Prescribing Errors that Cause Harm

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ABSTRACT

Errors that occur in the prescribing phase of the medication use process are less likely to reach the patient and cause harm because of the opportunity to intercept the error in the phases of transcribing, dispensing, administering, and monitoring. However, some prescribing errors make their way through the entire medication use process, reach the patient, and cause harm. A query of the Pennsylvania Patient Safety Reporting System (PA-PSRS) database revealed 811 Serious Events (harm score E through I) associated with reported prescribing errors that occurred from July 2004 through June 2016. Nearly 5% (4.7%, n = 38) of these errors required intervention to sustain life or contributed to or resulted in the patient's death. The most common types of events reported were wrong dose/overdosage (32.2%, n = 261), monitoring error/documented allergy (14.5%, n = 118), dose omission (14.3%, n = 116), and wrong patient (4.4%, n = 36). Recommended system-based risk reduction strategies include optimizing computerized prescriber order entry with clinical decision support to facilitate screening for drug-related problems; and developing well-designed standard order sets; (Pa Patient Saf Advis 2016 Sep;13[3]:81-91.)

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INTRODUCTION

Studies have found that a large number of medication errors originate in the prescribing phase of the medication use process.[1,2] Bates et al. found that 56% of preventable events originated in the prescribing stage,[1] while Leape and colleagues found that drug-drug interactions, failure to act on a test, wrong choice, and wrong dose errors occurred most frequently in the prescribing stage.[2] Reported rates of prescribing errors range from 3.13 to 62.4 errors per 1,000 medication orders.[3-5] However, a prescribing error is less likely to reach the patient and cause harm than errors that occur in subsequent phases of the medication use process, because there are more opportunities to intercept the error in the transcribing, dispensing, administering, and monitoring phases. Despite this, some prescribing errors make their way through the entire medication use process, reach the patient, and cause harm.

Historically, many medication prescribing errors have been associated with illegible handwriting, the use of error-prone abbreviations, incomplete orders, and incorrectly transcribed verbal orders. A 2004 study by Bobb et al. found that the most common medication error types for clinically significant prescribing errors were wrong dose (39.2%), wrong frequency (20.2%), nomenclature (9.4%), drug allergy (6.4%), wrong medication (6.4%), medication duplication (5.5%), and omission (4.7%). The most common drug classes for these prescribing errors were anti-infectives, cardiovascular agents, and opioids; and nearly two-thirds of the errors occurred upon hospital admission.[3]

Pennsylvania Patient Safety Authority analysts conducted an analysis of Serious Events associated with reported medication prescribing errors; that is, those that reached the patient and caused harm. Analysts sought to characterize contributing factors and identify appropriate system-based risk reduction strategies.

METHODS

Analysts queried the Pennsylvania Patient Safety Reporting System (PA-PSRS) database for Serious Events resulting from medication errors, harm score E through I as adapted from the National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP),[6] associated with the prescribing phase, that occurred from July 2004 through June 2016. This query yielded 837 event reports. Twenty-six reports (3.1%) were excluded from final analysis because the error likely did not originate with the prescribing phase (e.g., an error occurred because the infusion pump for an appropriately prescribed medication was programmed incorrectly at the point of administration). A total of 811 event reports remained for final analysis.

The medication name, patient care area, event type, event description, phase(s) of the medication use process, and harm score, adapted from the NCC MERP harm index,[6] were provided by the reporting facility. In reports in which a medication name data field was left blank or incomplete but the name was provided in the event description, an analyst adjusted the medication name field appropriately. Reports were categorized into type of prescribing error, drug class(es) involved, and order type (e.g., handwritten, verbal, computerized prescriber order entry [CPOE]). Reports of unsafe orders that were given verbally and then transcribed into an electronic order entry system by another practitioner were coded as verbal orders, when that distinction was possible.

Error reports were further evaluated to identify contributing factors and were assessed for the likelihood that the error could be intercepted by CPOE and clinical decision support (CDS) with basic functionality. Classification of the likelihood that errors

could be intercepted by CPOE and CDS and possibly prevented was adapted from previously published categories.[3,7] Prescribing errors related to illegible handwriting, incomplete orders, drug-allergy interactions, and wrong dose formulation were categorized as *likely* to be intercepted by CPOE and CDS, as described by Bobb et al.[3]

RESULTS

Results were categorized by harm score; the majority (67.7%, n = 549 of 811) of the Serious Events were reported as an error that occurred that may have contributed to or resulted in temporary harm to the patient and required intervention (harm score = E). Nearly 5% (n = 38) either required intervention necessary to sustain life (e.g., cardiovascular and respiratory support [harm score= H]) or contributed to or resulted in the patient's death (harm score = I; see Figure 1).

Nearly 40% (n = 319) of the events involved opioids, anticoagulants, and insulin—high-alert medications that pose an increased risk of patient harm when involved in medication errors.[8] Figure 2 shows the five most common drug classes involved in the reported events.

Four event types accounted for 65.5% (n = 531) of submitted prescribing error reports (see Figure 3).

Nearly one-quarter (21.5%, n = 174) of the serious prescribing errors in the present analysis were judged as *likely* to be intercepted and therefore possibly preventable if CPOE with CDS were used. Errors associated with the following event types and contributing factors were judged as *likely* to be intercepted: drug/allergy interactions (14.5%, n = 118), illegible handwriting (3.8%, n = 31), incomplete orders (2.2%, n = 18), and wrong dose formulation (0.9%, n = 7). See Table for examples of prescribing errors rated as *likely*, *possibly*, or *unlikely* to be intercepted by CPOE with CDS.

Figure 1. Harm Scores for Serious Events Associated with Prescribing Errors, as Reported to the Pennsylvania Patient Safety Authority, July 2004 through June 2016 (N = 811)

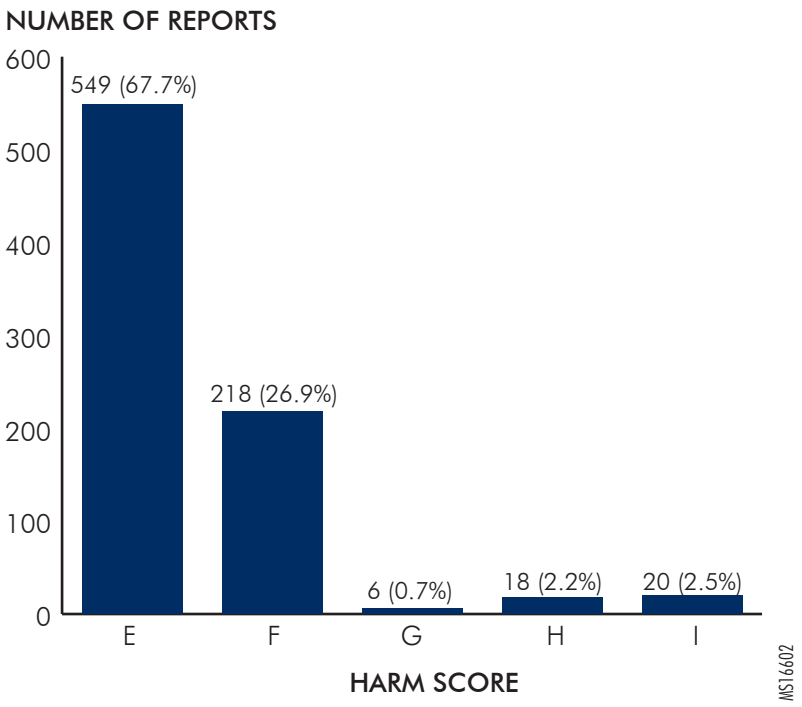
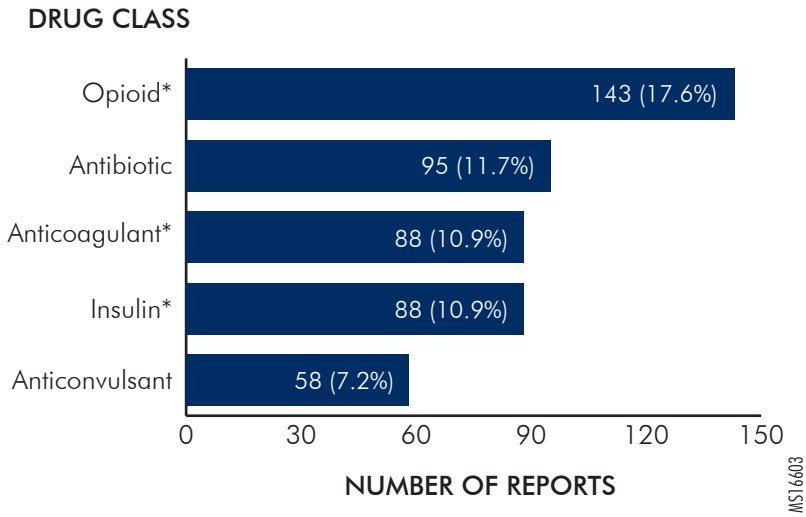


Figure 2. Most Common Drug Classes Involved in Serious Events Associated with Prescribing Errors, as Reported to the Pennsylvania Patient Safety Authority, July 2004 through June 2016 (N = 811)



* High-alert medication

Figure 3. Event Types Involving Serious Events Associated with Prescribing Errors, as Reported to the Pennsylvania Patient Safety Authority, July 2004 through June 2016 (N = 811)

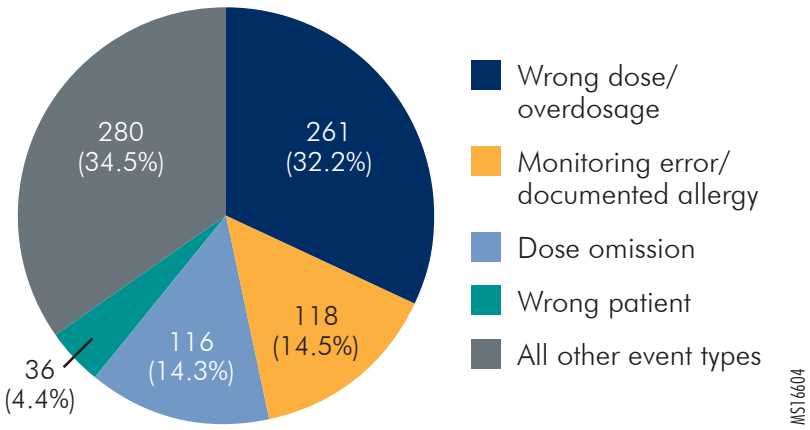
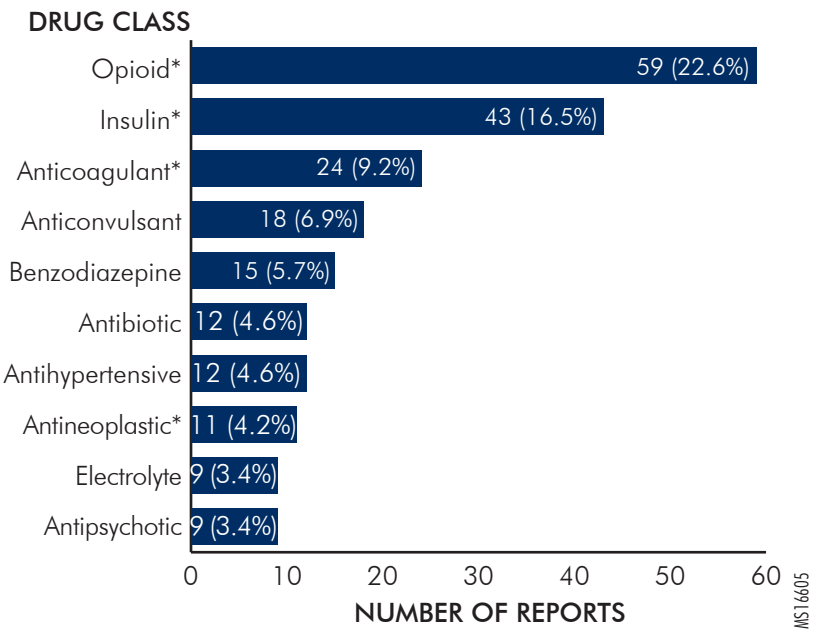


Figure 4. Most Common Drug Classes Involved in Serious Wrong Dose/ Overdosage Events Associated with Prescribing Errors, as Reported to the Pennsylvania Patient Safety Authority, July 2004 through June 2016 (n = 261)



* High-alert medication

Wrong Dose/Overdosage Errors

Nearly one-third (32.2%, n = 261 of 811) of the Serious Events were categorized by facilities as wrong dose/overdosage events. Of these reports, 22.6% (n = 59 of 261) involved opioids, 16.5% (n = 43) involved insulin, and 9.2% (n = 24) involved anticoagulants (see Figure 4).

Naloxone, a reversal agent for opioids, was administered in 71.2% (n = 42 of 59) of the reported wrong dose/ overdosage errors involving opioids. HYDROmorphone was the medication most frequently involved (52.5%; n = 31 of 59) in reported opioid wrong dose/ overdosage errors, and of these, 61.3% (n = 19 of 31) involved an intravenous (IV) HYDROmorphone dose of 1 mg or more and 41.9% (n = 13 of 31) involved an IV HYDROmorphone dose of 2 mg or more. An IV HYDROmorphone dose of 1 mg is equivalent to approximately 7.5 mg of IV morphine and is the current maximum starting dose for an opioid-naïve patient.

Similarly, rescue agents used to treat hypoglycemia (e.g., dextrose, glucagon) were administered in 72.1% (n = 31 of 43) of the wrong dose/overdosage errors involving insulin. Nearly one-fourth (23.3%, n = 10 of 43) of the reported wrong dose/overdosage errors involving insulin resulted in a 10-fold overdose. Illegible handwriting, the use of error-prone abbreviations (e.g., "u" for units) and trailing zeros, and confusing the product concentration (i.e., 100 units/mL) with the dose were identified as contributing factors linked to insulin overdosage errors.

Half (50.0%, n = 12 of 24) of the wrong dose/overdosage events involving anticoagulants mentioned the use of a reversal or rescue agent (e.g., vitamin K, protamine). Notable factors that contributed to anticoagulant overdosages included prescribing the treatment dose instead of the prophylaxis dose, wrong patient weight

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Table. Examples of Prescribing Errors and Likelihood of Being Intercepted by Current Versions of Computerized Prescriber Order Entry (CPOE) Systems with Clinical Decision Support (CDS)

CLASSIFICATION	EXAMPLE*	TYPE OF EVENT	POSSIBLE CONTRIBUTING FACTOR(S)
Likely to be intercepted with CPOE and CDS	ED [emergency department] physician wrote for .5 mg Dilaudid® [HYDROmorphone] IV. Handwriting looked like 5 mg. Due to patient's size and severity of pain, ED nurse did not question order which she read as 5 mg. The patient arrested and was resuscitated and placed on a ventilator. The patient did not regain consciousness and expired.	Wrong dose/ overdosage	Illegible handwriting
	Physician ordered Imitrex® [sumatriptan] 6 mg. No route or frequency documented. New graduate nurse gave Imitrex 6 mg IV. Patient experienced feeling of "being on fire," elevated heart rate and diaphoresis.	Wrong route	Incomplete order
	Patient with atrial fibrillation was ordered verapamil 360 mg po. It was given as immediate release. Patient became hypotensive necessitating transfer to the ICU [intensive care unit].	Wrong dosage form	Nomenclature issue—drug name suffix/modifier
Possibly intercepted with CPOE and CDS	Patient taking Effient® [prasugrel]. Post-catheterization orders started Plavix® [clopidogrel]. Both medications given and patient developed thrombocytopenia.	Duplicate therapy	Breakdown in medication reconciliation No active screening for duplicate therapy
	Female patient seen in the ED for cellulitis of the wrist and was prescribed Bactrim™ DS [sulfamethoxazole and trimethoprim] with a SCr [serum creatinine] of 4.2 mg/dL. The drug should have been contraindicated based on the patient's renal insufficiency.	Contraindicated drug	No active screening of drug order against laboratory values
	Patient admitted on Lexapro® [escitalopram] for depression. During hospitalization, physician ordered Zyvox® [linezolid] 600 mg every 12 hours. The drug interaction was not identified and the patient developed signs of serotonin syndrome.	Drug-drug interaction	No active screening for drug-drug interactions Ability to bypass alert level of major/highest severity
Unlikely to be intercepted with CPOE and CDS	Physician was computer charting on one patient and switched to print-on-demand order sheet which pulled the wrong patient name to order sheet. Methadone 50 mg was ordered on the wrong patient. Cardiac catheterization was delayed 24 hours.	Wrong patient	Multiple patient electronic records open at the same time Technology malfunction
	Patient's medication list from home states she takes HumaLOG® 75/25 Mix™ [insulin lispro protamine and insulin lispro (rDNA origin)], 60 units in the evening and 75 units in the morning. Physician inadvertently ordered HumaLOG [insulin lispro (rDNA origin)]—not 75/25 mix resulting in symptomatic hypoglycemic requiring D50 [dextrose 50%] IV.	Wrong drug	Breakdown in medication reconciliation Nomenclature issue—drug name modifier
	Patient admitted for I&D [incision and drainage] of shoulder joint. Patient was not written for pre-op or post-op antibiotics.	Dose omission	Slip or memory lapse

* The details of the Pennsylvania Patient Safety Reporting System event narratives in this article have been modified to preserve confidentiality.

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used to calculate dose, and inappropriate dose based on patients' laboratory studies.

Following are examples of reported errors that resulted in wrong dose/overdosage:*

> *Patient transferred to another facility for shortness of breath. Patient was on Lantus® [insulin glargine] insulin. When physician was reviewing the [previous] medication orders, the Lantus order read Lantus 100 units/mL vial inject 16 units subcutaneously at bedtime. Physician misinterpreted this order to mean Lantus 100 units subcutaneously at bedtime and ordered it as such. The patient's blood sugar was 83 at 2100 on [day 1], so this dose was not given and it was subsequently decreased to 80 units. The patient did receive the 80 units on [day] 2 and the blood sugar dropped to 55 on [day 3]. The Lantus dose was decreased again to 40 units on [day 4] and was administered at bedtime. At 0600 on [day 5] the patient had a respiratory arrest and patient's blood sugar was 9. The patient was intubated, transferred to ICU [intensive care unit], and placed on a ventilator.*

> *The patient was admitted to the ICU with sepsis and UTI [urinary tract infection]. The patient was on methotrexate as an outpatient [but] the methotrexate was held during the ICU stay. The patient was later transferred to the telemetry unit. [On the eighth day of the admission], the physician wrote for methotrexate 10 mg daily. The pharmacist entered the dose and the patient received 7-days worth of the drug before the error was caught. The records from the rehabilitation facility where the patient came from were scanned over and they showed that the patient was taking 5 mg on Sundays and 5 mg on Mondays (a total of 10 mg weekly).*

> *The patient experienced stomatitis, pancytopenia, was intubated and transferred to the ICU. The patient coded and expired.*

Monitoring Error/Documented Allergy

Errors related to documented allergies accounted for 14.5% (n = 118 of 811) of reports. The medication classes most commonly involved in documented allergy events included antibiotics (40.7%, n = 48 of 118), opioids (22.0%, n = 26), and nonsteroidal anti-inflammatory drugs (NSAIDs; 8.5%, n = 10). Similar to findings published in a 2008 *Pennsylvania Patient Safety Advisory*[9], morphine topped the list of medications involved in documented allergy events (9.3%, n = 11). Other commonly involved medications include ketorolac (6.8%, n = 8), levoFLOXacin (5.9%, n = 7), vancomycin (5.1%, n = 6), and ceFAZolin (4.2%, n = 5). The emergency department (ED) was the care area most frequently cited (26.3%, n = 31) in documented allergy events. Following are examples of reported prescribing errors that resulted in patients receiving a medication for which they had a documented allergy:

> *Patient listed allergy [reaction] to vitamin K as paralysis. The physician felt this was not a true allergy and ordered vitamin K to be administered prior to a surgical procedure (INR [international normalized ratio] 2.1). Patient suffered anaphylactic reaction, required intubation, pressor support, and was transferred to ICU.*

> *A patient [admitted] to the ED for worsening cellulitis was evaluated by the ED physician and given IV vancomycin. The patient was admitted for IV antibiotic treatment by teaching service and ordered cefepime 1 g IV, first dose now. An ED nurse initiated this order prior to transfer to the inpatient unit. Cefepime started. [Five minutes later], the patient [developed] respiratory distress, wheezing, and difficulty swallowing. IV [infusion] stopped. ED physician [came] to the room and initiated treatment for anaphylaxis including IV Solu-Medrol® [methylPREDNISolone sodium succinate], IV Pepcid® [famotidine], and subcutaneous EPINEPHrine. The patient was placed on BiPap [bilevel positive airway pressure] and symptoms/respiratory status improved. The ED physician called the teaching service residents and made them aware of the reaction. The patient was admitted to the ICU for close monitoring of airway secondary to anaphylaxis. Home medication list provided to the ED by the patient includes allergy to Ceftin® [cefuroxime].*

Dose Omission Errors

The third most common event type reported was dose omissions (14.3%, n = 116 of 811), which occurred when a medication was not ordered or reordered despite being appropriate for the patient's underlying condition. Harm related to dose omission was most commonly reported with anticoagulants (18.1%, n = 21 of 116), anticonvulsants (17.2%, n = 20), antibiotics (12.9%, n = 15), and insulin (10.3%, n = 12). Dose omissions can occur at any high-risk transition point in the patient's admission (e.g., new admission, transfer). Nearly 30% (27.6%, n = 32) of the dose omissions occurred when the patient's maintenance medication was omitted upon admission, 14.7% (n = 17) occurred when a medication was omitted upon discharge, and 10.3% (n = 12) occurred postoperatively. Nearly 13% (12.9%, n = 15) of the dose omissions were caused when the provider failed to reorder a medication that had automatically stopped. Following are examples of reported dose omission errors:

> *The patient had cardiac cath [catheterization] with insertion of drug eluting stents. On day one post-procedure, the attending physician*

* The details of the PA-PSRS event narratives in this article have been modified to preserve confidentiality.

told the physician assistant that the patient was ready to go home and to resume home medications. The physician assistant entered DCI [discharge instructions]/medication reconciliation and indicated that all home medications were to be resumed but deleted all in-house medications. Patient was discharged without orders or prescriptions for aspirin or Plavix® [clopidogrel]. The patient was seen in physician's office [about a week later] with complaints of not feeling well and having feelings of warmth and cold. EKG [electrocardiogram] indicated a myocardial infarction with ST elevation. Repeat cardiac cath [catheterization] identified occlusion of LAD [left anterior descending coronary artery].

A patient post CABG [coronary artery bypass grafting] with sternal wound infection underwent sternectomy and placed on long term ceFAZolin. The patient developed recurrent MSSA [methicillin-susceptible Staphylococcus aureus*] bacteremia/sepsis, and it was discovered that antibiotics expired without knowledge of the physician. The patient missed 3 doses/day for 10 days. Pharmacy policy automatically discontinues antibiotics after 10 days unless order specifies otherwise.*

Wrong Patient Errors

The fourth most common (4.4%, n = 36 of 811) type of reported prescribing errors were wrong patient errors. The majority (55.6%, n = 20 of 36) of these reports did not provide enough information to ascertain the type of order (e.g., verbal, handwritten, CPOE). Of the remaining reports, 75% (n = 12 of 16) of the orders were placed via CPOE, 18.8% (n = 3) were handwritten, and 6.3% (n = 1) were communicated verbally. Following are examples of reported wrong patient errors:

The patient became somnolent. Narcan® [naloxone] administered twice. The patient was intubated to protect airway. Admitted to the ICU which was initial plan for the patient anyway. The physician placed an order for HYDROmorphone via CPOE on wrong patient's record. This medication was to be entered for another patient.

Resident entered order into order entry system on wrong patient. The medication [rocuronium bromide] was prepared, dispensed, and given to the patient.

DISCUSSION

The use of technology to prevent and detect medication errors has been increasing over the past decade. CPOE systems with CDS designed to assist prescribers with therapeutic decisions have been promoted for their ability to reduce serious medication errors by more than 50%.[10,11] A 2013 survey showed that nearly 80% of US hospitals used a CPOE system, a 58.6% increase from 2007.[12,13] Of the hospitals with CPOE, 61.4% reported concurrent CDS use.[12] CPOE could avert many of the contributing factors that lead to prescribing errors, including poorly handwritten prescriptions, improper terminology, ambiguous orders, and omitted information. A study conducted by Bobb and colleagues assessed the potential impact of CPOE and found that 64.4% of prescribing errors were likely to be prevented with CPOE, including 43% of the potentially harmful errors.[3] In the present analysis, CPOE with properly implemented and optimized CDS would *likely* be able to intercept and possibly prevent the drug-allergy interaction errors and *possibly* intercept and prevent the wrong dose/overdosage errors.

CPOE and electronic health record (EHR) systems currently in place in healthcare facilities are probably unable to catch and prevent errors of omission occurring during the prescribing phase. Automated stopping (auto-stop) values, which are used to help safeguard patients against unnecessary and prolonged drug therapy, can also lead to unintended discontinuation and dose omissions if the prescriber fails to modify the default duration of therapy within the electronic order.[14,15] The risk of placing orders in the wrong patient record exists in electronic systems as it does in paper-based systems. In fact, an increased risk of placing orders on the wrong patient may be one unintended consequence of CPOE. A 2013 analysis of PA-PSRS data found that the predominant type of wrong-patient prescribing errors involved a prescriber ordering a medication on the wrong chart.[16] According to a study conducted by Adelman et al., about 14 wrong patient electronic orders were placed every day in a large hospital system. These errors are sometimes due to juxtaposition, whereby the wrong patient may be selected from a list of names, but are more often caused by interruptions and having more than one patient's electronic record open.[17] Wrong drug or strength selection from a dropdown menu or picklist is another failure mode that may be introduced with CPOE. An analysis of electronic prescribing systems in two hospitals found that incorrect selection errors from a drop-down menu were the most frequent mechanism of CPOE system-related medication errors.[18]

CDS systems provide various forms and levels of alerts to indicate possible issues with medication orders. However, when these alerts are not analyzed and prioritized, the excessive number of alerts displayed may lead to alert fatigue or may prompt hospitals to turn off alerts, or a subset of alerts, altogether. Alert fatigue may cause prescribers to override many of the safety features afforded by CPOE and CDS, including alerts of high severity when they are buried among irrelevant or less significant alerts. A 2015 study of PA-PSRS data found that CPOE was the second most common technology involved in medication error event reports related to overrides.[19]

Understanding vulnerabilities in CPOE and CDS systems is key to developing effective preventive measures. A 2010 analysis of 62 US hospitals' CPOE systems found that nearly 50% of prescribing errors that would result in patient fatality were unable to be detected.[20] More recently, researchers tested the vulnerability of thirteen CPOE systems to erroneous medication orders and found that nearly 80% of the unsafe orders could be placed. Over half of the orders were easily entered or entered with minor workarounds and only 26.6% of the unsafe orders generated warnings.[21] Evidence of high rates of adverse drug events in a highly computerized hospital further illustrates the need to ensure that electronic systems are operating efficiently before replacing manual safety checks.[22] To ensure CPOE systems are performing well and as expected, it is important for organizations to regularly monitor, test, and enhance these systems. The *Computerized Prescriber Order Entry (CPOE) System Evaluation Toolkit* was developed as a supplement to this *Advisory* to help organizations test their CPOE and CDS systems, to better understand their ability to detect unsafe orders and their management of high severity alerts. The Toolkit is available http://patientsafetyauthority.org/EducationalTools/PatientSafetyTools/Pages/home.aspx.

Limitations

In-depth analysis by the Authority of Serious Events resulting from medication prescribing errors is limited by the information reported through PA-PSRS, including the event descriptions. As with all reporting systems, the type and number of reports collected depend on the degree to which facility reporting is accurate and complete. Information about underlying patient conditions, which may have impacted dose calculations for individual patients, such as opioid tolerance, was not consistently available. Information regarding the adoption and use of CPOE and CDS by the reporting facilities was also not available.

RISK REDUCTION STRATEGIES

While prescribing errors may be intercepted during subsequent phases of the medication use process, these errors can reach patients and cause serious harm, including death. It is important that stakeholders, including healthcare organizations and health information technology vendors, continue to develop, implement, and refine CPOE and CDS systems to better support prescribers and make it easier to select the correct action. Consider the strategies described below, which are based on a review of current literature, events reported to the Authority, and observations from the Institute for Safe Medication Practices (ISMP).

Patient Information

- Ensure that current and complete allergy information, including descriptions of the reactions, is readily available to all prescribers when they are ordering medications.[9]
- Establish a forcing function to make the allergy, as well as a description of the reaction to the allergen, mandatory entries into the organization's CPOE system.[9]
- Encourage prescribers to verify the patient's identity using two identifiers when prescribing drug therapy.[23]
- Standardize the baseline patient information, including weight in kilograms and laboratory values (e.g., serum creatinine), needed to order medications that require adjustment based upon patient characteristics (e.g., anticoagulants), and have a standard process in place to update this information in the EHR.[24]
- Implement functionality to improve the capture and accuracy of all comorbid conditions in a structured diagnosis/problem list field in the patient's EHR, and to link this information to the order entry system, to promote appropriate screening when new drugs are prescribed.[25]

Drug Information

- Develop an expedited admission reconciliation process for specific high-alert medications such as insulin, anti-arrhythmic agents, and other medications that may need to be given to a patient before the generally-accepted, 24-hour medication reconciliation time limit.[26]
- Each time a patient moves from one care setting to another, review previous medication orders alongside new orders and plans for care, and resolve any discrepancies.[27]
- Establish and enforce institutional, therapy-specific dose limits. Such limits could include the maximum amount for a single dose, cumulative dose for a 24-hour period, and for each component of a combination product.[28]
- If your organization has an automatic stop policy, evaluate your organization's list of drugs and the associated indications governed by this policy to determine whether a valid need exists for the drugs to remain on the list. [14]

Communication of Drug Information

- Limit the use of verbal orders to emergency situations.[16]
- Encourage prescribers to avoid using error-prone abbreviations (e.g., "u" for units) in all written and electronic communication.[29]

Standardization

- Use carefully developed standard order sets to minimize incorrect or incomplete prescribing, standardize patient care, and ensure clarity when communicating medication orders.[30]
- In order sets that include opioid drugs, guide prescribers to an appropriate opioid dose based on patient age and opioid tolerance by providing default doses for three types

of patients: (1) most patients, (2) patients older than 64 years or with sleep apnea, and (3) opioid-tolerant patients.[31]

Environmental Factors

- Consider designing CPOE systems to allow prescribers to select the patient name from a list of patients assigned to him/her instead of a much larger list of patients.[23]
- Limit distractions during critical tasks such as medication selection.[32]
- Enhance the font size and readability of patient names on EHR screens.[23]

Staff Competency and Education

- Provide prescribers with education on medication allergies. Educational efforts need to focus on screening patients for potential allergic or other adverse reactions, recognizing an allergic reaction, and treating serious reactions.[9]
- After CPOE and CDS implementation, prioritize the most critical elements to plan for annual or semi-annual retraining and competency verification.[33]
- Assess staff competency related to the safe use of CPOE, CDS, and overrides, and provide education when indicated.[19]

Quality Processes and Risk Management

- Consider using the *Computerized Prescriber Order Entry (CPOE) System Evaluation Toolkit*, available at http://patientsafetyauthority.org/EducationalTools/PatientSafetyTools/Pages/home.aspx, to test the facility's CPOE system to see whether potentially fatal errors—such as an order for daily oral methotrexate—are detected.
- Encourage prescribers to report CPOE-related errors including incorrect or incomplete CDS information and develop a standard process to make timely safety and quality enhancements.
- Measure the use of trigger drugs used to reverse the effects of medication overdoses (e.g., naloxone, vitamin K, glucagon, dextrose 50%) to increase detection of preventable adverse drug events (ADEs) that may have been caused by medication errors.[34] (Visit the Authority's website at http://patientsafetyauthority.org/EducationalTools/PatientSafetyTools/opioids/Pages/ADEWorksheet.aspx to view or download a sample tool that can be used to identify and monitor actual or potential problems with the use of insulin, opioids, and anticoagulants.)
- Measure the use of trigger drugs used to treat allergic reactions (e.g., diphenhyDRAMINE, methylPREDNISolone, EPINEPHrine) to increase detection of preventable ADEs and determine whether there are other instances of patients with documented allergies erroneously receiving medications.[9]
- Improve the positive predictive value of alerts (e.g., the number of true positive alerts compared with all positive alerts), and adjust the presentation of the alerts (e.g., interruptive versus noninterruptive) according to the level of severity.[19]
- Develop a mechanism to identify and remove alerts that provide little or no clinical value, which may contribute to alert fatigue.[19]
- Examine the systems in place for notifying prescribers about automatic stop orders, the timing of the notification, and the process for review.[14]

CONCLUSION

Of the serious prescribing errors reported to the Authority since the inception of the program in 2004, the most common error types reported were: wrong dose/overdosage, prescribing a medication to which a patient has a documented allergy, dose omission, and prescribing a medication for the wrong patient. Well designed and implemented CPOE and CDS systems are *likely* to intercept and possibly prevent nearly one-quarter of these errors; however, evidence shows that poorly designed and implemented CPOE and CDS systems may introduce other types of errors. Opportunities exist for increasing the benefits that can be realized by CPOE with CDS. However, prescribing is just one phase of the medication use process. Implementing layers of risk-reduction strategies across all phases of the medication use process may help prevent prescribing errors from reaching the patient.

NOTES

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LEARNING OBJECTIVES

- Identify the most common prescribing error event types associated with Serious Events, as reported to the Pennsylvania Patient Safety Authority.
- Predict what types of prescribing errors are likely, possible, and unlikely to be intercepted by computerized prescriber order entry (CPOE) with clinical decision support (CDS).
- Identify and assess risk reduction strategies that can be implemented to help prevent prescribing errors.

SELF-ASSESSMENT QUESTIONS

1. Which of the following prescribing error event types was most frequently reported to the Authority as a Serious Event?
   a. Wrong patient
   b. Wrong rate (IV)
   c. Wrong duration
   d. Wrong dose/overdosage
   e. Wrong dose/under dosage
2. Which of the following type of event or contributing factor is NOT likely to be prevented or intercepted by CPOE with properly implemented and optimized CDS?
   a. Incomplete orders
   b. Illegible handwriting
   c. Drug-allergy interaction
   d. Wrong dose formulation
   e. Adverse drug reaction
3. Which of the following prescribing errors is NOT likely to be intercepted by CPOE with properly implemented and optimized CDS?
   a. An emergency department physician ordered .5 mg HYDROmorphone IV; however, the handwritten order looked like 5 mg.
   b. A physician ordered sumatriptan 6 mg but did not include route or frequency. A new graduate nurse gave sumatriptan 6 mg IV.
   c. A physician was documenting care in one patient's electronic medical record. The physician then switched to print-on-demand order sheet, which pulled the wrong patient name to order sheet. Methadone 50 mg was ordered on the wrong patient.
   d. Verapamil 360 mg daily by mouth was ordered for a patient with atrial fibrillation. The pharmacy dispensed the immediate-release formulation, which was administered to the patient.
   e. A patient was taking prasugrel. The post-catheterization orders stated to administer clopidogrel. Both medications were given and the patient developed thrombocytopenia.
4. Which of the following is NOT a quality improvement strategy that can be used to optimize CDS for CPOE?
   a. Improve the positive predictive value of alerts, and adjust their presentation so interruptive alerts fire for alerts of low severity.
   b. After CPOE and CDS implementation, prioritize the most critical information about CPOE and CDS to plan for annual or semiannual retraining and competency verification.
   c. Develop a mechanism to identify and remove alerts that provide little or no clinical value.
   d. Provide a mechanism to enable prescribers to report CPOE-related errors including incorrect or incomplete CDS information, and develop a standard process to make timely safety and quality enhancements.
   e. Assess staff competency related to the safe use of CPOE, CDS, and overrides, and provide education when indicated.

SELF-ASSESSMENT QUESTIONS (CONTINUED)

Question 5 refers to the following case:

> *The patient was admitted to the intensive care unit (ICU) with sepsis and a urinary tract infection. The patient was on methotrexate as an outpatient but the methotrexate was held during the ICU stay. The patient was later transferred to the telemetry unit. On the eighth day of the admission, the physician wrote for methotrexate 10 mg daily. The pharmacist entered the dose and the patient received 7 days' worth of the drug before the error was caught. The records from the rehabilitation facility where the patient came from were scanned over and they showed that the patient was taking methotrexate 5 mg on Sunday and methotrexate 5 mg on Monday for a total of 10 mg weekly. The patient experienced stomatitis, pancytopenia, was intubated and transferred to the ICU. The patient coded and expired.*

5. Which of the following risk-reduction strategies would NOT help prevent this prescribing error?
   a. Proactive testing of the facility's CPOE system to see whether potentially fatal errors (e.g., an order for daily oral methotrexate for non-oncologic indications) are detected.
   b. Implement functionality to improve the capture and accuracy of all comorbid conditions in a structured diagnosis/problem list field in the electronic health record, and link this information to the order entry system, to promote appropriate screening when new drugs are prescribed.
   c. Establish and enforce institutional, therapy-specific dose limits.
   d. Review previous medication orders alongside new orders and plans for care, and resolve any discrepancies each time a patient moves from one care setting to another.
   e. Measure the facility's use of trigger drugs (e.g., naloxone, vitamin K, glucagon, dextrose 50%) to reverse the effects of medication overdoses to increase detection of adverse drug events that may have been caused by preventable medication errors, and track performance over time.

PENNSYLVANIA PATIENT SAFETY ADVISORY

THE PENNSYLVANIA PATIENT SAFETY AUTHORITY AND ITS CONTRACTORS

PATIENT SAFETY AUTHORITY
An Independent Agency of the Commonwealth of Pennsylvania

The Pennsylvania Patient Safety Authority is an independent state agency created by Act 13 of 2002, the Medical Care Availability and Reduction of Error (Mcare) Act. Consistent with Act 13, ECRI Institute, as contractor for the Authority, is issuing this publication to advise medical facilities of immediate changes that can be instituted to reduce Serious Events and Incidents. For more information about the Pennsylvania Patient Safety Authority, see the Authority's website at http://www.patientsafetyauthority.org.

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