# Improving Medication Safety in Anesthesiology: A Quality Improvement Initiative Optimizing OR Pyxis Systems

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## Introduction

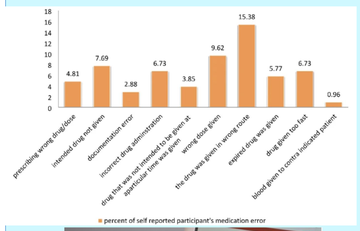
**Background**

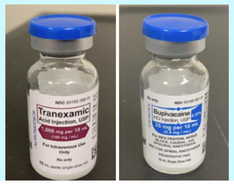
Medication errors are significant in perioperative anesthesia care, particularly during intraoperative management. The anesthesiologist, often the sole practitioner overseeing medication administration, assumes responsibility for prescribing, preparing, administering, and monitoring medications. This process bypasses the typical multi-step verification system involving pharmacists, nurses, and other healthcare personnel, increasing the risk of medication errors and potential patient harm.

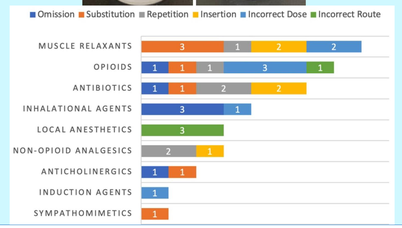
The Integrated Anesthesia Associates Quality Improvement team has extensively studied anesthesia-related medication errors within the Hartford Healthcare System. Some errors include incorrect drug selection, dosing inaccuracies, and inadvertent administration of the wrong medication.

**Case Examples**

- In 2022, a vial of phenylephrine (10 mg) was mistakenly administered instead of glycopyrrolate due to the similar appearance of the two medications. Fortunately, the patient experienced no lasting harm, but this event underscored the need for systemic improvements.
- In 2023, concentrated Tranexamic acid (TXA) was administered intrathecally instead of a local anesthetic, which, although it can prove fatal, fortunately, resulted in a full recovery after an extended ICU stay.
- Additionally, the potential for controlled substance diversion over a single user sign-in was identified as a concern about intraoperative Pyxis.




## Report

This ongoing quality improvement (QI) project aims to optimize the Pyxis system—an automated medication dispensing device used in the operating room—to reduce medication errors and prevent diversion. The focus was on implementing changes in medication storage, labeling, and access controls to improve patient safety and workflow efficiency.

**Interventions**

In response to the identified errors:

1. **Incorrect Medication Selection (Phenylephrine vs. Glycopyrrolate)**: The Pyxis layout was reconfigured to store vasopressors away from vasodilators, with medications such as phenylephrine and ephedrine in one drawer while labetalol and glycopyrolate are in another drawer. Additionally, concentrated phenylephrine (10 mg) was removed from the Pyxis, and only 1mg of prefilled syringes were stocked, reducing the risk of future errors. Since the changes, no similar incidents have been reported.
2. **Intrathecal Administration of Tranexamic Acid**: Concentrated Tranexamic acid vials were removed from the Pyxis and replaced with premixed bags to eliminate the risk of confusion and improper administration routes.
3. **Controlled Substance Diversion**: A fingerprint identification system was activated for all controlled substance withdrawals from the Pyxis, hence reducing concern for substance diversion.

## Discussion

Medication errors during intraoperative anesthesia management occur in up to 1.1% of cases (Murphy et al .). Substitution errors and dosing inaccuracies are the most commonly reported issues, with consequences ranging from no harm to severe patient outcomes. These errors also pose significant financial and legal risks, damage patient-provider trust, and undermine institutional credibility.

In the Hartford Healthcare System, medication swap errors and potential controlled substance diversion are significant concerns. The St. Vincent's Medical Center Anesthesiology Department implemented targeted changes to the OR Pyxis system to address these issues. These included:

- I am rearranging medication locations, placing opposing action medications farther away.
- Eliminate highly concentrated medications and replace them with pre-filled syringes with distinct external appearance.
- We activate fingerprint verification for controlled substances to prevent unauthorized access and diversion.

Table 2
Error Reduction Techniques

| Error Reduction Technique | Supporting References |
|---|---|
| Pre-filled syringes | 3 |
| Distinctive drug labels | 2,3,4,5 |
| Colored drug Labels | 2,3,4,6 |
| Check labels with second observer | 3,6 |
| Double check ampoule before labeling syringe, and syringe label before administration | 2,3,6 |
| Do not store concentrated solutions of hazardous medications (ACs) in OR | 1,3 |
| Standardization – drug preparation procedures | 2 |
| Standardization of layout of drug workspace | 2,3,5,6 |
| Standardization – syringe sizes | 2,6 |
| Bar codes on drug labels with audible reader | 3,4,7,8,9,10 |

**Conclusion**

Proactive and reactive improvements to automated medication dispensing systems like the Pyxis are essential for enhancing patient safety in perioperative settings. The changes implemented by the Anesthesiology QI committee at SVMC continue to demonstrate success in preventing medication errors and drug diversion, ensuring safer anesthesia practices , and protecting patients from avoidable harm .

## References

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