



A Case Report From the Anesthesia Incident Reporting System

Review of unusual patient care experiences is a cornerstone of medical education. Each month, the AQI-AIRS Steering Committee abstracts a patient history submitted to the Anesthesia Incident Reporting System (AIRS) and authors a discussion of the safety and human factors challenges involved. Real-life case histories often include multiple clinical decisions, only some of which can be discussed in the space available. Absence of commentary should not be construed as agreement with the clinical decisions described. Feedback regarding this article can be sent by email to airs@asahq.org. Report incidents or download the AIRS mobile app at www.aqiairs.org.

Case 2018-5

“If you put the federal government in charge of the Sahara Desert, in five years there’d be a shortage of sand.” – Milton Friedman

Outsourced (Pharmedium) hydromorphone syringes were unavailable due to a drug shortage. Pharmacy-prepared hydromorphone syringes were substituted, but lacked the blue (opioid) color coding on the label. In addition, pharmacy-prepared hydromorphone syringes were the same size syringe (5 ml in a 6 ml syringe) with a similar pharmacy label as dexmedetomidine syringes. Pharmacy did not vet this change with anesthesia providers before implementation to determine if the change was safe. On at least three occasions, hydromorphone was inadvertently administered instead of dexmedetomidine (prepared in the same size syringe with similar pharmacy labeling). On one occasion, a partially used hydromorphone syringe was thought to be dexmedetomidine and discarded instead of returned to pharmacy for controlled substance accountability. There were several near-misses.

Discussion

This case illustrates at least three significant patient safety issues: the first is the seemingly ubiquitous and eternal drug shortages; the second is the variable application of color-coded syringe labels for anesthesia drugs; the third centers on communication failures, in this case between pharmacy and anesthesia providers.

Drug shortages began to appear with some regularity in the early 2000s and seemed to peak in 2011 at 267 reported for the year (Figure 1). The FDA defines drug shortages somewhat differently than the American Society of Health-System Pharmacists (ASHP), so the ASHP numbers are always greater

than the FDA numbers. Hydromorphone would not have been counted as a drug shortage by the FDA, as there are alternatives (morphine, methadone, fentanyl); but as shown above, even an available alternative raises significant risks, as the alternative will have a different potency, may be less effective and have a different side-effect profile. Substitutions by the pharmacy, if not clearly and effectively communicated, can lead to significant confusion if pharmacists are unable to avoid look-alike vials or ampoules.

Substitutions may increase mortality. Among 27,835 patients with septic shock in 26 hospitals, patients admitted during times of norepinephrine shortage had an increased rate of in-hospital mortality compared to patients admitted during periods of normal supply (39.6 percent versus 36.9 percent), an absolute risk increase of 3.7 percent ($P = .03$).¹ Chemotherapy drugs carry perhaps the greatest risk, with some studies indicating worse outcomes with

alternative drugs,² and others showing no apparent affect.³ Whether drug shortages actually imperil health is not clearly known, but all agree that drug shortages are extremely costly, due to both more expensive drugs required as substitutes and the significant impact on pharmacist time to continually track shortages, search out alternatives and educate staff members in potential shortages. The National Health Service (U.K.) estimates that drug shortages cost the system £38 million in a single month.⁴ Anesthesiologists certainly have felt the impact of shortages,

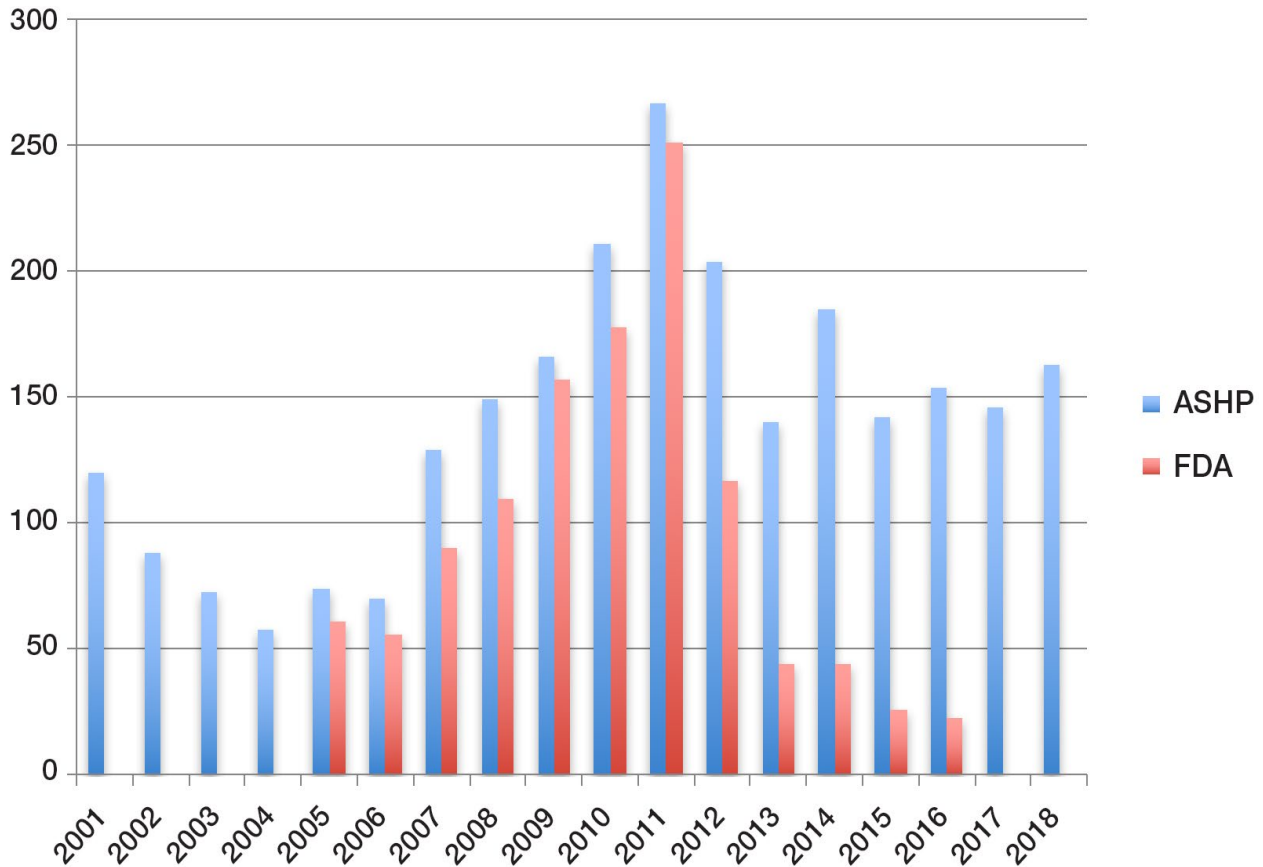
particularly now, with local anesthetics (bupivacaine and ropivacaine) in current short supply. Many institutions are altering which regional analgesic techniques will be favored or substituted (e.g., Exparel™ quadratus lumborum blocks in

Drug Shortage: Definition

FDA: “Products used to prevent or treat a serious or life-threatening disease or medical condition for which there is no other available source with sufficient supply of that product or alternative drug available.”

ASHP: “A supply issue that affects how the pharmacy prepares or dispenses a drug product or influences patient care when prescribers must use an alternative agent.”

Figure I: Drug Shortages 2001-2018 as Reported by the FDA vs. ASHP



Created with data from the FDA (<https://www.fda.gov/Drugs/DrugSafety/DrugShortages/default.htm>)
 And ASHP (<https://www.ashp.org/Drug-Shortages/Shortage-Resources/Drug-Shortages-Statistics>)

lieu of epidural or paravertebral blocks) in order to reserve bupivacaine or ropivacaine for obstetrical epidurals.

The second serious patient risk illustrated by this example is that of syringe labeling and the presence or absence of colored labels. The use of various colored syringe labels to provide a visual cue to the class of drug in the syringe has been around for at least 25 years. U.S., Canadian and Australian groups adopted the standardized color code system (Figure 2, page 44) promoted by the American Society for Testing and Materials (ASTM) prior to 2000; unfortunately, Great Britain and Ireland had, in 2002, a plethora of different local systems for color-coding anesthesia syringes.⁵ Trying to adopt to a single, uniform color code system actually increased the rate of drug errors for a time, until all anesthetists became familiar with the new system.⁶ The errors in this incident report were due, in part, to the absence of the expected blue opioid class label on pharmacy-prepared syringes of hydromorphone, and confusion with a plain white label that was very similar to that on pharmacy-prepared dexmetatomedine.

Colored labels are, at this time, ubiquitous in American anesthesia practices, whether on prefilled syringes from an outside provider such as Pharmedium, CAS or by a local provider who draws up their own medications. Virtually all of us adhere to the ASTM standards, which have now become an international standard as well (see text box). Unfortunately, not all agree that color coding labels is appropriate, and so many pharmacists do not color code prefilled syringes for anesthesia use – but, as in this case, simply use a plain white label. The Institute for Safe Medication Practices (ISMP) does promote the use of colored labels by anesthesiologists in the O.R., but they, together with ASHP and the AMA, oppose the use of colored labels for commercially available drugs.⁷ Their contention is that the myriad of different drugs within a single drug class make reliance on the label color a risky business. Anesthesia providers typically only use one or two drugs within a drug class, so mix-ups are less common. Copper is the color

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for cardiovascular drugs; in the O.R., anesthesia providers typically only use a small subset of what is available, but in the ICU there may be many more drugs of this class used, with increased confusion. The concern that using color-coded labels might promote errors may come from the experience with ophthalmology, who reported a significant number of errors when colored labels were used.⁷ The ISMP and ASHP strongly suggest that anesthesiologists only use the colored labels within the O.R. and use plain white labels on syringes when in the ED or ICU. There is little evidence and few case reports of color-coded labels resulting in errors in these locations, but this caution is the reason the pharmacy-prepared syringes always come with a plain white label. The pharmacy mantra is “Read the label!” Unfortunately, the “plain white labels”

“ISO 26825:2008 gives requirements for labels which the user attaches to syringes so that the contents can be identified just before use during anaesthesia. It covers the colour, size, design and general properties of the label and the typographical characteristics of the wording for the drug name.” <https://www.iso.org/standard/43811.html>

typically used by pharmacies 1) contain much information that is not germane to an O.R. setting and 2) the drug name is VERY small – a sure recipe for disaster (or near-disaster, as in this case). Furthermore, most human factors experts would recognize that instructing us to “be more careful” or “pay attention” is a sure recipe for medication errors.

While an anesthesiologist might give fentanyl in error when hydro-morphone was intended, the blue color cue would have at least gotten the patient a narcotic and not a neuromuscular blocker. Admonitions from pharmacy and an insistence on providing all prepared syringes with plain white labels may be short-sighted and possibly dangerous. An individual anesthesia provider could, of course, add a colored label, but at the expense of time and potential for confusion at that step.

Figure 2: Statement on Creating Labels of Pharmaceuticals for Use in Anesthesiology, ASA Committee on Equipment and Facilities (Approved by the ASA House of Delegates on October 27, 2004; last amended on October 28, 2015).

	PMS ^a	ASTM ^b RGB		ISO ^c RGB
Induction Agents	Process Yellow C	255.255.0		255.255.0
Benzodiazepines and Tranquillizers	Orange 151	255.102.0		255.102.0
Benzodiazepene Antagonists	Orange 151/White Diagonal Stripes	255.102.0		255.102.0
				
Muscle Relaxants	Florescent Red 805 ^d	255.114.118		
	Florescent Red 811 ^e			253.121.86
	Warm Red ^f			245.64.41
Muscle Relaxant Antagonists	Florescent Red/White Diagonal Stripes	255.114.118		253.121.86
				
Opioid/Narcotics	Blue 297	133.199.227		133.199.227
Opioid/Narcotic Antagonists	Blue 297/White Diagonal Stripes	133.199.227		133.199.227
				
Major Tranquillizers and Anti-Emetics	Salmon 156	237.194.130		237.194.130
Vasopressors	Violet 156	222.191.217		222.191.217
Hypotensive Agents	Violet 156/White Diagonal Stripes	222.191.217		222.191.217
Local Anesthetics	Gray 401	194.184.171		194.184.171
Anticholinergic Agents	Green 367	163.217.99		163.217.99
Beta Blockers	Copper 876U	176.135.112		NA ^g
	White	255.255.255		255.255.255

a – Pantone Matching System
b – ASTM International; prior to 2001 it was the American Society for Testing and Materials
c – International Organization for Standardization
d – Designated by ASTM International
e – Designated by ISO
f – Designated by ISO as an alternative if Florescent Red cannot be printed
g – ISO has not designated a color for Beta Blockers

11. *Standard Specifications for User Applied Drug Labels in Anesthesiology* and ISO 26825:2008 (only eight, copper has not been added). IMPORTANT: The colors represented in this electronic file are not intended to be used for color matching.

The final patient safety risk, or system vulnerability, was the lack of communication from the pharmacy about the shortage of prefilled hydromorphone syringes and that the substituted medication would have a simple white label rather than the expected blue label. In at least one hospital system (University of Michigan), a staple of the Thursday M&M is five minutes from the O.R. pharmacist about the latest shortages, and what the new substitutes will be, together with slides showing how the substitute will look. In cases where look-alike vials had to be purchased, this was called out clearly. It has also been suggested that anytime a significant substitution is made for a familiar drug, the substituted vial, ampoule or syringe be in the appropriate location in the drug tray, but be placed in a red bag that identifies it as a substitute, or bears some sort of clear warning that this is not the usual drug. We all do understand the “alert fatigue” that comes with repeated updates, but these must become part and parcel of our lives as long as drug shortages persist. Each anesthesia department should set an ad hoc committee to design a local system of communicating shortages and how the shortage will be addressed (local compounding, breaking multi-use vials into syringes in the pharmacy, substitutions) and substitutions announced.

“While an anesthesiologist might give fentanyl in error when hydromorphone was intended, the blue color cue would have at least gotten the patient a narcotic and not a neuromuscular blocker.”

Ultimately, the use of bar coding will significantly enhance our safety. While humans can misread labels, the computer rarely misreads a bar code. A comprehensive medication safety system that includes bar coding of syringes, together with visual and audio alerts, has been shown in both the real world and in simulation to decrease the number of medication errors.^{8,9} When bar coding becomes widespread, anesthesiologists will have at least three different cues to what is within the syringe: a visual display of the drug name, the audible identification of the drug and concentration, and the color-coded label. But, in the end, the final admonition, which is the absolute minimum standard for competence, is that providers take the time to actually read the entire label of every syringe, ampoule or vial and verify that it is the one they intended, prior to administration.

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