situations resulting in significant harm due to inadvertent administration of residual high-alert medications,

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ISMP perioperative guidelines are now available!

New guidelines for safe medication use in the perioperative and procedural settings were recently finalized and are now available on our website at: www.ismp.org/node/31601. The ***ISMP Guidelines for Safe Medication Use in Perioperative and Procedural Settings*** were developed after holding an invitational, multi-stakeholder, virtual National Perioperative Summit last fall, analyzing the findings from the ***ISMP Medication Safety Self Assessment for Perioperative Settings***, reviewing the current literature, and analyzing perioperative errors reported to ISMP. The guidelines focus on best practices associated with labeling medications in all phases of perioperative and procedural care, common practices that limit the protections offered by proven safety technologies, and the use of barcode scanning in these settings.

Supported by an educational grant from Fresenius Kabi

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- Not having an adequate supply of infusion pumps available
- Only using infusion pumps to deliver "high-risk" medications
- Starting infusions without confirming the infusion rate
- Failure to trace lines before opening the clamp on the IV set to start/restart infusions
- Distractions and time constraints during medication administration
- Failure to respond appropriately to infusion pump alarms (e.g., "air in line" alarm)

Safe Practice Recommendations: The following strategies can be implemented to help prevent these types of errors within your organization, many of which can be included in a short, standard safety checklist for practitioners to follow when hanging or changing IV bags, bottles, or syringes.

Establish an expectation. Require practitioners to administer all continuous and intermittent infusions, whether medications or hydrating fluids and regardless of "high-risk" designation, using a smart infusion pump (exception: fluid resuscitation efforts).

Provide an adequate supply of smart infusion pumps. If necessary, purchase additional smart infusion pumps to facilitate utilization of a pump to deliver all medication infusions and hydrating solutions (www.ismp.org/ext/958). Older infusion pumps without free-flow protected tubing should not be purchased or used.

Employ DERS. Maintain a complete drug library in smart infusion pumps, and require practitioners to engage the dose error-reduction system (DERS) when administering all infusions, including those deemed "low risk."

Label lines. Label all infusion lines (and other access lines/catheters) at the point(s) of connection (e.g., above the pump and above the access point into the patient's body).

Trace infusion lines. When infusions are started, reconnected, or changed (i.e., new bag/bottle/syringe), trace the tubing by hand from the solution container to the pump (and channel), to the connection port, and then to the patient to verify the proper drug infusion, pump/channel, and route of administration. Confirm that the infusion rate has been programmed accurately before starting the infusion.

Confirm before opening the roller clamp. After priming the tubing (or clearing air from the line), keep the roller clamp below the drip chamber closed until infusion lines have been traced to confirm the connection to the correct infusion pump and channel.

Respond appropriately to pump alarms. After troubleshooting an "air in line" alarm and clearing the line, ensure the tubing is placed back into the smart pump using DERS and then resume the infusion.

Provide handoff reports. Communicate with the care team, especially during handoffs or when someone other than the primary nurse or provider is helping to manage the patient's infusions. Trace all access lines as part of the handoff.

Manage distractions and time constraints. Encourage staff to speak up in situations where they feel that time constraints or distractions are creating an unsafe environment in which an error may be more likely to occur.

Manage the environment. Identify, report, and mitigate environmental factors that impair the ability to practice in a safe and efficient manner. For example, provide proper lighting in patient treatment areas and rooms, and ensure the practitioner's line of sight of both the patient and the pump is not obstructed.

Recognize and correct errors. Monitor patients for unanticipated events and investigate

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including opioids, oxytocin, and norepinephrine, have been reported (www.ismp.org/node/1161, www.ismp.org/node/27480).

Discontinued or "held" infusions should be immediately removed from the pump, disconnected from the patient, and discarded. The tubing should be changed to ensure no residual medication is left in the tubing, which could be inadvertently administered as a bolus when the tubing is used to administer other medications and fluids.

SAFETY wires

Accidental needlestick with Evenity prefilled syringe. A nurse in an outpatient infusion setting experienced an accidental needlestick injury when administering a subcutaneous injection of an **EVENITY** (romosozumab-aqqg) 105 mg/1.17 mL prefilled syringe from Amgen. Evenity is used for the treatment of postmenopausal osteoporosis in patients who are at high risk for fracture, or in patients in whom other available osteoporosis therapy has failed or cannot be taken. Two syringes and two subcutaneous injections are needed to administer the total dose of 210 mg, which should be administered by a healthcare provider. The needles lack a safety guard and are not retractable or removable, so users are not able to change the needle to one that has a safety guard. Other organizations reported the same concern about accidental needlesticks with this product.

Similar concerns have been reported with other subcutaneous prefilled syringes that do not come with a needle safety guard, including **KINERET** (anakinra) and **HUMIRA** (adalimumab). Even with prefilled syringes intended for self-administration, family members, other caregivers, long-term care staff, and hospital inpatient staff often administer these medications. Also, these products could make their way into garbage bins and other forms of common waste, exposing children, animals, and others to unintended needlestick injuries. We have notified the US Food and Drug Administration (FDA) and the manufacturer of this concern and

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pump connections if clinical deterioration or an unexpected adverse effect is detected.

Share good catches. Share impactful stories and recognize staff for good catches, especially when harmful errors were prevented due to tracing the infusion line, catching a programming error, and/or engaging the DERS.

Use data from technology. Utilize data from infusion devices to monitor compliance, establish performance measures, track adverse events related to infusions, and identify workarounds that impact compliance.

Educate staff. During orientation and ongoing training, educate staff about errors that have occurred when infusions are administered at a much faster rate because they were inadvertently not connected to an infusion pump. During nursing orientation, stress the need to trace infusion lines and practice tracing lines during periodic simulations.

Multi-chamber bag parenteral nutrition is not without risk

Problem: An increase in the number of errors and workarounds related to the shortage of parenteral nutrition (PN) components have been reported to ISMP. In some instances, organizations have been forced to reduce the number of days they provide PN to patients. For example, an organization reported they had to reduce the administration of PN to three times per week instead of daily. In other cases, organizations may elect to utilize alternative products, such as multi-chamber bag parenteral nutrition (MCB-PN) for select patients instead of patient-specific compounded PN.

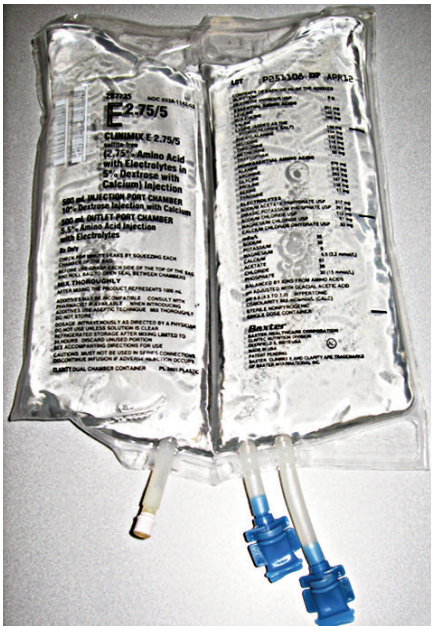

Figure 1. Clinimix E multi-chamber bag. Right side has amino acids with electrolyte additives, an administration port, plus a port for adding IV fat emulsion.

MCB-PN products are commercially available in various standardized compositions. They are available in two- or three-chamber bags. **CLINIMIX** and **CLINIMIX E** (**Figure 1**), manufactured by Baxter, have two chambers. Clinimix comes with one chamber containing amino acids and the other containing dextrose, and Clinimix E comes with one chamber containing dextrose with calcium and the other containing amino acids with electrolytes. **KABIVEN** and **PERIKABIVEN**, both manufactured by Fresenius Kabi, have three chambers holding dextrose, amino acids/electrolytes, and lipids. For all MCB-PN products, the seal(s) that separates the chambers must be broken and the chamber contents must be mixed to ensure complete activation prior to administration. While these products require fewer compounding steps, additives may still need to be added by pharmacy staff.

Some error reports submitted to ISMP involved mix-ups between MCB-PN bags. During a shortage of PN ingredients, for example, one organization purchased Clinimix E 4.25/10 (dextrose with calcium and amino acids **with** electrolytes) as well as Clinimix 4.25/10 (dextrose and amino acids **without** electrolytes). The organization reported multiple errors in which the wrong formulation was dispensed, due to similar-looking packaging as well as unfamiliarity with these products. Other events were related to not activating the MCB-PN bags. This resulted in the omission of certain components, such as dextrose and calcium. We have previously shared similar errors and actions to take to ensure the proper preparation of MCB-PN bags (www.ismp.org/node/32915, www.ismp.org/node/32885).

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recommended the addition of a needle safety guard for all prefilled syringes with an attached needle to prevent accidental needlesticks. The manufacturer has escalated our concern for further follow-up.

"Shellfish allergy" may be a red herring. Long-standing myths about allergy cross-reactivity with iodinated contrast media and shellfish, seafood, and iodine continue to impact patient care. Documented shellfish, seafood, and iodine allergies in an electronic health record (EHR) can lead to imaging delays or outright avoidance of imaging studies as well as unnecessary use of premedication(s). For example, an older survey of 231 physicians (Beaty AD, Lieberman PL, Slavin RG. Seafood allergy and radiocontrast media: are physicians propagating a myth? *Am J Med.* 2008;121[2]: 158.e1-4) found that 65% of the radiologists and 89% of the cardiologists that responded (49%) asked about shellfish allergies prior to administering contrast agents. Thirty-five percent of the radiologists and 50% of the cardiologists indicated they would hold contrast or premedicate patients who reported such an allergy.

Iodinated contrast media reactions are considered pseudoallergic or nonimmune-mediated anaphylactoid reactions attributed primarily to the osmolarity of the products (www.ismp.org/ext/966). On the other hand, allergies to shellfish, mollusks, and fish are reactions to proteins found in the food, not to the iodine content. In fact, iodine, an essential human nutrient required for the synthesis of thyroid hormones, cannot elicit an immune response and is often added to table salt across the globe to prevent iodine deficiency.

When patients tell you they have an allergy to shellfish, while it is important to document this in the EHR, you can assure them that they are at no greater risk for reactions from iodinated contrast media than are patients with other allergies. To learn more about identifying true patient risk factors and when it is appropriate to use premedications prior to contrast media, refer to the *2022 American College of Radiology (ACR) Manual On Contrast Media* (www.ismp.org/ext/960).

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SAFE PRACTICE RECOMMENDATIONS: If your organization has purchased or is thinking about purchasing MCB-PN, consider the following risk-reduction strategies:

Conduct an FMEA. Conduct a proactive risk evaluation, such as a failure mode and effects analysis (FMEA), prior to use. During the analysis, be sure to review the labeling and packaging of products and how mix-ups will be prevented, how MCB-PN bags will be ordered in your electronic health record (EHR) system and displayed on your medication administration records (MARs), and the method that will be used to remind practitioners to activate the bag.

Gather stability data. Require the pharmacy to reach out to product manufacturers to review stability data for any pharmacy additives, and make this information readily available to prescribers, pharmacists, and nurses. Establish a maximum timeframe in which MCB-PN should be administered (hang time).

Store safely. Store MCB-PN separately in the pharmacy, away from similar-looking bags. Avoid storing MCB-PN in an automated dispensing cabinet (ADC), as nurses may not be familiar with the need to activate all chambers.

Require pharmacy activation and compounding. Require the pharmacy to activate all MCB-PN bags (mixing the chambers) and add any prescribed additives, such as multivitamins and trace elements, in a sterile environment. Then dispense the activated PN (with additives, if required) to patient care units.

Apply auxiliary labels. Consider applying auxiliary labels to the overwrap of MCB-PN bags upon procurement in the pharmacy to differentiate the products with and without electrolytes. After pharmacy activation, consider applying auxiliary labels directly on MCB-PN bags for nurses to confirm that the product has been activated prior to administration.

Employ barcode technology. Use barcode scanning technology prior to dispensing, compounding, and administration to ensure the correct MCB-PN product is being used.

Convert PN orders. During transitions of care, work with home infusion pharmacies to determine if orders need to be converted from MCB-PN to patient-specific compounded PN. Require an independent double check of all calculations to verify accuracy.

Educate practitioners. Educate practitioners about how to calculate the amount of macronutrients, electrolytes, and additives patients will be provided from a MCB-PN bag, based on the ordered rate of infusion. Also let pharmacy staff know how to activate the bag, and educate nurses to confirm that the product has been activated prior to administration. Since MCB-PN products are commercially standardized, alert nurses to the likely waste of excess PN volume since each bag may contain more than required for a particular patient (e.g., patient may receive only 1,500 mL from a 2,000 mL bag).

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Report medication and vaccine errors to ISMP: Please call 1-800-FAIL-SAF(E), or visit www.ismp.org/report-medication-error. ISMP guarantees the confidentiality of information received and respects the reporters' wishes regarding the level of detail included in publications.

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Meet our three new 2022-2023 Fellows

Tyler Nichols, PharmD, BCPS, is the **2022-2023 ISMP International Medication Safety Management Fellow**, supported by Novartis, Name Creation & Regulatory Strategy. He completed his Doctor of Pharmacy degree at Albany College of Pharmacy and Health Sciences in Albany, NY. Prior to the fellowship, Tyler spent 12 years working in health-system pharmacy, most recently as an inpatient pharmacy manager with a focus on sterile compounding practices at the Albany Med Health System. Tyler hopes to use his time as an ISMP international fellow to gain a broader perspective on global safety initiatives and to work closely with subject matter experts across multiple organizations and disciplines to improve his ability to deliver safe and effective care.

Jose P. Nery, PharmD, is the **2022-2023 ISMP Safe Medication Management Fellow**, supported by Baxter International, Inc. He completed his Doctor of Pharmacy degree at the University of Pittsburgh School of Pharmacy in Pittsburgh, PA. Prior to the fellowship, Jose practiced as a Lead Pharmacist at the UPMC Children's Hospital of Pittsburgh, with primary oversight of medication error analysis. It is in this role that his passion for process improvement and medication safety was ignited. Jose's desire to gain mastery in the field of medication safety ultimately led him to pursue a fellowship with ISMP.

Sadik Owolewa, PharmD, is the **2022-2023 FDA/ISMP Safe Medication Management Fellow**. He completed his Doctor of Pharmacy at Northeastern University School of Pharmacy in Boston, MA. Before the fellowship, Sadik worked at a Rite Aid pharmacy as a staff pharmacist. It was while working in the retail pharmacy setting that he discovered his passion for medication safety, which led him to a fellowship role with ISMP. After his fellowship, Sadik hopes to use his skills in medication safety in a regulatory agency or in the pharmaceutical industry.