Pharmacist participation in medical rounds reduces medication errors

KIMBERLY K. SCARSI, MICHAEL A. FOTIS, AND GARY A. NOSKIN

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Management Case Studies *describe approaches to real-life management problems in health systems. Each installment is a brief description of a problem and how it was dealt with. The cases are intended to help readers deal with similar experiences in their own work sites. Problem solving, not hypothesis testing, is emphasized. Successful resolution of the management issue is not a criterion for publication—important lessons can be learned from failures, too.*

Problem

Adverse drug events are a complication of medication use and have received considerable attention after the release of the Institute of Medicine (IOM) report *To Err Is Human.*[1] Although the extent of the problem remains the subject of dispute, medication errors affect patient safety. Approximately 20% of medical injuries or deaths among hospitalized patients may be the result of an adverse drug reaction.[2] In addition, the mean length of stay, cost, and mortality are nearly double for patients suffering an adverse drug reaction.[3]

Background

Despite increasing interest in medication errors, little is known about their causes and preventability. Although it is widely recognized that medication errors are widespread, changing the culture of health care to facilitate their reporting has been difficult. While all physicians are instructed in the fundamentals of medication use, clinical pharmacists are trained to recognize, understand, and prevent medication errors.[4] Leape et al.[5] evaluated the impact of pharmacist participation in medical rounds in an intensive care unit on the occurrence of medication errors and adverse events. They found a 66% reduction in adverse events related to preventable errors when a pharmacist participated in daily morning rounds. On the basis of these results, we sought to evaluate the impact of pharmacist participation on a general medicine service on the occurrence and duration of medication errors. We performed a prospective observational investigation to quantify the extent and duration of medication errors and their impact on patient outcome when a pharmacist participated in daily medical rounds. Our objectives were to prevent medication errors from occurring at the time of prescribing and from continuing once they were identified and to improve the reporting of medication errors.

Analysis and resolution

From May 1 through May 31, 2000, one clinical pharmacist actively participated in daily rounds on 1 of 19 medical services in a 600-bed academic medical center. The members of the general medicine team include a medical student, an internal medicine intern, a resident, and an attending physician. A pharmacist had not previously participated in rounds with this team. The pharmacist performed daily activities during rounds, including investigating allergy information, monitoring trends in laboratory test values, and reviewing medication orders for appropriateness of dose and medication selection. Closely reviewed were drug indications; patient age, weight, and organ function; the medication administration record; and the provision of patient education. The pharmacist recorded all medication errors as they were discovered during the intervention period and filed appropriate medication-error reports using MedMARx 3.0 (United States Pharmacopeial Convention, Inc., Rockville, MD).

In the control group, another pharmacist participated in rounds each morning with the admitting

KIMBERLY K. SCARSI, PHARM.D., is Clinical Pharmacist, and MICHAEL A. FOTIS, B.S.PHARM., is Manager of Drug Policy and Staff Development, Department of Pharmacy, Northwestern Memorial Hospital, Chicago, IL. GARY A. NOSKIN, M.D., is Associate Professor of Medicine, Northwestern University Medical School, Chicago, IL.

Address correspondence to Dr. Scarsi at the Department of Pharmacy, Northwestern Memorial Hospital, Feinberg LC-700, 251 East Huron Street, Chicago, IL 60611 (kscarsi@nmh.org).

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team from the previous evening and had direct contact with each patient admitted to the service on the first inpatient day. During admitting rounds, medication orders and laboratory test values were reviewed and patients receiving high-risk medications were identified. Patients were monitored for the rest of their stay only if they were prescribed a designated drug per pharmacy policy. All other medication orders received routine profile review as part of the medication-ordering process. Routine profile review consisted of screening for drug–drug interactions and evaluating the appropriateness of each dose on the basis of patient-specific values. Although the existing process allowed the pharmacist to see more patients per month, it did not provide the continuity of care nor the patient–medical team interaction that daily rounds provided. Pharmacist time spent on clinical activities was similar in each group (approximately two hours per day).

The study group included all patients admitted to the participating general medicine service during May 2000 (n = 35). These patients were matched after hospital discharge to concurrently hospitalized patients by random selection using an internally designed computer-generated report prepared by the pharmacy department's information systems manager, who was blinded to the study purpose. The report identified 35 patients for inclusion in the control group, to ensure that both groups were evenly matched for age, sex, length of stay, number of medication orders written, and nursing unit. All control group patients received the same care as the intervention group. The groups were compared by age, length of stay, and number of inpatient medication orders. Every patient initially selected for the control group was included in the study.

Three pharmacists with previous experience using chart review to assess for medication errors and adverse drug reactions were selected to review all patients' medical charts. All of the pharmacists were senior members of the clinical staff with at least 10 years experience in this area. One author provided orientation and training for the reviewers and also served as a reviewer, evaluating the consistency of the assessments completed by the other two reviewers. After patient selection was verified, the blinded reviewers conducted a retrospective evaluation of patient medical records. A structured chart review began with examining the interfaces of care. Each admission, transfer, and discharge note was examined for medications currently taken, medication allergies, and discharge prescriptions. The medication orders and the medication administration record were searched for matching entries. Any unexplained variance was considered an error. The remaining progress notes were similarly searched. Medication selection, dosing, and monitoring were compared with recommendations published in the clinical staff manual *Optimizing Medication Use at NMH*.[6] Again, unexplained variances were interpreted as errors. An error was noted if a consultant note included an indication for additional or different medications, if no order was written for the specified medication, or if follow-up consultant notes confirmed the need for treatment. The same process was used for each chart reviewed. Reviewers classified medication errors as prescribing, administration, pharmacy, or discharge errors by using definitions derived from the 1999 IOM report (appendix).[1] Reviewers also documented the duration of the error before it was corrected.

Data were compiled and statistically evaluated in a spreadsheet using Microsoft Excel 97 (Microsoft Corporation, Redmond, WA). Statistical evaluation was performed with median and mean variables, confidence intervals (CIs), and odds ratios with chi-square tests to determine statistical significance. A p value of less than 0.05 was considered significant.

The intervention and control groups were evenly matched for age, sex, average length of stay, and number of medication orders written (Table 1). To further verify the internal validity between the intervention and control groups, the concurrent data reported by the clinical pharmacist participating in rounds with the medical service was compared with the retrospective data collected by the blinded reviewers. Overall, concurrent data collection identified 47 medication errors in the intervention group, compared with 46 errors documented by the reviewers in the intervention group.

When a pharmacist participated in daily medical rounds, medication errors were reduced by 51% ($p < 0.05$). The number of patients without a medication error during their hospitalization increased (22.9% in the control group versus 40.0% in the intervention group) ($p < 0.05$). The duration of time that an error continued after it occurred was also significantly less in the intervention group. An error persisted less than 1 day (mean, 0.73; 95% CI, 0.48–0.98) and with less than one dose of medica-

Table 1.
Patient Demographics[a]

Variable	Intervention Group (n = 35)	Control Group (n = 35)
No. (%) male	19 (54.3)	19 (54.3)
Mean age in years (95% CI)[b]	60 (57.8–62.2)	57 (55.0–59.0)
Mean length of stay in days (95% CI)	7.0 (6.2–7.8)	7.7 (7.0–8.4)
Mean no. orders per patient (95% CI)	20 (18.3–21.7)	21 (19.3–22.7)

[a]All patients were hospitalized during the same time period.
[b]CI = confidence interval.

tion (median, 0) in the intervention group, compared with 2.4 days (95% CI, 2.3–2.9) and two doses of medication in the control group (Table 2). Classification of errors was similar between the groups and consistent with the distribution of errors documented in the 1999 IOM report.[1] Prescribing errors occurred most frequently, followed by administration errors and pharmacy errors (Table 3).

The reduction in the number of medication errors that occur at the time of prescribing is likely due to the pharmacist gaining a more thorough clinical picture of the patient related to medication prescribing after participating in rounds. After reviewing a medication order, the pharmacist could evaluate medication use with a more extensive knowledge of the patient's medical history, drug contraindications, organ function, and the reason a drug was prescribed. This pharmacist could also serve in an interdisciplinary educational role for physicians, nurses, and other health care providers. Barriers to communication are greatly reduced when the pharmacist participates in daily rounds. It is easier for informal education to occur, such as answering questions about medication dose, adverse reactions, and drug interactions. Through this interaction, medication errors can be prevented.

The pharmacist had the opportunity on daily rounds to review the medication administration records for errors and educate the nursing staff on the appropriate administration of medications. Administration errors were primarily corrected by altering inappropriate administration time of food-dependent medications, preventing drug–drug interactions of coadministered medications, and encouraging timely administration of time-dependent medications, such as antimicrobials.

The reduction in pharmacy errors was primarily the result of clinical interventions on the basis of the application of the principles of therapeutic drug monitoring. For example, through interacting with the medical team and patients, the pharmacist could assess and document laboratory test values, whereas the control patients often did not receive routine follow-up of these values.

Medication errors occurring at the time of discharge were common in a pilot study at our hospital. The clinical pharmacist was able to reduce these by thoroughly evaluating the discharge summary written before patient discharge, ensuring that discharge medication orders were appropriate and complete. Routine pharmacy follow-up for patients in the control group did not allow for this, as discharge prescriptions are filled at community pharmacies.

Table 2.
Frequency and Duration of Errors

Variable	Intervention Group (n = 35)	Control Group (n = 35)
Total no. errors	46[a]	94
Mean errors per patient (95% CI)[b]	1.3[a] (1.1–1.5)	2.6 (2.3–2.9)
No. (%) patients with no errors	14 (40)[a]	8 (23)
Mean duration of errors in days (95% CI)	0.73[c] (0.48–0.98)	2.4 (2.3–2.9)
Median duration of errors in doses administered	0[c]	2

[a] $p < 0.05$.
[b] CI = confidence interval.
[c] $p < 0.001$.

Table 3.
Classification of Errors

Type of Error	Intervention Group (n = 46)	Control Group (n = 94)
No. prescribing errors	30	48
Inappropriate dose	14	25
Consultant note variance	5	9
Nonformulary agent	4	5
Transfer error	7	9
No. administration errors	13	25
Timing of dose	6	7
Transcription error	0	2
Missed dose	7	8
Extra dose given	0	3
Dose given after discontinuation	0	5
No. pharmacy errors	3	14
Inappropriate dose recommendation	0	6
Pharmacokinetic level not evaluated	1	5
Incomplete dispensing instructions	2	3
No. discharge errors	0	7

Discussion

Medication errors are a significant problem in U.S. hospitals. Because of the complexity of this issue, a multidisciplinary approach is required to effectively minimize the potential for medication errors. The specialized training and education of pharmacists allow them to serve as medication experts and potentially prevent medication errors. These data lend more evidence to the compelling body of literature supporting the active participation of pharmacists in medical rounds as a means of reducing the frequency and duration of medication errors.[5]

An important observation was that nearly 80% of the patients in the control group had a medication error. The participation of a pharmacist in medical rounds can reduce this number substantially. To our knowledge, this study is the first to document that pharmacist participation in medical rounds not only decreases the frequency of errors but

also the duration that an error persists once it has occurred. Not surprisingly, errors still occurred in the intervention group, even with a pharmacist present. These errors were typically identified and addressed shortly after the order was written and often before any doses of medication were administered to patients. We attribute this difference to the greater knowledge the pharmacist had of the patient's medical problem, history, and current goals of care. This increased knowledge about the patient made it much more likely that the pharmacist would recognize a potential error and take the appropriate action to prevent the error from occurring or continuing.

These data have had a significant impact on our institution. After this evaluation, two additional pharmacists attended medical rounds on the general medicine service. An automated medication administration record has also been implemented on the general care units of our institution. We anticipate that this automated record will significantly reduce the number of administration errors related to time- and food-dependent medications. Also, a patient safety team has been assembled, including physician, nursing, administration, and pharmacist staff, to further evaluate the broad scope of medical errors and the best way to reduce them in our institution.

During this evaluation, 37 errors were documented via the MedMARx system; 20 of those errors were reported in the intervention group. This demonstrates the difficulty in thoroughly and accurately documenting medication errors in most institutions. Since this study, the pharmacy and therapeutics committee, along with the patient safety team, has facilitated the documentation of errors in our institution. Specifically, these committees have been working toward identifying the systems failures, not the parties involved, that may contribute to errors. Emphasis has also been placed on error reporting with ease to encourage more error reporting in a time-efficient manner.

An active pharmacist presence on rounds was associated with a reduction in the rate and duration of medication errors. This improvement in safety may have been due to the extra time spent evaluating these patients by the pharmacist on rounds. We do not argue that extra pharmacist time would contribute to a reduction in errors; however, a collaborative effort allows the pharmacist to be fully informed about patient-specific issues and have greater access to other clinical decision-makers who affect patient safety.

There are several limitations inherent to retrospective evaluations of this type that must be considered that could impact the generalizability of the data. We used subjective evaluation of medication errors as interpreted by trained pharmacists. The blinding of the pharmacist reviewers and the definitions of medication errors (as set forth by IOM) helped compensate for this limitation. Also, the detection of medication errors relies on the information recorded in the medical record, which may result in underestimating some types of errors. However, the concurrence of prospectively and retrospectively collected data in our trial seems to indicate that, at least in this case, underestimation was minimal. Finally, we evaluated a small sample size in an academic medical center, which may not be representative of all hospitalized patients. The general medicine service was highly motivated, which facilitated interactions among all health care providers. Care was taken to minimize potential bias when possible. Patients were matched based on admission date, age, sex, duration of stay, and number of medication orders written to minimize the potential for a difference in the frequency of errors resulting from outside factors.

Conclusion

Pharmacist participation in medical rounds reduces the frequency of medication errors as well as their duration once they are identified.

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Appendix—Definitions of various medication errors adapted from the Institute of Medicine[1]

Administration error: Any inappropriate timing of medications; missed doses; inaccurate administration of any medication, such as concurrent administration of the medication with other medications or food that may interfere with the drug's bioavailability, or inappropriate rate of medication infusion.

Discharge error: Any discharge medication order or instruction that differs from the inpatient instructions or medications without documentation explaining the reason for the change.

Pharmacy error: Any inaccurate documentation of information; missing information from the official medication profile, including drug, dose, route, and frequency; any dose that is inappropriately recommended to physicians on the basis of patient-specific parameters, including renal function, hepatic function, and disease; and any inaccurate medication provided by the pharmacy, including the wrong medication, dose, frequency, or package labeling.

Prescribing error: Any medication order written by a physician that provides an inappropriate dose, frequency, duration of therapy, or drug for patient-specific circumstances, including renal function, hepatic function, disease, and concurrent therapy.