Effect of Admission Medication Reconciliation on Adverse Drug Events From Admission Medication Changes

Medication reconciliation, a process by which a health care provider obtains and documents a thorough medication history with specific attention to comparing current and previous medication use, has been a focus of major patient safety initiatives. Evaluations of medication reconciliation programs have reported factors associated with successful implementation1 and its effect on prescribing outcomes such as medication errors2 and potential adverse drug events3 but not its effect on actual adverse drug events (ADEs). The objective of this study was to estimate the effectiveness of inpatient medication reconciliation at the time of hospital admission on ADEs caused by admission prescribing changes.

Methods. The study setting was an urban, academic Department of Veterans Affairs (VA) medical center. A computerized medication reconciliation tool and admission process were developed to comply with the Joint Commission’s National Patient Safety Goal. The tool consisted of a dialogue with which a health care provider could (1) view the patient’s outpatient medication use for the last 90 days from VA computerized pharmacy data, (2) view current VA inpatient orders, (3) record discrepancies between patient-reported medications and outpatient and inpatient medications in the VA computerized database, and (4) record diagnostic indications for each medication and a response to each discrepancy. The tool was implemented in a staggered fashion between October 2005 and February 2006 on the 2 general medical units, with early and later implementation units. New admissions were assigned on an alternating basis between the units. Study procedures were approved by our institutional review board.

To ascertain the main outcome, which was ADE “probably” or “certainly” caused by an admission medication change, a research pharmacist (S.B., A.K., K.A.M., or J.Y.) reviewed medical records retrospectively and recorded adverse events during the hospital stay and 1 month after hospital discharge using predefined criteria. She rated whether each event was caused by an admission medication change using structured implicit review.4 An ADE was considered the result of an error when the admission prescribing change was classified as a “probable” or “certain” error.

The unit of analysis was hospitalization episode. We examined outcome as a function of admission unit and month (either an intervention unit-month or control unit-month), regardless of whether the medication reconciliation tool was actually used (ie, intention to treat), using multivariate logistic regression. Models included as covariates: age, race, number of chronic conditions, number of medications prescribed preadmission, receipt of any non-VA medications before admission, admission illness severity, nonbusiness hours admission, surgical service as primary team, and unit. Models were estimated using generalized estimating equations to account for clustering of patients by admitting physicians.

Results. Overall, 612 patients were admitted 795 times. Patients were 97.5% male, 66.9 years old on average, 48.2% white, and were taking a mean of 6.4 medications before admission. There were no significant differences between early and later study units in patient characteristics. There was an overall frequency of 0.165 ADEs caused by an admission medication change per admission (131 during 795 admissions; 95% confidence interval [CI], 0.140-0.193). Ninety-eight (75%) were symptomatic; 6 (4.5%) caused prolonged hospital stays; 1 (0.8%) required intensive care; and 5 (3.8%) caused hospital readmission after discharge. In addition, 66 (50%) were classified as due to errors, for an overall frequency of 0.083 ADEs caused by admission prescribing changes that were errors per admission (95% CI, 0.065-0.105).

Medication reconciliation was associated with fewer ADEs caused by admission prescribing changes that were errors (adjusted odds ratio, 0.57; 95% CI, 0.33-0.98; P = .04) but not with ADEs caused by all admission prescribing changes (adjusted odds ratio, 1.04; 95% CI, 0.68-1.61; P = .86) (Table). Of note, during intervention unit-months, 194 of 359 admissions (54%) received admission medication reconciliation (indicating partial adherence), and during control unit-months 25 of 436 admissions (5.7%) received medication reconciliation (indicating slight contamination).

Comment. In this study of medication reconciliation at the time of hospital admission, we found that medication reconciliation reduced by 43% ADEs caused by admission prescribing changes classified as errors but did not reduce ADEs caused by all admission prescribing changes. One example of a non–error-related ADE was...
discontinuation of transdermal nitroglycerin use in a patient with low blood pressure on admission and subsequent harm from recrudescent angina. Adverse drug events of this type would not be averted by 1-time medication reconciliation on admission, but might be averted by improved provider awareness and monitoring of admission prescribing changes during the hospital stay. The potential impact of such an intervention is large, since 50% of ADEs in this study were caused by admission medication changes that were not errors—a percentage consistent with other studies—and 85% of the ADEs in this study occurred before hospital discharge and would not be averted by discharge medication reconciliation.

Our findings are important because few studies have examined medication reconciliation’s effect on patient health, perhaps because of the resource intensiveness of ascertaining ADEs. One study showed a reduction of similar magnitude in discrepancy-related ADEs with medication reconciliation on readmission to a nursing home, but the magnitude in discrepancy-related ADEs with medication reconciliation is important given the resource-intensive nature of the process and organizational challenges with its implementation. Another study showed no difference in hospital use with medication reconciliation at the time of hospital discharge. Medication errors or discrepancies are an imperfect surrogate for ADEs because they are very common and only a small fraction of them cause harm. Studies have shown that medication errors that occur on hospital admission are most commonly incorrect or incomplete medication histories, variances in patient compliance from what is prescribed, and, as shown in the present study, noncomprehensive data systems (ie, a substantial minority of study patients received medications from outside the VA system).

A limitation of this study was that the medication reconciliation process during the first 3 months of implementation did not yet fit ideally into health care provider workflow and adherence was low. Although our findings provide overall support for medication reconciliation, they suggest that the optimal form of medication reconciliation should include tools to track prescribing changes that occurred on admission so that patients are not harmed by their unmonitored propagation during the hospitalization. Additional research on the effect of medication reconciliation on ADEs is important given (1) our finding of its association with no change in or even an increase in non–error-associated ADEs and (2) the resource-intensive nature of the process and organizational challenges with its implementation.

Kenneth S. Boockvar, MD, MS
Sharon Blum, PharmD
Anne Kugler, PharmD
Elayne Livote, MS
Kari A. Mergenhagen, PharmD
Jonathan R. Nebeker, MD
Daniel Signor, BS
Soojin Sung, PharmD
Jessica Yeh, PharmD

Author Affiliations: Geriatrics Research, Education, and Clinical Center, James J. Peters Veterans Affairs Medical Center, Bronx, New York (Dr Boockvar and Yeh; Ms Livote; and Mr Signor); Department of Geriatrics and Palliative Medicine, Mount Sinai School of Medicine, and Jewish Home Lifecare, New York, New York (Dr Boockvar); Brookdale University Hospital (Dr Blum) and Long Island University College of Pharmacy (Dr Kugler), Brooklyn, New York; VA Western New York Healthcare System, Buffalo, New York (Dr Mergenhagen); VA Geriatrics Research, Education, and Clinical Center, and University of Utah, Salt Lake City (Dr Nebeker); and Lutheran Medical Center, Brooklyn (Dr Sung).

Correspondence: Dr Boockvar, James J. Peters VA Medical Center, 130 W Kingsbridge Rd, Bronx, NY 10468 (kenneth.boockvar@mssm.edu).

Author Contributions: Dr Boockvar had full access to all the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis. Study concept and design: Boockvar, Nebeker, and Sung. Acquisition of data: Boockvar, Blum, Kugler, Livote, Mergenhagen, Signor, and Yeh. Analysis and interpretation of data: Boockvar, Blum, and Signor. Drafting of the manuscript: Boockvar, Blum, Sung, and Yeh. Critical revision of the manuscript for important intellectual content: Boockvar, Blum, Kugler, Livote, Mergenhagen, Nebeker, and Signor. Statistical analysis: Boockvar and Livote. Obtained funding: Boockvar. Administrative, technical, and material support: Boockvar, Blum, Sung, and Yeh. Study supervision: Boockvar and Blum.

Financial Disclosure: None reported.

Funding/Support: This work was supported by a VA Health Services Research and Development grant IAB-05-204. Dr Boockvar is also supported by the Greenwall Foundation.

Role of the Sponsor: The sponsor had no role in the design and conduct of the study; collection, management, analysis, and interpretation of the data; or preparation, review, or approval of the manuscript.

Previous Presentations: This study was presented as a poster at the VA National Medication Reconciliation Conference; May 18-20, 2010; Salt Lake City, Utah; and at the VA Office of Quality and Performance Systems Redesign Conference; June 22-24, 2010; San Francisco, California.