Case 2014-03: In the Eyes of the Beholder

Case Presentation
An 80-year-old woman with a history of brittle diabetes presented for right hemicolectomy under general anesthesia. During the case, measurement of blood sugar with a handheld device revealed a value of 290 mg/dL. The anesthesia provider, intending to administer 2 units of insulin, instead administered 0.2 mL of a 100u/mL solution. The 10-fold medication error was recognized immediately and the intravenous line was aspirated. Further glucose checks were conducted at 30-minute intervals until the patient stabilized.

Discussion
This event raises a number of issues in anesthesia quality management. In retrospect, the process of trying to draw a micro-dose from a macro-vial based on mental mathematics performed by a distracted provider seems like a set-up for error. Fortunately, the incorrect dose was immediately recognized and remediation attempted, although it is impossible to know how much insulin actually reached the patient. With a half-life of less than 15 minutes, it’s possible that a blood sugar measured 30 minutes later did not capture the true effect of the insulin dose – if any – and one can easily imagine outcomes ranging from hyperglycemia (no dose arrived) to severe hypoglycemia (the whole 20 units). Better practice might have been a repeat blood sugar within 10 minutes, or immediate administration of glucose. In perfect clinical practice there is seldom a situation in which a single bolus of short-acting insulin is indicated during anesthesia (only treatment of hyperkalemia comes to mind), and the problem in this case might have been avoided if the provider had chosen to start an infusion instead.

Medication errors continue to cause adverse events in the perioperative period. The anesthesia provider acts as physician, pharmacist, pharmacy tech and nurse. Medication safety measures are difficult to implement in the O.R.; reliable, yet practical, technological solutions have not been fully developed, and those that have – such as bar-code reading systems – are implemented in only a few practices. The incidence of medication errors in the O.R. is not known, due to both under-recognition and under-reporting.

A commonly used taxonomy for drug errors was first described by Webster et al.:  
- Omission: drug not given  
- Repetition: extra dose of an intended drug  
- Substitution: incorrect drug instead of the desired drug; a swap  
- Insertion: a drug that was not intended  
- Incorrect dose: wrong dose of an intended drug  
- Incorrect route: wrong route of an intended drug  
- Other: usually a more complex event not fitting the categories above.

In 2003, the ASA Closed Claims Project (CCP) reported that 4 percent of cases leading to malpractice suits in the registry involved drug errors. Incorrect dosing was the most frequent category (31 percent), followed equally by substitution.
(24 percent) and other (24 percent). Since under-reporting may affect different types of error differently, it is hard to know what to make of these numbers. Twenty-four percent of drug errors captured by the CCP resulted in death, and another 34 percent in serious, long-lasting or permanent injury. Epinephrine and succinylcholine were the two most implicated drugs (perhaps because of their potential for causing harm when misadministered), and no specific mention was made of insulin as a cause of morbidity or mortality.

The standard mandates that organizations develop processes to ensure safe handling and administration of these drugs. Unfortunately, many organizations have fallen short of the standards due to reliance upon out-dated lists, education rather than system/process safety nets, better drug storage and reminders to “be more careful.” To that end, ISMP and the Institute for Healthcare Improvement (IHI) have published guidelines and outlined various strategies to improve handling of high-alert medications. The IHI white paper makes specific recommendations for insulin; the following list includes those most relevant to the O.R.:

- An independent double-check (by a second provider) of the drug, concentration, dose, pump settings, route of administration and patient identity, before starting I.V. insulin.
- Preprinted diabetic and insulin infusion orders.
- The separation of look-alikes and sound-alikes by labeling, time and physical distance.
- Preparation of all infusions in the pharmacy and standardization of the concentration of I.V. insulin.
- Placing safeguards on high-dose insulin vials.
- Creation of a computer software routine that alerts providers to factors that may modify our dose such as NPO status, changing steroid doses, changing TPN or enteral feedings, and other drug/disease interactions.
- Completion of an insulin-safety self-assessment.
- Institution of monitoring protocols with triggers to administer glucose.
- Treatment as a sentinel event whenever a patient has an insulin-related blood sugar <40 mg/dL.
- Removal of tuberculin syringes from stock.
- Use of continuous blood sugar monitoring devices.
- Development of a defined protocol with clear monitoring guidelines when insulin is used to treat hyperkalemia.
- Use of a computer-assisted dosing adjustment program.
- Appropriate monitoring through frequent and rapid testing of blood sugars.

Since then, there have been a number of well-publicized heparin overdoses that have attracted national media attention. The ISMP’s list of medications has grown considerably since 1996 and currently includes all of the commonly used intravenous and volatile agents as well as specific drugs, including insulin, potassium, vasopressin and nitroprusside. All of the adrenergic agonists and beta-blockers are also included.

The Joint Commission now has a standard (MM.01.01.03) that requires hospitals to develop their own lists of high-alert and hazardous medications (http://www.jointcommission.org/assets/1/6/SampleMedications_HAP.pdf).
develop a protocol for storage, handling and safe delivery that works for them.

A potentially difficult issue is the first recommendation from the IHI: performing an independent double-check of the drug, concentration and pump settings. In physician-only practices or in situations where there is only a single anesthesia provider assigned to a case, this can pose practical problems. Many nursing departments across the country have policies that mandate this practice for high-alert medications. In spite of this, hospitals continue to report ADEs with these very drugs.

One of the causes is a cognitive error known as confirmation bias – the affirmation of one’s preconceived notions or hypotheses. For example, a patient requires an insulin infusion to be initiated during anesthetic management. One anesthesia provider may order the infusion and set up the infusion pump. As part of the double-check, the first provider may verbally state the infusion concentration and the rate of the infusion that is programmed into the pump. The second provider takes a quick, cursory look at the pump and verifies the settings. Is this a truly independent double-check? In all likelihood, no – the second provider was already subject to confirmation bias, i.e., he was expecting to see what the first provider verbally stated. In a truly independent double-check, the second provider would look at the label on the syringe, check the concentration of the insulin and then the pump settings. She would then state what was found and confirm it with the first provider. While more cumbersome and perhaps more time-consuming, this process is independent and eliminates confirmation bias.

The role of confirmation bias in undermining the intended safety gain of double-checks by a separate provider is not limited to insulin or even other high-alert medications. It is almost certainly a factor in errors involving blood administration, which continue to occur despite the near-universality of the two-provider check. In fact, confirmation bias is ubiquitous in medicine. Provider double-checks are a special case of redundancy often used as putative safety measures in engineering. As is the case in engineering, double-checks may just increase complexity without leaving the system any safer. Other types of cognitive biases occur in anesthesia and have been described.

## Conclusion

High-alert medications are defined as those that are especially dangerous when subject to administration errors. At a minimum, these drugs include insulin, potassium, magnesium, antiarrhythmics, and adrenergic agonists and antagonists. The ISMP and IHI have strongly recommended that hospitals develop a process to ensure their safe administration.

Workflows and practice patterns make it very difficult for anesthesiologists to follow the protocols that are mandated institution-wide for the handling of high-alert drugs. It would behoove us to create lists for our own departments and O.R.s.

Medication errors continue to be a significant safety issue for anesthesia patients. The Anesthesia Patient Safety Foundation (APSF) offers a video on medication safety that can be obtained free of charge. This video recommends a systematic multi-prong approach, looking to human factors and the adoption of standardized systems, processes and technological aids.

## References: