Potential Adverse Drug Events and Associated Costs During Transition from Hospital to Home

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OBJECTIVE: The purpose of this study was to evaluate differences in medication discrepancy identification between pharmacists and nurses for patients 50 years of age and older receiving home health services following discharge from an inpatient hospital. It also evaluates the potential cost savings to the health care system as a result of avoiding adverse drug events (ADEs). Medication discrepancies were documented within seven days following hospital discharge.

DESIGN: The study was a secondary analysis of existing data from a completed randomized clinical trial.

SETTING: Home health care following transition from inpatient hospital care.

PARTICIPANTS: Hospitalized patients (N = 101) 50 years of age or older referred for home care services following discharge.

INTERVENTION: Existing data on medication discrepancy identification by pharmacists and nurses and potential costs of ADEs that could result were evaluated. Anticipated costs of ADEs unrecognized by nurses were estimated using Centers for Medicare & Medicaid Services claims data.

MAIN OUTCOME MEASURES: Number and severity of medication discrepancies identified by pharmacists and nurses, potential consequences for patient health and health care utilization, and anticipated costs to the health care system.

RESULTS: Pharmacists identified 677 medication discrepancies, of which 271 (40%) were considered likely to result in an ADE. Nurses identified 202 (30%) of the 677 medication discrepancies identified by pharmacists. It was estimated that approximately $9,670 in additional health care expenses could have been prevented within the cohort by pharmacist intervention.

CONCLUSION: Pharmacists identified more medication discrepancies during transition from hospital to home when compared with nurses, with the potential benefit of preventing more ADEs and saving associated health care costs during such care transitions.

KEY WORDS: Adverse drug event, Care transitions, Health care costs, Medication discrepancy, Pharmacist.

ABBREVIATIONS: ADE = Adverse drug event, CAU = Care as usual, CMS = Centers for Medicare & Medicaid Services, ED = Emergency department, MDT = Medication Discrepancy Tool, ME = Medication error.

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Introduction

Accurate communication regarding patients' medication use is difficult across the continuum of care, but is particularly challenging during care transitions, with inferior transitional care processes likely contributing to medication errors (MEs) and adverse drug events (ADEs).[1-3] Preventable ADEs have been shown to frequently occur in a variety of settings including the hospital, long-term care, and ambulatory/outpatient care. ADEs occurring specifically in the outpatient setting are estimated to cost the health care system approximately $4.2 billion every year.[4] ADEs that lead to emergency department (ED) visits are known to be clinically significant and result in increased resource utilization and costs to the health care system.[5,6] The transition from hospital to community settings, including those receiving home

care services, is an exceptionally risky time for ADEs to occur. This is particularly true for older adults with multiple chronic morbidities, thus placing them at risk for medication discrepancies (differences in prescribed versus actual medication use) and associated ADEs.[7-10] Interventions to improve medication safety during transitions of care are therefore critical to enhance patient safety, improve clinical outcomes, and convey cost savings to the health care system.

In general, home health care includes a range of health care services that can be provided within the home environment to manage illness and/or injury. Our previous work indicates that up to 90% of patients experience at least one medication discrepancy in the transition from hospital to home care, and discrepancies occur within all therapeutic classes of medications.[2,3] Patients with hospital to home care medication discrepancies are almost twice as likely to be readmitted to the hospital within 30 days, compared with patients with no such discrepancies.[11] Similarly, ADEs result in increased resource utilization including additional diagnostic tests, physician visits, medication use, ED visits, and hospitalizations.[12]

A critical need exists to develop and implement medication risk management strategies to improve medication use and patient outcomes. Among all members of the health care team, pharmacists are ideally suited to identify medication discrepancies during transitions in care and, ultimately, prevent ADEs and resultant health care utilization and associated costs. While pharmacists are well trained to carry out such tasks during transitional care, the incremental benefit of a pharmacist versus other members of the team in a home health care environment is less certain. Indeed, the cost of employing pharmacists to perform such duties in the home health environment is a potential barrier. The purpose of this secondary analysis was to, first, evaluate differences in medication discrepancy identification between pharmacists versus nurses for patients receiving home health services. Second, it was to determine if pharmacists were more likely than nurses to identify significant medication discrepancies with the potential to result in ADEs. Third, it was to determine the cost savings to the health care system because of avoiding potential ADEs from medication discrepancies that were detected by pharmacists, but not identified by nurses.

Methods

Following Providence Health Care Institutional Review Board approval, an analysis was performed of secondary data from a previous study that evaluated and categorized hospital-to-home medication discrepancies via review of medical records and completion of participant interviews. ADE severity ratings and the potential impact of each ADE on health consequences and subsequent health care utilization were additionally utilized in the present analysis. A cost analysis was completed to determine the potential reduced ADE costs associated with having a pharmacist facilitate medication discrepancy identification and resolution during hospital to home care transitions for older adults.

Participants

Participants in the prospective parent study were discharged from one of two hospitals and received home health care services from a Medicare-certified home health agency. The home health care agency and both hospitals resided within the same health system. Hospitalized patients were eligible for participation if they were 50 years of age or older, were referred for home care services after hospital discharge, and had at least one of the following diagnoses: 1) cardiovascular condition, 2) peripheral vascular disease, 3) diabetes mellitus, 4) cerebral vascular accident, or 5) chronic obstructive pulmonary disease. Participants were excluded from participation if they had a known terminal illness (documented within the medical record with a life expectancy of six or fewer months), did not speak or understand English, or if they were not expected to receive skilled home care nursing services.[3] In the parent study, participants were randomized to either an intervention arm where a study nurse actively identified and worked to resolve medication discrepancies, or to a care as usual (CAU) group. Of note, the CAU group received high-quality home care services inclusive of in-home nursing visits and access to additional home care services (e.g., physical therapy, occupational therapy, social services, etc.) as-needed, and thus received more health care oversight than the typical patient transitioning out of the hospital back to home. In both arms, a study pharmacist conducted a home visit within seven days following hospital discharge to document medication discrepancies to provide a "gold standard" account of discrepancies for each study participant. The present analysis examined only those participants randomized to the intervention group (N = 101), where medication discrepancy identification was documented

independently by both a study nurse and a study pharmacist.[3]

Documentation of Medication Discrepancies

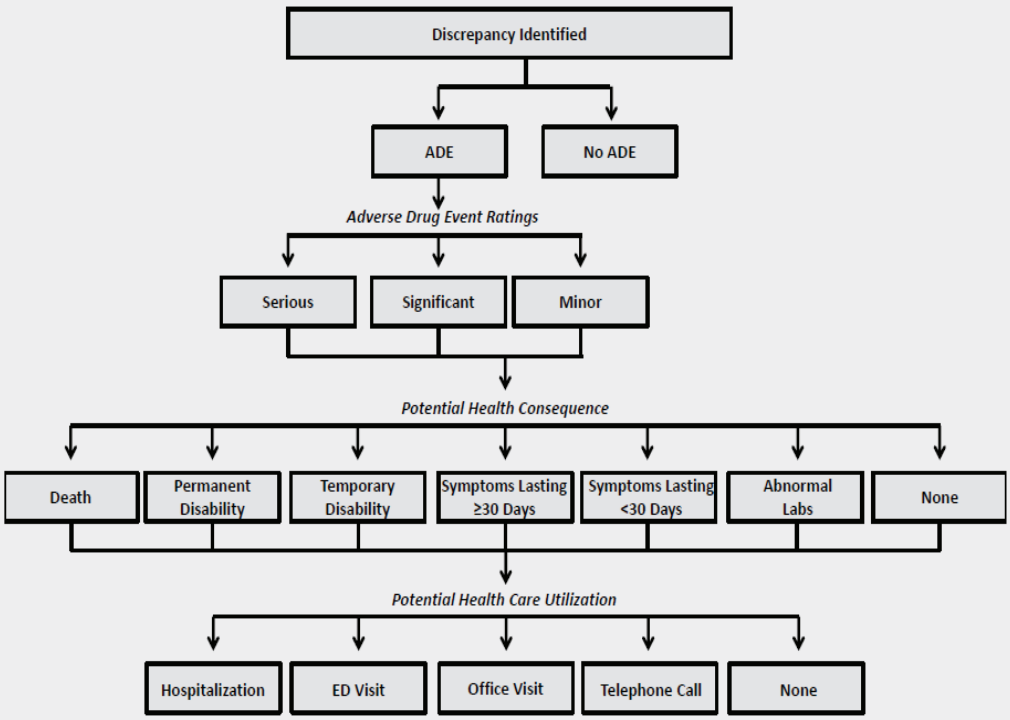
Medication discrepancies were operationally defined as any difference in medications being taken per patient/caregiver report (inclusive of prescription medications and over-the-counter/herbal products) in the home when compared with the instructions on the hospital discharge medication list. The nurses and pharmacists had ready access to the hospital discharge medication list through the home health agency. Each discrepancy was documented and classified using the Medication Discrepancy Tool (MDT).[13] The MDT is a tool that assists in describing and subsequently categorizing medication discrepancies by cause and/or contributing factors (e.g., wrong dose, intentional nonadherence, etc.). Nurses and pharmacists involved in medication discrepancy identification received training by the research team before the study began on standardized use of the MDT. Both the study nurses and study pharmacists independently utilized the MDT to document medication discrepancies for participants included in the present analysis. The nurses used information gathered via use of the MDT to actively resolve identified medication discrepancies. Results from the primary study have been previously reported.[3]

Classification of ADEs and Potential Health Consequences

Medication discrepancies were further independently evaluated by two additional pharmacists with experience identifying and resolving medication discrepancies.[14] Briefly, for each documented discrepancy, the reviewing pharmacists were provided with: 1) the age and gender of the participant, 2) medication name, 3) a brief narrative description of each discrepancy, and 4) categorization information for the documented discrepancy per the MDT. Based on medications within each participant's medication regimen and the type of discrepancy identified, the pharmacists projected whether each discrepancy would provoke a *potential* ADE and, if so, the potential severity of the ADE (serious, significant, or minor).[14] ADEs were defined as "potential" because the discrepancies that could have led to an ADE were detected and resolved before clinical consequences were experienced by study participants. The scheme utilized to conduct the review of discrepancies was based on the conceptual framework developed by Weingart and colleagues to assess drug-drug interaction safety alerts.[15] The model was modified to better assess the potential of a medication discrepancy to contribute to an ADE that could then potentially require additional health care utilization (see Figure 1).[14] In terms of ADE severity, minor potential ADEs were defined as those that could result in minimal injury or discomfort (such as flushing or mild stomach upset). Significant potential ADEs were defined as those that could cause or contribute to symptoms, such as fever or pruritus; laboratory abnormalities, such as hypoglycemia or hyperkalemia; or result in changes to vital signs, such as tachycardia. Serious ADEs were considered those that could potentially result in significant organ injury or failure, such as major gastrointestinal bleeding or onset of angina.[14,15] For those medication discrepancies deemed to potentially contribute to an ADE, the pharmacists noted potential health consequences if the medication discrepancy was not detected and resolved by study team medication review.[14] Potential health consequences included: death, permanent disability, temporary disability, symptoms present 30 days or longer, symptoms present for fewer than 30 days, abnormal lab results, or ADE but with no practical consequence. Finally, each ADE was rated in terms of potential resultant health care utilization, as outlined in Figure 1.[14]

As previously reported, cross tabulations among the independent pharmacists' judgments for whether medications would potentially result in an ADE revealed 84% agreement for medication discrepancies judged to cause an ADE, and 62% agreement for those discrepancies judged to not contribute to a potential ADE.[14] The overall initial agreement between pharmacists for all medication discrepancies evaluated resulted in a Cronbach's alpha for inter-rater reliability of 0.59. To adjudicate for disagreement, the pharmacists discussed those medication discrepancies for which there were discordant opinions about severity ratings or resultant health consequences/health care utilization to reach a consensus. If a consensus was not reached, a physician coinvestigator (a single physician not involved in the care of study participants) reviewed the medication discrepancy and independently rated the discrepancy per the predetermined conceptual model (Figure 1). In all cases of disagreement, the physician coinvestigator's assessment agreed with that of one of the pharmacist evaluators. In these cases, the evaluation and ratings of the physician were used.

Firgure 1. Conceptual Model for Assessing the Potential for Medication Discrepancies to Contribute to an ADE and Subsequent Health Care Utilization



Abbreviations: ADE = Adverse drug event, ED = Emergency department.
Source: Adapted from Reference 15.

Data Analysis

Medication discrepancy data recorded by study pharmacists and nurses were tabulated for each study participant and compared. Medication discrepancy data recorded by study pharmacists were considered the "gold standard" for each participant. Discrepancies identified by the study nurse were then compared against the list generated by the study pharmacist to compare and quantify medication discrepancy identification by pharmacists versus nurses. ADE severity and health care consequences determined in a previous analysis were used to characterize discrepancies identified/not identified in each case.[14]

An important contribution of this research is to translate potential reduction in medication discrepancies through pharmacist-led medication management intervention into potential cost savings. Cost savings would be realized if ADEs that led to health service use such as physician office visits, ED visits, and hospitalizations were more readily prevented by having pharmacists rather than nurses conduct medication reconciliation during hospital to home care transitions. To calculate the average payment for ADEs that led to ED visits, hospitalizations, and office visits, we used administrative data from the Centers for Medicare and Medicaid Services (CMS) for all Medicaid beneficiaries in the state of Washington in 2013. There are three important benefits to using the CMS data. First, the data are derived from actual costs, not self-reported costs, and reflect all Medicaid enrollees in the state. Second, these data note whether the event led to hospitalization and whether the event was first reported in or outside of an ED. This allows us to estimate costs by ADE severity. Third, among various private- and public-sponsored health insurances, Medicaid usually has the lowest provider reimbursement rates. Thus, comparing the intervention costs to Medicaid costs provides a lower bound

Table 1. Average Medicaid Costs Due to Adverse Drug Events

Characteristic	Hospitalization	ED No Hospitalization	No ED No Hospitalization
Including $0 values	$3,982.69	$30.52	$14.65
	N = 1,002	N = 7,277	N = 28,086
	($9,514.54)	($88.40)	($71.99)
Excluding $0 values	$8,527.05	$132.02	$60.11
	N = 468	N = 1,682	N = 6,845
	($12,458.24)	($142.88)	($136.14)

Note: Standard deviations are shown in parentheses.
Abbreviation: ED = Emergency department.

estimate for cost-savings. In other words, any positive cost-savings using data from the Medicaid population would imply greater-than-estimated cost-savings in the general population. The Medicaid Analytic eXtract (MAX) data from January 1 to December 31, 2013, are the most recent Medicaid data available from the state of Washington, consisting of approximately 1.48 million beneficiaries. Each calendar year the MAX database includes one individual-level summary file and four claims files. We used the Inpatient (IP) and Other Therapy (OT) claims file to examine ADE instances. A primary ICD-9 diagnosis code within 960-979 or E850-858 range was used to diagnose an ADE. The IP and OT claims files also contain information regarding location of provider, which allowed us to determine if, for instance, an ADE was reported in an ED. In Table 1, we provide average health care costs related to ADEs and the corresponding standard deviations. Costs are calculated for three instances – when an ADE is reported at an ED which may or may not lead to hospitalization, when an ADE leads to hospitalization but not through an ED, and when an ADE is reported outside an ED and does not lead to hospitalization (such as an office visit). The first row shows costs including zero payments, while the second row excludes zero payments. During cost comparison analysis using the intervention data, we used the latter values, as it is not known whether the zero payments are due to Medicaid nonreimbursement in the event of a rehospitalization within 30 days.

Data analyses and computations were conducted using SPSS version 24.0 (IBM, Chicago, IL) and SAS version 9.2.

Results

Results describing the types of medication discrepancies identified and medications most commonly associated with potential ADEs have been previously reported.[3,14] Briefly, the most common types of medication discrepancies identified in the larger parent study included: *discharge instructions incomplete/inaccurate/illegible*, *intentional nonadherence*, *conflicting information from different informational sources*, and *did not fill prescription*.[3] The top five medication classes for which medication discrepancies were recorded and determined to potentially contribute to an ADE were: antihypertensive agents, opioids, anticoagulants, antidiabetic agents, and inhaled COPD/asthma medications.[14] Additionally, medication classes associated with significant ratings were: opioids, antihypertensives, anticoagulants, diuretics, antidiabetic agents, antiarrhythmics, anti-infective agents, systemic corticosteroids, antipsychotic agents, immune suppressants, and antiepileptic medications.[14]

Within the intervention group of the parent study (N = 101), the mean age of participants was 73 years, with study participants ranging from 51-96 years of age (Table 2). The majority (63%) of participants were female, with 82% of participants reporting that they at least completed a high school education. Nearly one-third (31%) of participants self-rated their health as either "fair" or "poor." In terms of medications prescribed at hospital discharge, participants in the intervention group were discharged on a mean of 10.4 medications, with a range of 1-19 medications

Table 2. Characteristics of the Medication Discrepancy Cohort (N = 101)

Characteristic	Value
Age (years ± SD)	73 ± 9.8
Gender (female, %)	63%
High school graduate (yes, %)	87%
Health self-rated as "poor" or "fair" (%)	31%
Medication count on hospital discharge list (number ± SD)	10.4 ± 4.9 (range: 1-19)

Source: Adapted from Reference 3.

prescribed at discharge. In terms of medication discrepancies identified by a pharmacist, 96 of the 101 participants in the intervention group (95%) had at least one medication discrepancy recorded. In total, 677 medication discrepancies were documented by pharmacists within the intervention group. These 677 medication discrepancies identified by the pharmacists were considered the baseline standard by which medication discrepancies identified by the nurses were compared for the present analysis. Of the 677 medication discrepancies identified by the study pharmacists, study nurses documented 202 of them (30%). Using the predetermined conceptual model (Figure 1), 271 (40%) of the medication discrepancies identified by the study pharmacists in the intervention group were determined to potentially result in an ADE. Table 3 provides a summary of ADE severity ratings and the potential health consequences associated with the potential ADEs noted. The majority of potential ADEs were considered minor or significant, with only 4 of the 271 potential ADEs rated as serious. Accordingly, the potential health consequences associated with these potential ADEs were largely either abnormal laboratory values or symptoms lasting fewer than 30 days. No ADEs were rated as potentially leading to permanent disability or death.

For our cost analysis, we monetized the potential health care utilization associated with the potential ADEs. Table 4 provides a summary of potential health care utilization for the 271 potential ADEs identified and the number and percent of each that were identified by the study nurses. The study nurses documented most of the medication discrepancies associated with potential ADEs that would result in an ED visit (86%) and all of those that were rated as potentially resulting in hospitalization. The nurses, however, documented fewer medication discrepancies rated as potentially requiring a telephone call or office visit.

When examining potential health care cost savings, we assigned the dollar values from Table 1 to the findings in Table 3 based on ADE severity. For minor ADE severity, we used $60.11 in health care costs for every additional ADE noted by the pharmacists. We used $132.02 for an additional ADE of significant severity, and $8,527.05 for an additional ADE of serious severity. According to the data displayed in Table 3, study nurses identified 159 fewer medication discrepancies that could lead to a minor ADE. We expect this would lead to $9,557.49 in additional health care expenses in the study group. Study nurses identified only one fewer medication discrepancy that could lead to an ADE of significant severity, which would incur approximately $132.02 in health care costs. There was no difference between the nurses and the pharmacists in identification of medication discrepancies that would result in a serious ADE.

Discussion

While pharmacists are widely recognized as suited to identify and resolve medication-related problems during transitions in care, the cost-effectiveness of utilizing pharmacists versus other health professionals in certain situations and settings has not been documented. The presently reported secondary analysis aimed to explore health care costs associated with the treatment of potential ADEs resulting from medication discrepancies identified by pharmacists beyond those identified by nurses in home health care.

Table 3. ADE Severity Ratings for Pharmacist-Identified Medication Discrepancies and the Potential Impact of Each ADE on Health Consequences and Subsequent Health Care Utilization

RATING	n/N (%)
Would the medication discrepancy result in an ADE? (Yes, n/N [%])	271/677 (40)
ADE Severity Rating	
Minor	73/271 (27)
Significant	194/271 (72)
Serious	4/271 (1)
ADE Potential Health Consequence	
None	3/271 (1)
Abnormal labs	141/271 (52)
Symptoms lasting fewer than 30 days	121/271 (45)
Symptoms lasting 30 days or longer	5/271 (2)
Temporary disability	1/271 (< 1)
Permanent disability	0/271 (0)
Death	0/271 (0)

Abbreviation: ADE = Adverse drug event.

Table 4. Potential Health Care Utilization and Nurse Identification of Potential ADEs

ADE Potential Health Care Utilization	All Discrepancies Identified (n/N [%])	Proportion of Discrepancies Identified by Nurse (n/N [%])
None	40/271 (15)	21/40 (53)
Telephone call	188/271 (69)	54/188 (29)
Office visit	34/271 (13)	9/34 (26)
ED visit	7/271 (3)	6/7 (86)
Hospitalization	2/271 (< 1)	2/2 (100)

Abbreviations: ADE = Adverse drug event, ED = Emergency department.

When considering pharmacist-identified discrepancies as the "gold standard" evaluation, pharmacists identified a total of 677 discrepancies in a group of 101 adults transitioning from hospital to home. The nurses documented 202 of the 677 medication discrepancies documented by the pharmacists. While nurses identified approximately 30% of the medication discrepancies documented by pharmacists, the nurses documented all medication discrepancies rated as potentially resulting in an ADE requiring hospitalization. Additionally, nurses identified six of seven medication discrepancies identified by pharmacists and rated them likely to result in an ADE requiring an ED visit. As noted in Table 4, however,

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the nurses were less likely to document medication discrepancies considered less severe and potentially requiring lower-level clinical interventions, such as telephone calls to the prescriber or a follow-up office visit. While potentially less severe, lower-severity ADEs can be clinically significant and impart costs to patients and the health care system.

Using CMS claims data (MAX), we applied average health care costs related to ADEs (Table 1) to estimate costs associated with potential ADEs and associated health consequences determined for the medication discrepancies documented in the parent study. When accounting for the 159 fewer medication discrepancies that could lead to a minor ADE and the one fewer medication discrepancy that could lead to a significant ADE, it was calculated that an estimated $9,689.51 in additional health care expenses could have been prevented within the study cohort by pharmacist intervention. It should be noted that the additional health care costs do not include other indirect costs to the patients, such as loss of workdays (and income) and transportation costs. Also, as mentioned previously, Medicaid has the lowest reimbursement rates. Thus, we expect the additional medical care costs to be higher than the estimated values presented here for private-insured or even Medicare patients.

This study has several limitations that must be considered. First, the ADEs and associated health care utilization used to assign costs were not actual events, but rather potential events and outcomes. Second, by-design pharmacist-identified medication discrepancies were considered the "gold standard" by which nurse-identified discrepancies were compared. Medication discrepancies identified by nurses, but not pharmacists, were therefore not explored in this analysis. Third, differential costs associated with paying a pharmacist versus a nurse to evaluate medication discrepancies in the home setting were not included in the cost differential reported here, as the time required to complete the MDT was not recorded during the study. Prospective studies designed to assess and incorporate costs of delivering an intervention with different members of the health care team are needed to determine cost-effectiveness.

Conclusion

We conducted a secondary analysis of data from a completed clinical trial to compare identification of medication discrepancies between pharmacists and nurses in the home following hospital discharge. The analysis suggests that pharmacists identify more medication discrepancies when compared with

nurses. Thus, having a pharmacist conduct medication reconciliation during transitions of care has the potential benefit of preventing more ADEs and saving associated health care costs and may offset higher wages incurred by pharmacists compared with nurses in the home health setting. These results support the active role of pharmacists in the home care setting following hospital discharge to improve medication use safety and prevent health care expenditures associated with the treatment of ADEs. Additional research is needed to study the clinical and economic impact of pharmacist-based transitional care interventions in home health care populations at risk for ADEs and re-hospitalization.

REFERENCES

1. Aronson JK. Medication errors: what they are, how they happen, and how to avoid them. QJM 2009;102:513-21.

2. Setter SM, Corbett CF, Neumiller JJ et al. Resolving medication discrepancies in patients transitioning from hospital to home health care: impact of a pharmacist-nurse intervention. Am J Health Syst Pharm 2009;66:2027-31.

3. Corbett C, Setter SM, Daratha KB et al. Nurse identified hospital to home medication discrepancies: implications for improving transitional care. Geriatr Nurs 2010;31:188-96.

4. Burton MM, Hope C, Murray MD et al. The cost of adverse drug events in ambulatory care. AMIA Annu Symp Proc 2007;11:90-3.

5. Budnitz DS, Pollock DA, Weidenbach KN et al. National surveillance of emergency department visits for outpatient adverse drug events. JAMA 2006;296:1858-66.

6. Field TS, Gilman BH, Subramanian S et al. The costs associated with adverse drug events among older adults in the ambulatory setting. Med Care 2005;43:1171-6.

7. Foust JB, Naylor MD, Boling PA et al. Opportunities for improving post-hospitalization medication management among older adults. Home Health Care Serv Q 2005;24:101-22.

8. Greenwald JL, Denham CR, Jack BW. The hospital discharge: a review of high risk care transition with highlights of a reengineered discharge process. J Patient Saf 2007;3:97-106.

9. Kripalani S, LeFevre F, Phillips CO et al. Deficits in communication and information transfer between hospital-based and primary care physicians: implications for patient safety and continuity of care. JAMA 2007;297:831-41.

10. Marcotte L, Kirtane J, Lynn J et al. Integrating health information technology to achieve seamless care transitions. J Patient Saf 2015;11:185-90.

11. Coleman EA, Parry C, Chalmers S et al. The Care Transitions Intervention: results of a randomized controlled trial. Arch Intern Med 2006;166:1822-8.

12. Al-Tajier GK, Kelly WN. Epidemiology, comparative methods of detection, and preventability of adverse drug events. Ann Pharmacother 2005;39:1169-74.

13. Smith J, Coleman E, Min S. A new tool for identifying discrepancies in postacute medications for community-dwelling older adults. Am J Geriatr Pharmacother 2004;2:141-7.

14. Neumiller JJ, Setter SM, White AM et al. Medication discrepancies and potential adverse events during transfer of care from hospital to home. In Battles J, Azam I, Grady M, Reback K, eds. Advances in Patient Safety and Medical Liability. Rockville, MD: Agency for Healthcare Research and Quality (AHRQ); 2017.

15. Weingart SN, Simchowitz B, Padolsky H et al. An empirical model to estimate the potential impact of medication safety alerts on patient safety, health care utilization, and cost in ambulatory care. Arch Intern Med 2009;169:1465-73.