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ISMP Institute for Safe Medication Practices
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Acute Care
ISMP Medication Safety Alert!®
Educating the Healthcare Community About Safe Medication Practices

Do you know what is going on in your OR? The anesthesiology residents' perspective

Problem: If you interviewed members of your perioperative team to ask what keeps them up at night, you might be surprised by what you uncover. The operating room (OR) represents an area with high patient acuity and treatment complexities. In many organizations, there is less technology available in the OR for medication administration compared to other areas in the hospital. Anesthesiology is unique in that a single person is responsible for their own checks and balances. Anesthesiology providers are tasked with determining which medications and doses are indicated within the context of the patient's current medications, checking for allergies and contraindications, selecting the medications from the storage location, preparing the doses accurately, and administering them appropriately. They have multiple medications available at their fingertips, most of the time without the safeguards of entering orders prospectively in the electronic health record (EHR) to take advantage of clinical decision support (CDS), pharmacist verification, smart infusion pumps with dose error-reduction systems (DERS), and/or barcode scanning prior to administration. For these reasons, intraoperative medication administration can be uniquely error prone.

While any practitioner, regardless of experience level, may be susceptible to making medication errors, certain safety practices require targeted education and repeated practice. In our April 20, 2023 article, *Ensuring competency and safety when onboarding newly hired professional staff – Part I*, we indicated that the academic curricula for many healthcare practitioners, including anesthesiology residents, often does not sufficiently cover topics such as medication safety, medication-use systems, and basic medication prescribing, preparation, and administration.

When practitioners want to make a good impression on supervisors and colleagues, they might be afraid to speak up and admit that they do not feel comfortable with, or do not fully understand, what is being asked of them. To help intercept errors and avoid adverse patient outcomes, anesthesia providers are expected to be transparent and empowered to "stop the line" when they believe something is wrong. But are organizations promoting a culture in which staff feel safe to stop and ask for help before getting into an uncomfortable situation? Or do they find themselves in a position where they must troubleshoot issues on their own, making assumptions and guessing to avoid the risk of losing respect? Sharing and learning is crucial for continuous improvement. However, if a healthcare organization does not provide a psychologically safe environment, practitioners are less likely to question practices, share ideas, or report and learn from incidents.

Errors Reported to ISMP

The following errors involving anesthesia providers were reported to ISMP. We asked anesthesiology residents (not directly involved in these cases) to provide insights into what may have contributed to these events from the trainee's perspective. Academic institutions can learn from these easy-to-replicate mistakes and provide departmental education on learner pitfalls. These lessons learned can be applied to many practice models of anesthesia care.

Case #1: *An attending anesthesiologist caring for a patient undergoing carotid artery surgery directed the anesthesiology resident to reverse the patient's neuromuscular blockade using "neo and glyco," intending to use neostigmine and glycopyrrolate. Instead of neostigmine, the resident prepared a dose of* ***NEOSYNEPHRINE*** *(a former US brand name for phenylephrine)*

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Formalin almost administered instead of sterile water. A nurse found 30 mL containers of Formal-Fixx, a 10% neutral buffered formalin solution for storing laboratory specimens (by Epredia) (**Figure 1**), in a bin that also contained sealed 120 mL cups of sterile water by McKesson (**Figure 2**).

Figure 1. A nurse found Formal-Fixx, a clear formalin-containing solution, in the sterile water bin.

Figure 2. Procedural areas stored 120 mL cups of sterile water that were restocked by central supply.

The sterile water cups were purchased and restocked by central supply for procedural units such as endoscopy. The organization

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and administered it as an intravenous (IV) push. The patient's blood pressure increased rapidly to approximately 300/150 mm Hg and the patient began bleeding profusely from the surgical site, requiring further surgical intervention.

Case #2: *During an intubation consult on the inpatient medical unit, an anesthesiology resident instructed a nurse to give the patient "30 of prop" for induction. When the attending physician arrived, they recognized that the nurse had drawn up 300 mg/30 mL of propofol rather than 30 mg. While the nurse was injecting the propofol, the order was clarified before the full 300 mg was administered. Moderate hypotension ensued, but the mistake was realized, preventing an even more serious overdose.*

Anesthesiology resident perspective: In these cases, the anesthesiologist and residents may not have realized the risk of using shortened drug names or slang terminology. In Case #1, the resident may not have been familiar with the abbreviated terminology and may have felt uncomfortable asking the attending for clarification out of fear of knowing less than expected or jeopardizing personal trust. In Case #2, the use of short names and communicating a dose without a unit was something that the resident may have learned from their mentors and used when talking to their anesthesia peers. It is best to be as clear and detailed as possible when communicating verbal orders and allow/require the other practitioner to repeat back the order to ensure a clear understanding.

Case #3: *In the middle of the night a trauma patient arrived in the OR for an emergency thoracotomy. An anesthesiology resident placed a radial arterial line in the patient, and the case proceeded uneventfully. During handoff, the intensive care unit (ICU) nurse identified that the arterial line pressure bag was spiked with a mannitol infusion rather than a 0.9% sodium chloride infusion. Both products, made by Baxter, come in 500 mL bags with black fonts that looked like other infusion bags, including Lactated Ringer's (**Figure 1**).*

Figure 1. Similar-looking 500 mL IV bags of 0.9% sodium chloride (left), Lactated Ringer's (middle), and 20% **OSMITROL** (mannitol) injection made by Baxter.

Case #4: *For hydration, an anesthesiology resident intended to administer Lactated Ringer's to a pregnant patient prior to placing an epidural catheter. The resident removed the IV fluid tubing from the smart infusion pump to allow free flow at the fastest rate possible. Uterine tachysystole ensued, resulting in severe maternal pain and fetal bradycardia. The patient's nurse identified that the resident had inadvertently initiated rapid hydration with the oxytocin infusion that was started for induction of labor. Terbutaline was required to arrest labor, and an emergency Cesarean section was narrowly averted.*

Anesthesiology resident perspective: Cases #3 and #4 demonstrate how anesthesia providers are often tasked with selecting from medications and fluids that come in nearly identical-looking packaging, which often sets them up for mix-ups. In addition to similar-looking products, in many ORs, the systems in place for barcode scanning of medication and fluids and the use of smart infusion pumps with DERS are not always available, or with their use maximized.

Case #5: *A pregnant patient in labor who was receiving a **BUP**ivacaine and fenta**NYL** epidural infusion was brought to the OR for a Cesarean section. The chief anesthesiology resident prepared and labeled doses of lidocaine and ce**FAZ**olin in 20 mL luer lock (parenteral) syringes. The resident administered an epidural bolus of what was thought to be lidocaine for analgesia. The patient began experiencing seizures requiring intubation with general anesthesia for an emergency Cesarean section and the patient was transferred to the ICU. Later, the resident identified that*

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did not report what the sterile water was being used for, but the label indicates it is for moistening of wound dressings, wound debridement, and device irrigation. The nurse immediately notified pharmacy and the central supply department. All Formal-Fixx containers were accounted for, and it was determined that no patients had received the formalin-containing solution.

On more than one occasion, ISMP has learned of situations where non-drug substances were confused with medications. In a case that occurred more than two decades ago, two community pharmacies, located in different states, inadvertently reconstituted antibiotic solutions with 10% formalin solution (3% formaldehyde and 15% methanol). Both pharmacies stocked gallon containers of formalin (needed by laboratories and surgical centers located nearby) and distilled water (for reconstituting medications). The large containers were stored near each other and were mixed up when used to reconstitute the antibiotic solutions. The tainted antibiotics were administered to more than 35 children, some of whom required hospitalization for vomiting. Fortunately, none of the children suffered permanent harm.

Pharmacy should collaborate with non-clinical departments that purchase and stock chemicals (e.g., formalin). Determine if any chemicals could be confused with other products due to the container's color, size, or shape; the product's name; or the solution's color/clarity. Place prominent warning labels on non-drug products and ensure these items are stored away from medications. During monthly unit inspections, the pharmacy should assess the storage locations of chemicals to determine if adjustments are necessary and to remove any unnecessary substances. Most importantly, chemicals should not be stored in patient care areas or where medications are stored, prepared, and administered.

Caution: Drug names that end with the letter "l." An outpatient pharmacy received an electronic prescription (e-prescription) for "tra**ZOD**one HCl 50 mg oral tablet, take one to two tablets at bedtime" (**Figure 1**, page 3). The pharmacy technician confused the

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*he had inadvertently administered ce**FAZ**olin instead of lidocaine epidurally. The patient suffered some transient short-term memory loss, and there was no apparent harm to the neonate.*

Anesthesiology resident perspective: Preparing epidural medications using luer syringes is a widespread practice in the OR. Many hospitals have not yet converted to NRFit connectors, the system designed to prevent a neuraxial misconnection. NRFit connectors are 20% smaller in diameter than luer connectors and prevent medications in medical devices meant for neuraxial administration from connecting to devices used for IV, enteral, and other applications, or vice versa.

Case #6: *During a vascular case, a surgeon who had been practicing for years asked an anesthesiology resident to administer heparin, referring to the dose in mg rather than units. The resident did not repeat back the dose or units of measure and prepared and administered the dose in units rather than mg of heparin. The patient experienced thrombosis due to the underdose.*

Anesthesiology resident perspective: Heparin is prescribed in units rather than mg. The resident should have questioned the order with the surgeon, clarifying the dose in units not mg.

Safe Practice Recommendations: Organizations should proactively gather feedback and learn from errors that have been reported and investigated. Strategies should be implemented to prevent errors from happening. Implement the following recommendations in perioperative practices, workflow, and organizational culture.

Increase medication safety awareness. We encourage organizations to proactively engage in medication safety discussions with all members of the perioperative team (e.g., anesthesiologists, surgeons, residents, nurses, surgical technologists, students). Standardize the orientation process and provide medication safety-specific education to practitioners for tasks that are deemed critical to their role. Provide initial and annual competency assessments for skills and knowledge on tasks that are expected of them, including those that may not be performed often (e.g., low-volume/high-risk duties). Develop simulation programs to ensure competency when performing essential medication-related tasks (e.g., repeating the complete medication order, preparing and labeling doses, using a smart infusion pump with DERS). Provide them with information about medication errors that have occurred and strategies that have been implemented to prevent them. Use resources such as the ISMP ***Guidelines for Safe Medication Use in Perioperative and Procedural Settings*** and the ***ISMP Medication Safety Self Assessment® for Perioperative Settings***.

Conduct a proactive safety analysis. When the pharmacy receives a new product (e.g., new product added to formulary, drug shortage), conduct a review to identify potential risks with the product's design, including look-alike labeling and packaging concerns with other products in use. Refer to resources such as the *Anesthesia Patient Safety Foundation (APSF) Look-Alike Drug Vials* webpage. When the pharmacy recognizes potential risks, consider purchasing the product (or one product of a problematic pair) from a different manufacturer. Communicate concerns to practitioners, purchasers, manufacturers, ISMP, and the US Food and Drug Administration (FDA).

Maximize the use of commercially prepared products. Purchase medications in ready-to-administer formulations. Maximize the use of commercially prepared (e.g., from a manufacturer, compounding or outsourcing pharmacy) or pharmacy-prepared syringes in the perioperative setting.

Maximize barcode scanning. Factors that contribute to look-alike packaging and labeling events include the use of highly stylized label graphics and similar cap and label colors. Products that have similar names and dosages, are used in the same setting, and/or are stored near one another, add to the risk of incorrect selection. For this reason, the ISMP ***Targeted Medication Safety Best Practices for Hospitals***, *Best Practice #18*, calls for expanding the use of barcode scanning technology to short- and limited-stay locations such as perioperative and procedural areas. To learn

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lowercase "l" in HCl with a number 1 and processed the prescription as tra**ZOD**one 150 mg oral tablets. The transcription was not checked by a pharmacist as part of the new prescription verification process. The patient took the incorrect dose for 90 days. A pharmacy technician identified the error when they were processing a refill and noticed the dose discrepancy from previous prescriptions. The pharmacy notified the patient and the prescriber of the error, and no harm was reported. The pharmacy also contacted the prescriber's informatics administrator to remove HCl from the drug name and was told that they could not modify the name in the system.

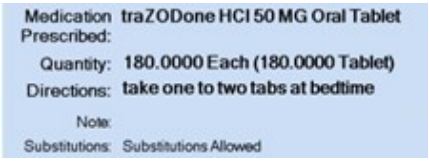

Figure 1. Image of the e-prescription for tra**ZOD**one HCl 50 mg which was manually entered as tra**ZOD**one 150 mg after a pharmacy technician confused the "l" in HCl as the numeral "1."

Drug names that end with the letter "l" have occasionally been the subject of overdoses reported to ISMP. Most often this has happened when there was not adequate space between the end of the drug name and the strength (e.g., propranolol20 mg), especially in handwritten prescriptions. So, it is important that even e-prescriptions have adequate space between the drug name and strength.

In the event described above, the inclusion of the salt of the chemical (i.e., HCl) contributed to the event. For this reason, the ISMP ***Guidelines for Safe Electronic Communication of Medication Information*** recommends when expressing a generic drug name, do not include the salt of the chemical unless there are multiple salts available or the salt alters the drug release (e.g., metoprolol tartrate and metoprolol succinate) and thus conveys meaningful information. In this case, tra**ZOD**one is only available as hydrochloride, so we do not recommend vendors include "HCl" in the drug name. To minimize the need for manual transcription of e-prescriptions into pharmacy systems, hospitals, medical offices, and clinics must ensure e-prescriptions are constructed

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more about how to overcome challenges with implementation, refer to our August 11, 2022 article, *An interview: Success with barcode scanning to enhance perioperative medication safety*.

Label practitioner-prepared doses. Label all practitioner-prepared infusions and syringes with the drug name, concentration, and volume. The ISMP ***Guidelines for Safe Medication Use in Perioperative and Procedural Settings*** calls for the elimination of handwritten labels, and to include machine-readable codes on all medication labels, including those that are practitioner-prepared. As an alternative, use preprinted sterile labels (or sterile blank labels and smudge-proof markers). When possible, have a second perioperative team member independently double check the dose and volume with the label prior to administration. If the dose or infusion is practitioner-prepared, also share the source container (e.g., vial) so the original label and dose can be confirmed during the double check.

Read medication labels. Carefully review individual product labels after removing the medication from the anesthesia tray and/or automated dispensing cabinet (ADC), when removing infusions from overwraps, when spiking an IV bag, and prior to administration. When possible, implement audio/visual feedback to verify the drug prior to administration. Refer to our September 8, 2022 article, *Barcode scanning by anesthesia providers in the OR*, where an organization shared how they introduced generated audio messages confirming in a clear, audible human voice, the identity of the scanned medication.

Communicate doses safely. Never use or accept shortened or truncated drug names (e.g., neo, glyco). Instead, refer to medications by their generic and/or brand names only and include an indication with medication orders to further avoid confusion. Refer to the ISMP ***List of Error-Prone Abbreviations, Symbols, and Dose Designations***. Practice closed loop communication where the receiver repeats back the verbal order, stating the exact dose of medication (e.g., not "30 of prop"), including the units of measure. Pronounce each numerical digit in the dose (e.g., "sixteen, one six," to avoid confusion with "sixty"). Ensure the prescribed medication and dose make sense in the context of the patient's condition. Encourage the perioperative team to clarify any medication-related concerns, especially when a prescriber requests a medication or dose that does not fit the patient's condition. Ensure the route of administration is always a part of the order and is never assumed.

Make use of DERS an expectation. The use of smart infusion pumps is most critical in patient care areas where high-alert medications are administered, including the OR. Leadership needs to establish that the use of DERS in smart infusion pumps is an expected practice in the OR and other perioperative areas for all continuous medication infusions, intermittent and secondary infusions, loading and bolus doses, patient-controlled analgesia infusions, epidural and nerve block infusions, and hydrating solution infusions (except when the hydrating fluid administration rate is greater than the pump allows).

Label and trace lines. Label all infusion lines at the point(s) of connection (e.g., above the pump and above the access point into the patient's body). When infusions are started, reconnected, or changed (i.e., new bag/bottle/syringe), trace the tubing from the solution container to the pump, to the connection port, and then to the patient to verify the proper infusion, pump/channel, and route of administration into the patient. Confirm that the infusion rate has been programmed accurately before starting the infusion.

Encourage open dialogue. Foster an organizational culture of safety in which practitioners are not intimidated to speak up. For additional information, refer to our March 10, 2022 article, *Addressing Disrespectful Behaviors and Creating a Respectful, Healthy Workplace–Part II*. Emphasize the need to ask questions and never make assumptions. It is important for practitioners to develop a questioning attitude regarding medication safety during orientation and throughout their career. Encourage them to ask questions and to be transparent about errors to help enhance understanding and learn from mistakes.

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and transmitted according to standards set by organizations such as the National Council for Prescription Drug Programs and Surescripts. Pharmacies should routinely test and update their systems to ensure accurate processing and matching of e-prescription information.

HIGH-ALERT

Close call with 0.9% and 3% sodium chloride bags. A pharmacy technician found similar-looking 500 mL bags of 0.9% sodium chloride injection and 3% sodium chloride injection in the same storage container in the pharmacy. Both products (Fresenius Kabi) are supplied in clear bags with similar black font on the labels (**Figure 1**). The 3% sodium chloride label states "Hypertonic Saline" in a small black box below the drug name, but practitioners easily overlooked it. The hospital that reported this is planning to purchase the 3% sodium chloride bags from an alternative manufacturer that has a red warning statement. They also plan to incorporate barcode scanning into the medication receiving process in the pharmacy.

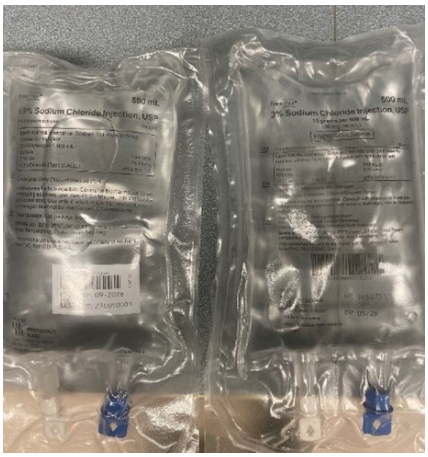

Figure 1. Similar-looking 500 mL bags of 0.9% sodium chloride injection (left) and 3% sodium chloride injection (right) by Fresenius Kabi were found in the same pharmacy storage bin.

A second hospital reported similar concerns, noting that the label on the 500 mL bags of 3% sodium chloride injection (Fresenius Kabi) lacks a prominent warning that this is hypertonic saline, a high-alert medication. We reached out to the manufacturer to recommend differentiating these infusion bags by making the labels less similar and by making the hypertonic warning more prominent.

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Plan for NRFit device conversion. The ISMP ***Guidelines for Safe Medication Use in Perioperative and Procedural Settings***, calls for organizations to use an interdisciplinary team to transition to the ISO 80369-6 design standards for neuraxial (NRFit) connectors to reduce the risk of IV and neuraxial misconnections. To learn more about transitioning to NRFit devices, refer to our November 14, 2024 article, *Take action to prevent tubing misconnections—Part II*, and the November 2024 NRFit webinar recording, *Improving patient safety—presented with the 1st US clinicians to adopt NRFit*.

Report errors. Emphasize that the organization values a culture of safety and encourages medication error reporting and sharing lessons learned. Consider implementing a program that includes "weekly shout-outs" or "good catches" to acknowledge practitioners who exemplify values in safety. This is a way for leaders to recognize colleagues who speak up for patient safety and to encourage a safe learning culture.

Special Announcements

Nominations open for CHEERS AWARDS

Each year, ISMP honors various healthcare disciplines that have demonstrated an exemplary commitment to medication safety through innovative projects with an ISMP **CHEERS AWARD**. Nominations for this year's **CHEERS AWARDS** are now open and will be accepted through **August 1, 2025**. For more details and to submit a nomination, click here.

Free activities from ASHP

The American Society of Health-System Pharmacists (ASHP) recently released **FREE** continuing education (CE) activities for pharmacists and pharmacy technicians. A podcast entitled, *USP <797> and Parenteral Nutrition: What's New on the Menu*, has faculty experts highlight USP <797> and discuss opportunities to reduce medication errors with respect to sterility, stability, and compatibility when compounding parenteral nutrition and assigning beyond use date. There is also an interactive web-based activity entitled, *Navigating the Life Cycle of Viable Air and Surface Samples*, which addresses frequently asked questions regarding facility environmental monitoring. For more information, please click on the program titles.

ISMP webinar on safety with ready-to-administer (RTA) products

Join us on **June 11, 2025**, for a webinar entitled, *Applying Best Practices for Injection Safety: A "How To" Roadmap*. Learn about the risks associated with manipulating medications at the bedside and how to optimize the use of RTA products. Click here to register.

Short survey on automated dispensing cabinets (ADCs)

Med Safety Board, an ISMP company, is surveying the safe use of ADCs regarding storage configurations, error risks, and medication access concerns. This survey is for all healthcare professionals involved with ADCs. Please take 5 to 10 minutes to complete the survey by **June 30, 2025**. Thank you for your participation!

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When pharmacy receives a new product, conduct a review to identify potential risks with the product's design, including look-alike labeling and packaging. If risks are identified, consider purchasing the product (or one product of a problematic pair) from a different manufacturer. Use barcode scanning technology when receiving, compounding, dispensing, and prior to administration. Store look-alike products separately, and consider the use of signage or other warnings on the infusion bags and in storage locations.

EPINEPHrine auto-injector without retractable needle. A pediatric emergency department nurse reported that the **EPINEPH**rine single-dose prefilled auto-injector (Amneal) does not automatically retract and shield the needle post-injection. According to the prescribing information, Amneal's **EPINEPH**rine auto-injector requires the user to manually slide a cover over the needle after administration, increasing the risk of a needlestick injury. The nurse expressed concern that this could lead to a needlestick injury, so they notified the pharmacy, which now purchases an **EPINEPH**rine product from a different manufacturer.

Other brands (e.g., **EPIPEN** [Mylan], generic products [Mylan, Teva]) have safety mechanisms in place that automatically covers the needle after administration or the needle automatically retracts (e.g., **AUVI-Q** [Kaleo]) to help prevent accidental needlestick injuries.

We have notified the manufacturer about this concern and recommended that they add engineering controls to the needle that protect people against needlestick injuries. Amneal has escalated our concern for further follow-up.

Organizations should consider purchasing products with automatic mechanisms to prevent needlestick injuries. Continue to report issues and concerns with devices that do not have safety mechanisms in place to ISMP, the US Food and Drug Administration (FDA), and the respective manufacturer.