The effect of a collaborative pharmacist–hospital care transition program on the likelihood of 30-day readmission

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Between 1997 and 2007, the annual inflation-adjusted cost for hospitalizations in the United States rose by 55% to $343.9 billion.¹ Research has found that many rehospitalizations occur relatively soon after discharge, with 20% of Medicare beneficiaries readmitted within 30 days of discharge and 34% readmitted within 90 days.² Readmissions cost Medicare an estimated $17 billion in 2004.³ Moreover, unnecessary and unplanned hospital readmissions may be associated with lower-quality treatment and poorer health outcomes.

Many risk factors have been found to be associated with a heightened likelihood of readmission, including patient-specific factors,⁴ quality of inhospital care,⁵,⁶ and the quality and adequacy of discharge planning and follow-up care.²,⁸–¹⁰ Hansen and colleagues¹¹ examined 43 interventions designed to reduce the risk of 30-day readmission rates. They developed a taxonomy of 12 specific interventions, which they then grouped into three categories based on when the intervention took place: predischarge, postdischarge, and bridging between hospital and home. Examples of predischarge interventions included patient edu-

Purpose. The effect of a collaborative pharmacist–hospital care transition program on the likelihood of 30-day readmission was evaluated.

Methods. This retrospective cohort study was conducted in two acute care hospitals within the same hospital system in the southeastern United States. One hospital initiated a care transition program in January 2011; the other hospital did not have such a program. All patients who were discharged from either hospital to home from January 1, 2010, through December 31, 2011, were included in the study. The two key program components included bedside delivery of postdischarge medications and follow-up telephone calls two to three days after discharge. The likelihood of readmission was assessed using multiple logistic regression.

Results. Over the 2-year study period, 19,659 unique patients had 26,781 qualifying index admissions, 2,523 of which resulted in a readmission within 30 days of discharge. After adjusting for various demographic and clinical characteristics, the usual care group (i.e., patients who did not participate in the program) had nearly twice the odds of readmission within 30 days (odds ratio [OR], 1.90; 95% confidence interval [CI], 1.35–2.67), compared with the intervention group (i.e., program participants). For patients age 65 years or older, those in the usual care group had a sixfold increase in the odds of a 30-day readmission (OR, 6.05; 95% CI, 1.92–19.00) relative to those in the intervention group.

Conclusion. A care transition program was associated with a lower likelihood of readmission and had a greater effect on older patients.

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Dr. Kirkham, Dr. Clark, and Mr. Duncan are employees of Walgreen Company. Ms. Paynter was an employee of DeKalb Medical at the time of writing.

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Medication reconciliation, discharge planning, and the scheduling of a follow-up appointment with a physician. Postdischarge interventions included follow-up telephone calls, patient hotlines, and home visits. An example of a bridging intervention is the use of a transition coach or an advanced practice nurse to coordinate required care.12,13 Many of the successful programs reviewed by Hansen and colleagues14 included multiple components bundled together, potentially offering an additive effect. Pharmacists can play a central role in various components, such as patient education and medication reconciliation.14,15

Medication errors constitute an important risk factor for rehospitalization. Forster and colleagues16 found that nearly two thirds of postdischarge adverse events were medication related and that 29% of these events were serious or life threatening, sometimes resulting in emergency department (ED) visits and hospital admissions. There is increasing evidence of the importance of medications in managing chronic conditions—especially the coordination of multiple medications and careful monitoring for adverse effects and drug interactions.17,18

The benefits of a clinical pharmacist during all phases of hospitalization, discharge, and postdischarge have also been documented.19,20 In particular, studies have found that medication counseling and reconciliation may reduce 30-day readmission rates.14,21,22 Pharmacists are increasing their role in patient care interventions,23–27 including care transition programs,13,19,21 but more research is needed to assess the impact of such programs.

This study retrospectively evaluated the effect of a care transition program on the likelihood of readmission within 30 days of discharge.

**Methods**

This retrospective cohort study was conducted in two acute care hospitals within the same hospital system in the southeastern United States. One hospital initiated a care transition program in January 2011; the other hospital did not have such a program. All patients who were discharged from either hospital to home from January 1, 2010, through December 31, 2011, were included in the study. Patients who were discharged to a skilled nursing facility or hospice were excluded. This study was approved by the hospital system’s institutional review board.

**Care transition program.** The overall goals of the care transition program were to promote medication adherence and reduce unplanned readmissions by expanding the role of the outpatient pharmacy. The two key program components included bedside delivery of postdischarge medications and follow-up telephone calls two to three days after discharge.

Patients were informed about the care transition program via a one-page flier in their admission packet. Because the outpatient pharmacy staff performed daily rounds in the hospital wards, they asked patients if they would like to participate in the program. The program was designed as an opt-in program to ensure patient choice, as some patients may have had pharmacy benefit plans with preferred pharmacy providers or may simply have preferred to use their regular pharmacy. Patients who wanted to participate in the program (intervention group) signed an enrollment form, which was then attached to the front of their chart. When a program participant was to be discharged with medications, hospital staff faxed the signed form and prescriptions to the outpatient pharmacy to schedule medication delivery before discharge. There was no additional charge to the patient or hospital for the program.

Medications were delivered directly to the patient’s room by either a pharmacy technician or pharmacist from the community pharmacy on the hospital campus and were given to the patient or caregiver within one to three hours of the scheduled hospital discharge. Prescriptions to be delivered to the bedside were handled in the same manner as they are in a community pharmacy. The pharmacist or technician asked patients if they had questions about their medication. If a patient had questions during a technician delivery, the technician had access to connect the patient and pharmacist via telephone or the pharmacist would come to the room. Furthermore, the pharmacy staff processed insurance verifications and approvals and collected copayments from the patient, just as they would if the patient had arrived at a community pharmacy.

Study participants could receive up to two follow-up telephone calls. The hospital call center contacted all patients by telephone within 24 hours of discharge, regardless of whether they were in the intervention group. Hospital calls included six scripted questions ranging from how patients had been feeling since discharge to whether they had scheduled a visit with their primary care provider. Pharmacists then called all patients in the intervention group (i.e., who received bedside delivery) within 72 hours to discuss the initial days of therapy. The pharmacists’ calls were not scripted and assessed compliance with the medication plan, ensured that patients understood the drug regimens, and addressed any new questions or concerns. Pharmacy claims provided evidence of bedside delivery of medication and were linked to hospital medical claims.

**Data collected.** Data related to patient demographics (age, sex, race, and insurance type) and index admission (length of stay, count of Centers for Medicare and Medicaid Services (CMS)-defined condition categories, and month of discharge) were documented. Age was initially
calculated as age in years at the time of admission but was transformed into a dichotomous measure, as Medicare was the payer for most patients age 65 years or older. Likewise, the payer category was transformed into a dichotomous variable (i.e., Medicaid as the primary insurance or not). In other words, the dichotomous age category (age of <65 years versus age of ≥65 years) also accounted for Medicare eligibility, while the dichotomous payer category (Medicaid versus not Medicaid) served as a proxy for socioeconomic status. In the claims data, there were eight categories for race; however, due to very small numbers in six categories and a large majority of discharges reporting race as black (70%), the variable was collapsed into two categories: black and nonblack. All International Classification of Diseases, 9th Revision diagnoses from index admissions were collapsed into 189 CMS-defined condition categories. A count of condition categories was used as a proxy for a patient’s comorbidities during the index admission, and length of stay was a proxy for the severity of the index admission. The month of discharge was documented to account for seasonal variation associated with hospitalizations.

Outcomes measured. The primary outcome measure was claims-based evidence of readmission within 30 days. Identification of an admission (the index event) was distinguished from a 30-day readmission (the outcome event) using the Yale–CMS SAS Analytic Package program.24 All claims from both hospitals for 30 days after an index admission were reviewed to determine if there was a readmission. Also consistent with the Yale–CMS criteria, admissions were excluded if the patient left against medical advice, transferred to another acute care hospital, or died before discharge. Hospital-level readmission rates were calculated as the percentage of discharges with a 30-day readmission.

Statistical analysis. Data were analyzed using descriptive statistics, bivariable associations, and multivariable associations. A multiple logistic regression model was used to assess the impact of program participation on 30-day readmission rates while controlling for various clinical and demographic factors. Logistic regression was used to examine bivariable interactions. Interactions were handled either by stratifying the model (e.g., by age) or by including interaction terms in the final models.

To ensure the statistical approach did not influence the outcome, a sensitivity analysis was performed using propensity score matching. A 1:4 propensity match was performed, where cases were individuals who participated in the program and the comparison group was drawn from patients discharged from the intervention hospital in the year the program was implemented (i.e., 2011). Matching criteria included age at index admission, race, sex, length of stay, Medicaid as primary insurance, month of index admission, comorbidity count, and whether the index admission was categorized as urgent or emergent. A repeated-measure regression was used with generalized estimation equations and an exchangeable working correlation structure.

All analyses were performed using SAS 9.2 (SAS Institute, Cary, NC). The a priori level of significance was set at 0.05. The Wald or Pearson’s chi-square statistic was used to determine 95% confidence intervals (CIs) and p values.

Results

Over the two-year study period, 19,659 unique patients had 26,781 qualifying index admissions, of which 2,523 resulted in a readmission within 30 days of discharge (Table 1). The unadjusted readmission rate for the entire cohort was 9.4%. Patients in the intervention group had a lower readmission rate than did those who received usual care (5.0% versus 9.5%, p < 0.05).

Across both the intervention and usual care groups, the majority of patients were younger than 65 years (69%), black (72%), and female (60%). Approximately 11% of discharged patients had Medicaid as their primary insurance. The mean ± S.D. length of stay was 4.3 ± 6.4 days, and the mean ± S.D. count of condition categories was 5.7 ± 2.8. The top five most frequent CMS-defined modified condition categories were fluid/electrolyte disorders (31%); drug or alcohol dependence, abuse, or psychosis (14%); arrhythmias (12%); vascular or circulatory disease (11%); and pneumonia (10%). Slight seasonal variations in admissions were noted, with the highest proportion of admissions occurring in December (9%). Of the 19,659 unique patients discharged to home within the study period, 692 (3.5% of all patients) participated in the care transition program. Compared with patients who did not participate in the program (i.e., usual care), patients who enrolled in the program were less likely to be 65 years or older (24% versus 32%), black (59% versus 72%), male (30% versus 40%), or have Medicaid as their primary insurance (9% versus 11%). Patients in the program also had a shorter mean ± S.D. length of stay (3.4 ± 3.0 days versus 4.3 ± 6.4 days) and fewer conditions (mean ± S.D. count of 5.1 ± 2.8 versus 5.7 ± 2.8) compared with the usual care group. The number of patients discharged increased over time in the intervention group because the program was rolled out gradually over the implementation year.

Primary outcome. Patients who did not participate in the care transition program had a 90% increased odds of readmission within 30 days (adjusted odds ratio [OR], 1.90; 95% CI, 1.35–2.67) when compared with the intervention group (Table 2). The propensity-matched analysis yielded similar results (adjusted OR, 1.87;
95% CI, 1.33–2.62) when comparing the subset of 797 patients who participated in the program with 3188 matched patients who did not participate in the program at the intervention hospital.

Other factors associated with readmission were black race (adjusted OR, 1.24; 95% CI, 1.12–1.36), a longer length of stay (adjusted OR, 1.01; 95% CI, 1.00–1.02), Medicaid as the primary insurance (adjusted OR, 1.38; 95% CI, 1.22–1.56), the month of discharge (adjusted OR, 1.02; 95% CI, 1.01–1.03), and a higher count of condition categories (adjusted OR, 1.12; 95% CI, 1.10–1.13). The effect size of all variables was similar in unadjusted and adjusted results.

Stratified analysis. Because the dichotomous age variable was associated with several other variables, we stratified the model by age (Table 3). For patients age 65 years or older, patients in the usual care group had sixfold increased odds of readmission within 30 days (adjusted OR, 6.05; 95% CI, 1.92–19.00) compared with the intervention group. Covariates associated with readmission in this model were black race (adjusted OR, 1.23; 95% CI, 1.06–1.44), month of discharge (adjusted OR, 1.03; 95% CI, 1.01–1.05), and count of conditions (adjusted OR, 1.07; 95% CI, 1.04–1.10). For patients younger than 65 years, usual discharge was associated with an increased likelihood of readmission (adjusted OR, 1.53; 95% CI, 1.07–2.19). In this model, readmission was also associated with black race (adjusted OR, 1.23; 95% CI, 1.08–1.40), Medicaid as the primary insurance (adjusted OR, 1.40; 95% CI, 1.23–1.59), and increased comorbidities (adjusted OR, 1.13; 95% CI, 1.11–1.15).

Discussion
The unadjusted readmission rate was lower for patients who participated in the care transition program compared with those who did not (5.0% versus 9.5%). After adjusting for differences in clinical and demographic characteristics, participants in the intervention group had nearly a twofold decrease in the likelihood of readmission compared with the usual care group. The program had a greater effect on patients who were age 65 years or older compared with younger patients (adjusted OR, 1.53 versus 6.05). Of the covariates, only race and count of comorbidities were
consistently associated with readmission in the stratified models.

Other investigators have reported on pharmacist-led programs that resulted in significantly lower readmission rates. O’Dell and Kucukarslan\textsuperscript{15} noted lower readmission rates among cardiac patients seen by a clinical pharmacist at discharge compared with cardiac patients who received usual care (1.3% versus 9.1%, \( p = 0.04 \)) for unstable angina. However, the results were not significant in patients with less-acute conditions. In a randomized controlled trial conducted by Koehler and colleagues,\textsuperscript{21} a pharmacist intervention resulted in reduced 30-day readmission rates compared with a control group (10.0% versus 38.1%, \( p = 0.04 \), but the difference was not significant by 60 days (30.0% versus 42.9%, \( p = 0.52 \)). Jack et al.\textsuperscript{19} noted significantly lower 30-day rates of combined ED admissions and hospitalization (incidence rate ratio [IRR], 0.695; 95% CI, 0.515–0.937) compared with a control group, but the association was not significant for 30-day readmissions alone (IRR, 0.720; 95% CI, 0.445–1.164). Unfortunately, none of these studies used logistic regression, so we could not directly compare our effect size to their results.

Other interventions to reduce readmission rates, including home visits, self-management interventions, and hospital-based case management, have resulted in positive clinical outcomes, though not always for 30-day readmissions. For example, a meta-analysis of 12 studies assessing the impact of hospital-based case management found a significantly shorter length of stay but no significant reduction in readmissions (adjusted OR, 0.87; 95% CI, 0.69–1.04).\textsuperscript{29} A meta-analysis of studies that assessed the effect of home visits among elderly patients noted a significant decrease in mortality rates (pooled OR, 0.76; 95% CI, 0.64–0.89) but not admission rates (OR, 0.95; 95% CI, 0.80–1.09); furthermore, the meta-analysis did not assess readmission rates.\textsuperscript{30} In contrast, a meta-analysis of self-management interventions for patients with heart failure did not find significant decreases in mortality rates, but all-cause readmission rates (pooled OR, 0.59; 95% CI, 0.44–0.80) were lower for patients who received the intervention.\textsuperscript{31} In all of these intervention studies, the program variables were coded so that usual care was the reference category, thereby reporting ORs that were less than 1. We coded our program effect variable so that the program was the reference category, as adjusted ORs that are greater than 1 are often easier for readers to interpret. However, for the sake of comparison with other studies, our program effect in the all ages logistic regression model (adjusted OR, 1.90; 95% CI, 1.35–2.67) would be equivalent to an adjusted OR of 0.53 (95% CI, 0.37–0.74) if the reference category was reversed. The effect size of our care transition program (0.53) is similar to the aggregate effect reported for self-management interventions (0.59).\textsuperscript{31}

Limitations. Our study was limited by several factors. First, we only had claims data from two acute care hospitals, so we could not account for readmissions in other hospital systems. In fact, Nasir et al.\textsuperscript{32} found that up to 20% of readmissions were to a different facility from the index admission, so our raw rates are likely underreported. However, this factor should affect both the intervention and nonintervention groups. Second, although we replicated the majority of readmission criteria developed by Yale for CMS, several variables were not available (e.g., historic outpatient claims, prior insurance eligibility). Third, although many aspects of our readmission calculation mimic those applied by CMS, our analysis was restricted neither to Medicare recipients nor to the targeted CMS conditions (i.e., heart failure, acute myocardial infarction, and pneumonia). Fourth, it is likely that we did not capture all Medicaid receipts in

<table>
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<th>Covariate</th>
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<tr>
<td>Age of &lt;65 yr</td>
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<tr>
<td>Usual discharge</td>
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<td>Male</td>
<td>0.98 (0.89–1.09)\textsuperscript{a}</td>
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<td>Length of stay</td>
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<td>Medicaid as primary insurance</td>
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<td>Month of discharge</td>
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<td>Count of conditions</td>
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<td>Age of ≥65 yr</td>
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\( ^{a} p < 0.05 \) unless otherwise noted.

\( ^{b} \)The adjusted results included all variables listed in the table in the model.

\( ^{c} \)Not significant.
our Medicaid variable, since we did not receive evidence of secondary insurance for dual-eligible individuals. Fifth, patients who choose to participate in a program (i.e., opt-in) are often inherently different from those who do not participate. As presented in our results and Table 1, program participants (compared with the usual care group) were more likely to have a shorter length of stay and fewer comorbid conditions and less likely to be older, black, or male or to have Medicaid as their primary insurance. Although we adjusted for these covariates in the logistic regression model, we also performed a sensitivity analysis using propensity-score matching to ensure the case and comparison cohorts were the same at baseline for these known covariates. The logistic regression results were the same as the propensity-score matching results, ensuring that our findings were robust when considering these known and measured covariates to predict 30-day readmission. However, there may be unknown or unmeasured covariates that influence 30-day readmission rates that our analysis did not take into account. Last, as an observational study, we can only infer associations and not causality.

Our findings suggest that the care transition program was associated with a lower likelihood of readmission and that it seems to have a greater effect among older patients. These results may be because older patients often have more complex medication regimens that would be more amenable to interventions that aim to improve medication knowledge and adherence. In addition, older patients typically have a higher risk of readmission, so there is greater opportunity for a reduction in readmissions in this group.

Our results may not be generalizable to all inpatient populations, since the study hospitals were located in only one region and served a high percentage of patients who were minorities and had a low socioeconomic status. Furthermore, the study period only included the implementation year of the program at one hospital. Because the capacity to offer the intervention increased gradually over the first year of the program, the effect may vary as program enrollment increases.

Implications for policy and practice. While health care providers throughout the United States have been highly engaged in reducing avoidable readmissions, the efforts employed to date have not yielded the intended results in lowering these rates. Numerous studies have linked inadequate knowledge, health care access, financial resources, medication management, and discharge planning and rapid discharge of sicker patients as causal factors for readmission. Misaligned health care financing and payment incentives, inadequate discharge planning, inadequate follow-up care, and a lack of ongoing community-based chronic disease management are all systemic failures that contribute to readmission. Multifactorial influences such as knowledge and literal and numerical learning ability affect whether medication and treatment plans can be effectively executed. In addition, patients with cognitive, behavioral, or physical impairments that inhibit self-care and patients who lack adequate caregiver support to sustain desirable health outcomes are prone to high rates of readmission. Ultimately, readmission is associated with worsening health outcomes, reduced quality of life, and loss of self-efficacy. Bedside prescription delivery before discharge and postdischarge care transitions with interventions by a clinical pharmacist have shown favorable results in reducing 30-day readmission rates. However, funding mechanisms to support the management of care transitions such as community-based pharmacist-led medication reconciliation and coaching programs and nurse navigator services are either grossly inadequate or completely lacking. While readmission is perceived negatively and attributed to individual and system failures and a lack of control of health practices and outcomes, research shows a high correlation between medication-related factors and rehospitalization. Building effective and sustainable community-based medication management intervention programs is an essential element for the care of patients and support of health care providers in successfully reducing avoidable hospital admissions. Interpretive research to understand the patient’s experience can be used to help guide the development of effective health care interventions that address the underlying causes of medication-related readmission for patients with chronic or disabling conditions. Understanding the roles of patients, providers, policymakers, and payers and their interrelatedness in establishing effective alternatives to readmission has important implications for health care policy and practice.

Implementation of collaborative pharmacy–hospital care transition programs could help decrease the burden of readmission rates. The ability to show a positive impact of the program in the first hospital supported expansion of the program to the second hospital (after the study). This research has increased knowledge of factors associated with the likelihood of readmission and, in turn, can help clinical staff identify high-risk patients. Furthermore, ongoing assessment will help refine the care transition program. Future research should evaluate the impact on readmission over longer periods (e.g., 90-day readmission rates) and assess the effectiveness of hospital-specific, claims-based predictive risk models. Given our positive findings among older patients, the expansion of care transition collaborations between hospitals and pharmacies may
be helpful in decreasing readmission rates among Medicare recipients.

Conclusion

A care transition program was associated with a lower likelihood of readmission and had a greater effect on older patients.

References