Retrospective Cohort Study of Medication Adherence And Risk for 30-day Hospital Readmission in a Medicare Cost Plan

Angela K. Hochhalter, PhD; Rashmita Basu, PhD; Karim Prasla, PharmD; and Chanhee Jo, PhD

ABSTRACT

Purpose: Reducing hospital re-admissions requires deploying appropriate interventions to groups at highest risk for readmission. Long-term medication adherence may indicate one’s ability to manage recovery and chronic illness after discharge. If so, medication adherence also may be a predictor of hospital readmission.

Design: The objective of this study was to test the association of long-term medication adherence with hospital readmission in a cohort of beneficiaries enrolled in a Medicare Cost Plan.

Methodology: The study employed a retrospective cohort design using administrative pharmacy and health care claims for a sample hospitalized in 2009. Medication adherence was measured with the medication possession ratio (MPR) for the 12 months prior to the first hospitalization in 2009. The likelihood of readmission within 30 days from the first hospitalization in 2009 was estimated using the logistic regression model.

Results: Long-term medication adherence was not associated with likelihood of 30-day hospital readmission (odds ratio [OR]=0.82, \(P=.71\)). However, older age (OR=1.07, \(P=.003\)) and longer length of hospital stay (OR=1.2, \(P<.001\)) were associated with higher likelihood of 30-day readmission, while having an office visit within 30 days of discharge (OR=0.38, \(P=.03\)) was associated with lower odds of readmission.

Conclusion: Except for older age, variables associated with likelihood of readmission are difficult for clinical teams to access during a hospital stay to identify those at risk for readmission. Additional work is needed to identify indicators of readmission risk that can be utilized during hospitalization to identify patients needing post-discharge support to help prevent readmission.

INTRODUCTION

Transitions from hospitals back to patient homes pose risks for adverse events that lead to costly hospital readmission (Amin 2009, Boling 2009, Tsilimingrad 2008). Older adults are particularly vulnerable to hospital readmission because many have complex care needs that require careful coordination by health care providers and systems in addition to illness self-management (Jencks 2009, Ross 2009). For example, approximately half of discrepancies between medications prescribed at hospital discharge and medications elderly consumers report taking have been classified as associated with intentional or unintentional nonadherence (Coleman 2005).

The majority of evidence on hospital-to-home transitions speaks to the role of health systems and practitioners. Transitional care interventions have extended the practice team’s presence into patient homes or nursing homes. For example, nurses may follow patients after discharge and provide supportive care and clinical guidance (Harrison 2002, Naylor 1999), coaches may work with patients to empower self-management, or tools for improved hospital-nursing home communication may be adopted (Coleman 2006, Ouslander 2009, Parry 2009). Effective interventions incorporate support or training for patients and families to carry out tasks that are important to the success of the hospital-to-home transition (eg, watching for signs of illness exacerbation, adhering to new medication regimens, communicating with outpatient clinicians). While it is assumed that patients play an important role in successful transitions, little is known about how patients manage the challenges of transitions in care, which health behaviors are most effective for avoiding readmission, or which consumers need additional support to actively manage challenges at home.

Empirical findings show that medication management after hospital discharge is a serious challenge for many older adults. Older adults are at higher risk than other age groups for self-discontinuation of certain medications following hospitalization because they report feeling worse on the medication, feeling that medications are not helping, or being unable to...
afford prescribed medications (Ali 2009). Li and colleagues (2004) found that after controlling for use of paid or unpaid nursing care, assistance with daily activities, and other factors, illness duration and self-reported recent medication adherence were consistent predictors of hospital readmission for elderly consumers with congestive heart failure. There is also evidence that better long-term medication adherence is associated with lower use of hospital services among populations without Medicare coverage. For example, Pittman and colleagues (2010) reported that adults aged 18 to 63 years with hypertension and high adherence to antihypertensive medication (per administrative billing records) had lower health care costs and fewer hospitalizations for cardiovascular-related events.

Medication adherence may be an indicator of overall engagement in self-management or other healthy behaviors important for mitigating vulnerability to readmission after hospital discharge. It is well documented that persons who are more adherent to medications also tend to show better health outcomes. For example, Simpson and colleagues (2006) reported lower odds of mortality for good versus poor adherence to beneficial drug therapies (pooled odds ratio [OR] = 0.55) and placebo (pooled OR = 0.45) in a meta-analysis of 21 studies, suggesting that persons who adhere to medication may also be healthier in general or that adherence may be a surrogate for healthy behavior in general.

Given the importance of health behaviors during transitions from hospitals to homes and given evidence that long-term medication adherence is associated with use of hospital services in some populations, we hypothesized that poorer long-term medication adherence may also be associated with higher risk for hospital readmission. The purpose of this retrospective cohort study was therefore to examine associations between long-term medication adherence and 30-day hospital readmission in a population of Medicare Cost Plan members in Central Texas. If poorer long-term medication adherence is associated with higher risk for readmission after hospital discharge, health care providers and systems may be able to leverage this information to better-target needed intervention to reduce readmissions.

### METHOD

#### Study population.

Members of Scott & White Health Plan SeniorCare, a Medicare Cost Plan, were eligible for study inclusion if they met the following criteria: were hospitalized at least once in 2009; if at least 1 pharmacy claim for a chronic condition medication (see Table 1) was available for the 12 months prior to the index hospitalization in 2009; if they were continuously enrolled in the product for the full study period; and if they were discharged to home after the initial hospital admission. A total of 1243 members were identified to have at least one hospitalization in the year 2009 with the discharge status of home. Forty-nine members, who had index hospitalization after Nov. 30, 2009, and no readmission before December 2009, were excluded to avoid selection bias from truncating the time available for readmission to less than 30 days. The sample of eligible members was 1192. This sample was further reduced to 721 after linking to pharmacy claims for prescription drug utilization during a 12-month period before the index hospitalization.

#### Data sources.

Electronic administrative claims data for pharmacy, inpatient services, and outpatient services were used to identify demographic and clinical characteristics, hospitalizations, and pharmacy claims for study inclusion. These data were obtained from Scott & White Healthcare Institutional Review Board.

### TABLE 1

<table>
<thead>
<tr>
<th>Variable characteristics and index hospitalization characteristics</th>
<th>N</th>
<th>Percent</th>
</tr>
</thead>
<tbody>
<tr>
<td>Study sample</td>
<td>721</td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Female</td>
<td>399</td>
<td>55%</td>
</tr>
<tr>
<td>Male</td>
<td>322</td>
<td>45%</td>
</tr>
<tr>
<td>Age</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum</td>
<td>27</td>
<td>—</td>
</tr>
<tr>
<td>Mean</td>
<td>77</td>
<td>—</td>
</tr>
<tr>
<td>Maximum</td>
<td>98</td>
<td>—</td>
</tr>
<tr>
<td>Length of stay (days)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Minimum</td>
<td>1</td>
<td>—</td>
</tr>
<tr>
<td>Mean</td>
<td>3.6</td>
<td>—</td>
</tr>
<tr>
<td>Maximum</td>
<td>77</td>
<td>—</td>
</tr>
<tr>
<td>Office visit within 30 days</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>620</td>
<td>86%</td>
</tr>
<tr>
<td>No</td>
<td>101</td>
<td>14%</td>
</tr>
</tbody>
</table>

1 A Medicare Cost Plan is a type of Medicare plan that provides full coverage (usually Part A and B, sometimes also Part D). Payment is based on reasonable cost of services. Beneficiaries are not restricted to a limited network of providers.
ervices during the study period were extracted for each eligible member. Inpatient hospital admission for any reason was identified based on the presence of a facility claim for an inpatient hospital stay (Mapel 2011). Outpatient visits were identified by CPT codes (medical evaluation and management) for new and established patients.

**Variables.** Member characteristics included gender and age. Characteristics of the first hospitalization in 2009 — the “index hospitalization” — included length of stay and discharge disposition (routine discharge to home). The outcome variable of interest was readmission within 30 days of the index discharge. Length of stay for the index hospitalization was calculated by the difference between the admission date and the discharge date for the index hospitalization. Office visits within 30 days of discharge from the index hospitalization were identified by a date of service within 30 calendar days of the index discharge date. Office visits were treated as dichotomous (Yes, visit within 30 days or No, no documented visit within 30 days).

Medication adherence for the 12 months before the admission date for the index hospitalization was measured by the medication possession ratio (MPR), a well-accepted methodology to assess medication use with administrative pharmacy claims data (Hess 2006, Steiner 1997). MPR is a ratio from 0.0 (ie, lowest) to 1.0 (perfect adherence). Values were capped at 1.0. Adherence was considered **low** if the MPR was less than 0.5, **medium** if between 0.5 and 0.79, and **high** if greater than 0.8 (Balkrishnan 2003, Lau 2004, Psaty 2001, Wei 2002).

MPR was calculated for 5 classes of medication relevant to management of common chronic illnesses: antidepressant, antihyperlipidemic, antiarrhythmic, antihypertensive, and diabetes medications. The drug categories were identified based on the American Hospital Formulary Service (AHFS) codes. Each individual drug within the AHFS category was identified based on the generic code number (GCN). MPR was calculated for medications with at least 2 pharmacy claims for the same GCN. For AHFS and GCN codes, see online version of this article at http://tinyurl.com/MC1401-adherence.

MPR was calculated by determining the total number of numerator and denominator days in the 12 months prior to the index hospitalization. MPR was further categorized by different drugs taken by a particular patient during the study period. Drugs were grouped based on the generic product identifier (GPI) code, excluding the last 2 digits. Denominator days were calculated by the difference between prescription filled date and the date of first hospitalization. MPR was calculated for 5 classes of medication relevant to management of common chronic illnesses: antidepressant, antihyperlipidemic, antiarrhythmic, antihypertensive, and diabetes medications. The drug categories were identified based on the American Hospital Formulary Service (AHFS) codes. Each individual drug within the AHFS category was identified based on the generic code number (GCN). MPR was calculated for medications with at least 2 pharmacy claims for the same GCN. For AHFS and GCN codes, see online version of this article at http://tinyurl.com/MC1401-adherence.

Statistical analysis. Member characteristics were tabulated or summarized by mean and range. The likelihood of 30-day rehospitalization was estimated using the logistic regression technique, where rehospitalization status within 30 days was a function of age, gender, length of stay at the first hospitalization, office visits within 30 calendar days of the discharge date for the index hospitalization. Analyses were performed in SAS 9.2 (SAS Institute, Cary, NC). P values <.05 were considered statistically significant.

**RESULTS**

Table 1 shows study sample characteristics. The average age was 76 (range: 37–98 years). Sixty-five percent of the sample was female. The average length of stay for the index hospitalization was 4 days (range 1–77 days). Approximately 85% of members attended an office visit within 30 days from the date of discharge from the index hospitalization.

Table 2 presents the 12-month medication adherence for the study sample. About 14% of members had low medication adherence, about 30% had medium adherence, and 56% had high adherence based on MPR scores.

**TABLE 2**

Medication adherence among members in the study sample (N=721)

<table>
<thead>
<tr>
<th>MPR (%)</th>
<th>Low (&lt;0.5)</th>
<th>Medium (0.5–0.79)</th>
<th>High (0.8–1)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>13.76</td>
<td>29.76</td>
<td>56.23</td>
</tr>
</tbody>
</table>
prior to index hospitalization. The mean MPR was 0.78 (range 0.08–1).

Only 43 of 721 health plan members experienced a hospital readmission within 30 days of index hospital discharge. Table 3 shows the OR estimates for the likelihood of 30-day readmission estimated with logistic regression. Increased age (OR=1.07, \(P=.003\)) and longer length of stay for the index admission (OR=1.2, \(P<.001\)) were associated with higher likelihood of 30-day readmission. Compared with those who did not have an office visit within 30 days of the index discharge, the odds of 30-day readmission was lower for those with an office visit (OR=0.38, \(P=.03\)). Individuals with low medication adherence (MPR <0.5) were not more likely to experience 30-day readmission compared with those who had higher medication adherence (MPR >0.8).

**DISCUSSION**

Contrary to expectations, long-term medication adherence prior to the index hospitalization was not associated with likelihood of 30-day readmission in the study sample of members of a Medicare cost plan. Older age and longer length of stay were associated with higher likelihood of readmission; follow-up office visit was associated with lower likelihood of readmission.

**Limitations.** The study sample may not be representative of all Medicare populations. Because of limitations in the available dataset, we are unable to provide detailed characteristics of the sample to include income, race/ethnicity, marital status, and other variables that may be associated with health and health behaviors. Overall long-term medication adherence was relatively high (mean = -.78) and only 14% of the sample had low adherence based on MPR scores. In addition, the 30-day readmission rate for the group was low relative to general Medicare samples (Jencks 2009).

Administrative claims data only capture information reported by providers to the cost plan payer. Pharmacy claims may miss prescriptions filled at pharmacies that do not submit claims to this payer (eg, self-paid prescription fills). The MPR measure of adherence does not capture whether members actually take medications as prescribed, but the measure has been validated and is a well-accepted method of capturing adherence (Andrade 2006, Steiner 1997). Medication errors are a well-known contributor to safety risks and readmission following hospital discharge (Coleman 2005, Forster 2003, Marcum 2010). This study does not address how members adhered to medications in the weeks following discharge.

In this study we selected classes of drugs commonly used for long-term treatment of chronic conditions. It is possible that adherence calculated on only the selected categories did not fully represent individuals’ long-term adherence behaviors.

**CONCLUSION**

Reducing hospital readmissions is a national health care priority. Interventions are available to help address patient needs in the time following hospital discharge, but these interventions require resources. Efficient use of those resources may be enhanced by successful identification of patient characteristics or behaviors that predict risk for readmission. To date, many of the variables that have been associated with readmission may be difficult or impossible for inpatient clinicians to easily identify before hospital discharge. For example, length of stay and attending a post-discharge office visit were associated with readmission in this study but these variables obviously are not available to clinicians who begin planning for hospital discharge arrangements early in a hospital stay (because at this point the length of stay has yet to be determined and the post-office visit has not yet occurred).

In this study, long-term medication adherence was not a predictor of readmission for a sample that was relatively adherent to medications before admission and may have been generally prepared for post-discharge challenges. Additional work is needed to identify indicators of readmission risk that can be utilized during hospitalization to identify patients needing post-discharge support to help prevent readmission.

**REFERENCES**


Amin AP, Mukhopadhyay E, Nathan S, Napan S, Kelly RF. Association of medical noncompliance and long-term adverse outcomes, after myocardial infarction in a minority and

<p>| TABLE 3 | Logistic regression model for 30-day readmission after index hospitalization in 2009 |</p>
<table>
<thead>
<tr>
<th>Parameter</th>
<th>Odds Ratio</th>
<th>95% CI</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age</td>
<td>1.07</td>
<td>1.02–1.11</td>
<td>&lt;.003</td>
</tr>
<tr>
<td>Office visits</td>
<td>0.38</td>
<td>0.16–0.92</td>
<td>.03</td>
</tr>
<tr>
<td>Length of stay</td>
<td>1.2</td>
<td>1.13–1.25</td>
<td>&lt;.001</td>
</tr>
<tr>
<td>MPR-low</td>
<td>0.82</td>
<td>0.28–2.03</td>
<td>.71</td>
</tr>
</tbody>
</table>


