Reconciliation of discrepancies in medication histories and admission orders of newly hospitalized patients

KRISTINE M. GLEASON, JENNIFER M. GROSZEK, CAROL SULLIVAN, DENISE ROONEY, CYNTHIA BARNARD, AND GARY A. NOSKIN

Am J Health-Syst Pharm. 2004; 61:1689-95

A 1999 Institute of Medicine report received national attention by highlighting system vulnerabilities within health care and indicating that medication errors are a leading cause of morbidity and mortality.1 One area of concern was the increased number of errors occurring in the prescribing phase of the medication-use process due to prescribers’ lack of essential drug knowledge and patient information at the time of ordering.2,9 Pharmacists’ participation in medical rounds has demonstrated a reduction in medication errors in the ordering stage.10-12 However, at most hospitals, pharmacists are not directly involved in obtaining medication histories,13 despite the findings of one study showing that over 70% of drug-related problems were recognized only through a patient interview14 and another study reporting a 51% reduction in medication errors when pharmacists were involved in obtaining medication histories.15

Medication errors and patient harm can result from inaccurate or incomplete histories that are subsequently used to generate medication regimens for hospitalized patients. To ensure that medications are prescribed safely on hospital admission, it is necessary to have an accurate and complete medication history and for health care professionals to validate this information.16 As the health care delivery system becomes more complex and specialized, this issue becomes even more important, as hospitalized patients may receive medications that interact with those taken as outpatients. Furthermore, as patients’ severity of illness increases, there is a greater likelihood that patients will be taking an increased number of medications. Prior investigations have demonstrated that patients taking numerous medications are at a higher risk for adverse drug events (ADEs).17

Discrepancies may exist among what is documented in the patient’s medical record, outpatient clinic or office records, prescription bottles, and outpatient pharmacy records and what medications the patient is actually taking. In 1981, Leister and colleagues18 reported a lack of concordance among physician-generated drug lists, patients’ pharmacy medication profiles, and patients’ current drug lists obtained during home interviews. Since that time, researchers working in a variety of clinical settings have reported similar findings of discrepancies between hospital and clinic records and the medication lists obtained from patients.15,19-22 Discrepancies most often involved patients taking medications for which there was no documentation,15,20-22 patients not taking...
documented medications, differences in dosages. Without appropriate verification of the patient's actual medication regimen (i.e., reconciliation), failure to detect drug-related problems, missed diagnoses, or errors in patient admission orders may occur. Based on medical literature and the results of a previous study conducted at our institution, a multidisciplinary team was formed to assess how medication histories were obtained on admission to our academic medical center. We identified several patient safety practices available to pharmacists for detecting medication discrepancies, but there was a concern that discrepancies may still go undetected because of the potential limitations of each method. For example, pharmacists' participation on rounds captured dosing errors and omissions in medication regimens, but pharmacists did not have the opportunity to attend medical rounds for every patient. When orders were entered into the pharmacy computer, the clinical pharmacist at the satellite pharmacy reviewed order legibility and completeness, drug-drug and drug-allergy interactions, therapeutic duplications, laboratory test values, drug selection, dosing and monitoring guidelines available in evidence-based resources, and information published in the staff handbook Optimizing Medication Use at NMH. Pharmacists also verified medications during dispensing and performed a final check before delivery. These steps may not capture omission errors in admission orders or identify an incorrect medication regimen that appeared correct based on information available to the pharmacist at the time of screening. Pharmacists obtained medication histories and provided education through a number of focused clinical programs for solid-organ transplant recipients, patients infected with human immunodeficiency virus, and patients requiring pain management, anticoagulation, and nutritional support. Pharmacists also periodically interviewed patients to clarify medication orders, verify allergy information, and assess patient compliance. Despite these patient interactions, systematic reconciliation was not a routine activity.

To address system limitations, our multidisciplinary team recommended performing medication reconciliation—confirming the patient's current medication regimen and comparing it with the physician's orders—to identify discrepancies. Any discrepancies or inconsistencies are discussed with the physician, and the order is modified, if necessary. Rozich and Resar found that medication errors were reduced from 213 per 100 admissions to 63 per 100 admissions when medication histories and orders were reconciled at admission, transfer, and discharge. Therefore, performing medication reconciliation on hospital admission could reduce the number of medication errors and the potential for patient harm.

The purpose of this study was to identify the type, frequency, and severity of medication discrepancies in admission orders and assess whether pharmacist-obtained and -reconciled admission medication histories reduced the number of medication errors and the potential for patient harm.

Methods. Patient selection. Patients are admitted to our medical center via the emergency department, directly from physicians' offices (direct admissions), and from other institutions (external transfers). This pilot study focused on direct admissions only, as the majority of these patients were admitted to general medical-surgical units and would most likely participate in an interview regarding their medication histories. Pharmacists received intensive education on the project's purpose and study methodology and training in data collection and the reconciliation process.

From August 7, 2002, to July 15, 2003, medication reconciliation was conducted with a convenience sample of patients directly admitted to a 725-bed, tertiary care, academic medical center. Patients were candidates for providing a medication history if they were directly admitted to any of 12 adult medical-surgical units served by one of two inpatient satellite pharmacies, spoke English, and agreed to participate in an interview by a pharmacist within 24-48 hours of admission. Patients directly admitted to labor and delivery, psychiatry, intensive care, and palliative care units were excluded, as well as those admitted from the emergency department and transfers from other hospitals. The institutional review board at our hospital approved this study.

A list of all direct admissions was obtained every weekday from the admitting department by a research nurse or research pharmacist. This information was provided to clinical staff pharmacists working in the two inpatient satellite pharmacies. From this list, pharmacists or doctor of pharmacy (Pharm.D.) students interviewed a convenience sample of patients who were directly admitted within 24-48 hours of admission to obtain their medication and allergy histories and admission medication orders.

Using a standardized data collection form, a clinical staff pharmacist or Pharm.D. student recorded medication and allergy histories documented in the patient's medical record and medications and allergies listed in the patient's admission orders. The pharmacist reviewed this information before interviewing the patient or patient's advocate. The interview took place in the patient's room (all private rooms) to ensure confidentiality. The discussion between the patient and pharmacist consisted of an assessment of the patient's medication use before admission, including all prescription
and nonprescription medications, investigational therapies, vitamins, herbal remedies, and any other products used to supplement the patient’s health. The interview also included an allergy assessment, classifying reported allergies as “immune-mediated reactions,” “sensitivities or intolerances,” or “no known allergies.” The information obtained during the interview was also recorded on the data collection form.

Reconciliation and intervention. Reconciliation consisted of comparing the medications listed in the admission orders to the medication information documented in (1) the history obtained by the physician, (2) the patient’s admission profile, a form completed collaboratively by the nurse and patient (or patient’s advocate), and (3) information obtained during the pharmacist-conducted interview. A discrepancy was defined as any inconsistency or difference in the medication regimen noted during this manual comparison. A taxonomy of discrepancies was adapted from various sources and is described in Appendix A. For our analysis, categories were collapsed into two groups: “no clarification required” and “discrepancies requiring clarification.”

For discrepancies requiring clarification, the pharmacist clarified conflicting information by confirming it with the patient or patient’s advocate and using additional available resources, such as previous medical records, prescription vials, and follow-up with the patient’s outpatient pharmacy or physician’s clinic or office. A pharmacist contacted the ordering physician to discuss outstanding discrepancies. After consultation, the physician determined if a medication order was to be continued as originally written, changed, or discontinued. Medication discrepancies that were changed or discontinued were considered errors, and the resulting changes were documented.

Each medication error was assessed for the potential to cause patient harm if the discrepancy was not reconciled (resolved), continued throughout the patient’s hospitalization, and continued after the patient left the hospital. The National Coordinating Council for Medication Error Reporting and Prevention’s (NCC MERP’s) 9-point index for categorizing the severity of medication errors was adapted and utilized and is described in Appendix B. A research nurse and research pharmacist collaboratively reviewed, rated, and reached consensus on all NCC MERP ratings. For our analysis of potential harm, categories were grouped into the following: (1) no potential harm (categories A–C), (2) potential monitoring or intervention needed to prevent harm (category D), and (3) potential harm (categories E–I).

Statistical analysis. Data were entered into a Microsoft Excel spreadsheet, version 1997 (Microsoft Corp., Redmond, WA), and analyzed using Excel tools and Epi-Info software, version 2000 (Centers for Disease Control and Prevention, Atlanta, GA). Categorical variables were compared using chi-square analysis or Fisher’s exact test, and continuous variables were compared using Student’s t test for unpaired samples. A p value of less than 0.05 was considered statistically significant.

Results. During the study period, 2046 direct admission patients were candidates for whom pharmacists could obtain and reconcile medication histories with admission medication orders. Of these, 204 direct admissions (10%) were interviewed (115 women and 89 men) by either a clinical staff pharmacist (n = 138) or Pharm.D. student (n = 66). The mean ± S.D. amount of time (self-reported) required to obtain a medication history was 11.4 ± 9.15 minutes per patient (range, 1–75 minutes). The mean ± S.D. interview duration was longer for patients with a discrepancy compared with those without a discrepancy (12.6 ± 10.18 versus 9.9 ± 7.35 minutes, respectively) (p = 0.018). The mean ± S.D. patient age was 58.6 ± 18.4 years (range, 19–96 years), which accurately reflects our patient population. There was no difference in age among patients with a medication discrepancy compared with those without one. The majority of patients (84%) were admitted to the medical service. Neither sex nor managing service accounted for differences among patients with and without medication discrepancies.

While we did not systematically measure severity of illness, the mean ± S.D. number of medications ordered at admission was 7.5 ± 3.8 (range, 1–21), indicating multiple comorbid conditions. The mean ± S.D. number of medications ordered at admission was higher in patients with discrepancies than in those without discrepancies (8.2 ± 3.9 versus 6.6 ± 3.5, respectively) (p = 0.0012). A mean ± S.D. of 1.2 ± 1.5 medication discrepancies per patient (241 total) was identified. The percentage of patients in relation to the number of discrepancies is reported in Table 1.

Pharmacists made 97 interventions involving 55 patients, and the majority (n = 69) of the recommended interventions were accepted by physicians. There were 6 instances in which the investigators were unable to determine whether the clinician accepted the pharmacist’s suggestion or the physician could not be reached and the patient or nurse was to provide further follow-up. There were 2 instances in which the pharmacist elected not to contact the physician; one situation involved clarifying a pharmacy profile, and the other was resolved through patient education conducted by the pharmacist.

For 20 interventions involving 10 patients, physicians provided appropriate rationale for rejecting the interventions. For example, during the pharmacist’s interview, a patient reported that the last ferrous sulfate
dose was taken over one month before hospitalization because the patient's supply ran out. The pharmacist discussed this situation with the physician, who was unaware of the patient's prior ferrous sulfate use. The physician elected not to restart the iron at that time but would take that information into consideration when determining the patient's discharge medication regimen.

The most common discrepancy requiring intervention (41/97 [42.3%]) was complete omission of a medication that the patient reported taking before hospitalization. The next most frequent discrepancy requiring intervention (34/97 [35.1%]) was a different dosage, route, or frequency of medication ordered compared with what the patient was taking before admission. The most frequent class of medications requiring intervention for a medication discrepancy was vitamins and electrolytes. These discrepancies usually occurred when a vitamin or electrolyte the patient was taking as an outpatient was not ordered on hospital admission. The classes of medications frequently associated with discrepancies requiring interventions are listed in Table 2.

By using the NCCMERP rating scale, each medication discrepancy requiring intervention was assessed for its potential to cause patient harm if it had not been reconciled within the first 24–48 hours of admission and was instead continued throughout hospitalization. The majority of the medication discrepancies for which an intervention was accepted fell into categories A–C (38/69 [55%]), indicating that they were unlikely to cause harm. For example, an omission of vitamin E was rated as a category C error because it was not likely to cause patient harm during hospitalization. However, there were 16 discrepancies (23%) that, if a pharmacist had not intervened, could have necessitated patient monitoring or intervention to preclude harm (category D). An example of a category D discrepancy was an order for the extended-release formulation. There were 15 medication discrepancies (22%) that could have resulted in patient harm (categories E and F) if the pharmacist had not intervened. An example of a category E discrepancy was an order for glipizide 15 mg every morning instead of an equivalent dosage of metoprolol succinate in the extended-release formulation. There were 16 discrepancies (23%) that could have resulted in patient harm during hospitalization. However, there were 16 discrepancies (23%) that, if a pharmacist had not intervened, could have necessitated patient monitoring or intervention to preclude harm (category D). An example of a category D discrepancy was an order for regular-release metoprolol tartrate 25 mg daily instead of an equivalent dosage of metoprolol succinate in the extended-release formulation. There were 15 medication discrepancies (22%) that could have resulted in patient harm (categories E and F) if the pharmacist had not intervened. An example of a category E discrepancy was an order for glipizide 15 mg every morning rather than an outpatient dosage of 10 mg. A patient admitted with acute renal insufficiency was ordered gemfibrozil 1200 mg twice daily, which was rated as a category F error, as the patient's outpatient regimen was 600 mg twice daily.

When the potential for patient harm was assessed if the error continued beyond discharge, there was a shift to greater harm. One discrepancy (1%) was not rated for its potential to cause patient harm beyond discharge because the patient's medication course was completed during hospitalization. There were 16 discrepancies that continued to be rated as categories A–C (23%) and 11 situations rated as category D (16%). Of the 41 instances rated as categories E–I (59%), 2 could have resulted in permanent harm (category G) and 1 could have resulted in death (category I). An example of a category G discrepancy was a patient who was taking tablets each containing hydrocodone bitartrate 5 mg and acetaminophen 500 mg (one tablet two or three times daily) in addition to acetaminophen 1000 mg p.o. every six hours before hospitalization. The hydrocodone–acetaminophen tablets were ordered on admission at a dosage of one tablet every four to six hours as needed; however, the physician was unaware of the patient's outpatient acetaminophen use. In this situation, the pharmacist provided patient education, informed the physician about the patient's acetaminophen use and the importance of obtaining this information during an interview, and recommended an alternative combination oral analgesic with a reduced acetaminophen content. An error rated as category I was an order for morphine sulfate oral solution 20 mg/mL to be given 20–30 mL every four hours as needed rather than a dosage of 20–30 mg. This was recently highlighted by the Food and Drug Administration's Medwatch program, which received reports of serious adverse events and deaths due to mistakenly interchanging milliliters for milligrams, resulting in 20-fold overdoses of morphine.

Discussion. More than half of the patients evaluated had discrepancies in their medication histories and admission medication orders. Of the discrepancies requiring clarification, we estimated that, in the absence of a pharmacist intervention, 22% of the discrepancies could have resulted in patient harm during hospitalization and 59% may have resulted in patient harm if the error continued beyond discharge. These results are noteworthy because our sample excluded patients who may have difficulty communicating their medication histories to health care professionals, such as non-English-speaking patients, and higher-risk patients, such as those in intensive care units and patients transferred from other hospitals to our medical center for acute, specialty services. Our results support the importance
of obtaining a complete and accurate medication history and instituting a medication reconciliation program, as demonstrated throughout the literature. Pharmacists are especially suited to obtain medication histories and reconcile discrepancies because of their education, experience, medication knowledge, and patient-counseling skills. Our interviews took about as long as those described by Nester and Hale (13.4 minutes each, on average).

Based on the amount of time required for medication reconciliation and pharmacists’ salaries, we estimated that approximately $5,000 was spent on pharmacists during this pilot study. Prior investigations revealed that the mean cost of injury resulting from ADEs was approximately $2,595 for all ADEs and $4,685 for preventable ADEs. For our study, we estimated that 15 discrepancies (22%) could have resulted in patient harm during hospitalization without a pharmacist intervention. Using the conservative figure, we estimated that the cost of potential harm avoided by pharmacists was almost $39,000 ($2,595 times 15). Therefore, there is a significant return on investment attributed to pharmacists obtaining medication histories and performing reconciliation. In addition, the cost savings of liability claims and lost patient trust in health care by avoiding harm associated with ADEs could also be significant.

As health care providers become more reliant on technology and patients’ health care records become available electronically, data initially entered into the patient’s electronic medical record will likely “follow” the patient from admission to admission. The success of current technologies, such as computerized prescriber order entry (CPOE) and clinical decision support, relies on the accuracy of data entered into the system.

In a previous study conducted at our institution, pharmacists identified in one week 1111 prescribing errors that required intervention with the physician. The authors evaluated whether the confirmed prescribing errors could have been prevented with a CPOE system, concluding that errors due to inaccurate or missing patient medication histories could not be prevented with most CPOE systems. As the implementation of a CPOE system requires time, planning, and resources and because CPOE systems may not capture errors related to medication histories, medication reconciliation can help ensure accurate and complete medication records.

Health care professionals should educate patients about the importance of maintaining an updated medication list and reconciling this information during every health care encounter. Several states are working on this initiative. In South Carolina, several health care organizations are proposing a universal medication form to encourage patients to keep track of their medication and allergy information, while the Massachusetts Coalition for the Prevention of Medical Errors has promoted medication reconciliation as a best practice for hospitals.

There are several limitations to our study. First, a small convenience sample of direct admissions was evaluated at one academic medical center. Our findings were descriptive in nature and may not be representative of all hospitalized patients. Also, trends in certain patient populations (or certain drugs or drug classes) were not noted because of our small sample size and lack of control group. Our sample did consist of patients with a wide range of clinical issues, and our results are consistent with those previously reported. Second, there was a possibility of recall bias. In an earlier study, a pharmacist or Pharm.D. student obtained patients’ medication histories within two hours of admission, before the history was recorded by the nurse, to avoid any second-recall bias. Because of the stress of being hospitalized, the patient or patient’s advocate may not remember the complete medication regimen. By interviewing patients within 24–48 hours of admission, we hoped to optimize patient recall and confirm information obtained by other clinicians and from other resources. Finally, because discrepancies identified and clarified by the nurse, pharmacist, or physician before the pharmacist interviewed the patient and performed medication reconciliation were not included in the analysis, our results may be an underestimation of the actual number of discrepancies that occurred.

Conclusion. Reconciliation by pharmacists of discrepancies in admission medication histories and orders decreased opportunities for medication errors and the potential for patient harm.

Table 2. Medication Classes Frequently Associated with Discrepancies Requiring Interventions

<table>
<thead>
<tr>
<th>Drug Class</th>
<th>No. (%) Interventions (n = 97)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamins and electrolytes</td>
<td>18 (18.6)</td>
</tr>
<tr>
<td>Cardiovascular agents</td>
<td>12 (12.4)</td>
</tr>
<tr>
<td>Gastrointestinal agents</td>
<td>10 (10.3)</td>
</tr>
<tr>
<td>Antidepressants</td>
<td>8 (8.2)</td>
</tr>
<tr>
<td>Nonopioid analgesics</td>
<td>7 (7.2)</td>
</tr>
<tr>
<td>Antidiabetics</td>
<td>6 (6.2)</td>
</tr>
<tr>
<td>Hormonal agents</td>
<td>6 (6.2)</td>
</tr>
<tr>
<td>Antibiotics</td>
<td>6 (6.2)</td>
</tr>
<tr>
<td>Other</td>
<td>24 (24.7)</td>
</tr>
</tbody>
</table>
NOTES

Medication histories and admission orders

References

Appendix A—Types of medication discrepancies noted on hospital admission

1. No discrepancy noted.
2. Discrepancy is noted but no clarification is required because
   a. A new medication is started at admission based on the patient's diagnosis or clinical status.
   b. Physician's decision not to order a medication or to change the medication's dosage, route, or frequency based on the patient's clinical status at admission (e.g., antihypertensive not ordered at admission because of existing hypotension, outpatient antibiotic dosage adjusted based on renal function laboratory test values).
   c. Similar or alternative drug is prescribed based on the hospital’s formulary or patient's condition upon hospitalization (e.g., patient’s H₂-blocker is substituted with the hospital’s formulary medication; before admission, patient is taking a combination oral analgesic and receives an order for a parenteral pain medication via a patient-controlled infusion device on admission).
3. Discrepancy requiring clarification because
   a. Omission of a medication. Patient reports taking a medication before hospitalization that was not ordered at admission. There is no clinical explanation for the omission.
   b. Commission of a medication. A medication is ordered at admission that the patient did not take before hospitalization. There is no clinical explanation for adding the medication to the patient’s therapy.
   c. Different dosage, route, or frequency of a medication than what the patient reports taking before hospitalization is ordered at admission. The differences are not explained by changes in the patient’s clinical status at admission, such as renal or hepatic function, nausea, and vomiting.
   d. Different medication is ordered. A medication in the same therapeutic class is ordered at admission that differs from what the patient reports taking before hospitalization. There is no clinical explanation or formulary justification for the substitution (e.g., patient taking one brand of antilipemic agent before hospitalization but regular-release formulation ordered instead).
Appendix B—Classification of medication discrepancies according to the potential to cause patient harm (adapted from reference 28)

Category A: No error, but capacity to cause error
Category B: Error that did not reach the patient; therefore, no harm
Category C: Error that reached the patient but unlikely to cause harm
Category D: Error that reached the patient and could have necessitated monitoring and/or intervention to preclude harm
Category E: Error that could have caused temporary harm
Category F: Error that could have caused temporary harm requiring initial or prolonged hospitalization
Category G: Error that could have resulted in permanent harm
Category H: Error that could have resulted in permanent harm requiring intervention to sustain life
Category I: Error that could have resulted in death

Program to restrict use of i.v. fluconazole

JASON C. GALLAGHER AND KIMBERLY B. LEE
Am J Health-Syst Pharm. 2004; 61:1695-8

Fungal infections are potentially serious events that can be life threatening. The growing number of immunocompromised patients due to the human immunodeficiency virus epidemic, successful solid-organ transplantation regimens, and bone-marrow-suppressive chemotherapy increases the number of patients who are susceptible to pathogenic fungi.1 Furthermore, financial pressure to keep patients out of the hospital has resulted in a hospital population that is more acutely ill than 10 or 20 years ago, resulting in more fungal infections. Antifungals are expensive, and their necessary use has been rising. Because of these factors, antifungal therapy has become a considerable expense to institutions.

Since its introduction in 1990, fluconazole has become a drug of choice in the treatment of many fungal infections. It has activity against common strains of yeasts and dimorphic fungi, including many Candida species, Cryptococcus neoformans, Blastomyces dermatitidis, Histoplasma capsulatum, Coccidioides immitis, Paracoccidioides brasilensis, and Sporothrix schenckii.2 The low toxicity profile of fluconazole has made it a treatment of choice in susceptible Candida infections.3 Fluconazole is available in both i.v. and oral formulations. The cost difference between the formulations is considerable: direct costs for i.v. fluconazole are approximately seven times those of oral fluconazole.4 Indirect costs, such as nursing time, convenience, and administration-related complications (e.g., catheter-associated bacterial infections), may also be higher with i.v. fluconazole.

The pharmacokinetics of i.v. and oral fluconazole are very similar. The bioavailability of oral fluconazole is very high, approaching 100% in most patients.5,6 The time to peak concentration is less than one hour, and the area under the plasma concentration versus time curve is similar for both forms. Many small studies have been conducted to evaluate oral fluconazole’s bioavailability and pharmacokinetics in populations that may have impaired absorption or excretion of fluconazole.7-13 Oral fluconazole has been shown to be effective in populations with impaired gastrointestinal function,7,8,10 recent major trauma,10 HIV,1,12 leukemia,11 or increased gastric pH1,12,13 and in patients admitted to intensive care units.7,9,10

The utility of i.v.-to-oral antibacterial programs has been documented in the literature.14-17 Some programs were able to document cost savings,15,17 and none were associated with negative clinical outcomes.14-17 In a study evaluating the pharmacoeconomic and clinical outcomes of an i.v. fluconazole restriction policy, pharmacists receiving orders for i.v. fluconazole were permitted to change the order to oral therapy if patients were receiving other oral medications.18 I.V. fluconazole use decreased 47%, with an estimated annual saving of $73,000. No detrimental effect on patient outcomes was noted, even in patients with moderate to severe infections, such as disseminated candidiasis. Recent Infectious Diseases Society of America guidelines for the treatment of candidiasis indicate that oral fluconazole is acceptable for most clinical

JASON C. GALLAGHER, PHARM.D., is Clinical Specialist—Infectious Diseases, Department of Pharmacy Services, Hahnemann University Hospital, Philadelphia, PA; at the time of this study he was Pharmacy Practice Resident, Department of Pharmacy Services, Medical College of Virginia Hospitals, Virginia Commonwealth University Health System (VCUHS), Richmond. KIMBERLY B. LEE, PHARM.D., BCPS, is Clinical Specialist, Antimicrobial Management Team, Department of Pharmacy Services, Medical College of Virginia Hospitals, VCUHS.

Address correspondence to Dr. Gallagher at Hahnemann University Hospital, Broad and Vine Streets, Mail Stop 451, Philadelphia, PA 19102 (jason.gallagher@tenethealth.com).

The contributions of Elizabeth S. Dodds Ashley, Pharm.D., BCPS, for her assistance in manuscript preparation, and Laurie J. Cooksey, Pharm.D., for her assistance with data collection, are acknowledged.

Presented in part at the ASHP Summer Meeting, Baltimore, MD, June 2002.

Copyright © 2004, American Society of Health-System Pharmacists, Inc. All rights reserved. 1079-2082/04/0802-1695$06.00.