

This series is compiled by Rosemary Burke, Chair, SHPA Committee of Specialty Practice in Medication Safety, and Director of Pharmacy, Concord Hospital, NSW, and edited by Penny Thornton, Federal Councillor, SHPA, and Pharmacy Services Manager, The Children's Hospital at Westmead, NSW. It brings you up-to-date information about medication safety issues and strategies to prevent medication errors. The section draws on Australian incidents and also US experience, including (with permission) material from ISMP Medication Safety Alert!, a bulletin published by the Institute for Safe Medication Practices, USA <www.ismp.org>.

AUSTRALIAN INCIDENTS

Comments are provided by the Committee of Specialty Practice in Medication Safety members in New South Wales.

Encourage doctors to prescribe generically

A ward pharmacist queried an order on an inpatient chart which included Avanza po daily and Cipramil po mane. The patient was unsure of the Avanza, but had her citalopram with her. The pharmacist contacted the community pharmacist and discovered that the patient was on Avandia (rosiglitazone) daily, not Avanza (mirtazapine). The doctor was notified and the order rewritten. A patient was prescribed Norflex bd as per their usual medications, with the order endorsed by the pharmacist as orphenadrine 100 mg tablets. At the end of the week when the chart was rewritten, Norflox bd was prescribed. The pharmacist was approached by a nurse requesting norfloxacin. The error was noticed and the doctor was contacted to change the order to orphenadrine.

Recommendation: Encourage doctors to prescribe drugs generically and not by brand name.

[Australian Incident 33, August 2004]

US SAFETY BRIEFS

Improvised drug delivery: a cause for concern

On occasions IV tubing/pumps are used to administer oral solutions or enteral feeds via a gastric or nasogastric tube. Bowel preparations, e.g. GoLYTELY have been administered via nasogastric tube to older children and adults due to vomiting or intolerance to the large volume necessary. In some cases, an enteral infusion pump is not capable of delivering it at the desired infusion rate (600–1000 mL/hour). There have been many instances in which an IV pump has been used by placing GoLYTELY in a plastic enteral container and jury-rigging the solution administration sets. For example, an IV pump set is cut just below its drip chamber, and the end of the enteral solution apparatus (with attached feeding tube connector) is then jammed into the cut IV tubing and secured with tape to prevent leakage. The solution is then administered via a nasogastric tube using an IV pump. This form of improvised drug delivery could result in the accidental connecting of the IV tubing to an IV access site. In fact, cases of accidental IV administration of a high molecular weight polyethylene glycol solutions, have been reported. Many years ago, nine patients received IV polyethylene glycol 300; seven developed renal tubular necrosis but recovered, and two patients died as a result of polyethylene glycol toxicity. More recently, a 4-year-old child presented to the emergency department after ingesting a large number of 6-mercaptopurine tablets. After treatment with activated charcoal, the child was started on GoLYTELY, which was to be administered using IV tubing attached to a nasogastric tube. After an hour, a nurse discovered that the solution was actually being administered through an IV access line; 391 mL had already infused. Luckily, the child showed no evidence of acidosis or renal failure, and

glycol levels were undetectable. He was discharged several days later without further complication. Ready-to-hang, closed enteral nutrition containers are easily spiked with an IV infusion set, allowing the formula to flow freely or to be delivered via an IV pump. In one case, the nurse couldn't find an enteral feeding set, so she improvised and used IV tubing and an IV pump until another nurse recognised that this was an error waiting to happen. In another case, the patient received the enteral feeding IV for 2 hours, but luckily suffered no harm.

Recommendation: The most obvious solution is to prohibit the use of IV tubing/pumps to administer enteral solutions. However, simply having such a policy is not sufficient; nor can violation of such a policy be considered the root cause if an error occurs. Healthcare providers use these devices to overcome obstacles to enteral administration. Thus, it might be helpful to hold focus groups with nurses to dig deeper into the obvious and subtle incentives for using IV tubing/pumps for enteral administration. The reasons are often rooted in system-based problems for which safer solutions can be found. For example, if enteral solutions must be administered quickly in large volumes, you might be able to use an adaptor to connect two enteral feeding pumps, each delivering half the desired volume simultaneously. Also, some enteral pumps are capable of delivering higher volumes per hour and some nasogastric tubes have a dual port to facilitate connection to two enteral pumps simultaneously. Labels that state 'WARNING! For enteral use only' should appear on the containers of all enteral products that could possibly be connected to IV tubing. *[ISMP Medication Safety Alert! April 22, 2004]*

Expressing large doses

Expressing doses such as 1,000,000, 100,000 and 1,000 can cause confusion and result in serious dosing errors, especially if commas are missing or misplaced.

Recommendation: As words exhibit more distinguishable characters than numbers, use a combination of both numbers and words (1 million, 100 thousand, 1 thousand) when expressing large doses. Avoid ambiguous abbreviations, such as M for million and K for thousand. *[ISMP Medication Safety Alert! April 22, 2004]*

Potassium chloride error harms child

A homecare pharmacy dispensed a syringe containing concentrated potassium chloride for a mother to add to her child's TPN after a prescribed increase in the potassium content. The mother confused the potassium syringe with a saline flush and administered it as an IV push. The child arrested and was resuscitated, but suffered residual harm.

Recommendation: Send only a 2 to 3 day supply of TPN to homecare patients when therapy is initiated. Return the TPN and have pharmacy add the required electrolytes if changes are made in the prescription. *[ISMP Medication Safety Alert! April 22, 2004]*

Errors during refill of implanted Medtronic pump

FDA received reports of fatal overdoses caused by accidental intrathecal injections of concentrated morphine while refilling implanted Medtronic SynchroMed infusion pumps. The drug had been intended for the pump's reservoir. A template was available in a refill kit to locate the reservoir port, but a similarly packaged catheter access kit was used instead.

Recommendation: If you use these devices, conduct a failure mode and effects analysis to determine error potential. Create standardised order sets for refilling the pumps and include the applicable refill kit number. Use devices with only a reservoir port, not a catheter access port. If pumps with catheter access ports are necessary, keep the catheter access kits separated from the refill kits. *[ISMP Medication Safety Alert! April 22, 2004]*

Misprogram a PCA pump? It's easy!

One patient died and another recovered after two nurses accidentally misprogrammed Deltec CADD-Prizm CS Pain Control System pumps (model 6101) used for patient-controlled analgesia (PCA). But while it's clear that human error played a small role in the mistakes leading up to these events, the real culprit is more likely a variety of system problems, including the pump's unseen default to a prior setting. The errors were first recognised when a post-operative patient became unresponsive after a bolus of fentanyl. The physician had ordered fentanyl PCA 'per protocol', which called for a 50 µg/mL concentration, a 10 µg demand dose, a 6 minute lockout, and clinician boluses of 20 µg (every 5 minutes x 3, repeat every 4 hours as needed). To program the pump, the nurse first scrolled through a wide range of numbers to select the correct concentration, but she accidentally programmed 1 µg/mL instead of the actual concentration of 50 µg/mL. Next, she programmed the demand dose as 0.10 µg instead of 10 µg. Two nurses were initially present when the pump was being programmed, but one left to take a phone call. When she returned, she asked the other nurse to read the settings to her for verification, but the programming errors were missed. Since the pump had been programmed to deliver fentanyl in a 1 µg/mL concentration, each demand dose delivered only 0.1 mL. So, despite an actual concentration of 50 µg/mL, the patient received only half of the intended dose (0.1 mL of 50 µg/mL, or 5 µg). When the patient continued to complain of severe pain, a nurse on the next shift decided to give the patient a 20 µg bolus. She correctly programmed the bolus dose, but since the pump had been set incorrectly at a 1 µg/mL concentration, the patient received 20 mL of the 50 µg/mL concentration, or 1000 µg! A few minutes later, the patient was found unresponsive and quickly transferred to ICU, and the patient died 3 days later. A similar incident had occurred in the hospital several weeks earlier, but went unrecognised until this event. The physician had ordered fentanyl PCA 'per protocol' with 10 µg demand doses. But again, with a 50 µg/mL concentration actually in the cassette, the pump was erroneously set at 1 µg/mL. The patient received one demand dose post-operatively, which delivered about 500 µg of fentanyl; 5 minutes later, the pulse oximetry alarm sounded, and the patient was found unresponsive and with poor respiratory effort. Suspecting postoperative haemorrhage, the patient was taken back to theatre for an exploratory laparotomy. When no blood was found in the abdomen, the cause of the respiratory failure was initially attributed to a seizure. The patient required care in the ICU, but recovered.

Now, here's why the errors happened

The infrequent use of fentanyl for PCA by the nurses could have contributed to the error in the first event. In the most recent fatal event, the nurses were familiar with fentanyl, and both were well aware of the correct concentration and demand dose that should have been entered into the pump. In fact, the nurse who verified the pump settings mentioned the need for 'extra care with fentanyl' to the programming nurse, and both nurses felt certain that the fentanyl concentration had been set at 50 µg/mL, and the demand dose at 10 µg. And this may well have been the case initially, at least for the concentration. During investigation of these events, the hospital learned that the pumps could automatically default to a prior setting if the current setting was not confirmed by pressing 'Enter' within a short period of time. As such, the nurse could have initially entered the correct concentration, but failed to press the enter key within the allotted time. Thus, the setting could have defaulted back to a prior setting on the scroll of numbers -1 µg/mL for the concentration. Failures in the system of double checks also played a role in both events. While the hospital required two nurses to confirm PCA pump settings, the policy did not clarify that the double checks should be performed independently with one nurse setting the pump, and another nurse independently checking the patient, drug, and settings against the orders. A final causative factor was that the pump manufacturer had not alerted the hospital that they could set default values for PCA drugs by locking out the unused range of numbers available.

Recommendation: As PCA errors can be deadly, special precautions are needed when administering narcotics to patients using PCA. **Limit** the variety of drugs used for PCA. Also consider restricting fentanyl PCA use to anaesthesia or pain management team members only. **Improve access to information** by developing a quick reference sheet on PCA use for nurses, including programming tips and maximum dose warnings for each of the PCA drugs in use. **Improve label readability** by matching the sequence of information that appears on PCA drug labels and order sets with the sequence of information that must be entered into the PCA pump. Highlight the concentration of PCA drugs on drug labels using bold font or other means. **Program default settings** by actively querying the pump manufacturer to learn about any safety features available with your PCA pumps, and fully employ their use. Standardise the concentrations of PCA drugs, and when possible, set default values for each concentration, or lock out inappropriate ranges for the concentrations that are not used. If a single option exists for default settings, select 'zero' to force an entry. As an added measure, check if your pumps can be set to a maximum bolus dose for each drug (at least a maximum volume for each drug). **Perform periodic biomedical checks** on the pumps to ensure proper default settings. Alert staff to situations in which the pump will default to a standard setting. **Introduce new pumps slowly** after performing a failure mode and effects analysis on any new PCA pump considered for use. Introduce the pumps initially in a small controlled setting to ensure that the safety features are operational, and to uncover any unanticipated problems. **Suspect a problem** if the patient is not responding to the PCA doses as anticipated, suspect an error and re-verify the drug, concentration, pump settings, and line attachment (with

comparison against the original order), especially before administering a clinician bolus dose. Clearly define a manual independent double check process that clinicians should follow when verifying PCA drugs, pump settings, the patient, and line attachments. When possible, use barcoding technology; when available, use 'smart' PCA pumps that can alert clinicians to potential programming errors. However, until 'smart' pumps are adapted for barcoding, automated checks won't entirely replace manual independent double checks to verify other dimensions not covered by the automation (e.g. patient identification when using current 'smart' pumps, pump settings when using current barcode systems).

[ISMP Medication Safety Alert! April 29, 2004]

Burns in MRI patients wearing transdermal patches

Because of the strong magnetic field created during magnetic resonance imaging (MRI), ferromagnetic metal objects can be pulled by the magnet toward the patient at high speed. ISMP have previously reported the tragic death of a 6-year-old child in New York who suffered a skull fracture and intracranial haemorrhage after being struck by an oxygen tank. Prior to MRI, patients are told to remove all metal objects they may be wearing, and are asked about the presence of any metal implants (e.g. pacemaker, prosthetic hip, implanted IV port). Even retained bullets and shrapnel, tattoos, and permanent eyeliner may create problems. However, few people are aware that drug patches such as Transderm Nitro (glyceryl trinitrate), Androderm (testosterone), Nicabate (nicotine) and Catapres-TTS (clonidine) should also be removed. Some patches are formulated with an aluminised backing that could potentially cause injury to the patient if worn during MRI. MRI systems use radiofrequency (RF) pulses to create the magnetic resonance signal. When conducting materials are placed within the RF field, the result may be a concentration of electrical currents sufficient to cause excessive heating and tissue damage. The metallic component of these patches is nonferromagnetic and, therefore, not attracted to the static magnetic field of an MRI system. However, transdermal delivery systems with a metallic component are conductive and can be heated. A patient entered an MRI scanner wearing a Habitrol 21 mg (nicotine) patch and started thrashing upon initiation of the third scanning cycle, and the test was stopped immediately. When the patient was removed from the magnet, he stated that his arm was burning. Upon examination, his upper left arm was mildly erythematous and there was a small, denuded, blister where the patch had been residing. A patient underwent a short (< 40 seconds) MRI of the lumbar spine while wearing a nicotine patch. Later, the patient complained of burn lines on his upper arms. An additional report from ISMP involves second degree burns when a patient underwent an MRI with a Deponit (glyceryl trinitrate) patch in place.

[ISMP Medication Safety Alert! April 8, 2004]

Australian comment: The policy is to remove **all** patches prior to MRI. We are aware of a reported incident that occurred when an Emla patch was discovered on a patient post-MRI. A small pink area was noted on the skin when the patch was removed. The patient was having a brain MRI and the Emla patch was on the buttock area so it may be possible that it could have resulted in a burn if the two had been closer together.

[Australian Incident 32, August 2004]

15 or 50?

An on-call pharmacist received a call during the night from a nurse working on the ventilator unit of a long-term care hospital. The nurse told the pharmacist that she had a new order for 50 mEq of potassium phosphate for a 'now' dose. When the pharmacist questioned the dose, the nurse stated that she was sure the doctor had ordered that much. The pharmacist was aware of the error-prone nature of ordering phosphate salts, especially via a phone order, so she insisted that the nurse verify the dose with the prescriber. When the nurse called the prescriber, she learned that she had misunderstood. He had prescribed 15 mEq, but she had heard 50 mEq. Always transcribe the order on the patient's medication order form (not scrap paper) and read back all oral orders, stating numerical doses in single digits such as 'one-five' for 15 and 'five-zero' for 50.

[ISMP Medication Safety Alert! April 8, 2004]

Oops, sorry, wrong patient!

When you think of 'wrong patient' errors, the most common scenario that comes to mind is a nurse administering medications intended for one patient to another patient. However, 'wrong patient' errors occur in a variety of ways and may originate during any phase of the medication use process, not just during drug administration.

Mixing up patient profiles: Most often, pharmacists select the correct patient profile in the pharmacy computer by entering either the patient's name or identification number. But poor visibility of the patient's name and number on paper order copies (often via an addressograph imprint), compounded by look-alike last names, has occasionally resulted in entering orders into the wrong profile. Recently, a pharmacist reported a similar error with a different twist. To enter a new order for a patient named Franklin Hope (fictitious name), a pharmacist tried to access the profile using the identification number. However, the number was poorly visible, and the profile could not be located. He then entered the patient's name, Franklin Hope, and a profile appeared on the screen. While entering the order, the pharmacist happened to notice that the patient was female, not male. He soon realised that he had been entering the order into Hope Franklin's profile, not Franklin Hope's profile! Similar errors have been reported during electronic prescribing. In one case, the prescriber had spelt the patient's last name wrong, which happened to correspond to another patient's last name. Both had identical first names, so the orders were added to the wrong profile.

Mixing up monitoring results: Prescribed medications are often based upon recent diagnostic or patient monitoring results. However, we have received numerous reports of prescribing drugs for the wrong patient after laboratory or other diagnostic/monitoring results were mixed up. Recently, a physician prescribed diltiazem 20 mg IV followed by 30 mg orally for a patient in bed A after a telemetry unit nurse called to report that his cardiac monitor showed atrial fibrillation and flutter with a heart rate of 140. When the patient exhibited no change in his heart rate or rhythm after receiving the drug, the nurse called the physician again and received an order to administer amiodarone 150 mg IV followed by a 60 mg per hour infusion. A short time later, the nurse realised that the rhythm she was viewing on the monitor was for the patient in bed B. The names of the patients in bed A and bed B had been mixed up and posted on the wrong channel of the central monitoring unit at the nurse's station.

Mixing up medication administration records (MAR): To aid identification, the patient's MAR should always be brought to the bedside for verification of two unique patient identifiers such as name and identification number. But it's possible mistakenly to use the wrong patient's MAR. Recently, MARs for two infants were mixed up, resulting in administration of palivizumab to the wrong child. The infants were side-by-side in isolettes, and both their MARs were on the counter between the two isolettes. Coincidentally, both infants had the same first name along with very similar hospital identification numbers. The nurse failed to notice that she was referring to the wrong MAR and administered a dose of palivizumab to the wrong infant.

Recommendation: From 2004, it is a Joint Commission standard for healthcare organisations to use at least two patient identifiers whenever taking blood samples or administering drugs or blood products. However, patient verification using two identifiers is not required when physicians prescribe drugs; when pharmacists/pharmacy technicians enter orders and dispense drugs; when unit secretaries and nurses transcribe drug orders; or when healthcare providers participate in critical processes not specified in the requirement. Perhaps patient verification using two identifiers should be required for all critical processes. Hospitals would have to make it a priority to ensure that two identifiers (name, birth date, identification number) are readily available to staff. However, making this information available to physicians in a way that allows comparison of the identifiers for verification presents a challenge. The computerised prescriber order entry system could be designed so that, the physician would select the name from a list of patients assigned to him, not a larger list of all patients. In the ambulatory setting, a comparable list would be the schedule of patients who are to be seen that day. Enhancing the font for the patient's name on the screen also can improve accurate order entry. Some systems alert staff to similar names in the registry and require a second form of identity to proceed. There are several other measures that could help prevent the 'wrong patient' errors. Hospitals should discretely separate the work areas around isolettes for each infant to prevent mix-ups. For paper orders, hospitals consider replacing addressograph imprints with laser printed identification stickers to improve clarity, especially on order copies. Cardiac monitors that display multiple patients' rhythms should be labelled with patient names using a standardised verification process involving two individuals.

[ISMP Medication Safety Alert! June 3, 2004]

Wait... that's not right!

We've been reminded again how important it is to fully investigate situations that 'just don't seem right', even if there's been an initial confirmation by an authoritative source. A pharmacist received an order for SC topotecan 0.75 mg. Topotecan is to be given as an IV infusion, and infiltrations have been associated with mild local reactions (erythema, bruising). The pharmacist checked with the prescriber who explained that he had copied the order from a protocol sent to him by an oncologist at a well-known university cancer centre. Still not satisfied, the pharmacist telephoned the university hospital oncologist who developed the protocol and asked him to fax the original. The protocol listed the dose per square meter as 'topotecan 0.75 mg/sq m², which was mistaken as the route 'sq' or 'subcutaneous'. The order was corrected and the patient received the correct dose of topotecan as an IV

infusion. During orientation of new staff or ongoing education of current staff, it's important to instill the thought that 'the protocol says to do it this way' or 'that's the way they do it at university hospital' should never be considered an endpoint when investigating the safety of an order.

[ISMP Medication Safety Alert! July 29, 2004]

Just say no to ratio!

A treatment for priapism (prolonged erection without sexual stimulation) is to inject an alpha-agonist (phenylephrine, adrenaline) into the penis. This causes vessels to narrow and reduces blood flow. The corpora cavernosa is irrigated with 10 to 20 mL of the 1:1 000 000 adrenaline solution (adrenaline 1 mg (1:1000) added to 1 litre normal saline). This may be repeated 3 to 4 times if needed. But as we've often pointed out, people confuse these ratios, sometimes with tragic results! Recently a 16-year-old male was brought to an emergency department with priapism. A urologist ordered adrenaline, but he thought that the 1:1000 ratio on the adrenaline 1 mg/mL label meant that the adrenaline was already 'pre-diluted' with 1000 mL of fluid. The patient received 4 mL (4 mg) of undiluted solution injected into his penis. As the adrenaline reached systemic circulation, the patient arrested and could not be resuscitated. To reduce the risk of errors, do not stock the 30 mL vials of adrenaline 1:1000. If this concentration is necessary, stock the 1 mL ampoules so that the need for multiple ampoules can serve as a red alert to the healthcare provider.

[ISMP Medication Safety Alert! July 29, 2004]

Abandon immediate-release nifedipine

The effect of immediate-release nifedipine in adults is unpredictable. Several reports describe cases of profound hypotension, cerebrovascular ischemia, stroke, conduction disturbances, acute myocardial infarction, and death after the drug was given during hypertensive emergencies. Although physicians may understand that sublingual nifedipine should not be used, they may still believe it's acceptable to prescribe the immediate-release capsules for hypertensive emergencies if the capsules are swallowed. This is not true; it's known that sublingual doses do not work until the liquid inside the capsule is swallowed. Thus, the same adverse effects that occur with sublingual nifedipine can also result if the capsules are swallowed. Recently, a pharmacist noticed that a patient admitted through the emergency department (ED), had been ordered 'nifedipine 10 mg PO every 2 hours prn hypertension' by an experienced physician. He wondered how widespread the practice was in the ED and ran a usage report for a month and discovered that immediate-release nifedipine had been administered to ten patients. He randomly reviewed four cases, all of which documented that the drug had been used for a hypertensive emergency. Usage in the remaining six cases was presumed to be similar. On occasion, the immediate-release form is used to treat hypertensive emergencies in children, who are asked to chew and swallow the capsule. The safety concerns in adults do not appear to be applicable to children who have more resilient cardiovascular systems. There is also data to support its use to inhibit uterine contractions in pregnant women. Otherwise, administration to treat a hypertensive crisis is unsafe and our previous advice that such dosing should not be employed is worth repeating.

[ISMP Medication Safety Alert! July 29, 2004]