Multidisciplinary approach to inpatient medication reconciliation in an academic setting

Prathibha Varkey, Julie Cunningham, John O’Meara, Robert Bonacci, Nima Desai, and Robert Sheeler

Purpose. The effectiveness of a multidisciplinary medication reconciliation process was studied in an inpatient family medicine unit of an academic hospital center.

Methods. In phase 1 of this two-phase study, nurses, pharmacists, and physicians used an admission medication reconciliation form to reconcile patients’ home medications on admission. The form was then reviewed by the pharmacist on the unit and by the attending physician, who reconciled the discharge medication list. The discharge medication list was compared against the patient’s home medications list, inpatient medication profile, and prescriptions documented in the electronic medical record to investigate any medication discrepancies. Pharmacists participating in the study documented and categorized medication discrepancies by the potential severity of the error. In phase 2, family medicine medical residents and staff were instructed to include reconciled admission and discharge medication lists in the hospital summary.

Results. A total of 102 patients formed the study sample. There was no significant difference between phase 1 and phase 2 patients in mean age, sex, and length of hospital stay. Totals of 432 and 367 admission medications required reconciliation during phase 1 and phase 2, respectively. The mean number of admission medication discrepancies decreased from 0.5 per patient in phase 1 to 0 per patient in phase 2. The mean number of discharge medication discrepancies decreased from 3.3 per patient in phase 1 to 1.8 per patient in phase 2.

Conclusion. The mean number of medication discrepancies occurring during admission and discharge decreased after a multidisciplinary medication reconciliation process was implemented in an inpatient family medicine unit of an academic hospital center.

Index terms: Documentation; Errors, medication; Hospitals; Prescriptions; Records

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Adverse drug reactions account for about 4.7% of admissions to U.S. hospitals. Hospital costs related to adverse drug events (ADEs) are estimated to be about $3.8 million per hospital per year, about $1 million of which is preventable. The Institute for Healthcare Improvement’s 100,000 Lives campaign, as well as the Joint Commission on Accreditation of Healthcare Organizations, has identified the prevention of ADEs as a priority for national action. Both organizations have called on health care institutions to perform medication reconciliation as a proven method to reduce ADEs. Medication reconciliation is the process of identifying the most accurate list of all medications a patient is taking, including the name, dosage, frequency, and route of each medication, and using this list to provide correct medications for the patient anywhere within the health care system. Experience from multiple organizations has shown that a lack of medication reconciliation accounts for 46% of all medication errors and up to 20% of ADEs in the hospital setting. To initiate medication reconciliation at the Mayo Clinic in Rochester, Minnesota, we pilot tested a struc-

Address correspondence to Dr. Varkey at the Mayo Clinic College of Medicine, Baldwin 5A, 200 1st SW, Rochester, MN 55905 (varkey.prathibha@mayo.edu).

The assistance of Amanda Davis, Pharm.D., Shaun Bridges, B.S.Pham., Michael Murno, Pharm.D., Denise Root, B.S.Pham., Kristine Gillard, B.S.N., R.N., and Stephanie Bagniewski, B.S., is acknowledged.

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Inpatient medication reconciliation program in the academic family medicine hospital service.

Methods

This study was exempt from review by the institutional review board because it was considered a quality-improvement pilot study. A family medicine hospital inpatient care unit was chosen as the pilot site for the institution as it was a primary care site serving patients of varying complexities of diagnoses, many on a significant number of medications because of older age, and because the staff volunteered for this project. All patients admitted to the family medicine hospital service on the study unit during the study period were eligible for study inclusion.

The study was conducted in two phases, with 51 patients randomly selected for each phase. We deemed that this sample would be sufficient to yield necessary information to enhance change through rapid-cycle testing.

Phase 1. Before the start of this study, no formal medication reconciliation process was in place in the study unit. Medications were reviewed by the medical resident at admission, but pharmacists and nurses did not formally review home medications with patients. As part of the study, an admission medication section was added to the electronic medical record (EMR) in the hospital summary. During patient admission, direct care nurses recorded the patient’s home medication use, including medication name, dosage, route, and frequency of administration, using information obtained from patients, family members, and medication bottles. Nurses, pharmacists, and physicians used an admission medication reconciliation form to reconcile patients’ home medications (Figure 1). After completion of the outpatient medication history, the nurse placed the medication reconciliation form on the patient's chart. The pharmacist on the unit collected the forms on the charts of new patient admissions, compared the nursing admission medication history to the admission medications ordered by the admitting resident, and noted any discrepancies. The admission medication reconciliation form was also reviewed during morning patient rounds by the attending family medicine physician, who reconciled the discharge medication list. Any corrections that needed to be made to the hospital admission orders were communicated to the respective medical resident. This medication reconciliation process was completed within 24 hours of patient admission. This timeframe was chosen based on previous published reports with medication reconciliation in institutional settings. High-risk medications, such as insulin and warfarin, were reconciled before medication administration.

The discharge medication list in the hospital summary document was compared against the patient’s home medications list, inpatient medication profile (active medication orders

<table>
<thead>
<tr>
<th>Patient Name: ___________________________</th>
<th>Clinic Number: ____________</th>
<th>Admit Date: ________________</th>
<th>Time: __________</th>
</tr>
</thead>
</table>

A. Patient medication list at admission (RN):
List medication name, dose, route, and frequency

Check if NH patient _________________________

Total RN Time: _____________________________

RN ______________________________________

B. Written Admission Orders within 3 hours of admission:
✓ if no discrepancy, otherwise add discrepancy in medication name, dose, route or frequency. Please write N.O. if not ordered. RPh

C. Consultant reconciliation: Please ✓ if no discrepancy, and indicate any changes that should be made to the resident orders in Column B and kindly communicate to them as necessary.

Consultant ______________________

<table>
<thead>
<tr>
<th>Daily scheduled medications including over-the-counter medications</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drug name</td>
</tr>
<tr>
<td>-----------</td>
</tr>
<tr>
<td>1.</td>
</tr>
<tr>
<td>2.</td>
</tr>
<tr>
<td>3.</td>
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<tr>
<td>4.</td>
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<tr>
<td>5.</td>
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<tr>
<td>6.</td>
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</tbody>
</table>

<table>
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<tr>
<th>PRN medications and herbal supplements:</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
</tr>
<tr>
<td>2.</td>
</tr>
<tr>
<td>3.</td>
</tr>
<tr>
<td>4.</td>
</tr>
<tr>
<td>5.</td>
</tr>
</tbody>
</table>
Inpatient medication reconciliation

on the day of hospital discharge), and prescriptions documented in the EMR to investigate any medication discrepancies. The discharge medication list included medications received during hospitalization to be continued after discharge, new medications added to the patient's regimen, and any medications that were to be discontinued. Changes to preadmission medications, new medications ordered upon hospital discharge, and discontinued medications were to be specifically noted on the discharge sheet. Pharmacists participating in the study documented and categorized medication discrepancies by the potential severity of the error (appendix).\(^8\) In addition to inaccurate medication information, the omission of newly prescribed medications and the lack of notation of discontinued and changed medications were considered discrepancies because of the potential for harm. These discrepancies were reviewed on a weekly basis by the study team for confirmation and appropriate categorization.

Phase 2. In addition to the processes established in phase 1, family medicine medical residents and staff consultants were instructed to include reconciled admission and discharge medication lists in the hospital summary. A weekly summary e-mail of noted discrepancies was distributed to all caregivers involved in the study. A member from the study group also presented the information to residents and the attending physician before morning rounds each week.

Results

A total of 102 patients formed the study sample. There was no significant difference between phase 1 and 2 patients in mean age, sex, and length of hospital stay (Table 1). Nurses spent a mean of 8.2 minutes in phase 1 and 5.0 minutes in phase 2 obtaining and documenting each patient’s medication history.

Totals of 432 and 367 admission medications required medication reconciliation during phase 1 and phase 2, respectively. On admission, patients were taking a mean of 8.5 medications in phase 1 of the study, compared with 6.7 medications in phase 2 (\(p = 0.12\)).

The mean number of admission medication discrepancies decreased from 0.5 per patient in phase 1 to 0 per patient in phase 2 (\(p = 0.018\)). At discharge, patients in phases 1 and 2 were receiving a mean of 10.5 and 9.2 medications, respectively. The mean number of discharge medication discrepancies decreased from 3.3 per patient in phase 1 to 1.8 per patient in phase 2 (\(p = 0.003\)). Table 2 denotes the types of discrepancies observed at discharge.

The mean length of stay for study patients was three days. When the length of stay was more than three days, the mean discharge discrepancy rate per patient was 3.8 in phase 1 and 2.2 in phase 2, compared with 2.8 in phase 1 and 1.6 in phase 2 when the length of stay was less than three days. The mean discharge medication discrepancy rate per patient was 4.1 in phase 1 and 2.0 in phase 2 when the mean number of discharge medications exceeded 11, compared with 2.5 in phase 1 and 1.5 in phase 2 when the number of discharge medications was fewer than 11.

There were no potentially lethal medication reconciliation discrepancies and one potentially serious discrepancy recorded in phase 2 (Table 3). The percentage of potentially significant discrepancies in phase 2 was lower than in phase 1 (20.9% versus 47.7%), but the percentage of minor discrepancies was greater in phase 2 than in phase 1 (78% versus 48.4%).

Discussion

As hospitals across the nation attempt to address medication reconciliation across the continuum of care, ...
care, the identification of the most effective method for reconciliation is paramount. This study examined medication reconciliation in an academic family medicine inpatient unit.

Discrepancies occurred more commonly during discharge than during admission. Patients’ length of stay and the number of medications patients were taking were also associated with higher numbers of discrepancies. Before implementation of the reconciliation process, 0.5 discrepancy per patient was found on the admission medication list and 3.3 discrepancies per patient were found on the discharge medication list. These discrepancies may have occurred because residents often forget to include home medications on the discharge list that were discontinued on admission to the hospital. These discrepancies may also be linked to our study’s rigorous definition of a discharge medication discrepancy.

A standardized medication reconciliation process using a multidisciplinary approach, academic detailing (targeted one-on-one education), crosschecks, audits, and feedback led to a reduction in medication discrepancies in this study. Studies conducted in other institutions have yielded similar results.⁹⁻¹¹ Along with a decrease in the number of discrepancies after the medication reconciliation process was established, we noted a decrease in the severity of discrepancies that did occur. The majority of potential errors in phase 2 were considered minor in the severity category. Failure to reconcile home, as-needed, and nonprescription medications accounted for the majority of these discrepancies at discharge. We anticipate that health care providers will continue to struggle to accurately reconcile nonprescription medications, as both health care providers and patients may deemphasize the importance or potential safety risk of these drugs in the inpatient setting.

In academic medical centers where residents provide frontline care, medication reconciliation education and implementation should be emphasized on an ongoing basis. In the setting of the current apprenticeship model of education, the role of exemplary staff physicians is vital to the process of medication reconciliation. Although the final responsibility for reconciliation lies with the prescriber, the shared accountability of various team members significantly aids in accurate medication reconciliation. Although reviewing patient medication use was not a standard of inpatient nursing practice at our institution at the time of this study, our study included training nurses to obtain a medication history using information from medication bottles or the most current medication list, including nonprescription medications and herbal supplements, as well as the necessity to bring medication histories for patients being admitted to the hospital.

Although we did not specifically target improvement efforts at patients, their role cannot be underestimated. A recent study found that less than 30% of patients were able to list the medications they were taking at the time of discharge from the hospital.¹² Patients must be taught about the importance of an accurate and updated medication list, including nonprescription medications and herbal supplements, as well as the necessity to bring medication histories to every provider visit or hospital at admission. Such education would significantly enhance the efficiency and accuracy of medication reconciliation.

This study had several limitations. It was conducted as a quality-improvement project and did not have patient randomization, blinding, and other characteristics typical of rigorous research. A Hawthorne effect may have contributed to the decrease in discrepancies from phase 1 to phase 2, as more participants were aware of observation by the study team. Patients were not followed beyond the study period to evaluate for ADEs resulting from the lack of reconciliation; thus, we are not aware of the effect of this process on patient outcomes.

Pharmacists were an outstanding resource for nurses, residents, and consultants as reconciliation was performed through various stages of the hospital stay. During the study, pharmacists had to enhance the quality of the nursing medication lists with additional information on several occasions. After dissemination of the study findings, pharmacists in our institution are now empowered to edit patient medication lists in the electronic hospital summary in collaboration with prescribers to enhance accuracy. In addition, pharmacists have begun performing medication histories for patients being admitted to the hospital.

NOTE

Inpatient medication reconciliation

<table>
<thead>
<tr>
<th>Error Type</th>
<th>No. (%) Errors</th>
<th>Phase 1 (n = 153)</th>
<th>Phase 2 (n = 91)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minor</td>
<td>74 (48.4)</td>
<td>71 (78.0)</td>
<td></td>
</tr>
<tr>
<td>Significant</td>
<td>73 (47.7)</td>
<td>19 (20.9)</td>
<td></td>
</tr>
<tr>
<td>Serious</td>
<td>4 (2.6)</td>
<td>1 (1.1)</td>
<td></td>
</tr>
<tr>
<td>Life threatening</td>
<td>2 (1.3)</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>

Table 3. Severity of Error Ratings for Medication Discrepancies in Study Phases 1 and 2
on medical outcomes. The EMR used in this unit was not interactive with the discharge medication list, likely accounting for errors. An advanced EMR is being developed for the inpatient and outpatient areas and may improve the medication reconciliation process. In our study, the potentially life-threatening medication discrepancies noted in phase 1 were caused by copying and pasting an inaccurate list of home medications into the discharge medication list.

This study demonstrated the benefit of a multidisciplinary approach to medication reconciliation in an academic setting. Future research should explore the use of electronic tools in medication reconciliation, the effect of outpatient medication reconciliation on inpatient medication reconciliation, and the effect of inpatient medication reconciliation on ADEs.

Conclusion
The mean number of medication discrepancies occurring during admission and discharge decreased after a multidisciplinary medication reconciliation process was implemented in an inpatient family medicine unit of an academic hospital center.

References

Appendix—Definitions and examples of minor, significant, serious, and life-threatening medication errors

- **Minor**: Incomplete information in medication order; unavailable or inappropriate dosage form; nonformulary drug; illegible, ambiguous, or nonstandard abbreviation.
- **Significant**: High dosage (1.5–4 times normal dosage) of drug with low therapeutic index, drug dosage too low for patient’s condition, errant dual-drug therapy for single condition, inappropriate dosage interval, omission from medication order.
- **Serious**: Dosage resulted in serum drug concentration in potentially toxic range, drug could exacerbate patient’s condition, misspelling or mix-up in medication order could have led to dispensing of wrong drug.
- **Life threatening**: High potential for life-threatening adverse reactions, potentially lifesaving drug at a dosage too low for the disease being treated, high dosage of drug with low therapeutic index.