

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.⁵

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

Table. Multivariable Models for the Association Between Admission to a Unit With Medication Reconciliation (Intention-to-Treat) and Outcomes

Variable	ADEs Caused by Erroneous Admission Medication Changes, OR (95% CI)	ADEs Caused by All Admission Medication Changes, OR (95% CI)
Admission to a unit with medication reconciliation	0.57 (0.33-0.98) ^a	1.04 (0.68-1.61)
Age	0.99 (0.97-1.00)	0.99 (0.98-1.01)
Preadmission medications	1.15 (1.06-1.25) ^b	1.11 (1.04-1.18) ^b
Illness severity	1.12 (1.03-1.22) ^a	1.14 (1.07-1.22) ^c
Race, white	0.97 (0.57-1.65)	0.93 (0.58-1.48)
Admission off-hours	1.33 (0.77-2.29)	1.04 (0.67-1.61)
Chronic conditions	0.97 (0.86-1.10)	1.03 (0.92-1.15)
Surgical service	3.87 (1.30-11.5) ^a	3.34 (1.35-8.22) ^b
Use of any non-VA medication	1.63 (0.68-3.87)	1.45 (0.70-3.00)
Unit, "early" (reference, "late")	0.72 (0.41-1.27)	0.83 (0.54-1.29)

Abbreviations: ADEs, adverse drug events; CI, confidence interval; VA, Department of Veterans Affairs.

^a $P < .05$.

^b $P < .01$.

^c $P < .001$.

discontinuation of transdermal nitroglycerin use in a patient with low blood pressure on admission and subsequent harm from recrudescing 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 studies⁶—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 from a hospital.⁷ Another study showed no difference in hospital use with medication reconciliation at the time of hospital discharge.⁸ Medication errors or discrepancies are an imperfect surrogate for ADEs because they are very common and only a small fraction of them cause harm.⁶ Studies have shown that medication errors that occur on hospital admission are most commonly incorrect or incomplete medication histories,⁵ variances in patient compliance from what is prescribed,⁹ 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.

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