

This series brings you up-to-date information about medication safety issues and strategies to prevent medication errors. It draws on Australian incidents and US experience, including (with permission) material from ISMP Medication Safety Alert! a bulletin published by the US Institute for Safe Medication Practices <www.ismp.org>. This series is coordinated via the Committee of Specialty Practice in Medication Safety (Chair, Rosemary Burke, Director of Pharmacy, Concord Hospital, NSW). Australian incidents are collated and editorial recommendations made by Penny Thornton (Principal Advisor, Medication Safety, NSW Health; <medsafety@shpa.org.au>).

## AUSTRALIAN INCIDENTS

### Over-prophylaxis against VTE?

A frail elderly patient was brought to hospital by ambulance following an accidental hip fracture. A complex medical history included atrial fibrillation, permanent pacemaker and daily warfarin. The patient's warfarin was ceased pre-operatively and a heparin infusion started. Post-operatively Clexane was ordered in the medical notes but not recorded on the medication chart. Day 1 post-surgery, the patient's urine output was decreasing and when reviewed by a junior doctor it was noted that no anticoagulation therapy was administered. The orthopaedic registrar was informed by telephone as it was the weekend and permission given to start Clexane (dose not discussed). Enoxaparin 60 mg subcutaneously twice daily was prescribed to continue until a therapeutic international normalised ratio was achieved (previous 1.2). Warfarin prescription on the medication chart had directions to withhold pre-surgery (day prior to surgery and day of surgery) and restart on Day 1 post-surgery at 10 mg and 5 mg the following day (usual orthopaedic regimen for patients on warfarin) and aspirin was also started in line with hospital policy. The patient experienced significant blood loss and died on Day 4.

**Clinical Messages.** The patient's low body weight and poor renal function combined with the junior doctor prescribing anticoagulants for an unfamiliar patient over the weekend allowed prescription of excessive anticoagulants. This may have contributed to the patient's haemorrhage and subsequent death. Pharmacists have to be prepared to risk-assess and select patients eligible for venous thromboembolism prophylaxis. It is easy to unintentionally over-treat if doses of the recommended drugs are not individualised. Ceasing and restarting regular anticoagulants must be accompanied by review of diagnostic tests and reassessment of the need for dose adjustment. This case also calls for review of the system and communication in hospitals outside regular specialist team hours and on weekends.

[Australian Incident 105, November 2009]

### Beware of confusion: Look-alike products

In 2010, the Health Purchasing Victoria contracts were renewed. The Alfred Drug Availability Working Group reviewed around 300 new product brands to identify areas of medication safety risk for nursing and pharmacy staff. One major safety issue was the similarity between two Aspen products – ciprofloxacin and fluconazole intravenous infusions (Figure 1). Both are antimicrobials and used in a similar patient population and likely to be used on the same ward. The concentration and volume of the products are also the same, as is the packaging for the infusion bag and outer box. There was an overlap between changing the intravenous ciprofloxacin brand, so the Aspen product was still on the wards. To prevent



Figure 1. Aspen's fluconazole 200 mg/100 mL (top) and ciprofloxacin 200 mg/100 mL (above) infusion bags.

errors in selection, individualised medication safety notices were issued and placed next to the products on all ward areas, including pharmacy store. The notice included photos (Figure 1) and the advice: 'Please pay close attention when selecting your antimicrobial product'. Health Purchasing Victoria and Aspen Pharmacare were notified and they are acting on suggestions to avoid similar packaging in the future.

**Recommendation:** Therapeutic Goods Administration, manufacturers and state contract authorities for public hospitals should keep packaging in mind when approving products. Mandating clear labelling avoids incorrect selection and administration of medicines. Until this happens universally, hospital pharmacists should review all new products before they reach our patients. [Australian Incident 106, June 2010]

## US SAFETY BRIEFS

### Preventing errors administering drugs via enteral feeding tubes

**Problem:** Did you know administering drugs through feeding tubes can be prone to errors? Medication errors related to this route of administration happen more often

than reported or recognised. These errors are often the result of administering drugs that are incompatible with administration via a tube, preparing the drugs improperly, and/or administering drugs using improper techniques, which can lead to occluded feeding tubes, reduced effect, or toxicity.

**Incompatible route.** We cannot assume that a medication intended to be taken by mouth can be safely given through a feeding tube. The physicochemical properties of the drug controls release and subsequent absorption. These delivery mechanisms may be altered or destroyed if the drug is administered through a feeding tube, reducing its effectiveness or increasing the risk of toxicity. Accupril (quinapril) tablets contain magnesium carbonate and crushing an Accupril tablet and dissolving it in water for enteral use allows the carbonate to increase the pH of the solution, causing quinapril to rapidly degrade into a poorly absorbed metabolite.

**Improper absorption.** Drug absorption depends on the drug's solubility and ability to permeate the intestinal mucosa. Many drugs must be administered into the stomach or duodenum so they can dissolve using gastric juices, bile and pancreatic enzymes, and be absorbed through the intestines. Warfarin absorbed high in the small bowel, and oral iron dissolves in the stomach and is then absorbed in the duodenum, may not be properly absorbed if administered via a jejunostomy tube.

**Improper preparation.** Medications intended to be taken by mouth must be prepared for enteral use. Tablets must be crushed and diluted, capsules must be opened and the content diluted, and many commercial liquid forms of drugs should be further diluted before enteral use. Many immediate-release tablets can be crushed into a fine powder and diluted prior to use but sublingual, enteric-coated and extended/delayed-release drugs should not be crushed. In addition to destroying the protective coating, crushed enteric-coated tablets tend to clump and clog feeding tubes. Crushed sublingual or extended/delayed-release drugs can lead to dangerous and erratic blood levels and dangerous adverse effects. The various suffixes used by manufacturers to denote an extended/delayed-release formulation (e.g. CD, CR, ER, LA, SA, SR, TD, TR, XL, XR) or their absence, such as with Oxycontin (oxyCODONE controlled release) make it difficult to quickly determine whether a drug can be safely crushed. Some drugs should not be crushed or dissolved, e.g. crushing Tracleer (bosentan) or opening Zavesca (miglustat) capsules, can expose nurses to powder that can cause serious birth defects, Prevacid (lansoprazole) solutabs must not be crushed because they contain enteric-coated micro-granules. Some capsules contain immediate- and extended/delayed-release granules. With liquid-filled capsules, it is difficult to ensure that all the liquid has been removed to give the correct dose. Commercial liquid forms or other preparations used to make oral suspensions may seem like a safe alternative, but some, may not be appropriate for administration via feeding tubes. Excipients in some oral solutions and suspensions, such as sweeteners, gums, stabilisers and suspending agents, can increase viscosity and osmolality, causing diarrhoea, clogged tubes, and/or undelivered medication left in the tube.

**Improper administration technique.** Most nurses rely on their own experience and that of their co-workers for information on preparing and administering enteral drugs.

Few rely on pharmacists, nutritionists or guidelines, which has resulted in a variety of improper techniques and a lack of consistency. Common improper techniques include mixing multiple drugs to give together and failing to flush the tube before, between and after each drug. Correct techniques must be used to prevent incompatibilities (between drugs and feeding formula) and tube occlusions. Data about drug compatibility with feeding formulas are limited and may not be applicable to different formulations of the same drugs within the same class. For example, 2 mg/mL liquid morphine decreases the pH of the feeding formula and results in a precipitate, but 20 mg/mL liquid morphine does not. Compatibility issues between the feeding formula and drug, and between multiple drugs administered together can result in tube occlusions, particularly if drugs are crushed and mixed together before use. Mixing drugs together, creates a new and unknown entity with an unpredictable mechanism of release and bioavailability.

**Safe practice recommendations.** Within organisations, an interdisciplinary team of nurses, pharmacists, nutritionists, and physicians should work together to develop protocols for administering drugs through enteral feeding tubes. Protocols should address using appropriate dosage forms, preparing drugs for enteral use, administering drugs separately, diluting drugs as appropriate, and flushing the feeding tube before, between and after drug administration. An interdisciplinary task force has developed the Enteral nutrition practice recommendations, which are available on the American Society for Parenteral and Enteral Nutrition's web site <[www.nutritioncare.org/safety](http://www.nutritioncare.org/safety)>.

**Establish route suitability.** Practitioners should determine the location of the distal end of the feeding tube and consult pharmacists to ensure the drugs will be properly dissolved and absorbed.

**Establish drug and dosage form suitability.** Practitioners should ensure that the drug and formulation are appropriate for enteral use. Use only immediate-release solid or liquid dosage forms. To help determine suitability of solid dosage forms, refer to the list on <[www.ismp.org/Tools/DoNotCrush.pdf](http://www.ismp.org/Tools/DoNotCrush.pdf)>. Nurses should consult pharmacists if they have questions or to check if liquid dosage forms are available and appropriate. Pharmacists can also contact prescribers to switch to another product more suitable for enteral tube use.

**Prepare separately.** Each medication should be prepared individually so it can be administered separately.

**Open capsules.** Immediate-release gelatine capsules should be opened to remove the powder or to crush the solid contents.

**Crush solid dosage forms.** Whenever possible, pharmacy staff should crush tablets into a fine powder using a fully self-contained, pill-crushing device, which prevents residue from one drug being mixed with another. Allergenic, cytotoxic, carcinogenic, or teratogenic drugs should be crushed by a pharmacist under controlled conditions, and only when necessary.

**Dilute medication.** The crushed drug as well as liquid medications should be diluted. Purified water is the preferred diluent for most drugs. Tap water is not advised, as it often contains chemical contaminants (e.g. heavy metals) that might interact with the drug. The diluted medication should be drawn up into an oral syringe and dispensed to the unit ready for administration.

**Do not mix medications with feeding formulas.** Medications should not be added directly to the feeding formula. Mixing drugs with the formula could cause drug–formula interactions, leading to tube blockages, altered bioavailability, and changes in bowel function.

**Flush.** The feeding should be stopped and the tube flushed with at least 15 mL of purified water before and after administering each medication.

**Administer separately.** Each medication should be administered separately through the feeding tube using a clean 30 mL or larger oral (non-luer tip) syringe.

**Flush again.** The tube should be flushed again with at least 15 mL of purified water to ensure drug delivery and to clear the tube.

**Restart the feeding.** Feeding can usually be restarted after drug administration and flushing.

**Report and investigate.** Any occlusion of a feeding tube or unexpected response to drug therapy should be reported and investigated to determine the cause.

*[ISMP Medication Safety Alert! 6 May 2010]*

### **Documenting lot numbers detect vaccine errors**

A nurse working in an immunisation clinic had a client who needed an adult hepatitis B vaccine. The nurse removed the vial from its carton, read the vial label and drew up the vaccine. When she was recording data after administration she realised that she had given an adult hepatitis A vaccine. She noticed the error based on the lot number, which was different to the previously documented hepatitis B lot numbers. The clinic stocks GlaxoSmithKline adult hepatitis B vaccine and Merck adult hepatitis A vaccine and both vials have orange caps/covers. Another nurse had removed a vial of hepatitis A vaccine from its carton, and not needing it, had put it in an empty hepatitis B vaccine carton. The nurse knew the vial label stated ‘hepatitis A’ but she still read ‘hepatitis B’ because that was what she was expecting it to be. Placing a vial into the wrong carton is a problem previously mentioned with insulin <[www.ismp.org/Newsletters/acutecare/articles/20080508-1.asp](http://www.ismp.org/Newsletters/acutecare/articles/20080508-1.asp)>. To avoid mix-ups, consider removing vials from cartons prior to storage and document the vaccine, including lot number on the vaccine form/log just prior to use (do not document actual drug administration until after the vaccine has been given). Recognising a difference in lot number format from what is normally recorded could help identify that the wrong product is in hand. Involving a family member to assist in the double-check process is also advisable.

*[ISMP Medication Safety Alert! 6 May 2010]*

### **Latest heparin fatality speaks loudly**

A deadly heparin error claimed the life of a toddler about to celebrate her second birthday. She was born with gastroschisis (protrusion of the intestines) and had undergone various procedures and hospitalisations before her physicians decided that a transplant was necessary. In early December 2009, she underwent transplantation of the small bowel, liver and pancreas. She progressed satisfactorily and was discharged in February 2010 but readmitted a week later with a viral illness and infection that resulted in renal failure. Her condition was critical, and she required renal dialysis and intravenous heparin to prevent clotting. During the infusion, she received a large overdose of heparin, which

led to cerebral bleeding and subsequent brain death. News reports suggest that hospital leaders plan to share the details of the event with the healthcare community nationwide to help prevent this from happening to another child. Initiating person and checker, fall victim to the same external conditions causing the error or distractions and other environmental conditions reduce staff attention to detail. The smart pump involved had a drug library and dose-checking capabilities, but this feature was not being used at the time or not to its fullest extent so an error of this nature could be quickly recognised. Although the reasons for not using the technology are unclear, studies have provided insight into why clinicians bypass the dose-checking technology: falsely low perceptions of risk; failure to make adjustments in the drug library when alerts are not credible; extra work needed to use the technology; lack of standard drug concentration and dosage methods; time constraints; clinical emergencies; and a culture that supports technology workarounds.

**Heparin is a high-alert medication.** ISMP identified heparin as a high-alert medication over 20 years ago. A year later, heparin was again identified during a national benchmarking study as one of six drugs most frequently involved in serious and fatal events. Errors with heparin gained widespread media attention 4 years ago after several infants died from overdoses during routine flush procedures, and after newborn twins could have died from a similar overdose caused by mix-ups with heparin 10 000 units/mL and 10 units/mL vials. In January 2009, our QuarterWatch program identified that heparin has repeatedly been among the top ten drugs involved in serious, preventable injuries, disabilities and deaths reported to the US Food and Drug Administration. The types and causes of errors associated with heparin are varied; the one constant is that errors with heparin typically harm patients, so prevention requires your full attention!

**Enhance perception of risks.** Most health professionals are familiar with heparin, having prescribed, dispensed, and/or administered it many times. From the small doses associated with heparin flushes to the large doses associated with therapeutic use, familiarity with heparin has led to a faded perception of the risks associated with its use and misuse. Those familiar with heparin may forget that even a slight mistake can lead to patient harm. Thus, attention is needed to enhance staff perception of the risks associated with heparin, and to remind staff that regardless of the concentration or dose, heparin is a high-alert drug and that safeguards must always be used.

**Remedy workarounds.** It is not enough to purchase smart pumps, program the drug library to enable the technology, distribute the pumps, educate users, and hope that the dose-checking feature is functional and will always be used. A culture of safety must exist that drives clinicians to avoid bypassing a safety feature, or to report conditions that encourage workarounds so they can be remedied. Additional measures that can nurture compliance with smart pump technology and attention to the alerts include:

- setting up the infusion pumps so they turn on and default to the dose-checking mode;
- analysing pump logs and making adjustments to the drug library;
- evaluating all overrides;

- publicising 'good catches'; and
- conducting focus groups and satisfaction surveys to solicit nursing feedback.

Compliance with the technology should be measured and any barriers to using it identified and removed.

**Safety team examination.** ISMP urges medication safety teams to examine internal errors associated with heparin and to identify weaknesses in the organisation that could lead to errors. ISMP's Medication safety self assessment for antithrombotic therapy in hospitals <[www.ismp.org/selfassessments/asa2006/Intro.asp](http://www.ismp.org/selfassessments/asa2006/Intro.asp)> could help organisations analyse safeguards and improve medication safety with heparin and other antithrombotics. *[ISMP Medication Safety Alert! 8 April 2010]*

#### Is it 'units' or a 4?

We recently became aware of a situation in the UK where a nurse at a long-term care facility misread an order for '8U' of insulin as 84 units. This resulted in the death of a critically ill diabetic patient with pneumonia. In most cases where a medication error has occurred as a result of misinterpreting the letter 'U', a zero has been seen, causing a 10-fold overdose. The abbreviation U has also been misread as 'cc', which has resulted in infusion rate errors with IV insulin. Great progress has been made in eliminating 'U' as an abbreviation for units, thanks to the Joint Commission's 'Do Not Use' list, but most of all, thanks to your persistence in teaching others about this and other dangerous abbreviations.

*[ISMP Medication Safety Alert! 11 March 2010]*

#### Parental dosing: a cup of trouble

A study has found that up to 50% of parents make errors in the dosing of liquid medications for children. The authors also sought to determine how literacy influenced medication administration errors. They enrolled 302 parents (primarily mothers) of children who presented to an urban paediatric clinic. Participants were asked to measure 1 teaspoon or 5 mL of a test medication using six different methods:

- dosing cup with black, printed calibration marks (max volume 15 mL);
- dosing cup with clear, etched calibration marks (max volume 30 mL);
- dosing spoon (max volume 10 mL);
- medicine dropper (max volume 5 mL);
- oral syringe with bottle adapter (max volume 5 mL); and
- oral syringe without bottle adapter (max volume 5 mL).

The actual dose measured by participants was determined by weighing the measured sample and subtracting the weight of the measuring instrument. A parent measured dose that equalled no more than 120% of the expected dose (0 to 20% overdose) was considered no error; a measured dose 121 to 140% of the expected dose (20 to 40% overdose) was a small error; and a measured dose over 140% of the expected dose (> 40% overdose) was considered a large error. Participants measured a test medication dose using all six methods, but the order in which they were presented the instruments was random. Carer literacy was assessed with the Newest Vital Sign test (6 = highest literacy). The investigators also collected sociodemographic data to use as control variables. The dosing cups had the highest risk for overdose; only 30%

of parents provided the correct dose with the printed cup and 50% provided the correct dose with the etched cup. Almost all errors with the cups were overdoses and the rate of large error was around 25% for the two cup types. The dropper had the most accurate dosing, with 94% of parents measuring the correct dose. The syringe measurements were also accurate (91% measured the correct dose) and the dosing spoon provided correct measurements 86% of the time. For all measuring instruments, the rates of large error were higher (by several times) when participant literacy was low. The authors concluded that both the measuring instrument type and literacy of the carer are related to risk of dosing error in outpatient medication administration, and both of these factors are amendable to intervention. A viewpoint is to consider whether measurement error is a consequence of the cups or overall large instrument volume (greater possible error). Small measuring devices also appeared to offer protection for individuals with low literacy. The take-home message is that small instruments appear to work best across the spectrum of carer literacy, but cups should be avoided with carers that have the lowest literacy.

*[Abstracted in Medscape Pediatrics Viewpoints 14 April 2010 <[www.medscape.com/viewarticle/719609](http://www.medscape.com/viewarticle/719609)>]*