

Prescription Errors and the Impact of Computerized Prescription Order Entry System in a Community-based Hospital

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Adverse drug events occur often in hospitals. They can be prevented to a large extent by minimizing the human errors of prescription writing. To evaluate the efficacy of a computerized prescription order entry (CPOE) system with the help of ancillary support in minimizing prescription errors. Retrospective study carried out in a community-based urban teaching hospital in south Brooklyn, NY from January 2004 to January 2005. Errors were categorized into inappropriate dosage adjustment for creatinine clearance, duplication, incorrect orders, allergy verification, and incomplete orders. The pharmacists identified the type of error, the severity of error, the class of drug involved, and the department that made the error. A total of 466,311 prescriptions were entered in the period of 1 year. There were 3513 errors during this period (7.53 errors per 1000 prescriptions). More than half of these errors were made by the internal medicine specialty. In our study, 50% of the errors were severe errors (overdosing medications with narrow therapeutic index or over-riding allergies), 46.28% were moderate errors (overdosing, wrong dosing, duplicate orders, or prescribing multiple antibiotics), and 3.71% were not harmful errors (wrong dosing or incomplete orders). The errors were also categorized according to the class of medication. Errors in antibiotic prescription accounted for 53.9% of all errors. The pharmacist detected all these prescription errors as the prescriptions were reviewed in the CPOE system. Prescription errors are common medical errors seen in hospitals. The CPOE system has prevented and alerted the prescriber and pharmacist to dosage errors and allergies. Involvement of the pharmacist in reviewing the prescription and alerting the physician has minimized prescription errors to a great degree in our hospital setting. The incidence of prescription errors before the CPOE has been reported to range from 3 to 99 per 1000 prescriptions. The disparity could be due to the definition of medical errors, which has changed over the years, and also number of prescriptions included in the study and the study design.

Keywords: adverse drug events (ADEs), computerized prescription order entry (CPOE)

INTRODUCTION

With an increasing number of studies being published about the rising number of medical errors and the

resulting financial burden, the Institute of Medicine (IOM) has brought in new definitions for medical errors and adverse events. A medical error is defined as "the failure to complete a planned action as intended or the use of a wrong plan to achieve an aim."^{1,2} An adverse event is defined as "an injury caused by medical management rather than by the underlying disease condition of the patient."^{1,2} The aim of our study is to find the incidence of prescription errors in our hospital, when using a computerized prescription entry system.

Medication errors because of prescribing flaws are not new. In November 1999, IOM issued a report entitled "To err is Human: Building a Safer Health

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System."¹ This report focused mainly on medical errors and patient safety in United States hospitals, and found that 44,000 to 98,000 people die annually because of them. These errors cost the nation approximately 37.6 billion dollars each year, of which 17 billion dollars are attributed to preventable errors. Prescription errors are preventable errors and have been cited as one of the main causes of deaths in hospitals.^{1,2}

METHOD

Our hospital is a community-based hospital with residency programs in internal medicine, surgery, orthopedics, urology, pediatrics, obstetrics and gynecology, podiatry, and psychiatry. We retrospectively evaluated the adverse drug events (ADEs) during a period of 1 year from January 2004 to January 2005. Residents entered more than 95% of the prescriptions, attending physicians and physician assistants entered the remaining 5%. All prescriptions were placed through the computerized prescription order entry (CPOE) system in the wards, intensive care units, and clinics. The exception was the emergency room, in which prescriptions were hand written. The pharmacist reviewed all prescriptions placed before the medication was released to the nursing staff to be administered to the patient. If there was any doubt about a particular order, the pharmacist would directly clarify the prescription with the resident, and if it was a true error, he would record the error and report it to the head of the specific department. The errors were categorized into dosage adjustment, duplication, incorrect orders, incomplete orders, and allergy verification. Depending on the type of error, these were further categorized into not harmful, moderately harmful, and severe errors. The type of errors, the severity of the errors, and the method to detect them were already in place in the CPOE system. As this was a retrospective study, neither the prescriber nor the dispenser was solicited about the error or the detection of the error.

RESULTS

Prescriptions (466,311) were placed via the CPOE system from January 2004 to January 2005. Out of these prescriptions, the CPOE and the pharmacist initially detected 5325 errors. After discussing with the prescriber, 3321 (0.71% of all prescriptions) were reported as true errors. These true errors consisted of 1303 dosage adjustments (39.25%), 988 duplications (29.75%), 834 incorrect orders (25.11%), 91 incomplete orders (2.74%), and 105 allergy violations (3.16%) (Fig. 1).

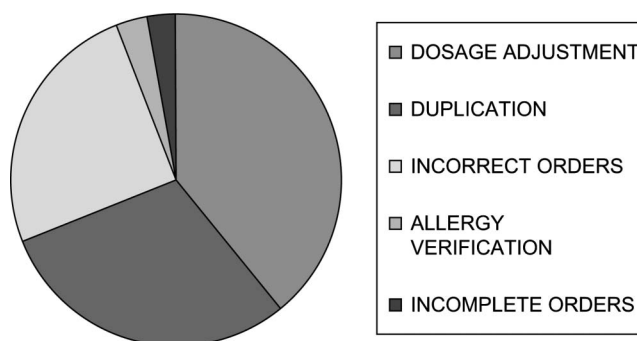


FIGURE 1. Types of prescription errors.

The Department of medicine made more than half of the prescription errors (55.16%). The Departments of surgery 22.89%, psychiatry 5.45%, pediatrics 4.44%, obstetric and gynecology 4.06%, orthopedics 3.42%, urology 2.48%, and podiatry 0.82% followed them. The overall high error rate in internal medicine was attributed to high patient number handled by the Department. When correcting the number of errors by the percentage of prescription orders placed by each department, it was found that they ordered the following percentage of prescriptions and produced the corrected percentage of the errors, respectively: medicine 81% and 0.49%; surgery 10.5% and 1.55%; psychiatry 2% and 1.94%; pediatrics 4.44% and 1.58%; obstetric and gynecology 3% and 0.96%; orthopedics 1% and 2.43%; urology 0.3% and 5.88%; and podiatry 0.2% and 2.91%. The high number of errors seen in some subspecialties was mainly because of the fewer number of prescription orders placed by these subspecialties. (Fig. 2 and Table 1).

Wrong dosing and incomplete orders were categorized as not harmful errors. Overdosing, wrong dosing, duplicate orders, and prescribing multiple antibiotics were included as moderate errors. Overdosing opioids, antiepileptic, and other medications with a narrow therapeutic index, free text of allergies, (ie, prescribers over-riding allergy alerts with a typed-in explanation), and over-riding allergies were included in the category

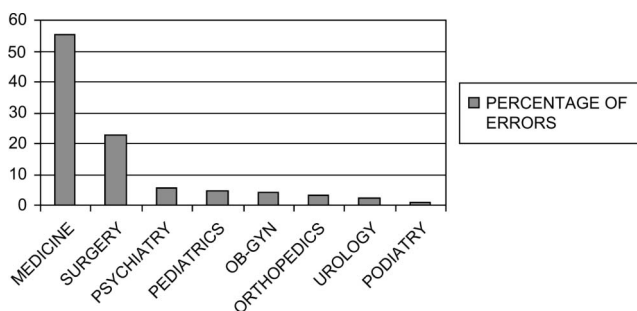


FIGURE 2. Percentage of errors made by subspecialty.

Table 1. Comparison of prescription errors among subspecialties.

	Prescriptions no.	Overall error%	Error % for the subspecialty
Medicine	373048.8 (81%)	55.16%	0.49%
Surgery	48962.65 (10.5%)	22.89%	1.55%
Obstetrics and gynecology	13989.33 (3%)	4.06%	0.96%
Psychiatry	9326.22 (2%)	5.45%	1.94%
Pediatrics	9326.36 (2%)	4.44%	1.58%
Orthopedics	4663.21 (1%)	3.42%	2.43%
Urology	1398.93 (0.3%)	2.48%	5.88%
Podiatry	932.63 (0.2%)	0.82%	2.91%

of severe medical errors. In our study, 50% of the errors were severe errors, 46.28% were moderate errors, and 3.71% were not harmful errors.

The errors were also categorized according to the class of medication. Errors in antibiotic prescription accounted for 53.9% of all errors. The other medications involved were pain medications 11.2%, cardiac medication 6.56%, psychiatric medications 5.79%, antihyperglycemic medications 3.73%, and anticoagulation medications 3.21%. All other drugs were categorized as miscellaneous and they accounted for 15.57% of total prescription errors.

DISCUSSION

Prescription errors can be made by the prescriber during the first emergency room encounter, during hospital admission, hospital stay, during discharge, and during the subsequent clinic visits. Before the implementation of computer-based prescription writing, errors were blamed on illegible writing and verbal orders, especially given during emergency circumstances. Several studies revealed that 75% of ADEs were due to incorrect dosing of medications.³ Prescribing the wrong type of drug, ordering an improper dose, giving a patient a drug the patient is allergic to, and combining medications that are incompatible were the most common medical errors that were found in many studies.¹⁻³ ADEs are now the fourth leading cause of death in the United States after heart disease, cancer, and stroke.³

According to the American Hospital Association,^{1,2} the most common causes of prescription errors are as follows:

1. Incomplete patient information (not knowing about the patients' past medical history, allergies, other medications, dosage, laboratory results).
2. Unavailable drug information/lack of knowledge about medications.^{4,5}
3. Miscommunication about medications, such as poor hand writing, confusion among medications with similar names, misuse of a zero or a decimal point, confusion regarding dosing units, and the use of nonstandard abbreviations.
4. Lack of proper labeling.
5. Environmental stresses that can distract the health professional.⁶

The IOM recommends voluntary or mandatory reporting of all medical errors.¹ But this method has created fear among the health-care professionals because of medical malpractice and litigation. To prevent this, the health-care professionals should be made aware of, assured, and encouraged to report medication errors.^{1,2,7} To alleviate apprehension a few suggestions have been made. These include stopping the use of medication error reporting systems primarily for punishment. Instead, emphasis should be placed on recognizing the inherent errors in the system and ordering a scientific investigation to prevent patient harm. It is important to understand the complexity of human performance in stressful situations and develop strategies to enhance rather than restrict performance.⁷

Steps have recently been taken to bring this goal closer to reality. The Patient Safety and Quality improvement act of 2005, signed on July 29th, created the first-ever national database for nonidentifiable patient safety data. Under the legislation, only confidential medical errors that are reported to a patient safety organization, which has been approved by the US Health and Human Services Administration, will be included in the database. Reporting error to the database would also protect a provider from any litigation that may result as a direct consequence.

After the IOM report was published in 1999, most hospitals have completely eliminated paper

prescriptions and have switched to computer-based prescriptions. This has overcome the problem of illegible handwriting and verbal orders. Koppel et al⁸ showed that the CPOE system reduced medication errors by up to 81%. It was heralded as the ideal solution for the long term problem of prescription errors. However, no system is error proof. Use of the CPOE system has created new problems when correcting the old ones. Pharmacy inventory display numbers have been mistaken for dosages, antibiotic renewals have been ignored, doses doubled, and ordering formats can be inflexible, generating wrong orders.^{8,9}

The development of CPOE systems in United States hospitals is still in its infancy. Many hospitals are taking a closer look at their CPOE systems. Improvements should be made to produce better systems that can detect the errors, warn the prescriber, and alert the dispenser.⁹ The ideal CPOE system should support the specific recommendations made by the physician, matching individual patient data to a computer-based database.^{10,11} Currently available programs are far from this ideal CPOE system. Recent studies show that most hospital-based CPOE systems have fewer than 10 alerts on average.^{9,12} In these systems, owing to the lack of specificity of the alert, warnings may appear too frequently leading the prescriber to ignore the alerts altogether. Taking into consideration the practical difficulties faced with a CPOE system and the cost of implementation, the hospitals are reconsidering the pharmacist's involvement in the multidisciplinary team approach to patient care.^{7,9}

The incidence of medication errors have ranged from 2 to 8 per 100 admissions.^{13,14} We found a very low prescription error rate (0.71% of all prescriptions). Cornish et al¹⁵ showed that prescription errors occur most commonly at the time of initial hospital admission. In the same study, 53.3% had at least 1 discrepancy and the most common error was omission of a regularly used medication (46.4%). These errors (38.6%) had a potential of causing moderate to severe harm to the patient.¹⁵ Few studies have shown that antiinfective, cardiovascular agents, and opioid analgesics accounted for more than 50% of all clinically significant prescription errors.^{16,17} In our study, errors in antibiotic prescription accounted for 53.9% of all errors. Combined with cardiovascular agents and pain medications, they accounted for 71.66% of all errors.

The low prescription error rate in our study could be due to the error proofing system in our hospital. In case of doubt, the prescriber is encouraged to call the pharmacist before placing the order for a medication. Once an order is placed it will be checked and clarified by the pharmacist. The CPOE system will not allow

placing orders unless allergies are entered into the system; it will then alert all prescribers to these allergies in the future. The CPOE automatically calculates and displays creatinine clearance. It also allows prefixed dosing for selection depending on creatinine clearance. The CPOE system has been combined with MICROMEDEX (pharmaceutical database), which helps the prescriber to check the dosage, indications, contraindications, and interactions of the drugs. The errors detected by the pharmacist were reported to the heads of the Departments at the end of each month. Subsequently these errors were discussed in a nonpunitive manner with the responsible physician to create constructive awareness and to prevent further errors being made.

A proper history taken during the initial admission, talking to the family, talking to the patient's personal physician, and requesting the patient or the family to bring medications to the hospital will help avoid omitting regularly taken medications. One suggestion is that computerized medical records be made available to share between the hospital and pharmacies; however, the issue of patients' privacy and patients' rights has been cited as an obstacle to this initiative being realized.

No system is perfect. Prescription errors because of inaccurate or missing medication history and omissions are unpreventable even in the presence of the most perfect CPOE systems, because these functions are in the hand of the health-care provider. Too many alerts result in prescribers overriding warnings without paying attention to alerts. Current CPOE systems are not flexible enough, for example, prefixed prescription doses do not always cater to individual patient requirements. System delay in calculating the creatinine clearance often causes a delay in giving the proper dose of medication.

CONCLUSIONS

To err is human. There is no perfect solution for human errors. Even with an ideal CPOE system, the errors occurring as a result of miscommunication between health-care personnel and patients are unavoidable. Communication is the key to overcoming these errors. The health staff should be educated regarding communication skills. At the time of admission, gaining data from the patient, his family, and his private physician is essential. Particular attention should be paid to the medications and pertinent medical history.

The CPOE system has reduced prescription errors drastically. Better upgrades that can suit the individual patient will further decrease the error rate. In our

hospital, the low rate of errors is not only because of the CPOE system, but also because of the ancillary service provided by the pharmacist. On discharge, a direct communication between hospital staff and the patients' primary physician, in addition to his pharmacy, should be encouraged.

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