Misadministration of IV insulin associated with dose measurement and hyperkalemia treatment

We are aware of numerous reports of serious errors associated with the misadministration of insulin.

Human error (e.g., mental slips, lapses, forgetfulness) associated with insulin dose measurement and treatment of hyperkalemia was the predominant proximate cause of these events; most of the human errors were associated with mental slips or knowledge deficits regarding insulin concentration (specifically that “U-100” means the concentration is 100 units per mL), the differences between insulin syringes and other parenteral syringes, and a perceived urgency with treating hyperkalemia.

In one event, a physician ordered IV dextrose 50% injection (50 mL) along with 4 units of regular insulin IV (U-100) for a patient with renal failure and severe hyperkalemia. However, a nurse drew 4 mL (400 units) of insulin into a 10 mL syringe and administered the dose IV. The patient became severely hypoglycemic and had to be transferred to a critical care unit for treatment and monitoring.

In another case, a nurse accidentally added 50 units of regular insulin instead of 5 units to an existing IV infusion. A physician had asked the nurse to add the 5 units of regular insulin to the IV bag. The nurse felt the ½ inch needle on an insulin syringe was not long enough to insert into the IV bag. Thus, the nurse drew the insulin into a 3 mL syringe with a longer needle. However, she accidentally withdrew 0.5 mL (50 units) of insulin instead of the correct volume of 0.05 mL (5 units). She quickly showed the prepared dose to another nurse, who also failed to pick up the error. Later, the nurse recognized her error while preparing a subcutaneous insulin dose for another patient using a U-100 insulin syringe.

A third case involved the incorrect preparation of an insulin infusion. While the pharmacy was closed, a pharmacist prepared an IV insulin infusion for a patient. Near the end of her shift, a new graduate nurse was asked to prepare a “1:1” insulin infusion (1 unit/mL). An experienced nurse who checked the solution failed to notice that the graduate nurse had drawn 10 mL (1,000 units) of insulin into a 10 mL syringe, instead of 1 mL (100 units) in an insulin syringe, and then added that amount to a 100 mL bag of 0.9% sodium chloride. This resulted in a 10 units/mL insulin infusion. Several hours later, both nurses—by then, at home—independently called the hospital because they were worried that “something was not right” with the insulin infusion. When the error was discovered, the patient had already received 160 units of insulin over several hours instead of the prescribed 16 units. The patient's blood glucose level dropped as low as 13 mg/dL. He was treated and experienced no additional adverse effects.

A similar event was reported, but in this case, a pharmacist prepared an insulin infusion of 10 units/mL concentration instead of the required 1 unit/mL concentration. It is not unusual to prepare an admixture or dose using half of a vial or more when dealing with other medications that typically come in multidose vials. Thus, staff may not find it odd to use half of a vial or more to prepare an insulin infusion, particularly if they are busy, distracted, or preoccupied. But a 10 mL multidose vial of insulin

Consider the following recommendations to enhance safety with IV insulin.

✓ Provide education. Education regarding the concentration of insulin products, the differences between insulin syringes and other parenteral syringes, how to measure doses, recognition of safe dosage ranges, and how to administer the drug should be provided to all who might prescribe, prepare, and/or administer insulin. Restrict insulin preparation and administration to those who have demonstrated competency.

✓ Supply insulin syringes. Insulin syringes should be readily available in all patient care units, and steps should be taken to separate insulin syringes from other parenteral syringes so they cannot be inadvertently mixed-up.

✓ Dispense from pharmacy. To preserve an independent double-check, pharmacy should prepare, label, and dispense insulin doses to treat hyperkalemia whenever possible. Some organizations dilute the IV insulin dose and dispense it in a mini-bag. Hyperkalemia is a medical emergency, yet the administration of insulin, in most circumstances, can wait until a pharmacist prepares a stat dose.

✓ Provide reminders. In organizations that do not dispense patient-specific insulin doses from the pharmacy, a warning should appear on automated dispensing cabinet (ADC) screens and electronic/computer-generated medication administration records (MAR) that states the insulin needs to be prepared using an insulin syringe.

✓ Conduct an independent double-check. Require an independent double-check of all doses before discontinuation on page 3—Check it out!
Bortezomib deaths due to misadministration

Health Canada, the European Medicines Agency, and Janssen (www.ismp.org/sc?id=57) recently issued an alert about fatal outcomes associated with the inadvertent administration of intravenous bortezomib (VELCADE) into the intrathecal space. Bortezomib is used to treat multiple myeloma and mantle cell lymphoma. Similar to intravenous vinCRISTine and other vinca alkaloids such as vinBLASTine and vincorelbine, bortezomib is fatal if given intrathecally. At least three medication errors with bortezomib have been reported in Europe since 2003, all resulting in death. ISMP is not aware of any fatal events in the US, nor is the FDA. We’d like to see it remain that way, so now is a good time to proactively address the risk.

As with vinCRISTine deaths, the scenario of misadministration of bortezomib has invariably involved intrathecal chemotherapy or other intrathecal drugs scheduled on the same day and at the same time as intravenous bortezomib administration. Intrathecal chemotherapy and intravenous bortezomib are both administered in small volumes via small syringes, which creates a condition favorable to error.

Unfortunately, we are unaware of studies that support dilution of bortezomib in volumes unsuitable for intrathecal injection, a tactic adopted by many healthcare settings in the US to prevent vinCRISTine errors. But there are other steps healthcare professionals are encouraged to adopt to prevent fatal intrathecal misadministration of bortezomib and other IV chemotherapy:

- Distinctive packaging. Ask pharmacy to package intrathecal medications in a distinctive manner (e.g., use of unique overwraps) to prevent confusion with IV medications. Do not rely on syringe labeling alone, as some of the vinCRISTine errors happened despite labels on the syringes with warnings about intravenous use only.

- Limit access. Ask the pharmacy to only deliver IV chemotherapy to a location where intrathecal drugs are prohibited. Ban IV chemotherapy from rooms where lumbar punctures are performed. Administer chemotherapy intended via the intrathecal route at a different time than IV chemotherapy.

- Verification. Call the pharmacy to verify that an intrathecal medication has been administered before the pharmacy dispenses IV chemotherapy (or vice versa) for patients who are receiving medications by both routes.

- Double-check. Require an independent double-check before administration of intrathecal medication and chemotherapy.

Oncology self-assessment. Oncology practitioners around the world can now access a tool that will assist in making drug treatment for cancer even safer for their patients. The Institute for Safe Medication Practices (ISMP), along with ISMP Canada and the International Society of Oncology Pharmacy Practitioners, has launched the 2012 ISMP International Medication Safety Self Assessment for Oncology. The assessment will help to identify a baseline of oncology-related medication practices and opportunities for improvement. Hospitals, ambulatory cancer centers, and physician office practices where chemotherapy is administered are being asked to convene interdisciplinary teams to complete the assessment tool. You can access the tool on the websites of all three organizations (www.ismp.org, www.ismp-canada.org, www.isonp.org). Data can be submitted online, anonymously, through June 29, 2012. At the completion of the project, respondents will be able to compare their confidential results with aggregate results from demographically similar organizations and use the information to improve safety.

Use of two pumps allows bypass of drug library. Propofol is sometimes prescribed for refractory status epilepticus. Recently, a nurse infused propofol IV for this indication at a rate of 225 mcg/kg/minute. The nurse had been titrating the rate up as directed and confirmed by the patient’s physician. However, the smart pump’s drug library was set with a hard stop at 130 mcg/kg/minute. Since the nurse could not make the pump infuse at the rate required to administer the dose due to the hard stop, she instead used two infusion pumps to deliver the dose. The nurse had initially questioned the high propofol dose, but the physician had misinformed her that the dose was appropriate (even though a 70 kg patient, for example, would go through about 1 bottle of propofol [1,000 mg/100 mL] per hour). The patient exhibited symptoms similar to propofol infusion syndrome (www.medscape.com/viewarticle/713867_3), a sometimes fatal disorder seen when the drug is infused at doses above 70-80 mcg/kg/minute for more than 24-48 hours. The syndrome is characterized by severe metabolic acidosis, rhabdomyolysis, hyperkalemia, renal failure, and cardiovascular collapse. This is not the first time we have heard about this workaround—using two infusion pumps in order to exceed a hard stop on the infusion rate set in a smart pump library. Needing a technology workaround like this or employing devices in an unintended manner should always prompt an immediate peer review of the conditions that require the workarounds before they are employed. Under most conditions, the need for the workaround is a clear signal of a potentially serious medication error.
Is it insulin or heparin?

How can injectable heparin wind up in an insulin syringe?
Your first thought may be a vial mix-up in which a nurse, pharmacist, or pharmacy technician accidentally drew heparin into an insulin syringe, believing it was insulin. But what if we told you it was no accident?

We recently learned about an at-risk behavior in which nurses were intentionally drawing heparin into an insulin syringe because they did not have a syringe with a 25-gauge needle to use for subcutaneous heparin injections. Of course, the primary risk with this practice is that an insulin syringe with heparin could easily be mistaken as an insulin syringe with insulin. Even if the insulin syringe is clearly labeled as containing heparin, nurses will associate the orange-capped syringe with insulin, not heparin.

This scenario can lead to disastrous results due to inattentional blindness. When reading a label, most of the visual processing occurs outside of conscious awareness. To combat information overload, the brain scans and sweeps until something sticks out to capture its attention. Unfortunately, the brain is a master at filling in gaps and making do, compiling a cohesive portrait of reality based on just a flickering view. In this case, the orange color of the syringe cap could capture the nurse's attention, and anything lying outside the initial capture of attention—such as the actual drug name on the label—could get short shrift.

Nurses in this facility engaged in the at-risk behavior because the syringes/needles they required were not available. Over time, the perception of risk associated with this practice habit was lost, particularly given that using an insulin syringe was the only way to administer subcutaneous heparin in that institution. Until syringes with a 25-gauge needle are readily available, this dangerous workaround will continue. A safer option is to provide commercially available prefilled syringes of heparin with 25-gauge needles.

Be sure you have all the necessary medication-related supplies in all patient care units, including parenteral and oral syringes (small-volume oral syringes in neonatal/pediatric units), infusion pumps, infusion tubing, port caps, and so on. Do not employ policies which force staff to engage in workarounds in order to provide care to their patients.

With insulin, it should not be assumed that all healthcare practitioners are knowledgeable and skilled with measuring doses, preparing insulin infusions, and recognizing doses that exceed safe limits. Consider the recommendations to enhance safety with this high-alert medication found in the check it out! column to the right, starting on page 1.

IV insulin—continued from page 1 can essentially contain up to 100 doses or more.

We also recently became aware of a case in which a patient with hyperkalemia had orders to receive insulin and a 50% dextrose injection, but the patient received only the insulin portion of the treatment and experienced significant hypoglycemia.