ORIGINAL INVESTIGATION

# Posthospital Medication Discrepancies

## *Prevalence and Contributing Factors*

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**Background:** Despite the national attention being given to the problem of medication safety, little attention has been paid to the medication problems that are encountered by older patients who are receiving care across settings. The objective of this study was to determine the prevalence and contributing factors associated with posthospital medication discrepancies.

**Methods:** The study population consisted of community-dwelling adults aged 65 years and older admitted to the hospital with 1 of 9 selected conditions (n=375). A geriatric nurse practitioner performed a comprehensive medication assessment in the patient's home within 24 to 72 hours after institutional discharge. The assessment focused on what older patients reported taking in comparison with the prehospital medication regimen and the posthospital medication regimen. Prevalence and types of medication discrepancies were categorized using the Medication Discrepancy Tool.

**Results:** A total of 14.1% of patients experienced 1 or more medication discrepancies. Using the Medication Discrepancy Tool, 50.8% of identified contributing factors for discrepancies were categorized as patient-associated, and 49.2% were categorized as system-associated. Five medication classes accounted for half of all medication discrepancies. Medication discrepancies were associated with the total number of medications taken and the presence of congestive heart failure. A total of 14.3% of the patients who experienced medication discrepancies were rehospitalized at 30 days compared with 6.1% of the patients who did not experience a discrepancy ($P=.04$).

**Conclusions:** A significant percentage of older patients experienced medication discrepancies after making the transition from hospital to home. Both patient-associated and system-associated solutions may be needed to ensure medication safety during this vulnerable period.

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NATIONAL ATTENTION TO the problem of medical errors in general and medication errors in particular has increased significantly over the past decade.[1] However, this attention has primarily focused on errors occurring within specific settings. Despite the frequency with which older patients transition across settings,[2,3] few studies have explored the prevalence and types of medication problems experienced by patients who receive care across different settings. Multiple practitioners in unaffiliated institutions may unknowingly prescribe duplicate or contraindicated medication regimens. These inadvertent prescribing actions not only contribute to suboptimal treatment of chronic illnesses, they may also potentially jeopardize patient safety.

Patients with complex care needs frequently require care in different settings and are particularly vulnerable to experiencing medication problems at each care transition, or "handoff," between practitioners.[4-12] This vulnerability is further heightened by a high burden of illness and accompanying polypharmacy, transient or chronic cognitive impairment, and variable health literacy.[13-15] While receiving care in institutional settings, such as hospitals or skilled nursing facilities, patients often assume a passive or dependent role as clinical staff members address their needs. However, on discharge to home, patients (and their family members) are abruptly expected to assume a significant self-management role in the recovery of their condition and in the management of their medications, often with little support or preparation.[16-19]

The problem of medication problems experienced by older adults transitioning across health care settings has received relatively little attention in the medical literature. Gray et al[20] identified adverse drug events in 20% of patients discharged from hospital to home with home health care



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services. Additional studies have reported patients' limited recall of discharge instructions,[21] problems with adherence,[22] frequency of errors on discharge medication lists,[23] and reported problems with medications on return home.[24]

The objectives of this study were (1) to examine the prevalence and contributing factors associated with discrepancies between patients' prehospital medications, posthospital medications, and medications actually taken after discharge and (2) to identify potential risk factors for experiencing medication discrepancies and their association with rehospitalization.

## METHODS

### STUDY SETTING

The study was conducted in collaboration with a large not-for-profit group-model managed care delivery system located in Colorado that cares for more than 60 000 patients aged 65 years and older. The delivery system contracts with a single hospital, 8 different skilled nursing facilities, and a single home health care agency. In general, physicians affiliated with the delivery system practice in a single setting (ie, hospital, skilled nursing facility, or outpatient clinic) and do not follow up patients across settings. The health care delivery system, hospital, and skilled nursing facilities each have a distinct medication formulary. To comply with these formularies, it is not uncommon for substitutions to be made on more than 1 occasion during an episode of illness. The institutional review board of the participating health system and the University of Colorado Health Sciences Center, Aurora, approved the study.

### PATIENTS

Study patients were recruited to participate in the intervention arm of an investigation that aimed to improve care transitions by providing patients and their caregivers with tools and support to encourage them to participate more actively in the transition from hospital to home (ie, the care transitions intervention). A comprehensive description of the intervention is provided elsewhere.[25] The study reported herein—an examination of medication discrepancies—was planned and designed at the same time as the primary intervention study (ie, preplanned rather than post hoc).

Patients were recruited directly from the contract hospital. Inclusion criteria included persons aged 65 years and older, enrollment in the participating health system, nonelective hospital admission, and having at least 1 of the following 9 diagnoses: congestive heart failure, chronic obstructive pulmonary disease, coronary artery disease, diabetes, stroke, medical and surgical back conditions (predominantly spinal stenosis), hip fracture, peripheral vascular disease, and cardiac arrhythmia. These conditions were selected because of their likelihood for requiring skilled posthospital services (ie, leading to additional care transitions).[26] Also, eligible patients had to reside in the community (ie, not in a long-term care institution) both before and after hospitalization. Additional eligibility included the ability to correctly answer at least 3 items of a 4-item cognitive screen. The 4 items included the patient's current age, today's date, the name of the facility, and the patient's telephone number. Patients who were unable to answer at least 3 items correctly could participate provided they had a willing and able caregiver to serve as a proxy. The analysis reported herein includes those patients for whom comprehensive information regarding basic demographic data and medication use was available (n=375).

### MEASURES AND DATA COLLECTION

Determining that a patient experienced (or did not experience) a medication in error implies the existence of a single medication list, or "gold standard," for what the patient should be taking. For patients receiving medications from multiple prescribers across different settings, such a single medication list rarely exists. For example, a discharge summary may not completely account for a patient's prehospital medication regimen, because the hospitalist often does not have access to an accurate list of what the patient took before hospitalization. In the absence of such a gold standard, the use of the term *error* may not be appropriate. Instead, the term *discrepancy*, implying a lack of agreement (incompatibility) between different medication regimens, may provide a more precise term for capturing the potential medical errors that can occur during the transition between acute and postacute care settings.[27]

Previously, we developed the Medication Discrepancy Tool (MDT), which was designed to categorize medication discrepancies that might arise as patients transition across sites of care. This study was conducted from the perspective of the patient and/or caregiver, and, as such, its focus was on the instructions (or lack thereof) provided by health care practitioners to the patient. The development of the tool and interrater and intrarater reliability testing has been reported elsewhere.[28] In brief, the MDT facilitates categorization of the types of discrepancies at the level of the delivery system (inclusive of the prescriber), as well as at the level of the patient. Within each category, the user is given a variety of potential causes for the discrepancy and asked to check all that apply. An example of a system-associated discrepancy includes the situation when the discharge medication instructions are either incomplete or illegible. As to patient-associated discrepancies, an important distinction is made between intentional nonadherence and nonintentional nonadherence. The former refers to a situation when a patient knows what medications were recommended by a prescribing clinician but chooses not to follow this advice. The latter refers to a situation when a patient did not know what medications were prescribed and therefore adherence was not a matter of choice.

The medication assessment protocol was conducted by a geriatric nurse practitioner (GNP) in the patient's home within approximately 24 to 72 hours after discharge either from the hospital (for patients discharged directly to home) or from a skilled nursing facility (for patients receiving posthospital skilled treatment in one of the contract facilities). The patient's family caregiver was encouraged to participate in the assessment. At the time of the home medication assessment, study patients had been introduced to the care transitions intervention but had not yet begun to receive the intervention. Medication assessment concerned the prehospital and posthospital medication regimens. The GNP had access to the patient's prehospital medication list from the health delivery system's electronic medical record, the patient's discharge instructions, and the medication containers in the patient's home. This assessment included both prescribed and over-the-counter medications (with particular attention to nonprescription analgesics, vitamins, and calcium supplementation). For each medication discrepancy identified, the GNP completed an MDT. A given patient may have had more than 1 medication discrepancy.

### STATISTICAL ANALYSIS

The prespecified primary study outcomes included the prevalence of discrepancies, types of discrepancies, classes of medi-



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**Table 1. Patient Characteristics**

| Variable | % |
|---|---|
| Age, y | |
| 65-74 | 51.9 |
| 75-84 | 38.7 |
| ≥85 | 9.4 |
| Female sex | 50.4 |
| Activity of daily living impairments | |
| Bathing | 16.5 |
| Bed mobility | 20.8 |
| Dressing | 11.5 |
| Eating | 4.0 |
| Toileting | 9.9 |
| Walking | 26.9 |
| Married | 57.6 |
| Education | |
| Did not graduate from high school | 13.3 |
| High school graduate | 48.0 |
| At least some college/university/trade school | 38.7 |
| Self-rated health status | |
| Poor | 18.8 |
| Fair | 26.1 |
| Good | 32.8 |
| Very good | 17.2 |
| Excellent | 5.1 |
| Ethnicity | |
| African American | 5.3 |
| Non-white Hispanic | 9.1 |
| White | 85.6 |
| Chronic conditions | |
| Congestive heart failure | 23.7 |
| Chronic obstructive pulmonary disease | 37.7 |
| Diabetes | 29.5 |
| Coronary artery disease | 39.7 |
| Cardiac arrhythmia | 29.8 |
| Stroke | 13.8 |
| Hip fracture | 5.5 |
| Peripheral vascular disease | 7.4 |
| Medical/surgical back problems | 20.4 |
| Hospital length of stay, d | |
| 1-3 | 22.9 |
| 4-6 | 40.3 |
| 7-9 | 18.0 |
| ≥10 | 18.8 |
| Discharge location | |
| Home without home health care | 54.7 |
| Home with home health care | 28.2 |
| Skilled nursing facility | 16.0 |
| Other | 1.1 |

cations most commonly associated with discrepancies, patient- and system-associated factors with discrepancies, and marginal association of discrepancies with rehospitalization. A *t* test was used to compare the number of medications taken between patients who experienced a discrepancy and those who did not. Logistic regression was used to determine which patients were at greatest risk for experiencing 1 or more medication discrepancies (the dependent variable). The demographic, diagnostic, and prior and current utilization data included in **Table 1** composed the independent variables. A $\chi^2$ test was used to examine the association between patients experiencing a medication discrepancy and 30-day hospital readmission rates.

**Table 2. Categorization of Medication Discrepancies by Patient- and System-Associated Factors***

| Factor | Frequency, No. (%) |
|---|---|
| Patient-associated factors | |
| Adverse drug effects | 0 |
| Intolerance | 0 |
| Did not fill prescription | 6 (4.8) |
| Did not need prescription | 1 (0.8) |
| Money/financial barriers | 7 (5.6) |
| Intentional nonadherence | 6 (4.8) |
| Nonintentional nonadherence | 42 (33.9) |
| Performance deficit | 1 (0.8) |
| Subtotal | 63 (50.8) |
| System-associated factors | |
| Prescribed with known allergies/intolerances | 3 (2.4) |
| Conflicting information from different informational sources | 18 (14.5) |
| Confusion between brand and generic names | 3 (2.4) |
| Discharge instructions were incomplete, inaccurate, or illegible | 20 (16.1) |
| Duplication | 10 (8.1) |
| Incorrect dosage | 1 (0.8) |
| Incorrect quantity | 1 (0.8) |
| Incorrect label | 4 (3.2) |
| Cognitive impairment not recognized | 1 (0.8) |
| No caregiver or need for assistance not recognized | 0 |
| Sight/dexterity limitations not recognized | 0 |
| Subtotal | 61 (49.2) |
| **Total** | **124 (100)** |

*A medication discrepancy may have more than 1 identified contributing factor.

## RESULTS

### PREVALENCE

Of the 375 study patients, 53 (14.1%) experienced 1 or more medication discrepancies. Of those who experienced discrepancies, 62% experienced a single discrepancy, 25% experienced 2 discrepancies, 8% experienced 3 discrepancies, and 5% experienced 4 or more discrepancies. The mean and median number of discrepancies was 1.6 and 1.0, respectively. Patients who experienced a discrepancy averaged significantly more medications (mean number of medications, 9.0; range, 4-18 medications) than those who did not (mean number of medications, 7.1; range, 0-20 medications) ($P<.001$).

### TYPES OF MEDICATION DISCREPANCIES

The types of identified medication discrepancies, categorized using the MDT, are provided in **Table 2**. More than 1 explanatory factor (ie, patient- or system-associated) may have been used to categorize each medication discrepancy. At the patient level, nonintentional nonadherence accounted for the greatest percentage of identified contributing factors, followed by money or financial barriers, intentional nonadherence, and not filling a prescribed medication. At the system level, incom-



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plete, inaccurate, or illegible discharge instructions (as a result of either handwriting or use of Latin abbreviations) were the most common of the identified contributing factors, followed by conflicting information from different informational sources and duplicate prescribing. Illustrative examples of patient- and system-associated factors that contributed to medication discrepancies are provided in **Table 3**.

### MEDICATION CLASSES

The following 5 medication classes accounted for 50% of all identified medication discrepancies: anticoagulants (13%), diuretics (10%), angiotensin-converting enzyme inhibitors (10%), lipid-lowering agents (10%), and proton pump inhibitors (7%).

### RISK PROFILE

Associations between the presence of 1 or more medication discrepancies and the variables included in Table 1 were examined. Two variables were significantly associated with patients having experienced medication discrepancies: the number of medications taken (odds ratio, 1.13; 95% confidence interval, 1.04-1.23) and the presence of congestive heart failure (odds ratio, 2.10; 95% confidence interval, 1.09-4.03).

### REHOSPITALIZATION RATES

Thirty-day rehospitalization rates were examined among patients who experienced 1 or more identified medication discrepancies and patients who had no identified discrepancies. The rehospitalization rate among patients with identified medication discrepancies (14.3%) was significantly higher than that among patients with no identified medication discrepancies (6.1%) ($P=.04$). The number of medications taken was not associated with rehospitalization rates ($P=.71$).

**Table 3. Illustrative Examples of Medication Discrepancies**

| Factor | Causes and Contributing Factors |
|---|---|
| Patient-associated factors | |
| Nonintentional noncompliance | Before hospitalization, a patient was prescribed digoxin, 0.25 mg/d; the discharge instructions read, "digoxin, 0.125 mg/d"; she had only the prehospitalization 0.25-mg digoxin pills and had been taking them since discharge |
| Intentional noncompliance | A patient was admitted to the hospital for COPD exacerbation; after discharge, he was not using his maintenance steroid inhaler because he believed that "that medication makes my breathing worse" |
| System-associated factors | |
| Discharge instructions illegible or incomplete | The patient's hospital discharge instructions were written as follows: "KCl 10 mEq BID" |
| Conflicting information | A patient's discharge instructions indicated that she should take "nortriptyline, 50 mg at bedtime," but her new prescription bottle indicated "nortriptyline, 25 mg at bedtime" |
| Prescribed with known allergies | During hospitalization, a patient's medical record indicated intolerance to diltiazem; on discharge, he was prescribed "diltiazem XR, 240 mg twice daily" |
| Duplication | A patient was taking ranitidine before hospitalization; her discharge instructions indicated that she should take pantoprazole; at a home visit, she was found to be taking both ranitidine and pantoprazole |

Abbreviations: BID, twice a day; COPD, chronic obstructive pulmonary disease; KCl, potassium chloride; XR, extended release.

## COMMENT

### SUMMARY OF FINDINGS

The present study is one of the few studies that have examined medication problems that arise during the vulnerable period of transitions across settings. As such, it offers important new information to the medical literature that has not been reported previously. Among the hospitalized chronically ill older adults, approximately 14% experienced 1 or more medication discrepancies. Because of the short interval between the hospital discharge and the GNP's medication assessment, most of the discrepancies were detected "upstream" from potential patient harm. Although not formally evaluated, the examples provided in Table 3 indicate that these discrepancies were potentially avoidable.

Patient- and system-associated factors were found to contribute equally to the identified medication discrepancies. This finding suggests that an effective strategy designed to reduce the prevalence of this problem would require attention to both types of factors in general and to the most prevalent individual categories identified within the MDT in particular. The MDT was explicitly designed for quality improvement approaches, and each of its individual categories are actionable at the point of care.

This study also provides insight into the characteristics of older patients who may be at greater risk for medication discrepancies and subsequent rehospitalization and who may therefore benefit from interventions or quality improvement efforts designed to reduce the frequency of such problems. For patients with congestive heart failure in particular, the observed higher prevalence of discrepancy may reflect a greater frequency with which medication regimens are adjusted, or it may reflect the fact that evidence-based treatment regimens that recommend prescribing multiple different medications are well



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developed. Patients who are prescribed higher numbers of medications face greater challenges as they experience formulary-driven medication substitutions during transitions across settings. In the absence of a designated clinician who is accountable for medication reconciliation, these patients are often left to sort out this challenge without adequate oversight and support.

Also, this study identified particular classes of medications that were most commonly associated with discrepancies. However, we acknowledge that these classes of medications are among the most frequently prescribed and that their association with discrepancies may simply reflect the prevalence of use.[29]

## COMPARISON TO PREVIOUS STUDIES

Forster et al[4] and Moore et al[5] are among the few investigators who provide estimates of the frequency of posthospital medication problems. The former authors, focusing on adverse events in 400 recently hospitalized patients, found that approximately 13% experienced an adverse drug event in the 3 weeks after hospitalization. The latter authors, focusing on discontinuity of care among 86 patients after hospitalization, reported that 42% had 1 medication continuity error by the time of outpatient follow-up. A direct comparison of their findings to the results reported herein is limited by the fact that both studies were conducted in tertiary academic hospitals and both examined a longer period. Furthermore, both studies assessed medication problems via a telephone call or medical record review, while our study obtained comprehensive data directly from the hospital records, the electronic health record system, and the patient and caregiver in the home.

## SIGNIFICANCE

The results of our study need to be considered in light of national efforts to reduce medical errors and to ensure patient safety. To date, national efforts have focused mainly on safety within a particular health care setting. However, care transitions, or handoffs, among care providers may represent a time of heightened vulnerability to error owing to a lack of oversight by health care professionals and an associated lack of accountability.[30] Identifying transition-related medication problems creates an opportunity to consider implementing a variety of evidence-based interventions to improve quality, such as medication reconciliation, enhanced interprofessional communication, pharmacist-led interventions, and electronic health record systems.[24,31-34]

The Joint Commission on Accreditation of Healthcare Organizations has identified medication reconciliation before hospital discharge as one of its patient safety goals.[35] A successful hospital medication reconciliation program at Luther Midelfort Clinic, Eau Claire, Wis, has been disseminated through the Institute for Healthcare Improvement.[7,12,36] The added insight obtained by the GNP in our study into the challenges that patients face in attempting to reconcile their medications after hospital discharge raises some question as to whether the process of medication reconciliation can be accurately performed using only the information available in the hospital.

A high proportion of discrepancies detected in the present study were attributed to system-associated problems, suggesting a role for quality improvement activities that identify gaps in continuity and communication and include a mechanism for feedback after the patient has reached the next care venue.[37] Within the context of system level quality improvement, there is often great interest in the role of electronic health information systems for improving coordination and continuity of care across settings. Yet, in most health care systems, electronic information does not extend to the multitude of settings in which older adults receive care, including skilled nursing facilities and home health care.[38,39] System level approaches to reducing medication-related problems across settings might also be driven by cost containment. Not only are transitioning patients receiving medications that are duplicates of what they already have at home or are simply not used, but it is also likely that some of these discrepancies lead to greater use of hospital and emergency services.[40-42]

We also determined that many types of discrepancies were attributed to patient-associated factors. In particular, patient knowledge deficits were frequently identified. Qualitative studies have consistently found that patients do not feel adequately prepared to participate in their posthospital care.[16-19] The brief period immediately before discharge may not be an ideal time to convey new and complex information to older patients, as pain, anxiety, sleep deprivation, or delirium may limit receptivity or new learning.[14]

Medication discrepancies were identified relatively early in this study, within 24 to 72 hours of each patient's hospital discharge. It is not known how many of these discrepancies may have subsequently resulted in patient harm had they not have been detected by the GNP.

## STRENGTHS AND LIMITATIONS

With respect to strengths, our study was conducted in a community hospital rather than in a referral or tertiary medical center, potentially enhancing its generalizability. Comprehensive medication data were gathered from multiple sources, including directly from the patient in the home setting. Furthermore, identifying medication problems in this manner provided a relatively "upstream" opportunity for immediate corrective action (rather than a retrospective approach).

With respect to limitations, study patients were recruited from a single health care delivery system in the Denver, Colo, metropolitan area. The subjects were predominantly white and relatively well educated, and all had prescription drug coverage (a potential explanation for the observed low frequency with which financial barriers were reported). When both of these observations are considered, the generalizability of our findings to patient populations in other health care delivery systems is unknown. Finally, it is possible that study patients may not have been able to provide the GNP with accurate information on medication use during the home visit.



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## CONCLUSIONS

The present study contributes important new insights into the prevalence and types of medication problems that older adults encounter during their transition from the hospital. These problems have important implications not only for patient safety (medical errors) but also for quality of care (suboptimal management of acute and chronic conditions) and cost (duplication and unused medications). Using the MDT to categorize these problems helps to direct potential next steps toward improving processes of care when multiple prescribers are involved. National efforts to promote prescribing safety should include patients receiving care across settings.

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