



## Preventing harmful errors with anticoagulants

**A**nticoagulants are high-alert medications that carry a significant risk of causing serious injuries or death to patients if they are misused. Errors with these products are not necessarily more common than with other drugs, but when used or omitted in error, anticoagulants can cause life-threatening or fatal bleeding events or thrombosis.

Anticoagulants are currently among several high-alert medications that have been targeted for enhanced safety by The Joint Commission—through its 2008 National Patient Safety Goals—and the Institute for Healthcare Improvement—through its 5 Million Lives Campaign ([www.ihl.org/IHI/Programs/Campaign/](http://www.ihl.org/IHI/Programs/Campaign/)). To assist with these important, nationwide medication safety efforts, ISMP has identified common risks associated with unfractionated heparin, low-molecular weight heparin, and warfarin, as well as recommended safeguards.

### Common risks associated with heparin, low-molecular weight heparin, and warfarin

#### Duplicate or concurrent therapy

- ▶ Unrecognized concomitant use of anticoagulants; for example, starting a heparin infusion upon admission shortly after the patient has received low-molecular weight heparin in the emergency department (ED), or continuing the low-molecular weight heparin prescribed in the ED after the start of the heparin infusion.
- ▶ Patient confusion about generic and brand names of warfarin, leading to self-administration of both warfarin and **COUMADIN**.

#### Accidental stoppage of therapy

- ▶ Forgetting to resume an anticoagulant after holding a dose(s) or upon discharge.

#### Look-alike bags, vials, or syringes

- ▶ Mix-ups among various concentrations of heparin packaged in bags or vials (e.g., recent vial mix-ups involving the twins of Dennis and Kimberly Quaid who received heparin flushes from vials containing 10,000 units/mL, not 10 units/mL [[www.ismp.org/Newsletters/acute/acute/articles/20071129.asp](http://www.ismp.org/Newsletters/acute/acute/articles/20071129.asp)]).
- ▶ Mix-ups between heparin vials and other drugs in look-alike vials (e.g., insulin, saline).
- ▶ Mix-ups between heparin flush syringes and other drugs in look-alike syringes (e.g., saline flush, low-molecular weight heparin).
- ▶ Confusion among look-alike bags of IV heparin, lidocaine, and **HESPAN** (hetastarch).

#### Look-alike names

- ▶ Handwritten orders for **AVANDIA** (rosiglitazone maleate) misread as Coumadin or hespan mistaken for heparin, and vice versa.

#### Dosing/infusion errors

- ▶ Administration of the wrong dose because the barrel of **LOVENOX** (enoxaparin) prefilled syringes lacks milliliter gradations.
- ▶ Patient self-administration errors due to confusion when they are required to take different warfarin doses on alternate days, or if frequent dose adjustments are

continued on page 2

### safetywires

#### ⚡ Drug mix-up leads to cardiac catheterization lab error.

A nurse who was being oriented to a hospital's cardiac catheterization lab inadvertently administered 5 mL of 5 mg/mL nitroglycerin (25 mg total) intraarterially during a procedure. She thought she was giving 5 mL of heparin, 1,000 units/mL (5,000 total units). Small amounts of nitroglycerin are sometimes used during cardiac catheterizations to reduce arterial spasm. A more experienced nurse preceptor had arranged the table where the procedure drugs were kept. The preceptor asked the orienting nurse to prepare a dose of 5,000 units of heparin from a vial that she indicated was on the table. Since the orienting nurse had not arranged the table, she did not know that a vial of nitroglycerin had been placed on the table, in addition to the heparin vial. While searching for the heparin, she observed a partially turned vial, saw the letters "rin" on the label, assumed it was a heparin vial, and withdrew 5 mL of nitroglycerin in error. This was given to the patient, who suffered severe hypotension but recovered after a brief stay in ICU. This event serves as a reminder to always double-check any high-alert medication before administration. Another safeguard would be to always keep heparin and nitroglycerin vials segregated. Hospitals should firm-up dose-checking systems, and purchase and use commercially available premixed IV bottles of nitroglycerin instead of the vials. The bottles should be discarded after each procedure. Additionally, to minimize error-prone handoffs, the nurse who arranges the table should also prepare the medications during a procedure.

continued on page 2

Anticoagulants continued from page 1

required (especially if the dose differs from the label on the prescription bottle).

- ▶ Prescribing the wrong dose when resuming warfarin after reversal of its effects with phytonadione (vitamin K), which continues to block warfarin effects for about a week).
- ▶ Failure to reduce the standard starting dose of warfarin for elderly patients, or to consider weight or renal function when dosing low-molecular weight heparin.
- ▶ Use of the abbreviation "U" for units, resulting in 10-fold overdoses.
- ▶ Infusion pump setting errors with IV heparin, often involving the concentration or rate of infusion, forgetting to reset the pump after the delivery of a bolus dose from the continuous infusion bag, or multi-channel infusion pump line mix-ups.
- ▶ Mix-ups between kilograms and pounds, or not using a current measured weight to calculate the dose.

### Calculation errors

- ▶ Math errors when determining the dose/volume of heparin to administer/infuse.

### Patient monitoring problems

- ▶ Failure to obtain baseline lab tests before starting anticoagulation therapy.
- ▶ Failure to verify the most recent lab values before administration of the next dose.
- ▶ Erroneous INR/aPTT results (from changes in equipment or reagents, incorrect amount of sodium citrate in blood collection tubes, overfilling the tube with blood).
- ▶ Patient failure to comply with outpatient laboratory testing.

### Drug and food interactions

- ▶ Lack or disregard of electronic alerts for clinically significant interactions with drug(s), herbal(s), and food.

### Adverse reactions

- ▶ Failure to detect and quickly treat heparin-induced thrombocytopenia.
- ▶ Possible development of a spinal hematoma if anticoagulants are in use at the time of a spinal puncture.

### Recommended safeguards for heparin, low-molecular weight heparin, and warfarin

(Key: H=heparin, LMWH=low-molecular weight heparin, W=warfarin)

#### Standardization

- Use a standard weight-based heparin protocol for each indicated use of a heparin infusion. (H)
- Use approved standard order sets or preprinted orders. (H, LMWH, W)
- Do not abbreviate units as "U" on handwritten, typed, or computerized materials. (H, LMWH)
- Standardize the concentration of therapeutic heparin infusions; require pharmacy to prepare, dispense, and highlight any approved non-standard concentration. (H)
- Administer warfarin at a standard time that allows for thorough review of daily laboratory results and necessary dose adjustments before administration. (W)
- Establish and follow a strategy for handling hold/resume orders. (H, LMWH, W)
- Establish and follow protocols for standard (before a planned procedure) and rapid (emergency) reversal of anticoagulation. (H, LMWH, W)

#### Simplification

- Administer bolus doses from a pharmacy-prepared syringe (unless a smart pump is used and can alert the nurse to resume the maintenance infusion rate after the bolus dose has been administered from the bag). (H)
- Have pharmacy dispense warfarin in exact patient doses. (W)
- Have pharmacy dispense heparin flush solutions in the exact concentration

continued on page 3

**safetywires** continued from pg. 1



**Talc given IV.** A physician ordered talc in saline to perform a pleurodesis on a patient with a pleural effusion. The talc serves as an irritant when instilled inside the pleural space via a chest tube, causing inflammation that results in the pleura of the chest wall and lung (parietal and visceral pleura) to adhere together. (Bleomycin can also be used for this purpose.) This prevents buildup of fluid in the space between the membranes. The pharmacy prepared the talc and saline in a 50 mL Luer-lock syringe with a screw-on cap. The syringe was labeled with a standard IV room label, which included the preprinted name of the hospital and "IV additive service." When the patient's nurse received the syringe, she was unaware of the physician's intention to use the talc in saline for a pleurodesis. The physician's handwritten order was difficult to read. Consequently, the nurse misinterpreted the word "in" amid the order for "talc in saline" as "IV." Given that she had a syringe with a Luer-lock tip, and it was labeled as an IV additive product (i.e., "IV additive service"), the nurse administered the product intravenously. Tragically, the patient died as a result of the error. Products that are not intended for IV administration should *not* be dispensed in a Luer-lock syringe that can be used for IV administration. Drugs for pleurodesis should be delivered by a pharmacy staff member directly to the patient care unit immediately before use in a catheter-tipped syringe, along with a label that boldly warns, "**For chest tube instillation only.**" The product should not be delivered to a patient care area via a pneumatic tube system, as leakage may occur despite the cap on the catheter-tipped syringe. One pharmacist told us that his hospital packages the talc, diluent, and syringe inside a preassembled kit for a pleurodesis. Another pharmacist told us that his hospital uses a prepackaged talc spray (**SCLEROSOL Intrapleural Aerosol**), although others have expressed concern with the spray because maximum coverage of the pleural spaces may be difficult; the spray talc

continued on page 3

Anticoagulants continued from page 2

required for the patient population (e.g., neonates) and/or parenteral device in use. (H, LMWH, W)

#### Externalize error-prone processes

- Use commercially prepared, premixed IV heparin solutions for infusion. (H)
- Use commercially prepared, unit-dose syringes (including adult heparin flushes when saline flushes will not suffice). (H, LMWH)

#### Improved access to information

- Use smart pumps, bar-coding, and computerized prescriber order entry to support prescribing, dispensing, and administration processes. (H, LMWH, W)
- Use the patient's actual weight in kilograms (or ideal body weight if indicated) to determine heparin doses. (H, LMWH when indicated)
- Have pharmacy affix infusion rate charts (preprinted on labels) to heparin infusion bags for easy reference when programming or checking pump settings. (H)
- Improve access to prior/current drug therapy by sending all ED and cardiac catheterization orders to the pharmacy if patients are admitted to the hospital. (H, LMWH, W)
- Use approved anticoagulation flow sheets designed for use during the inpatient stay, and provide them to patients/transfer facilities upon discharge. (H, W)
- Educate patients about self-monitoring, administration of anticoagulants, and the importance of dietary restrictions with vitamin K enriched foods. (H, LMWH, W)

#### Differentiation or constraints

- Safely select, procure, and store anticoagulants away from other drugs with look-alike names or packaging. (H, LMWH, W)
- Only administer anticoagulants after a pharmacist has reviewed the initial or changed order. (H, LMWH, W)
- Restrict access to multiple/high concentrations of heparin (in vials and/or syringes) on patient care units. (H, LMWH)
- When unit stock of heparin is appropriate, stock the smallest size packages (unit-dose syringes, single-use vials) and the fewest doses necessary to meet the needs of the patient care unit. (H, LMWH)
- Use saline, not heparin, to flush peripheral venous access catheters. (H)

#### Redundancies

- Consistently employ independent double-checks (e.g., a second nurse checks the drug, dose, patient, line attachment, and pump settings before IV administration). (H, LMWH, W)

#### Patient monitoring

- Obtain baseline laboratory tests (e.g., hemoglobin, hematocrit, serum creatinine, platelet count, INR, aPTT) before starting therapy. (H, LMWH, W)
- Monitor the timeliness of associated lab results to ensure results are consistently available within 2 hours from the time they are drawn. (H, LMWH, W)
- Use a protocol and/or preprinted orders for evaluation and treatment of heparin-induced thrombocytopenia. (H, LMWH)
- If available, utilize inpatient pharmacy anticoagulation services and outpatient warfarin services for dosing, monitoring, and teaching patients about their therapy. (H, LMWH, W)

#### Failure mode and effects analysis (FMEA)

- Conduct a FMEA to identify organization-specific sources of failure with the use of anticoagulants and individualize the key improvements needed to reduce the risk of harmful errors. To assist you, ISMP has created a sample FMEA for anticoagulants ([www.ismp.org/Tools/FMEAofAnticoagulants.pdf](http://www.ismp.org/Tools/FMEAofAnticoagulants.pdf)).

*safetywires* continued from pg 2

will only stick directly to the areas sprayed, while the talc solution can be spread throughout the pleural spaces via gravity, by repositioning the patient. Some hospitals are also using a time-out before the procedure to verify patient identity as well as equipment and medications. One last recommendation: Examine your pharmacy labels. Extraneous, misleading words, like "IV additive service," should not appear on the labels.

#### ► Special Announcement

**ISMP teleconference.** Please join us for our first 2008 teleconference, **Safe Use of ADCs: Choosing Safety Over Convenience**, to be held on **January 30** from 1:30-3:00 p.m. ET. The speakers will address common errors associated with the use of automated dispensing cabinets (ADCs) and present new consensus recommendations designed to improve formulary management, drawer configuration, restocking procedures, system overrides, and medication withdrawal and transport. To register, visit: [www.ismp.org/educational/teleconferences.asp](http://www.ismp.org/educational/teleconferences.asp).

**Free FDA patient safety videos.** The latest FDA medication safety-related videos are now available free for viewing or downloading on the ISMP website at: [www.ismp.org/Tools/fdavidoes.asp](http://www.ismp.org/Tools/fdavidoes.asp).

Recent topics include:

- **Rare Side-Effect of Codeine in Nursing Mothers**
- **Avoiding Dangerous Mixups between Amphotericin B Formulations**
- **Warnings for Rocephin.**

**ISMP Medication Safety Alert! Nurse Advise-ERR** (ISSN 1550-6304) © 2007 **Institute for Safe Medication Practices (ISMP)**. Permission is granted to subscribers to reproduce material for internal newsletters or communications. Other reproduction is prohibited without written permission. Unless noted, published errors were received through the USP-ISMP Medication Errors Reporting Program. **Editors:** Judy Smetzer, RN, BSN, FISMP; Charlotte Huber, RN, MSN; Michael R. Cohen, RPh, MS, ScD; Russell Jenkins, MD. **ISMP, 1800 Byberry Road, Suite 810, Huntingdon Valley, PA 19006.** Tel. 215-947-7797; Fax 215-914-1492; E-MAIL: [nursing@ismp.org](mailto:nursing@ismp.org). **Report medication errors to ISMP at 1-800-FAIL-SAF(E).**

# Special Recognition...

## *Our 2007 Nurse Advise-ERR® Clinical Advisory Board*

Production of this peer-reviewed newsletter would not be possible without the assistance of a reliable and talented clinical advisory board. As 2007 nears an end, we want to thank each of the following members of the advisory board for their dedication to making this newsletter a valuable medication safety resource for clinicians.

- ❖ **Gay Bailey**, RN, MBA, OCN, Memorial Sloan-Kettering Cancer Center, New York, NY
- ❖ **Sally Barbour**, PharmD, BCOP, CPP, Duke University Medical Center, Durham, NC
- ❖ **Palma Berardi**, RN, MSN, Suburban Hospital, Bethesda, MD
- ❖ **Thomas Burnakis**, PharmD, Baptist Medical Center, Jacksonville, FL
- ❖ **Helene Burns**, MSN, RN, CNA, BC, Delaware County Memorial Hospital/Crozer-Keystone Health System, Drexel Hill, PA
- ❖ **Eileen Farley**, MSN, RN, CNA, BC, Bryn Mawr Rehab Hospital, Main Line Health System, Paoli, PA
- ❖ **Theresa Gregory**, RN, Thomas Jefferson University Hospital, Philadelphia, PA
- ❖ **Adina S. Gutstein**, RN, MSN, CRNP, Achieving Better Control, Inc., Lower Gwynedd, PA
- ❖ **Susan Hohenhaus**, MA, RN, FAEN, Duke University Health System, Durham, NC
- ❖ **Joanne Kowiatek**, RPh, MPM, University of Pittsburgh Medical Center, Presbyterian Shadyside, Pittsburgh, PA
- ❖ **Timothy Lesar**, PharmD, Albany Medical Center, Albany, NY
- ❖ **Ellen Lynch**, RN, MSN, Cranaleith Spiritual Center, Philadelphia, PA
- ❖ **Anne May**, RN, BSN, CEN, Montgomery General Hospital, Olney, MD
- ❖ **Kim Noble**, PhD, RN, CPAN, Temple University, Philadelphia, PA
- ❖ **Ginette Pepper**, RN, PhD, FAAN, University of Utah, Salt Lake City, UT
- ❖ **Joanne Peterson-Falcone**, RN, CCRN Alumnus, Memorial Hospital, Colorado Springs, CO
- ❖ **Regina Phariss**, RN, Covenant Health System, Lubbock, TX
- ❖ **Lille Plumer**, PharmD, Duke University Hospital, Durham, NC
- ❖ **Joanne Farley Serembus**, EdD, RN, CCRN, CNE, Drexel University, Philadelphia, PA
- ❖ **Therese Staublin**, PharmD, St. Francis Hospital and Health Centers, Beech Grove, IN
- ❖ **Jean Whelan**, PhD, RN, University of Pennsylvania, Philadelphia, PA



# Happy Holidays...

*The staff and trustees at the Institute for Safe Medication Practices wish you joy, health, and happiness this holiday season!*

## ISMP Trustees

- ❖ David Bates, MD, MSc ❖ Michael Cohen, RPh, MS, ScD ❖ Mark Cziraky, PharmD ❖ George DiDomizio, JD ❖ Janice Dunsavage, RPh, MS
- ❖ Russell Jenkins, MD ❖ Louis Martinelli, PharmD, PhD ❖ Margaret McGoldrick ❖ Joel Shuster, PharmD, BCPP ❖ J. Russell Teagarden, RPh, MA
- ❖ David U, BScPhm, MScPhm ❖ Zane Wolf, RN, PhD, FAAN ❖ G. Rodney Wolford

## ISMP Staff

- ❖ Renee Brehio, MA ❖ Hedy Cohen, BSN, MS ❖ Michael Cohen, RPh, MS, ScD ❖ Rachel Cohen, MS, RD ❖ William Cunningham, BSEE, MCSE, CAN
- ❖ Stephanie DeGraw, PharmD ❖ Sharon Dicker ❖ Matthew Fricker, RPh, MS ❖ Michael Gaunt, PharmD ❖ Nancy Globus, PharmD
- ❖ Nicole Graser ❖ Matthew Grissinger, RPh, FASCP, FISMP ❖ Reuben Grubb ❖ Donna Horn, RPh, DPh ❖ Charlotte Huber, RN, MSN ❖ Russell Jenkins, MD
- ❖ Arounsavanh Khemdy ❖ Marci Lee, PharmD, FISMP ❖ Stuart Levine, PharmD ❖ Michelle Mandrack, RN, BSN ❖ Lena Medvinsky
- ❖ Kristine Needleman, RPh ❖ Barbara Olsen, RNC, MS ❖ Susan Paparella, RN, MSN ❖ Susan Proulx, PharmD ❖ Heather Quarry, CPA
- ❖ Lisa Shiroff ❖ Judy Smetzer, RN, BSN, FISMP ❖ Mimi Spiegel ❖ Kelly Stever ❖ Nancy Tuohy, RN, MSN ❖ Allen Vaida, PharmD