Pharmacists on Rounding Teams Reduce Preventable Adverse Drug Events in Hospital General Medicine Units

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Background: Previous studies found that medication errors result from lack of sufficient information during the prescribing step. Therefore, it is proposed that having a pharmacist available when patients are evaluated during the rounding process may reduce the likelihood of preventable adverse drug events (ADEs). The objectives of this study were to evaluate the impact of having a pharmacist participate with a physician rounding team on preventable ADEs in general medicine units and to document pharmacist interventions made during the rounding process.

Methods: A single-blind, standard care–controlled study design was used to compare patients receiving care from a rounding team including a pharmacist with patients receiving standard care (no pharmacist on rounding team). Patients admitted to and discharged from the same general medicine unit were included in the study. The main outcome measure of this study was preventable ADEs. Patient records were randomly selected and evaluated by a blinded process involving independent senior pharmacist specialists and a senior staff physician. Interventions made by the pharmacists in the treatment group were documented.

Results: The rate of preventable ADEs was reduced by 78%, from 26.5 per 1000 hospital days to 5.7 per 1000 hospital days. There were 150 documented interventions recommended during the rounding process, 147 of which were accepted by the team. The most common interventions were (1) dosing-related changes and (2) recommendations to add a drug to therapy.

Conclusion: Pharmacist participation with the medical rounding team on a general medicine unit contributes to a significant reduction in preventable ADEs.

Arch Intern Med. 2003;163:2014-2018

MEDICATION ERRORS occur more frequently than expected. Laz-arr et al stated that fatal adverse drug events (ADEs) were the sixth leading cause of death in the United Stated in 1994, with 10.9% of all hospital patients experiencing some adverse drug reaction and 2.1% of admissions resulting in serious events. A systems solution that looks at processes rather than at individual behavior is proposed as a viable approach to address the medication error problem.\(^{3,4}\) When processes are examined, a common root cause of medication errors occurs at the time when decisions about therapy are made.\(^{5,6}\) Failure to obtain sufficient information about the patient or about the pharmaceutical agent has contributed to medication errors. Thus, modifying the rounding process by adding the expertise of a pharmacist is proposed as a systems improvement to address the medication error problem.

Having a pharmacist on a rounding team in an intensive care unit (ICU) has been shown to reduce the incidence of ADEs by two thirds.\(^7\) The rationale for putting a pharmacist in an ICU is that those patients are sicker and thus require a greater complexity of care. However, patients admitted to a non-ICU also have many comorbidities, which require careful pharmacological management. One would also expect a significant reduction in medication errors. Thus, we asked the following questions:

1. Is there a significant reduction in preventable ADEs for patients cared for by rounding teams with pharmacists?
2. What were the pharmacists interventions during the rounding process?
3. Is there a significant reduction in secondary outcome measures, such as length of stay and resolution of condition?

METHODS

The study was conducted at Henry Ford Hospital in Detroit, Mich, from September 5, 2000, through November 31, 2000. Patients admit-
Sample
Henry Ford Hospital has 2 patient care units considered primarily internal medicine service. Both of these units were included in the study, one as the intervention group and the other as the control group. Patients had equal chance of being admitted to the control group or the intervention group. The admitting process was based on the availability of beds and physician service. Patients in both groups were included in the study if they were admitted to the internal medicine service and remained in the same patient care unit. The demographics and number of comorbidities in both groups were compared to determine if they were similar.

Two clinical pharmacists were assigned to provide patient care services at the bedside. Their services included rounding, documenting pharmacotherapy history, and providing discharge counseling. The pharmacist-patient ratio was approximately 1:1.5. Services were provided Monday through Friday, 7 AM to 3:30 PM. The control group received standard care. Standard care was provided by 1 pharmacist for approximately 30 patients. Pharmacists identified medication-related problems through the review of medication orders (ie, medication administration records) every morning. Also, a list of medications, which require evaluation because of cost or safety, was used to identify potential medication-related problems. Both processes are retrospective methods of evaluating medication profiles vs the prospective method of evaluating patients’ medications when pharmacists round with physicians. The 2 practice models existed concurrently. Pharmacists for both the intervention and control groups have bachelor of science degrees in pharmacy, with number of years of experience ranging from 2 to 25 years. Pharmacists’ competencies are maintained by annual departmental training and educational modules. There were 6 different pharmacists rotating through the study practice model.

Pharmacist Interventions
An intervention documentation form was developed for the pharmacists, based on the interventions identified by Leape et al.7 The intervention types and response by the rounding team were documented. The interventions identified by Leape et al were (1) clarification of drug order; (2) provision of drug information; (3) recommendation of alternative therapy; (4) identification of drug interaction; (5) identification of “systems error”; (6) identification of drug allergy; (7) approval of nonformulary use of a drug; (8) provision of special-order drug; and (9) identification of ADE.

Primary Outcome Measure: Preventable ADEs
A preventable ADE was defined as an undesired reaction to medication, which may have been prevented by appropriate drug selection or management. Two senior pharmacist specialists who round in the critical care areas reviewed the emergency department notes, progress notes, nursing flow sheets, medication orders, medication administration records, and laboratory reports. The senior pharmacists (M.P. and M.M.) and coauthors were blinded to the patients’ identity and patient care unit assignment. Each documented the preventable ADE (κ = 0.87 for nonrandom agreement). The physician coinvestigator (D.A.N.) reviewed the patient documents for those patients with ADEs identified by the senior pharmacists (κ = 0.71). The pharmacist and physician coinvestigators did not adjudicate any disagreements regarding the preventable ADEs. The physician evaluation was the final step to identify the preventable ADEs.

Secondary Outcome Measures
Length of stay and time to respond to therapy were both evaluated in the study. We expected a shorter length of stay and time to respond to therapy for patient care units that include pharmacists in the rounding process. The length of stay is determined by the patient’s recovery time, the efficiency of the discharge process, and the patient’s discharge disposition. Therefore, we included time to respond to therapy as another outcome measure, which was expected to be a more direct measure of patient’s response to therapy. This measure was also documented by the senior pharmacists, who reviewed the patient documents and determined the time to resolution of the condition. The progress notes were often used. For cases in which resolution was not an outcome (ie, terminally patients and chronic conditions), the time to resolution of the condition was considered missing data. The pharmacists reviewed cases individually and then together to reach consensus.

Patient Variables
The study and control groups were compared using age, sex, race, number of comorbidities, and the number of medications ordered for the patient during the admission. The number of comorbidities were secondary or complicating conditions documented in the discharge summary prepared by the physician caring for the patient. The comorbidities were equally weighted when calculating the sum of comorbidities for each patient.

Statistical Analysis
Patient variables for the control and study groups were compared using analysis of variance for age and number of comorbidities and χ² analysis for sex and race. The number of preventable ADEs were compared using χ² analysis. SPSS for Windows version 10.0 (SPSS Inc, Chicago, Ill) was used.

Results
There were 165 patients in the study. Both the control and intervention groups were not significantly different with respect to age, sex, race, and number of comorbidities (Table 1).

The pharmacists provided 150 interventions during the rounding process for the patients in the study group. The physicians accepted 147 of the 150 recommendations made by the pharmacists. The most common intervention was recommending dosage or fre-
frequency for medication followed by the addition of medication. Pharmacists also made recommendations for discharge medication that would reduce the potential for problems after discharge. One problem addressed by the pharmacists was the affordability of medication. Approximately 1 of 10 of the patients were cash customers. Therefore, recommending affordable medication for these patients should reduce the likelihood of noncompliance due to economic reasons (Table 2).

Preventable ADEs were compared with the rates determined by Leape et al. The control group (phase 2) for the ICU patients in the study by Leape et al had a rate of preventable ADEs of 12.4 per 1000 patient days. The control group in the internal medicine unit for the present study was 26.5 per 1000 patient days. Leape et al found the rate for preventable ADEs for the study group to be 3.5 per 1000 patient days (phase 2). In the present study, the internal medicine group with the rounding pharmacist had a rate of 5.7 preventable ADEs per 1000 patient days. The reduction in preventable ADEs was 72% in the study by Leape et al and 78% in the present study. A similar reduction is found in the ratio of preventable ADEs per $1000 drug charges in the present internal medicine unit study (Table 3).

The preventable ADEs listed in Table 4 serve to illustrate how these could have been avoided with the inclusion of a pharmacist on the rounding team. Contraindications, dosing recommendations, and appropriate selection of antihypertensives account for all of the documented cases. Pharmacists working in a central dispensing area are less able to assist the physician with prescribing information. Also, the standard care model, in which the pharmacist is available on an as-needed basis to answer questions or to resolve problems after the prescribing decisions have been made, may not be sufficient to reduce preventable ADEs.

We compared the length of stay of patients with a preventable ADE. Patients with an ADE had on average a 1.4-day longer stay at the hospital.

When comparing the study and the control group with respect to the secondary outcome measures, the study group had on average a 0.3-day shorter stay and shorter time to resolution of the condition. However, these figures were not significantly different from the control group. The readmission rate was 44% less for the study group; however, the difference was not significant. The drug charges were very similar. Our study showed that 21% of the pharmacist’s recommendations identified a situation in which the addition of a drug to the patient treatment plan was indicated. This finding raises the question of whether drug charges should be the performance measure for pharmacy departments. Pharmacists should also be accountable for assuring appropriate use of pharmaceuticals.

The principal cause of medication errors is insufficient information when the prescribing decisions are made. The prescribing decisions in teaching institutions are often made during the rounding process. Previous research has identified that adding a pharmacist to the rounding team in the ICU reduces preventable ADEs by 72%. Our study shows a pharmacist on the rounding team in the general medicine unit reduces preventable ADEs by 78%. The interventions made by pharmacists in this study included dosage or frequency adjustments (35%), the addition of drugs to therapy (21%), the identification of potential problems with continuing therapy (8%), deletion of drugs from therapy (7%), and recommendation of laboratory monitoring (6%).

A system is defined as “any collection of components and the relationships between them, whether the components are human or not, when components have been brought together for a well-defined goal or purpose.” Current health care delivery systems are responsible for sicker patients in an environment that is challenged with limited resources. A systems approach to care can reduce the waste attributed to error by including specialized components in the process. Pharmacists specialize in pharmacotherapy and can assist physicians in making prescribing decisions. The rounding process involves a compilation of information to diagnose the

### Table 2. Pharmacist Intervention Recommendations Made During Rounding Process (Study Group)

<table>
<thead>
<tr>
<th>Intervention</th>
<th>No. of Recommendations (% of Total)*</th>
<th>No. Accepted by Physicians</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dosage or frequency</td>
<td>52 (35)</td>
<td>52</td>
</tr>
<tr>
<td>Addition of drug to therapy</td>
<td>31 (21)</td>
<td>30</td>
</tr>
<tr>
<td>Identification of potential problem with continuing therapy after discharge</td>
<td>12 (8)</td>
<td>11</td>
</tr>
<tr>
<td>Deletion of drug from therapy</td>
<td>11 (7)</td>
<td>11</td>
</tr>
<tr>
<td>Laboratory monitoring</td>
<td>9 (6)</td>
<td>9</td>
</tr>
<tr>
<td>Therapeutic alternative</td>
<td>8 (5)</td>
<td>8</td>
</tr>
<tr>
<td>Intravenous to oral conversion</td>
<td>7 (5)</td>
<td>6</td>
</tr>
<tr>
<td>Identification of adverse drug reaction</td>
<td>6 (4)</td>
<td>6</td>
</tr>
<tr>
<td>Approval of nonformulary or restricted drug</td>
<td>4 (3)</td>
<td>4</td>
</tr>
<tr>
<td>Clarification of order</td>
<td>4 (3)</td>
<td>4</td>
</tr>
<tr>
<td>Drug interaction</td>
<td>3 (2)</td>
<td>3</td>
</tr>
<tr>
<td>Preferred agent</td>
<td>2 (1)</td>
<td>2</td>
</tr>
<tr>
<td>Therapeutic duplication</td>
<td>1 (1)</td>
<td>1</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>150 (100)</strong></td>
<td><strong>147</strong></td>
</tr>
</tbody>
</table>

*Percentages do not total 100 because of rounding.

### Table 3. Preventable Adverse Drug Events

<table>
<thead>
<tr>
<th>Medication-Related Metrics</th>
<th>Study Group (n = 86)</th>
<th>Control Group (n = 79)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total patient days</td>
<td>350</td>
<td>339</td>
<td>NA</td>
</tr>
<tr>
<td>No. of medications per patient</td>
<td>15.58 (5.73)</td>
<td>14.95 (7.67)</td>
<td>.55</td>
</tr>
<tr>
<td>Total drug charges, $</td>
<td>32 647</td>
<td>30 450</td>
<td>NA</td>
</tr>
<tr>
<td>No. of events (%)</td>
<td>2 (2.5)</td>
<td>9 (10)</td>
<td>.02</td>
</tr>
<tr>
<td>No. of events per 1000 patient days</td>
<td>5.7</td>
<td>26.5</td>
<td>NA</td>
</tr>
<tr>
<td>No. of events per $1000 drug charges</td>
<td>0.06</td>
<td>0.60</td>
<td>NA</td>
</tr>
</tbody>
</table>

Abbreviation: NA, not applicable.
medical problem and to develop a treatment plan. This is the step in the patient care process in which the pharmacist may contribute to improving the quality of patient care. In most practice settings, the pharmacist is placed distant from the medication selection step of the patient care process. The information required for evaluating the appropriateness of drug therapy is limited for most pharmacists practicing in an institutional setting. Intervening with recommendations to adjust doses, to add or delete drugs to therapy, to monitor laboratory values, or to identify potential problems at discharge are more difficult to identify and to respond to in a timely manner because of the pharmacist’s distance from the decision-making process.

The Institute of Medicine report To Err Is Human recommends a systems approach to addressing the prevalence of medical error. The Institute of Medicine states that pharmacists should be included during the rounding process as one strategy to improve medication safety. Thus, the pharmacist would be able to recommend medication, doses, and monitoring parameters for the patient. Recommendations are more effective during the rounding process when these decisions are made. A survey of 934 acute care hospitals in 1992 found that 14.9% of them had pharmacists participating in the rounding process. Those hospitals that did have this service had significantly less drug charges.9 Our study found that 14.9% of them had pharmacists participating in the rounding process as one strategy to improve medication safety. Further research is required to evaluate the impact of rounding pharmacists on preventable ADEs in specialty units.

Finally, the preventable ADE rate in the study by Leape et al was lower than the reported rate in our study.
even though the study by Leape et al involved intensive care patients. We used the same definition of preventable ADE. However, there could have been differences in how these definitions were operationalized. Also, it may have been less clear in the ICU population if the drug caused a reaction or if the patient condition deteriorated, thus contributing to the differences in measuring preventable ADEs. However, the percentages of reduction in preventable ADEs with a pharmacist on the rounding team in our study and the study by Leape et al7 were consistent.

In summary, a physician rounding team with a pharmacist contributes to a significantly lower likelihood of preventable ADEs than a rounding team without a pharmacist. This was demonstrated in ICUs by Leape et al7 and in general medicine units in our study.

Accepted for publication November 14, 2002.

This study would not have been possible without the assistance of Ed Szandzik, RPh, MBA, David B. Wright, PharmD, Mark Touchette, PharmD, Kate M. Truong, PharmD, Christopher Zimmerman, PharmD, and Theresa Mazurek, RPh, who supported the pharmacist-counseling model. We express gratitude for their support and vision.

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REFERENCES