Intraoperative Handoffs Among Anesthesia Providers Increase the Incidence of Documentation Errors for Controlled Drugs

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Background: When electronic anesthesia records are compared to pharmacy transactions, discrepancies in total doses of controlled drugs are commonly found (≈16% of cases), potentially affecting patient safety and placing hospitals at risk for regulatory action. Errors (≈5%) persisted even with near real-time drug reconciliation feedback to providers. A study was conducted to test the hypothesis of greater risks of discrepancy for longer-duration cases and for intraoperative handoff involving a permanent handoff of care.

Methods: Anesthesia drug documentation and pharmacy transaction data were examined for all anesthetics between May 2014 and September 2015 at an academic medical center, and discrepancies between the two systems were determined. Nine logistic regression models were constructed to evaluate the influence of covariates (for example, case duration, general anesthesia vs. sedation, and handoff involving a permanent transfer of patient care) on the presence of a discrepancy. Linear regression was also performed between case duration decile and the logit (discrepancy rate), stratified by anesthesia type and handoff.

Results: For all models, handoffs were associated with higher discrepancy rates ($p < 10^{-6}; \text{odds} \geq 1.38$). There was a progressive increase in discrepancy rates as a function of the case duration.

Conclusions: Handoffs involving a permanent transfer of patient care during cases increase the risk of controlled drug discrepancies. Staff scheduling and assignment decisions to decrease the chance of a handoff occurring should help mitigate this. In addition, future studies should examine ways to improve the handoff process related to controlled drugs (for example, a formal, structured processes in the anesthesia information management system).

When documentation of controlled drug administration in electronic anesthesia records is compared to transaction records in pharmacy systems, discrepancies are commonly found. The incidences of discrepancies are large (approximately 16%) because the workflow for most medication delivery in the operating room (OR) by anesthesiologists and nurse anesthetists (“anesthesia providers”) differs substantially from that of practices in the rest of the hospital. This workflow is designed to allow rapid administration of drugs in response to sudden changes in the patient’s condition. A consequence of this requirement is loss of pharmacy oversight and bypass of systematic processes designed to ensure accurate documentation.

For most drugs administered in the OR, orders are not reviewed by a pharmacist. The hospital’s computerized provider order entry system is not used (for example, no automatic checks of allergy and drug interactions). Rather, the anesthesia provider has immediate access to a large supply of drugs, including controlled drugs such as opioids and sedatives. The source is either an automated drug-dispensing cabinet or a bag of drugs signed out to the provider by the pharmacy and subsequently assigned to patients. The provider personally withholds the drug into a syringe (for example, a 1 mL vial containing 10 mg morphine diluted to a total volume of 10 mL) and labels the drug (often improperly). He or she then administers portions of the syringe contents at various times (for example, 5 mg at 9:43 A.M., then an additional 2 mg at 10:11 A.M.), and documents each dose in the anesthesia information management system (AIMS) record, if implemented, or on a paper record. There are often considerable delays (>15 minutes) between the administration and documentation of drugs given in the OR.

At some time near or after the end of the case, the anesthesia provider adds up the totals for each controlled drug (principally opioids and midazolam), determines how much drug was drawn up but not administered, and wastes the residual amounts in the presence of a witness. This last reconciliation step is subject to considerable error. A discrepancy exists when the amount documented in the AIMS does not match the balance of the transactions in the pharmacy database. This can occur for a variety of reasons related to incorrect documentation in either or both systems (see Table 1). On the basis of feedback from our providers contacted about discrepancies, in most situations, they did not realize that they had made a mistake in their calculations. At the large numbers of facilities where the pharmacy system and the AIMS are not linked (or if an AIMS is not in use) and systematic analysis is not performed, anesthesia providers...
and pharmacists simply do not appreciate the high prevalence of inaccurate opioid and sedative documentation in the OR.

Understanding the problem of controlled drug discrepancies is important for several reasons. First, such discrepancies may involve patient safety issues if an inaccurate amount is documented in the anesthesia record. For example, a common situation is that the anesthesia provider gives an additional dose of an opioid to treat pain just before transporting the patient to the recovery room (see Table 1, Scenario 5). If the anesthesia record is not updated to reflect this, medical personnel taking care of the patient in the recovery room might administer additional opioid too soon, resulting in an overdose. A second issue relates to the quality of care. It is axiomatic that medical records should accurately reflect the care that a patient has received. A third reason why these types of error matter is that there may be regulatory consequences of controlled substance discrepancies. Accurate accounting of controlled drugs is a requirement of the US Controlled Substances Act. In part because of issues related to inaccurate reconciliation of controlled drugs by anesthesia providers, Massachusetts General Hospital recently paid a multimillion dollar fine and agreed to a corrective action plan. Fourth, repeated errors involving controlled drugs may result in an investigation for potential diversion, and, possibly expose the provider to loss of his or her license to prescribe such medications. Finally, there were approximately 27 million surgical cases performed in the United States nonfederal hospitals in 2014. Even if all such hospitals implemented the informatics solutions and achieved a discrepancy rate of 5.2%, this would create 1.4 million controlled substance discrepancies, nationwide. Thus, this is a substantive problem.

Previously, Epstein et al. developed a novel informatics solution to provide near real-time feedback to the anesthesia providers as to the total amount of controlled drug documented in the AIMS, and the balance in the automated drug dispensing system between the amounts vended minus the amounts wasted, returned, or transferred to another patient. This immediate feedback provides a tool that allows providers to ensure full and accurate accounting for all controlled drugs. The system resulted in a reduction in the discrepancy rate from 16.0% (95% confidence interval [CI]: 15.1%–17.0%) to 5.2% (95% CI: 4.9%–5.6%). Presumably, the residual discrepancy rate persisted because of clerical errors and incomplete use of the feedback system (for example, mistyping the amount of wasted drug and not rechecking the discrepancy report before leaving for the day).

In the current study, we tested two hypotheses. Hypothesis 1 was that the longer the case duration, the greater the controlled substance discrepancy rate. We expected that longer cases have larger quantities of controlled drugs dispensed and larger number of individual doses administered, compared to shorter cases. Hypothesis 2 was that the presence of permanent handoffs between anesthesia providers increases the discrepancy rate because of information loss during the handoff process. For example, the original provider might have forgotten to document a dose of a controlled drug (for example, 2 mg of midazolam for anxiolysis in the holding area prior to entering the OR; Table 1, Scenario 6). The discrepancy would have been identified by the near real-time

### Table 1. Examples of Scenarios Resulting in Reconciliation Discrepancies

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Description</th>
<th>Consequence</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>A 100 mcg vial of fentanyl is dispensed to Patient A. The full dose is given, but only 75 mcg is documented in the anesthesia record.</td>
<td>There will be a fentanyl discrepancy of 25 mcg for Patient A.</td>
</tr>
<tr>
<td>2</td>
<td>A 100 mcg vial of fentanyl is dispensed to Patient A. 75 mcg is documented in the anesthesia record, but wastage of 50 mcg is documented.</td>
<td>There will be a fentanyl discrepancy of −25 mcg for Patient A.</td>
</tr>
<tr>
<td>3</td>
<td>A 100 mcg vial of fentanyl is dispensed to Patient A, but the full amount is given to Patient B. The provider forgets to transfer the drug from Patient A to B.</td>
<td>There will be a fentanyl discrepancy of 100 mcg for both patients. Patient A will have 100 mcg dispensed, and 0 mcg administered. Patient B will have 0 mcg dispensed, and 100 mcg administered.</td>
</tr>
<tr>
<td>4</td>
<td>A provider takes out 100 mcg fentanyl on Patient A from a Pyxis workstation in the postanesthesia care unit where a nurse is still logged in. The full dose is given to Patient A and appropriately documented in the AIMS.</td>
<td>There will be a fentanyl discrepancy of 100 mcg for Patient A. The transaction will be attributed to the nurse for use in the postanesthesia care unit, and thus excluded from intraoperative reconciliation.</td>
</tr>
<tr>
<td>5</td>
<td>Following surgery, just before transport to the postanesthesia care unit, 25 mcg fentanyl is given to treat pain. The provider does not update the electronic anesthesia record to reflect this dose.</td>
<td>There will be a fentanyl discrepancy of 25 mcg, even if the administration is noted in a handwritten note in the postanesthesia care unit.</td>
</tr>
<tr>
<td>6</td>
<td>A 2 mg vial of midazolam is dispensed by the nurse anesthetist to Patient A. The supervising anesthesiologist gives the drug in the holding area. Neither remembers to document the dose in the anesthesia record.</td>
<td>There will be a midazolam discrepancy of 2 mg. There will be 2 mg dispensed to Patient A, but no record that the drug was administered.</td>
</tr>
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AIMS, anesthesia information management system.
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