

# Patient Safety Tip of the Week

November 3, 2015

## Medication Errors in the OR - Part 2

In our March 24, 2009 Patient Safety Tip of the Week "[Medication Errors in the OR](#)" we discussed the many reasons that medication errors are likely to occur in the OR. But, frankly, at that time we were surprised at the paucity of literature on the issue. We had no accurate quantification of how often medication errors occur in that setting. Though the OR was not one of the top 10 sites for medication errors in the USP MEDMARX® database, one study highlighted the serious nature of the outcomes of such errors in the OR ([Beyea 2003](#)).

But the big news last week was a new study from the MGH (Massachusetts General Hospital) demonstrating that medication errors in the perioperative setting are extremely common ([Nanji 2015](#)). In fact, one in every 20 perioperative medication administrations resulted in a medication error or adverse drug event. The **overall rate of 5.3%** is pretty close to the rates we typically see on inpatient units. And almost **half of all surgery cases had at least one medication error or adverse drug event**.

The study utilized direct observation of 277 randomly selected operations plus further chart review of the same cases. 124 of the 277 cases had at least one medication error or adverse drug event. In all, there were 193 events in 3675 medication administrations (153 medication errors and 91 adverse drug events). **A third of the medication errors led to adverse events**. Moreover, **79% were felt to be potentially preventable**. Over half of the events occurred within 20 minutes of the induction period.

The most common error types were labeling errors (24.2%), wrong dose errors (22.9%), and omitted medication/failure to act (17.6%). Three drugs (propofol, phenylephrine, and fentanyl) were associated with 45% of the events.

Patient characteristics had little influence on rates of medication errors or adverse drug events. Longer procedures were associated with more errors and ADE's, as were procedures in which 13 or more medication administrations occurred. Importantly, the error rates were almost equal between attending anesthesiologists, CRNA's, and residents.

Perhaps the most striking observation was that the installed barcoding medication safety system was not always utilized. In some cases the barcoding system was not installed in that particular location but in others anesthesia personnel used workarounds to avoid

using the barcoding system. In the latter, sticker labels were applied manually to syringes. That actually should not be surprising since we saw multiple workarounds when barcoding was initially introduced to other parts of hospitals (see our June 17, 2008 Patient Safety Tip of the Week “[Technology Workarounds Defeat Safety Intent](#)”).

The Nanji study does far more than simply provide an estimate of how often such perioperative medication errors occur. It provides lots of potential opportunities to reduce such errors, utilizing both technology-based strategies and process-based strategies (see below).

As noted in the accompanying editorial ([Orser 2015](#)) this high frequency of errors and ADE’s occurred despite the fact that the MGH uses a barcoding system in the OR and has an electronic documentation system in the OR. The editorialists attribute the high rate of errors and events to observation by independent observers compared to self-reported errors in prior studies.

In our March 24, 2009 Patient Safety Tip of the Week “[Medication Errors in the OR](#)” we noted many of the factors that make medication errors in the OR both more likely and more serious when they do occur:

- Complex, rapidly changing environment
- High-risk drugs with narrow therapeutic windows
- Multiple variables may mask drug effects (eg. changes in vital signs may be attributed to other things going on during the surgery)
- Direct access to drugs (no benefit of having a pharmacist involved)
- A single person (the anesthesiologist) may be prescribing, dispensing, and administering drugs
- Many available safety tools often not yet used in OR (eg. BMV/barcoding, CPOE decision support, verification double checks)
- In many hospitals the OR or anesthesia information system has not yet been integrated with the hospital-wide EMR
- Sterile field/labeling issues (when transferring medications to and from sterile fields)
- Nurse or anesthetist change of shift or other handoff issues
- Verbal orders for medications common and often done thru a mask
- Pt can’t speak for himself (he’s under anesthesia or sedation) and does not have an “advocate” present
- Emergency circumstances and other time pressures often present
- Distractions common
- Cross covering (eg. a nurse not familiar with certain types of case may be covering)
- Workload issues
- Drugs taken from cabinet after cabinet restocked/rearranged
- Allergy knowledge often inadequate
- Surgical techs may not have full knowledge of medication issues
- LASA (look-alike sound-alike) drugs or packaging

- Timing issues
- Lack of standardization (carts, medication concentrations or preparations, etc.)

So it should not be surprising that serious outcomes may arise from medication errors occurring in the OR.

Several other organizations have been at the forefront in addressing perioperative medication errors: ISMP Canada, ISMP (US), AORN, and the APSF (Anesthesia Patient Safety Foundation).

Many of you are undoubtedly already familiar with APSF's video on medication safety in the operating room ([APSF 2012](#)). It is based on a consensus conference convened by APSF in 2010 ([Eichhorn 2010](#)) and also highlights a patient safety initiative at Wake Forest University Baptist Medical Center ([Vanderveen 2010](#)).

The video noted that medication errors occurred in one of every 133 anesthetic administrations (? a gross underestimate in view of the recent findings in the MGH study). The most frequent medications involved included NMBA's (neuromuscular blocking agents), opioids, benzodiazepines, heparin, epinephrine, antibiotics, and insulin. It also noted that 4% of closed claims in a large anesthesia malpractice database were related to medication errors. 24% of these were "substitution" errors (and NMBA's and epinephrine were most frequently involved), 18% were "insertion" errors (where a medication never intended for the patient was given inadvertently), and 31% were "incorrect dose" errors. About 50% of the errors led to serious adverse effects for the patient. Contributing factors identified included lack of standardization, no protocols, production pressures, and lack of agreement on best practices. A study of perioperative medication errors from Australia noted about 50% syringe and drug preparation errors (with NMBA's and opioids again heading the list). 62% were felt to be preventable and contributing factors identified included haste, fatigue, communication difficulties, inattention, and labeling issues.

The video goes on to note several of the features we noted above (from our March 24, 2009 Patient Safety Tip of the Week "[Medication Errors in the OR](#)") that make the OR especially vulnerable to medication errors. In the OR the anesthesiologist is typically the individual who chooses the drug, prepares it, and administers it without the system of checks and balances from nursing and pharmacy that we'd typically see elsewhere in the hospital. In addition, the drugs being dealt with are often high-risk medications and are used in high volume. LASA (look-alike sound-alike) issues are also especially frequent in the OR.

Basic medication safety principles outlined in the video include:

- Label all syringes
- Read all labels before administering
- Use distinctive drug labels
- Color-coding

But APSF says these are not enough and therefore advocates a new paradigm for medication safety in the OR, with the acronym “STPC”:

- S** Standardization
- T** Technology
- P** Pharmacy/Prefilled/Premixed
- C** Culture

Standardization includes not only drug dosages, dosing units, concentrations, and drug preparation methods but also workplace design. Technology includes better drug identification and delivery systems with technologies such as bar coding systems. The “P” includes provision of dedicated pharmacy resources for the OR and using premixed solutions or prefilled syringes in the OR so the anesthesia personnel are relieved of such preparation activities. The cultural changes needed are adoption of a non-punitive “just culture” type system that encourages reporting of errors and discussion of lessons learned from errors. The culture of “identify, blame, and punish” needs to be replaced by one of accountability.

The “STPC” paradigm suggests that high-alert medications (such as epinephrine and phenylephrine) should be available only in standardized concentrations and be prepared by pharmacy personnel wherever possible. They should be in ready-to-use syringes or infusion form for both adult and pediatric patients. The video discusses the labeling elements needed to meet The Joint Commission requirements (drug name including TALLman lettering where appropriate, concentration in dose per mL, diluent, preparer, preparation date and time, expiration date, standardized colorcoding where available, and barcode). Technology includes systems to identify every medication during preparation and before administration (such as barcoding) and automated systems for documentation and clinical decision support. Such automation of documentation of time a drug is administered also is a time saver that enables the anesthesia personnel to attend to other responsibilities. The most important element under the “P” is for the anesthesia personnel to discontinue routine preparation of medications at the point of care, instead using prefilled syringes or premixed solutions prepared by pharmacists or commercial vendors. The other key element of the “P” is involvement of pharmacists, either directly in a satellite pharmacy in the OR suite or otherwise as part of the perioperative team. They also recommend use of standardized prepared medication kits by case type wherever possible. The “C” is for cultural change including a “just culture” for reporting errors, including near misses, and learning from such reports.

The example of “STPC” provided by the Wake Forest project involved hospital-wide standardization of infusion pump technology, drug libraries, concentrations, dosing units, and dosage limits ([Vanderveen 2010](#)). Pump types no longer had to be changed when patients were moved between OR, ICU or med-surg units. Certain “anesthesia only” medications were identified and a list of medications pharmacy would prepare for use in the OR was developed. A strong culture of cooperation and dedication to patient safety and involvement of staff from multiple departments were key to the implementation.

The recent MGH study ([Nanji 2015](#)) suggests a variety of both technology-based and process-based interventions. The technology-based ones include use of barcoding systems and clinical decision support tools. Process-based interventions include changing the timing of documentation and reducing the opportunity for workarounds. The latter might include making it slightly harder for anesthesia personnel to get manual stickers in lieu of using the barcode scanner. They also note that being able to connect infusions to the most proximal IV port (ideally through a dedicated carrier line) may minimize inadvertent boluses of IV infusates.

In our March 24, 2009 Patient Safety Tip of the Week “[Medication Errors in the OR](#)” we mentioned the an [Operating Room Medication Safety Checklist](#) developed by ISMP Canada in collaboration with the Canadian Anesthesiologists’ Society, the Operating Room Nurses Association of Canada, and ISMP (US) and other parties. The Association of periOperative Registered Nurses (AORN) also produces the [AORN Safe Medication Administration Tool Kit](#), another valuable tool in developing your OR medication safety program.

The current APSF Newsletter also has a timely reminder about an issue related to medications and the OR. It has to do with medication safety issues during emergency transfer of obstetric patients to the OR ([Kacmar 2015](#)). It notes that during such emergency transfers there may be inadvertent administration of some of the high-risk medications a patient may have had infusing prior to the transfer. See the article for details and recommendations about which ones to discontinue prior to transport and other issues.

The recent MGH study highlights the significant frequency of perioperative medication errors. Now is a good time for hospitals or free-standing surgery centers to review their medication safety as it applies to the OR and perioperative settings.

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