



## Omission of High-Alert Medications: A Hidden Danger

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### ABSTRACT

*A drug omission occurs when a patient does not receive a medication that has been ordered or when a medication has not been ordered despite being appropriate for an underlying condition. Over 2,700 medication errors categorized as drug omissions involving more than 500 different medications were reported to the Pennsylvania Patient Safety Authority from January 1, 2013, through April 30, 2013. Antibiotics (19.7%) and medications used for respiratory therapy (11.5%) were the most common medications cited in reports. More than 21% of reports involved at least one high-alert medication. A majority of omissions during the administration process (52.9%), followed by occurrence during the transcription (22.9%) and prescribing (12.0%) processes. Most administration omissions involved a medication intended to be given by an intravenous (IV) route (32.9%) or by other injectable routes (38.0%). The most commonly cited types of omissions involving an IV high-alert medication included IV infusions that were not started, IV tubing that was not connected or was clamped, and IV infusion pumps that were not turned on or were turned off. Risk reduction strategies include developing a consistent administration process for IV medication setup, tracing IV lines, and using healthcare technology fully and properly. (Pa Patient Saf Advis 2014 Dec;11[4]:149-55.)*

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### INTRODUCTION

A drug omission can be defined as an event in which an appropriate medication is not provided to a patient, either because the medication has not been prescribed or has not been administered. There are clinical reasons why patients may not receive medications (e.g., when patients are designated “nothing by mouth” [NPO] status, when patients are off of the unit for tests or otherwise unavailable to take their medications).

The impact of a drug omission varies from insignificant to severe harm, depending on the medications and the patient’s medical conditions.<sup>1</sup> Suboptimal treatment may also lead to an increased length of stay. The frequent occurrence of drug omissions may both reflect and contribute to significant organizational inefficiency.

Drug omissions can occur during any stage of the medication-use process. Medications may be omitted from initial medication lists obtained upon admission, prescribers may omit a drug when writing or entering orders, orders for medications may not be transcribed onto a paper medication administration record (MAR), pharmacy personnel may neglect to enter an order into the pharmacy computer system or may not deliver medications to patient care areas on time, or nurses may fail to administer the medication as prescribed. Based on an analysis of other medication error reporting programs, drug omissions are frequently the most common type of medication error reported.<sup>2</sup>

While there are studies showing that omissions are a leading type of medication error, there are few studies that reveal the reasons why they are occur. Green et al. studied admission prescription charts, recording all drugs prescribed but not given in the first 48 hours, along with the reason given for omission during the administration process. Twenty percent of prescriptions did not reach the intended patient, affecting 17% of the patients.<sup>1</sup> Warne et al. examined the documentation of medication administration in medical and surgical patients to determine the point prevalence of medication omissions, finding that 79% of patients did not receive at least one dose for one drug during one admission and that the average number of medication omissions was 2.5 per patient.<sup>3</sup> Other studies examining omissions have shown various rates of occurrence ranging from 1.1% to 58%.<sup>4,5</sup> McMillan et al. and Dean et al. suggest that up to 57% of missed medications could be detrimental<sup>6</sup> or even life-threatening.<sup>7</sup>

Analysis of drug omissions reported to the Pennsylvania Patient Safety Authority has identified where in the medication-use process these events occur, the reasons why medications were not prescribed or administered to patients, and the factors that may have contributed to these events. The analysis focused on high-alert medications,<sup>8</sup> as these drugs pose an increased risk of patient harm when involved in medication errors.

### METHODS

Analysts queried the Authority’s Pennsylvania Patient Safety Reporting System (PA-PSRS) database for reports assigned the event type “medication error/omissions.” Based on another analysis of medication error reports that showed that drug omissions were the most common medication error event type, analysts queried a short duration of time.<sup>2</sup> The query yielded 2,787 medication error reports that had been submitted to the Authority from January 1, 2013, through April 30, 2013, representing 16.1% of all medication events submitted (N = 17,276) and the most common type of medication error reported in that time period.

## RESULTS

Categorization of the reports by harm score, which is adapted from the National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) harm index,<sup>9</sup> shows that 88.6% (n = 2,469) of the drug omission events reached the patient (harm score = C to I) and that only 0.2% (n = 5) of the events resulted in patient harm (harm score = E to I). According to the NCC MERP harm index, when a patient does not receive the medication (i.e., an error of omission), the error is considered to have reached the patient.<sup>9</sup>

Overall, 91 unique care areas were associated with drug omissions. The most common units implicated in drug omissions included medical-surgical units (17.8%, n = 496), respiratory care–diagnostic/therapeutic units (8.0%, n = 223), and rehabilitation units (6.8%, n = 189). Omissions that take place during prescribing (e.g., failure to prescribe a medication) are not necessarily a reflection of the care area but may simply reflect the location of the patient at the time of the omission.

More than half of the reports involved the elderly population (65 years old or above) (51.8%, n = 1,445), followed by the adult population (18 to 64 years) (41.2%, n = 1,147). Only 7.0% (n = 195) of the reports involved the pediatric population (less than 18 years of age)

More than 500 different medications were cited in omission reports (see the Table), with antibiotics mentioned in 19.7% (n = 549) of the reports and medications used for respiratory therapy involved in 11.5% (n = 320) of the reports. Over 21% (n = 593) of the reports involved at least one high-alert medication. While omissions may be viewed as events that normally would not result in harm to a patient, the omission of high-alert medications, such as anticoagulants (e.g., heparin, warfarin) or hypoglycemic agents (e.g., insulin), could result in serious harm

Table. Top 10 Medications Involved in Drug Omission Events Reported to the Pennsylvania Patient Safety Authority from January 1, 2013, through April 30, 2013 (n = 994, 35.7% of total reports)

MEDICATION	NO. OF REPORTS	% OF TOTAL REPORTS*
Insulin <sup>†</sup>	140	5.0
Albuterol sulfate and ipratropium bromide	137	4.9
Vancomycin	134	4.8
Albuterol	110	3.9
Multiple medications	101	3.6
Heparin <sup>†</sup>	100	3.6
Hydration	78	2.8
Warfarin <sup>†</sup>	72	2.6
CeFAZolin	63	2.3
Enoxaparin sodium <sup>†</sup>	59	2.1

\* Total drug omission reports (N = 2,787)

<sup>†</sup> A high-alert medication

such as thrombotic or hyperglycemic events. Due to this potential for harm, the analysis focuses on the omission of high-alert medications.

## ANALYSIS

### Omission of High-Alert Medications

When studying admission prescription charts, Green et al. identified the two dominant reasons for medications not being given to patients: (1) the medication was not available in the patient care area (38% of omissions) or (2) the patient was designated NPO status (32% of omissions). In 10% of cases, the patient refused the medication; in 19% of cases, no reason for omission was given; and in 0.3% of cases, the patient was away from the unit. There was no correlation between the day of the week admitted and the number of medication omissions related to drug unavailability in the patient care area. In particular, weekends (when the pharmacy runs at a reduced staff level) were no different from weekdays (when the pharmacy is fully staffed).<sup>1</sup>

In order to identify prescribing and administration errors, Ghaleb et al. conducted a prospective review of medication charts as well as a prospective observation of nurses preparing and administering drugs. They found that 5% of the errors were omissions—either the drug was not available on the patient care unit or the nurse did not realize the drug was due for the patient.<sup>10</sup>

A retrospective review of electronic medication administration records (eMARs),<sup>11</sup> which included adult hospitalized patients who were ordered pharmacologic venous thromboembolism (VTE) prophylaxis with unfractionated heparin or enoxaparin over a seven-month period, measured the proportion of ordered doses of VTE prophylaxis not administered. Heparin regimens had higher rates of nonadministration and documented patient refusal than enoxaparin. For example, while medicine floors had significantly higher overall rates of nonadministration and documented patient refusals, heparin regimens had significantly higher nonadministration and documented refusal rates than enoxaparin regimens

## TYPES OF OMISSIONS

Following are descriptions of how drug omissions involving intravenous (IV) high-alert medications occurred during the administration node, as reported to the Pennsylvania Patient Safety Authority from January 1, 2013 through April 30, 2013:

- IV accidentally discontinued
- IV bag empty
- IV drug delivery system vial (e.g., Add-Vantage™) not activated
- IV hung but not infusing (e.g., IV pump never turned on or was turned off)
- IV line occluded
- IV medication not sent with patient upon transfer to another unit
- IV not connected
- IV not hung
- IV not started
- IV stopped
- IV tubing clamped when it should have been infusing
- Nurse distracted
- Problem with IV solution bag (e.g., bag defective)
- Wrong IV solution hung and ordered solution not given

on medicine floors. Likewise, on virtually every floor that had substantial use of both heparin and enoxaparin regimens ordered every 12 hours, these rates were significantly higher for the heparin regimens. Nearly 12% of ordered doses of pharmacologic VTE prophylaxis were not administered, nearly identical to rates reported in other studies.<sup>11,12</sup>

### Administration Node

A majority (52.8%, n = 313) of the drug omission reports that involved high-alert medications (n = 593) describe omissions that took place during the administration process. Predominantly, these events involved a medication intended to be given by an intravenous (IV) route (32.9%, n = 103) or other injectable route (e.g., subcutaneous, intramuscular [IM]) (38.0%, n = 119).

Most event descriptions did not provide enough information to determine what may have led to the omission of the medication. Analysis did reveal a variety of types of drug omissions (see “Types of

Omissions”). The most common types of omissions involving an IV high-alert medication included IVs that were not started (7.0%, n = 22), IV tubing that was not connected (3.2%, n = 10), IV tubing that was clamped (2.9%, n = 9), and the IV infusion pump not being turned on or being turned off (2.2%, n = 7).

Following are examples of reports of drug omission errors occurring during the administration process:

*[The patient] only had a PCA [patient-controlled analgesia pump] running with KVO [keep vein open] fluids. [The patient] had an order for a heparin drip to be restarted. After assessing the patient and reviewing the orders, I noticed the nurse reviewed an order in the afternoon stating to restart a heparin drip in two hours, per vascular. I called down to see if this order had been discontinued since there was no heparin drip with the patient. The heparin drip was then started at night.*

*The patient was on a heparin drip. It [was determined] that the prior nurse had changed the IV tubing and never connected it to patient. [The tubing was] under the patient’s bed. The patient had a KVO that had been turned off but never disconnected, which made me think that it was the heparin tubing connected to the patient. When I realized this, I reconnected the heparin tubing, kept the rate the same, and placed an order to recheck the aPTT [activated partial thromboplastin time]. I also notified the charge RN.*

*The nurse hung a new TPN [total parenteral nutrition] bag with lipids. Two hours later, the nurse assessed the line and found the tubing clamped and fluid leaking from the lipids port, which was loose. Pump did not alarm, indicating problem with line. Hourly blood sugar was lower than previous result. The nurse did not open IV clamp when new bag hung.*

*Patient admitted with a third-degree heart block, hypotension, and MI [myocardial infarction]. She was on 0.5 mcg/kg/minute of Levophed™ [norepinephrine] and was receiving hemodialysis in her room. When her Levophed beeped to KVO, the dialysis nurse in the room turned the drip off instead of notifying the nurse that the bag needed to be changed.*

### Transcription Node

The transcription node comprised the second most common (22.9%, n = 136) node where reported omissions of high-alert medications originated. For this analysis, the transcription node included any process that involved the communication of an order after the medication was prescribed and before a medication was dispensed or obtained and administered. The most common types of omissions included orders that were not transcribed



and/or orders that were missed (52.9%, n = 72) and orders that were not transmitted (e.g., faxed or scanned) to the pharmacy or other care area (16.2%, n = 22).

Following are examples of reports of drug omission errors occurring during the transcription node:

*Methotrexate order incorrectly listed on emergency department's medication reconciliation form as [two doses daily]. [Order was] clarified to weekly. However, when transcribed, the two doses were transcribed to begin one week apart. Patient missed [one] dose (seeking additional clarification of schedule) and potentially would have missed [a second] dose if the error was not detected.*

*While doing the 24-hour chart check, it was noted that an order was written on the VTE risk assessment sheet for Lovenox® [enoxaparin] 40 mg subcutaneous once daily. The order was never faxed to the pharmacy, and in turn, the patient missed two doses of the medication. Once discovered, the order was immediately faxed, verified on the MAR, and signed off.*

### Prescribing Node

The third most common node involved in reported omissions of high-alert medications was the prescribing node (12.0%, n = 71), which, for this analysis, included any activity pertaining to the ordering or reordering of a medication. The most common classes of high-alert medication mentioned in omissions occurring during this node were anticoagulants (63.4%, n = 45), insulin (12.7%, n = 9), and TPN therapy (7.0%, n = 5). Medication classes such as anticoagulants and TPN are often ordered with the expectation that a new order will be written daily or an order is automatically stopped and the medication would not be administered until the next new order is written. The most frequently noted breakdown in the prescribing

process for anticoagulants involved problems with the reordering process (44.4%, n = 20), such as prescribers not being called to write new orders, orders being discontinued and not rewritten, or orders not being written due to the unavailability of lab results.

Following are examples of reports of drug omission errors occurring during the prescribing node:

*Patient was on Coumadin® [warfarin sodium] for atrial fibrillation. The patient missed two days of Coumadin secondary to the medication not being ordered. This was noticed on the day of discharge back to outside facility. Medication ordered for outside facility.*

*Patient did not receive evening dose of warfarin because the INR [international normalized ratio] was not available. Order for warfarin was placed by the physician's assistant, but recent order set change does not prompt nonphysicians to order an INR for warfarin [on the first day of administration]. Previously, this "ONCE" INR was prechecked in the order set.*

At a 658-bed academic hospital with computerized prescriber order entry (CPOE) that lacked electronic medication administration charting, a retrospective manual chart audit compared expected (from CPOE) and actual timing of medication administrations.<sup>13</sup> The analysis showed that the most common event involved dose omissions (12.6%). The authors concluded that while inpatient CPOE orders are legible and can be conveyed electronically to nurses and the pharmacy, unit-based medication administrations do not consistently occur as ordered. As more facilities use CPOE systems to enter drug orders, drug omission events may originate from issues associated with these systems. Of the events in the prescribing phase reported to the Authority (n = 71), nine (12.7%) involved electronic systems and eight (11.3%) involved anticoagulants.

Examples of these events include the following:

*A 60-year-old inpatient was admitted status post right femoral rodding. The patient was ordered Arixtra® [fondaparinux sodium] 7.5 mg [treatment dose], but when the nurse rescheduled the medication, the order date ended and dropped off the active orders. The patient missed doses for two days. On the third day, it was discovered the patient missed two doses, and the Arixtra was reordered.*

*Physician wanted to restart patient's heparin drip at night. He entered the order through CPOE as a nursing communication instead of choosing the heparin drip and picking a start time. Since this order was a nursing communication, pharmacy did not receive any notification to restart the heparin drip. Pharmacy was not aware that there was nursing communication that contained a medication order until nursing contacted pharmacy.*

*An order was entered for warfarin 2 mg po [by mouth] once daily and validated by pharmacy. Because order start time by the physician is after [the prescribed time of administration], the first occurrence for order became [the following day]. The patient missed the dose.*

### RISK REDUCTION STRATEGIES

The drug omission events submitted to the Authority reveal the complex nature and large variety of factors that contribute to drug omissions. While medication omissions are often thought to occur or originate primarily during the administration process, omission errors were identified in all phases of the medication-use process. Unfortunately, most of the PA-PSRS event reports did not explicitly describe the errors nor disclose the causes and contributing factors linked to the errors; however, these

reports, observations from the Institute for Safe Medication Practices (ISMP), and the medical literature suggest strategies that healthcare facilities may consider to decrease the risk of drug omissions.

### Use Healthcare Technology Fully and Properly

Although not always easy to implement, technological innovations can enhance patient safety.<sup>14</sup> Paper transcription omissions may be avoided with CPOE systems that integrate with eMARs and pharmacy computer systems. The need to identify pending orders in a paper chart and then transcribe the order to a paper or eMAR as well as send the order to the pharmacy can be eliminated.

Technology could help to reduce omissions in the following ways:<sup>15</sup>

- A bar-code medication administration (BCMA) system or eMAR could help to detect omissions caused by simple oversights when the drug was administered but administration was not documented or when administration was intentionally held or omitted but neither the omission nor the reason were charted. However, some unexplained omissions are likely to continue even with real-time BCMA and eMAR systems. For example, nurses might fail to give a scheduled dose or chart a reason when they unexpectedly have to attend to a life-threatening emergency for a patient in a room nearby to the index patient.
- BCMA and eMAR systems could reduce some omissions that occur because the nurse is unaware of the order. New orders are readily available in the eMAR, thus eliminating the need to monitor and track down multiple paper charts. However, these systems would not impact errors of omission that occur due to the nurse's urgent duties elsewhere. In addition, BCMA and eMAR systems

typically do not serve as order notification vehicles, so the nurse must actively look elsewhere for new medication orders.

- eMAR technology can help reduce the risk of drug omissions through the use of signals or alerts to remind nursing when a dose is due.

The author also noted that errors due to a wrong or erroneous actual medication order could potentially increase with the implementation of BCMA and eMAR technology.<sup>15</sup> The current lag between ordering and administration (predominantly for “stat” or “now” orders) allows time for corrections when faulty orders are detected, whereas the window for corrections would be greatly reduced with BCMA and eMAR technology replacing the slower manual transcription process.

The use of well-designed standard order sets for high-alert medications, whether electronic or paper formats, have the potential to reduce variation and unintentional oversight through standardized formatting and clear, predictable presentation of orders.<sup>16</sup> For example, order sets that include medications appropriate to the condition and available in a facility's formulary may help to reduce the incidence of missed orders.

However, medication administration discrepancies are likely to persist even after implementing CPOE and other electronic systems unless interventions are made to address workarounds and usability issues. In fact, while historical studies have shown error reduction up to 81%, CPOE systems can also lead to error risk.<sup>17</sup> Therefore, these systems need to be continually examined and enhanced. Many factors such as system, user, organizational, and environmental attributes, as well as level of support from others, can impact successful adoption of technology.<sup>18</sup> Technical design of the system is also important, as staff acceptance and use of technology can be impacted by the technology's usability and usefulness.<sup>19</sup>

### Transcribing and Communicating Orders

ISMP has observed that the following strategies can be used to identify contributing factors of omissions related to the transcribing and communication of orders:

- Ensure that there is a standardized and consistent process in place for reviewing the previous day's MAR and validating whether any new medications have been ordered prior to transcribing information to the new record.
- Standardize the way in which nursing personnel designate a discontinued order and how new orders are added to the MAR or eMAR. If using a paper-based system, provide nurses with the ability to print a new MAR at any high-risk transition point in the patient's stay (e.g., new admission, transfer, postoperative).
- If a paper-based ordering and documentation system is currently in use, convene a group of staff involved in these processes to determine the risk points in identifying when orders are handwritten and need to be further transcribed and communicated, in part to avoid repeated duplication and possible error.
- Establish a process to track and trend any identified MAR omissions. For example, in organizations with pharmacy-generated MARs, nurses on the night shift perform a verification process as soon as the new MARs are delivered to the units. Inform pharmacy of any discrepancies and allow time for pharmacists to review and investigate reported variances, make corrections to the MAR if needed, and communicate changes back to the nursing unit. Reports of MAR discrepancies due to omissions should continue to be collected and used for safety and quality initiatives in order to identify patterns, trends,



causes, and contributing factors, as well as to help create solutions.

- Develop a standardized workflow for pharmacists performing order entry in which they self-check sheets of orders for omissions. Many computer systems include electronic notation capabilities that can be leveraged for this purpose.

#### IV Administration of High-Alert Medications

Developing a consistent process, including standardized policies and procedures, for IV medication setup to support identification of IV lines that are not connected to the patients despite being placed within an infusion pump, IV pumps that are not turned on, and IV tubing that is clamped can help reduce the risk of IV infusion omissions. ISMP suggests that “when using multiple channel pumps, nurses should handle just one IV solution at a time.”<sup>20</sup> Physically tracing the line can help ensure that the correct channel has been used to program the infusions as well as confirm that the IV line has been connected to the patient at the correct

port. The Joint Commission recommends tracing all lines back to their origin before connecting any devices or infusions.<sup>21</sup> In addition, nurses could hang the high-alert solution, prepare it for infusion, and then have another nurse independently validate the original order, the patient’s identification, the dose and concentration, the insertion site (route), and the pump or channel setting before initiating the infusion.<sup>20</sup>

Affixing a label with the name of the drug to each IV line, at the end closest to the patient and above each channel on the pump, may help prevent omissions with infusions and may also help prevent errors if tubing has to be detached from patients during procedures, imaging, or transfers. While this additional labeling alone should not be used to identify the medication, the labels can aid practitioners in line tracing and independent double checks.

#### CONCLUSION

Analysis of drug omission reports involving high-alert medications submitted to

the Authority reveals that these events take place across the continuum of the medication-use process. While the majority of reported events took place during the administration process, omissions can originate in all nodes, even with the use of healthcare technology. Developing more effective technology, using that technology fully and properly, developing a consistent administration process for IV medication setup, tracing IV lines, and standardizing policies and procedures can help to reduce omission errors.

The reports submitted to the Authority reveal the incidence of errors, the severity of errors, and the frequency with which high-alert medications are not administered to the patient. Using this information to raise professional staff awareness of the prevalence of omission errors is likely to be helpful, as a lack of research and data in the field has contributed to low appreciation of this common threat to safety. It is important to note that more research must be done to determine the exact causes of drug omissions and the best risk reduction strategies for drug omission.

#### NOTES

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# PENNSYLVANIA PATIENT SAFETY ADVISORY

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