

Analysis of allergy alerts within a computerized prescriber-order-entry system

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Computerized prescriber order entry (CPOE) has been identified as one method of improving medication safety.^{1,2} CPOE design is intended to reduce medication errors by streamlining the prescribing process and allowing for consistent methods of documentation.^{2,3} Such programs can also improve communication and provide advanced clinical decision support and other reminders to aid prescribers.³ By examining data from MEDMARX, a national voluntary medication-error reporting program, a group of investigators found fewer inpatient errors in hospitals with CPOE.⁴ While this finding did not reach statistical significance, the number of errors that reached the patient ($p < 0.01$) or resulted in harm ($p < 0.01$) was lower in CPOE-implemented hospitals.

Although the CPOE process has demonstrated benefits on medication safety, studies have also documented potential problems with alerts intended to aid in prescribing.^{3,5-15} A retrospective evaluation describing adverse drug event (ADE) rates within a Veterans Affairs hospital with CPOE found an occurrence of 52 ADEs per 100 admissions.⁵ Of

Purpose. Allergy alerts within a computerized prescriber-order-entry (CPOE) system were analyzed.

Methods. A retrospective analysis was performed to evaluate inpatient CPOE orders that triggered an allergy alert for one month in November 2007. Data were extracted from a computer-generated report to identify the total number of prescription orders and the number of orders triggering an allergy alert during the study time frame. When overriding an allergy alert from the CPOE system, prescribers had to choose one of three rationales: the benefit outweighs the risk, the patient previously tolerated the medication, and the medication is therapeutically appropriate. Data collected included the number of allergy alerts, allergy alert overrides, override rationale, and patients' demographic information. Descriptive statistics were used to summarize the results.

Results. Allergy alerts were triggered on 643 (1.3%) of the 49,887 total orders

entered during the month (95% confidence interval [CI], 1.2–1.4%). Alerts were triggered on a total of 289 patients, with a mean of 2 orders triggering alerts per patient. The median age was 65 years old. The median hospital stay for patients with an order triggering an alert was three days. Overall, 625 of 643 alerts (97%) were overridden for rationales as following: the patient previously tolerated the medication (49%), the benefit outweighed the risk (29%), and the medication was therapeutically appropriate (24%), and a free text explanation (8%).

Conclusion. While a small portion of prescription orders generated through a CPOE system triggered an allergy alert, most of the allergy alerts were overridden by prescribers.

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the total ADEs identified, 9% caused serious harm and 22% required additional monitoring or interventions. A meta-analysis of 17 CPOE-related studies found that prescribers overrode 46–96% of drug safety alerts.⁶ Another study that focused on

problems within the CPOE-ordering process reported that allergy warnings may be ignored secondary to the possibility of inaccuracies in patient allergy profiles and alert fatigue from scrolling through multiple screens.⁷ In a study evaluating 7761 CPOE

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allergy alerts, 6182 (79.7%) of those examined were overridden.⁸ The investigators generally found those overrides to be clinically justified. However, these investigators also noted that allergy documentation varied among patients. A subgroup analysis of this study also found that ADEs occurred among 6% of the overridden prescription orders (19 of 320). In a survey regarding pharmacists' perceptions of CPOE, a median level of satisfaction was found among pharmacists with CPOE in their institutions. Survey comments indicated that an assessment of CPOE is necessary following implementation to ensure optimal medication safety because of frequently encountered system challenges.¹⁶

Initial results from a study conducted at our institution (Mayo Clinic/St. Luke's Hospital, Jacksonville, FL) showed an overall reduction of 5.47 per 1000 orders ($p < 0.001$) in prescribing errors following the implementation of CPOE. One notable exception was that the number of allergy contraindication errors increased after CPOE introduction from 2% to 4%. Although the increase was not statistically significant ($p = 0.46$), this was an unexpected result and indicated a need for further investigation of allergy alerts within the CPOE system.¹⁷

The purpose of the current study was to evaluate allergy alerts built within the CPOE system and then use the results to target areas for improvement in order to reduce preventable adverse events secondary to known allergies.

Methods

This retrospective analysis examined one month (November 2007) of inpatient CPOE orders that triggered an allergy alert and were entered by Mayo Clinic practitioners at St. Luke's Hospital (a 314-bed academic hospital) in Jacksonville, Florida. The institution used PowerChart, (Cerner Corporation, Kansas City,

MO), a provider-centered ordering and clinical documentation application with an integrated electronic medical record (EMR) and data repository. PowerChart was linked with the Millennium Pharmnet (Cerner Corporation) inpatient application, an automated clinical pharmacy system.

Allergy documentation was generally recorded upon admission within the patient's EMR. Alerts were generated from an electronic screening of the ordered medication against the patient's allergy profile. When an allergy alert was issued in the CPOE system, the prescriber had to cancel the order or override the alert and include one of three rationales: the benefit outweighs the risk, the patient previously tolerated the medication, and the medication is therapeutically appropriate. The prescriber could also free text an explanation regarding the override for the allergy. These alerts were issued across the spectrum of care—from a prescriber entering an order to a nurse entering an oral order to a pharmacist verifying the order.

Data were extracted from a computer-generated report to identify the total number of prescription orders and the number of orders triggering an allergy alert during the study time frame. Prescription orders with allergy alerts that were overridden by prescribers were analyzed further to establish the percentage of the overridden alerts. CPOE orders by prescribers outside of the Mayo network were excluded from the analysis. The specific rationale for overriding an allergy alert was then classified and analyzed.

Documentation of allergies within the patient's profile was assessed through EMR review for completeness in terms of reaction description and classification. An allergy profile was considered complete if details were provided in the reaction field. The subsequent action of the order triggering the allergy alert was evalu-

ated to determine if the medication was administered to the patient, discontinued before administration, or voided.

Factors such as drug class, total number of profile medications, number of allergy-alert warnings per patient, hospital service providing care, length of stay, practitioner type, patient age, patient race, and patient sex were collected from the original computer-generated report. Further clarification was obtained through an EMR review. Drug class was based on the American Hospital Formulary Service classification.¹⁸ The practitioner overriding the alert was classified by profession and included nurses, pharmacists, midlevel practitioners, medical residents, and attending physicians.

In emergent situations, pharmacist review before medication administration is not always possible. Therefore, the current analysis included the patient's location for orders that triggered allergy alerts to specifically evaluate override frequency among areas with licensed independent practitioners (LIPs) not requiring pharmacy review of orders because of emergent needs.

The primary objective of the analysis was to estimate the proportion of allergy alerts issued within CPOE, the frequency of the allergy-alert overrides, and the proportion of allergy-alert overrides according to prescriber override rationale.

Numerical variables were summarized with the sample median, minimum, 25th percentile, 75th percentile, and maximum. Categorical variables were summarized with number and percentage. The proportion of allergy alerts and allergy-alert overrides were estimated along with the exact binomial 95% confidence interval (CI). Because of the small number of alerts that were not overridden, no formal tests were performed to investigate associations between allergy-alert overrides and allergy-alert information.

Results

Allergy alerts were triggered for 643 (1.3%) of the 49,887 total prescription orders entered during November 2007 (95% CI, 1.2–1.4%). Figure 1 displays the flow of orders entered, allergy alerts issued, and orders overridden for the given time frame. Alerts were triggered for a total of 289 patients, with a mean of 2 orders triggering alerts per patient.

The majority of patients studied were white (88%) and were women (65%). The median age was 66 years (range, 24–94 years). Patients were further classified by hospital location, service ordering the medication, and medication classification (Table 1). Allergy alerts occurred most frequently within LIP areas (54%) and were prescribed most from the anesthesia (28%) and emergency (18%) departments. Narcotic analgesics triggered the greatest number of allergy alerts among the population studied (69%). The median hospital stay for patients with an order triggering an alert was three days. Patients studied had a median of 12 other medications at the time the alert was triggered (range, 1–62).

Of 643 total alerts, 625 (97%) were overridden by practitioners. For those overridden alerts, the following prescriber rationale was given: the patient previously tolerated the medication (49%), the benefit outweighed risk (29%), the medication was therapeutically appropriate (24%), and a free-text explanation (8%).

After the allergy alert, patients received the medication (69%), had the medication discontinued before administration (29%), or had the medication order voided (2%). Of the 643 allergy alerts, 287 patients (47%) had a complete allergy profile with information provided regarding the reaction detail. Allergy information was primarily entered by nurses (70%).

Discussion

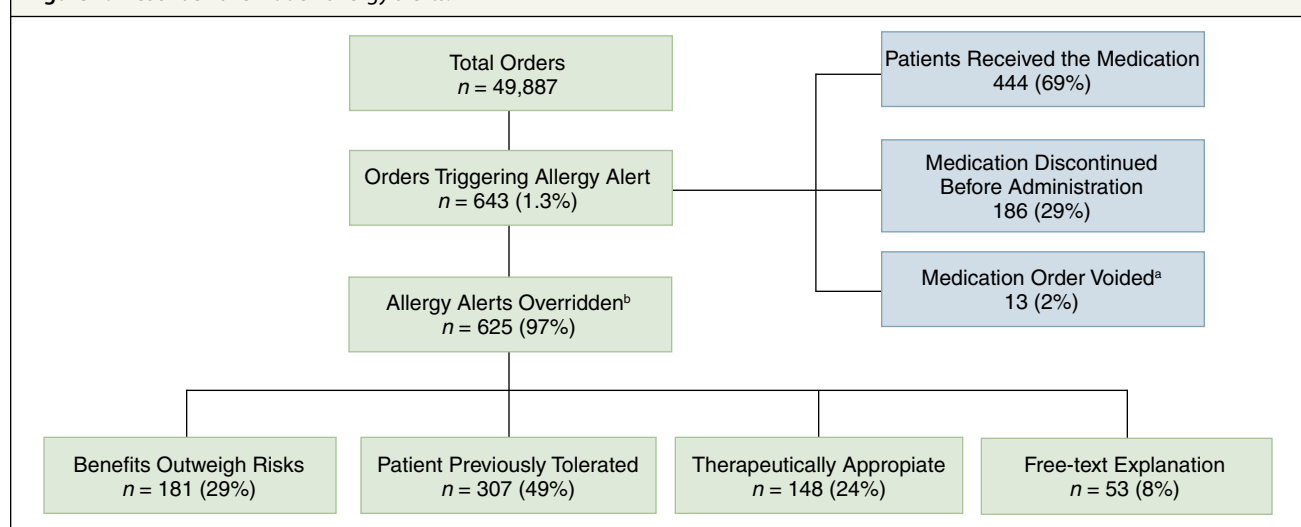
The majority of allergy alerts issued within CPOE during the analysis period were overridden. Practitioners are required to enter an override reason for allergy alerts or void the order before moving past the alert screen. Only the pharmacist may proceed without entering an override rationale. Alert fatigue

was likely not a contributing factor to the high percentage of overridden alerts, as the alerts were triggered on a small percentage of the total orders (1.3%). Initially, clinical decision-support tools, other than allergy alerts, were not used at our institution in an attempt to limit alert fatigue; however, these tools are currently undergoing further review for potential use.

Incomplete or inaccurate patient allergy profiles were common among patients with medication orders triggering allergy alerts. Gaps within the patient's allergy profile may limit the information readily available to the prescriber to assist in evaluating the nature and severity of the reported allergy. In many cases, override rationale indicated that the patient had previously tolerated the medication; however, allergy profiles were often not updated to reflect this. Additionally, in some patient profiles, allergy information was misclassified. For example, a known adverse effect of a medication was documented as an allergy.

Alerts were most common among narcotic and miscellaneous analgesics. While opioid analgesics have

Figure 1. Prescriber-overridden allergy alerts.



^aDefined as medications that were removed before final verification was received.

^bIndicates a variable for which there is more than one possibility per allergy alert.

Table 1.
Allergy-Alert Information (n = 643)

Variable ^a	No. (%) Alerts
Hospital location	
Licensed independent practice	350 (54)
Oncology/medicine	96 (15)
Transplant/medicine	90 (14)
Cardiology	62 (10)
Other	24 (4)
ICU	21 (3)
Service	
Anesthesia	180 (28)
ED	118 (18)
Other	101 (16)
Internal medicine	75 (12)
Orthopedics	51 (8)
Cardiology	31 (5)
Family medicine	25 (4)
Inpatient surgery	24 (4)
Neurosurgery	21 (3)
Outpatient surgery	17 (3)
Medication class	
Narcotic analgesic	442 (69)
Other	62 (10)
Miscellaneous analgesic	60 (9)
Cephalosporin	27 (4)
Salicylates	18 (3)
Thiazide diuretic	12 (2)
Loop diuretic	12 (2)
Antiemetic	10 (2)
Clinician entering allergy information ^b	
Nurse	447 (70)
Attending physician	146 (23)
Pharmacist	64 (10)
Other	24 (4)

^aICU = intensive care unit, ED = emergency department.

^bIndicates a variable for which there is more than one possibility per allergy alert.

been associated with allergies, true allergic reactions to this drug class are infrequent.¹⁹ Also, these medications are commonly associated with adverse effects, which may lead to misclassified allergies within the patient's profile.

Allergy alerts occurred more frequently among LIP areas. This may be related to the acuity of patients in these areas. Also, these areas generally use more narcotic and pain medications. Because of the frequency of alerts with LIPs, further investigation is warranted to analyze the ordering process.

In this analysis, adverse drug reactions (ADRs) were not assessed. Additional research is needed to evaluate the relationship among ADRs, patient allergy profiles, and overridden allergy alerts. This analysis also did not evaluate the quality of allergy information in the patients' profile.

Information from this study identifies the need for increased education on the process of entering patient allergy histories into the CPOE system. Improving allergy profile completeness and accuracy will assist practitioners during the order-entry process when allergy alerts are issued.

Providing this piece of the medication history is a key step toward improving overall medication safety, reducing the number of alerts that are overridden inappropriately, and protecting against legal ramifications of allergic reactions occurring in the setting of an overridden alert.

Conclusion

While a small portion of prescription orders generated through a CPOE system triggered an allergy alert, most of the allergy alerts were overridden by prescribers.

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