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New Bundled World: Quality of Care and Readmission in Diabetes Patients

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Abstract

Background:

Hospital readmissions among patients with diabetes are substantial and costly. Although prior studies have shown that receipt of outpatient quality of care significantly reduces the risk of hospitalization among patients with diabetes, little is known about its impact on hospital readmission. The objective of this study is to assess the impact of outpatient quality of care on 30-day readmission among patients with diabetes.

Methods:

We used deidentified administrative claims data from the IMS LifeLink and included commercially insured diabetes patients ≥ 19 years old discharged from hospitals in the United States in 2009 and 2010 (n = 30,139). The outcome was readmission within 2–30 days of discharge. The main independent variables were receipt of outpatient quality-of-care measures (i.e., two hemoglobin A1c tests, low-density lipoprotein (LDL) test, 90-day supply of statin, and 90-day supply of angiotensin-converting enzyme inhibitors/angiotensin receptor blockers). Multivariate logistic regression was used to examine the impact of outpatient quality of care on hospital readmission while controlling for demographics, clinical characteristics, health care utilization, and insurance type in the year prior to admission.

Results:

Overall 30-day readmission rates among patients with diabetes were 18.9%. Patients who received at least one LDL test [odds ratio (OR) = 0.918, 95% confidence interval (CI; 0.852 0.989), $p < .025$] and ≥90-day supply of statins (OR = 0.91, 95% CI [0.85 0.97], $p < .01$) were less likely to be readmitted to the hospital.

Conclusions:

Receipt of LDL testing and adherence to statin medications were effective in decreasing the likelihood of 30-day hospital readmission and may be considered as elements of a quality focused incentive-based health care delivery package for diabetes patients.

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Abbreviations: (ACEI) angiotensin-converting enzyme inhibitor, (ARB) angiotensin receptor blocker, (CI) confidence interval, (HbA1c) hemoglobin A1c, (HEDIS) Healthcare Effectiveness Data and Information Set, (LDL) low-density lipoprotein, (OR) odds ratio, (U.S.) United States

Keywords: diabetes, quality of care, readmission, statins

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Introduction

The Patient Protection and Affordable Care Act signed by President Obama in March 2010 emphasized improving the quality and efficiency of the health care system.[1] One piece of this reform involves developing and evaluating payment bundling by an episode of hospitalization (defined as all care 3 days prior to hospitalization through 30 days following discharge). In addition, Medicare is considering ways to penalize hospitals with high readmission rates.[2] Thus it is increasingly important to minimize cost and utilization, not only during the hospitalization, but also in the 30 days post-discharge. According to data collected by the Healthcare Cost and Utilization Project, 15% of all patients admitted to hospitals in the United States (U.S.) in 2009 had diabetes.[3] Because inpatient stays account for the largest proportion of health care expenditure for diabetes (44%), followed distantly by nursing home stays (15%) and office visits (11%),[3] decreasing 30-day hospital readmission rates among patients with diabetes is paramount in controlling health care costs in this new bundled world.

Readmission rates among patients with diabetes are substantial. Existing literature shows that 30-day readmission rates range from a low of 7.7% among the commercially insured to a high of 20% among Medicare and Medicaid patients.[4,5] Studies have shown that up to 55% of hospital readmissions may be due to inappropriate inpatient care or poor discharge planning and, thus, are preventable.[6–9] Robbins and Webb[5] demonstrated that the absence of a diabetes diagnosis in the hospital discharge record in patients with known diabetes was a highly significant predictor of hospitalization after adjustment. Failure to code a diabetes diagnosis in administrative data suggests that the diabetes-specific needs of the patient were not met during hospitalization and no attention was given to diabetes-specific discharge planning. These findings strongly support that high-quality inpatient care and attention to diabetes discharge planning can reduce the likelihood of readmission.

However, questions remain as to whether receipt of high-quality outpatient care can have a significant impact on 30-day hospital readmissions. A study by Chen and colleagues[10] found that receipt of two quality care processes, hemoglobin A1c (HbA1c) and lipid monitoring, in the previous year reduced the risk of hospitalization by 20% in the following year.[10] Another study by Stuart and associates[11] found a strong association between persistence of medication use and risk of hospitalization. Each additional prescription filled by users of oral anti-diabetic agents decreased the risk of hospitalization by 0.3%, while each additional prescription filled of an angiotensin receptor blocker (ARB) reduced risk of hospitalization by 1.3%. Furthermore, every additional angiotensin-converting enzyme inhibitor (ACEI) prescription filled reduced the risk of hospitalization by 0.9% and additional 3-hydroxy-3-methylglutaryl-coenzyme A reductase inhibitor (statin) prescriptions filled lowered the risk of hospitalization by 0.5%. There is no direct research on the impact of these outpatient quality practices on readmission.

The objective of this study is to assess the impact of outpatient quality of care on 30-day hospital readmission rates among commercially insured patients with diabetes. Since the Institute of Medicine has recommended quality-based incentive programs as a mechanism to better align payment and quality in the United States, the Centers for Medicare and Medicaid Services, state governments, and a majority of payers have implemented outpatient quality initiatives.[12–14] As the flurry of outpatient quality initiatives continues, it is important to understand the potential impact of outpatient quality of care on the likelihood of hospital readmission.

Methods

We used administrative claims data from the IMS LifeLink Database (formerly PharMetrics), encompassing both fee-for-service and managed-care coverage. The LifeLink population is representative of the U.S. commercially insured population in terms of age, gender, and type of health plan. Data were deidentified in compliance with the Health Portability and Accountability Act. For this study, we used data from approximately 12 million unique members from over 30 health plans living in all regions of the United States in 2010. Membership and health plan eligibility information were linked to claims from inpatient, outpatient, professional, emergency department, and ancillary sources. Data elements drawn from these databases included member demographics (age, gender, residence region, and enrollment), service dates, setting of care (outpatient, inpatient, or emergency room), diagnosis codes, procedure codes, and outpatient pharmacy (retail and mail-order prescriptions) claims.

Study Selection

This study included patients 19 years and older who were discharged from the acute inpatient setting with diabetes (ICD-9 diagnosis codes: 249.xx, 250.xx, 357.2, 362.0x, 366.41) between December 1, 2009, and November 30, 2010. Of note, the diagnosis of diabetes did not need to be the principal discharge diagnosis. To accurately assess both the baseline clinical characteristics prior to the hospital admission and the outcome of interest (i.e., 30-day hospital readmission), the study only included patients who were continuously enrolled in the health plan for medical and pharmacy benefits during the year prior to the admission date through 30 days after the discharge date (n = 30,139).

Outcome Variable

The outcome of this study was hospital readmission for any diagnosis in the 2–30 days after discharge. We did not include readmission 0–1 days after discharge because of the difficulty differentiating between transfer to another facility and inpatient readmission using commercial administrative claims data.

Main Independent Variables

The main independent variables we assessed include receipt of outpatient quality of care in the year prior to admission [i.e., two or more HbA1c lab tests (yes/no), one or more low-density lipoprotein (LDL) tests (yes/no), ≥90 days supply for a statin, and ≥90 days supply for ACEIs or ARBs]. We measured a 90-day supply of these medications because we wanted to capture the concept of medication adherence instead of just a one-time prescription.

Covariates

The covariates included demographics (i.e., age, gender, region, and health plan), clinical characteristics (i.e., Elixhauser comorbidities, any insulin use), health care utilization, and insurance type in the year prior to admission. We did not present information by health plan because of concerns regarding confidentiality. Elixhauser comorbidities is specifically adapted for administrative data sets and have been shown to predict a variety of patient outcomes, including mortality, length of stay, and hospital charges.[15] We measured any insulin use (yes/no) as a proxy of diabetes severity; the hypothesis is that patients with more severe diabetes require insulin. Health care utilization in the year prior to admission included number of outpatient visits, hospitalization (yes/no), and emergency room use (yes/no). We controlled for the following insurance types: health maintenance organization, preferred provider organization, and other.

Statistical Analysis

Univariate descriptive statistics were calculated for all independent variables. Bivariate statistical tests (i.e., chi-square) were conducted to test significant differences in patient characteristics by readmission (yes/no). Multivariate logistic regression modeling was used to examine the impact of outpatient quality of care (i.e., two HbA1c tests, LDL test, 90-day supply of statin, and 90-day supply of ACEI/ARBs) on hospital readmission while controlling for covariates. We included health plan fixed effects to eliminate the variation in readmission across plans. All variables were assessed for colinearity prior to their inclusion in the final model. Because region was highly colinear with health plan (r = 0.87), we dropped region from the multivariate model. The results are presented as odds ratios (ORs), 95% confidence intervals (CIs), and p values. A p value of 0.05 was considered to be significant. SAS® Proprietary Software, Release 9.1 (SAS Institute Inc., Cary, NC), was used for all statistical analyses.

Results

The overall 30-day readmission rate among patients with diabetes was 18.9%. The majority of patients in the hospitalized diabetes cohort were 55 years and older (72.41%; **Table 1**). Older patients were significantly more likely to be readmitted in both the bivariate (**Table 2**) and the multivariate (**Table 3**) analysis. Approximately half of the hospitalized patients with diabetes were female (50.1%), and gender was not a significant predictor of 30-day hospital readmission. Among hospitalized patients with diabetes, the majority had hypertension (76.3%), almost one-fourth had chronic pulmonary disease (23.0%) and anemia (23.6%), approximately one-fifth had heart failure (19.8%) and fluid and electrolyte disorders (21.9%), and nearly one-sixth had peripheral vascular disease (15.5%) and renal failure (16.7%). Patients with the following comorbid conditions were more likely (p < .05) to be hospitalized, even when controlling for other patient characteristics: heart failure, peripheral vascular disease, other neurological disorders, renal failure, lymphoma, solid tumors, weight loss, fluid and electrolyte disorders, chronic blood loss anemia, drug abuse, and psychoses. Prior history of hospitalization (OR = 1.55, 95% CI [1.43 1.68], p < .001) and emergency use (OR = 1.13, 95% CI [1.05 1.22], p = .001) in the past year were both predictors of hospital readmission among patients with

Table 1.
Characteristics of Diabetes Patients and 30-Day Hospital Readmission Rate by Characteristic

Patient characteristic	Sample (*n*)	Percentage of total (%)	Readmission rate (%)
Total	30,139	100.00	18.88
Age (years)			
18–44	3548	11.77	13.36
45–54	4765	15.81	16.03
55–64	9522	31.59	18.21
65–74	5091	16.89	21.25
75–84	5293	17.56	22.73
85+	1920	6.37	22.50
Gender			
Male	15,048	49.93	18.75
Female	15,091	50.07	19.00
Clinical characteristics			
Heart failure	5969	19.80	27.98
Valvular disease	3386	11.23	25.87
Pulmonary circulation disease	1503	4.99	26.75
Peripheral vascular disease	4658	15.46	26.36
Paralysis	925	3.07	27.68
Other neurological disorders	3659	12.14	27.33
Chronic pulmonary disease	6935	23.01	22.91
Hypertension	22,984	76.26	20.01
Hypothyroidism	4103	13.61	20.16
Renal failure	5036	16.71	28.51
Liver disease	1370	4.55	24.16
Peptic ulcer disease x bleeding	59	0.20	22.03
Acquired immune deficiency syndrome	53	0.18	20.75
Lymphoma	350	1.16	29.71
Metastatic cancer	627	2.08	30.30
Solid tumor without metastasis	2280	7.56	26.45
Rheumatoid arthritis/collagen vascular disease	1189	3.95	23.13
Coagulopathy	1414	4.69	29.42

Continued →

Table 1. Continued

Patient characteristic	Sample (*n*)	Percentage of total (%)	Readmission rate (%)
Obesity	3902	12.95	19.22
Weight loss	1464	4.86	30.46
Fluid and electrolyte disorders	6606	21.92	27.48
Chronic blood loss anemia	521	1.73	31.48
Deficiency anemias	7121	23.63	25.88
Alcohol abuse	448	1.49	24.11
Drug abuse	436	1.45	29.82
Psychoses	2006	6.66	26.42
Depression	2982	9.89	22.70
Any insulin	11,265	37.38	21.61
Health care utilization in the year prior to hospitalization			
Hospitalized	13,524	44.87	25.97
Emergency department use	16,630	55.18	22.74
Number of outpatient visits			
0–3 visits	5243	17.40	15.35
4–8 visits	8519	28.27	16.21
9–12 visits	5549	18.41	18.27
13 or more	10,828	35.93	22.99
Receipt of outpatient quality of care in the year prior to hospitalization			
Receipt of two HbA1c tests	11,082	36.77	17.79
LDL test	14,457	47.97	17.26
≥90 days of statin prescription	13,589	45.09	18.93
≥90 days of ACEI/ARB prescription	15,529	51.52	18.73
Insurance type			
Health maintenance organization	6022	19.98	19.98
Preferred provider organization	18,591	61.68	18.53
Others	5526	18.34	18.84
Region			
East	2413	8.01	17.16
Midwest	10,217	33.90	19.73
South	8321	27.61	19.94
West	9188	30.49	17.41

Table 2.
Bivariate Analysis: Patient Characteristics by 30-Day Hospital Readmission

Patient characteristic	Not readmitted (n = 24,450)	Not readmitted (%)	Readmitted (n = 5689)	Readmitted (%)
Age (years)[a]				
18–44	3074	12.57	474	8.33
45–54	4001	16.36	764	13.43
55–64	7788	31.85	1734	30.48
65–74	4009	16.40	1082	19.02
75–84	4090	16.73	1203	21.15
85+	1488	6.09	432	7.59
Gender				
Male	12,226	50.00	2822	49.60
Female	12,224	50.00	2867	50.40
Clinical characteristics				
Heart failure[a]	4299	17.58	1670	29.35
Valvular disease[a]	2510	10.27	876	15.40
Pulmonary circulation disease[a]	1101	4.50	402	7.07
Peripheral vascular disease[a]	3430	14.03	1228	21.59
Paralysis[a]	669	2.74	256	4.50
Other neurological disorders[a]	2659	10.88	1000	17.58
Chronic pulmonary disease[a]	5346	21.87	1589	27.93
Hypertension[a]	18,385	75.19	4599	80.84
Hypothyroidism[b]	3276	13.40	827	14.54
Renal failure[a]	3600	14.72	1436	25.24
Liver disease[a]	1039	4.25	331	5.82
Peptic ulcer disease x bleeding	46	0.19	13	0.23
Acquired immune deficiency syndrome	42	0.17	11	0.19
Lymphoma[a]	246	1.01	104	1.83
Metastatic cancer[a]	437	1.79	190	3.34
Solid tumor without metastasis[a]	1677	6.86	603	10.60
Rheumatoid arthritis/collagen vascular disease[a]	914	3.74	275	4.83
Coagulopathy[a]	998	4.08	416	7.31
Obesity	3152	12.89	750	13.18
Weight loss[a]	1018	4.16	446	7.84
Fluid and electrolyte disorders[a]	4791	19.60	1815	31.90
Chronic blood loss anemia[a]	357	1.46	164	2.88
Deficiency anemias[a]	5278	21.59	1843	32.40
Alcohol abuse[c]	340	1.39	108	1.90
Drug abuse[a]	306	1.25	130	2.29

Continued →

Table 2. Continued

Patient characteristic	Not readmitted (n = 24,450)	Not readmitted (%)	Readmitted (n = 5689)	Readmitted (%)
Psychoses[a]	1476	6.04	530	9.32
Depression[a]	2305	9.43	677	11.90
Any insulin[a]	8831	36.12	2434	42.78
Health care utilization in the year prior to hospitalization				
Hospitalized[a]	10,012	40.95	3512	61.73
Emergency department use[a]	12,849	52.55	3781	66.46
Number of outpatient visits[a]				
0–3 visits	4438	18.15	805	14.15
4–8 visits	7138	29.19	1381	24.27
9–12 visits	4535	18.55	1014	17.82
13 or more	8339	34.11	2489	43.75
Receipt of outpatient quality of care in the year prior to hospitalization				
Receipt of two HbA1c tests[a]	9110	37.26	1972	34.66
LDL test[a]	11,961	48.92	2496	43.87
≥90 days of statin prescription	11,016	45.06	2573	45.23
≥90 days of ACEI/ARB prescription	12,621	51.62	2908	51.12
Insurance type[b]				
Health maintenance organization	4819	19.71	1203	21.15
Preferred provider organization	15,146	61.95	3445	60.56
Others	4485	18.34	1041	18.30
Region[a]				
East	1999	8.18	414	7.28
Midwest	8201	33.54	2016	35.44
South	6662	27.25	1659	29.16
West	7588	31.03	1600	28.12

[a] $p < 0.001$.
[b] $p < 0.05$.
[c] $p < 0.01$.

diabetes. Number of outpatient visits in the year prior to admission had no significant impact on the likelihood of readmission when controlling for other patient characteristics.

Patients who received both quality processes of care (i.e., two HbA1c and LDL tests) in the year prior to admission were significantly less likely to be readmitted to the hospital in the bivariate analysis ($p < .001$; **Table 2**]. However, when controlling for other patient characteristics, only patients who received an LDL test in the year prior to admission were significantly less likely to be readmitted to the hospital (OR = 0.918, 95% CI [0.852 0.989], $p < .025$; **Table 3**). Patients who filled at least a 90-day supply of a statin in the year prior to admission were significantly less likely to be readmitted to the hospital (OR = 0.91, 95% CI [0.85 0.97], $p < .01$; **Table 3**). Conversely, patients who filled at least one prescription for insulin were significantly more likely to be readmitted to the hospital (OR = 1.20, 95% CI [1.12 1.28], $p < .001$).The majority of patients in our analysis were in the preferred provider organization insurance type. Insurance types were not a significant predictor of readmission in the multivariate analysis.

Table 3. Multivariate Analysis: Predictors of 30-Day Hospital Readmission among Patients with Diabetes

Patient characteristic	OR	95% CI
Age (years)		
18–44	1.00	reference
45–54[a]	1.26	(1.11, 1.43)
55–64[a]	1.42	(1.26, 1.59)
65–74[a]	1.53	(1.34, 1.75)
75–84[a]	1.57	(1.37, 1.79)
85+[a]	1.53	(1.30, 1.80)
Gender		
Male	1.00	reference
Female	1.01	(0.95, 1.07)
Clinical characteristics		
Heart failure[a]	1.23	(1.13, 1.33)
Valvular disease	1.04	(0.95, 1.14)
Pulmonary circulation disease	0.98	(0.86, 1.11)
Peripheral vascular disease[a]	1.19	(1.10, 1.29)
Paralysis	1.08	(0.92, 1.26)
Other neurological disorders[b]	1.10	(1.01, 1.21)
Chronic pulmonary disease	1.02	(0.95, 1.10)
Hypertension	0.99	(0.91, 1.07)
Hypothyroidism	0.96	(0.88, 1.05)
Renal failure[a]	1.27	(1.17 1.38)
Liver disease	1.10	(0.96, 1.26)
Peptic ulcer disease x bleeding	0.75	(0.40, 1.42)
Acquired immune deficiency syndrome	1.02	(0.51, 2.03)
Lymphoma[c]	1.39	(1.10, 1.77)
Metastatic cancer	1.22	(1.00 1.49)
Solid tumor without metastasis[b]	1.20	(1.07, 1.35)
Rheumatoid arthritis/ collagen vascular disease	1.13	(0.98, 1.31)
Coagulopathy	1.13	(1.00, 1.29)
Obesity	0.92	(0.84, 1.01)
Weight loss[a]	1.29	(1.14, 1.46)

Continued →

Table 3. Continued

Patient characteristic	OR	95% CI
Fluid and electrolyte disorders[a]	1.15	(1.07, 1.24)
Chronic blood loss anemia[b]	1.22	(1.01, 1.49)
Deficiency anemias	1.05	(0.97, 1.13)
Alcohol abuse	1.02	(0.80, 1.28)
Drug abuse[c]	1.41	(1.13, 1.76)
Psychoses[b]	1.15	(1.03, 1.29)
Depression	1.07	(0.97, 1.19)
Any insulin[a]	1.20	(1.12, 1.28)
Health care utilization in the year prior to hospitalization		
Hospitalized[a]	1.55	(1.43, 1.68)
Emergency department use[c]	1.13	(1.05, 1.22)
Number of outpatient visits		
0–3 visits	1.00	reference
4–8 visits	0.94	(0.85, 1.04)
9–12 visits	0.92	(0.82, 1.03)
13 or more	0.94	(0.85, 1.05)
Receipt of outpatient quality of care in the year prior to hospitalization		
Receipt of two HbA1c tests	0.94	(0.87, 1.02)
LDL test[b]	0.92	(0.85, 0.99)
≥90 days of statin prescription[c]	0.91	(0.85, 0.97)
≥90 days of ACEI/ARB prescription	0.94	(0.88, 1.01)
Insurance type		
Health maintenance organization	0.95	(0.82, 1.10)
Preferred provider organization	1.00	reference
Others	0.95	(0.87, 1.04)

[a] $p < 0.001$.
[b] $p < 0.05$.
[c] $p < 0.01$.

Discussion

The 30-day hospital readmission rate among commercially insured patients in this study (18.9%) was higher than those reported in prior studies of commercially insured populations (7.7–11.6%)[4,5] but was in line with a study of the Medicaid and Medicare population (21.2–23.3%).[5] This rate may be more in line with rates reported of Medicare populations, because 40% of the patients in this

study were 65 years and older (mean age = 63.0 years) and have Medicare plus commercial insurance.

We found in this study that patients who filled at least a 90-day supply of a statin medication were significantly less likely to be readmitted to the hospital. This may be because most 30-day readmissions among patients with diabetes were associated with exacerbations of vascular disease, and a robust randomized control trial, the Heart Protection Study, has shown that statin therapy was associated with a 22–33% reduction in cardiovascular events among all patients with diabetes, regardless of history of vascular disease.[16] What is most interesting is that we found that patients who received a standard quality-of-care intervention consisting of at least one LDL test as an outpatient in the year prior to hospital admission were also significantly less likely to be readmitted to the hospital in the 30 days post-discharge. This is important because the receipt of at least one LDL test among patients with diabetes is one of the Healthcare Effectiveness Data and Information Set (HEDIS) diabetic process of care measures that is used widely by quality-based incentive programs such as pay for performance or transparency programs. Although a majority of payers have adopted some form of quality-based incentive program, the evidence for the effectiveness of these programs to impact outcomes has been scant. This study suggests that quality-based incentive programs, including the receipt of at least annual LDL testing among patients with diabetes, can lead to reduced rates of 30-day hospital readmission.

We did not find significant association between receipt of HbA1c testing, another commonly used HEDIS diabetic process of care measure, and the reduction of 30-day hospital readmission. This may be because good glycemic control is difficult to achieve, a long period of tight glycemic control may be needed to see its benefit, and the receipt of HbA1c testing is only first of many steps in achieving good glycemic control.

Unlike Stuart and associates,[11] who found a significant reduction in hospitalization associated with persistence of ACEI/ARBs, we did not find a significant reduction in 30-day readmission among diabetes patients who received at least 90 days of ACEI/ARBs. This may be because the benefit of ACEI/ARBs among patients with diabetes is strongest for subgroups of high-risk diabetes patients, mainly those with existing cardiovascular disease, heart failure,[17,18] or diabetic nephropathy,[19] and the evidence for reduction of cardiovascular events among diabetes patients in general is conflicting.[20,21]

There are some limitations to consider. First, this is an administrative-claims-based data analysis, with potential biases secondary to coding variation and missing data. However, administrative claims data have been used successfully in many studies to examine patterns, effectiveness, and gaps in quality of care and assess outcomes in care.[22–25] Second, although the IMS LifeLink Database is a fairly comprehensive database, it is only representative of a commercially insured population. The findings of this study cannot be generalized to other populations, specifically Medicaid and the uninsured. Lastly, there were unmeasured factors that predict hospital readmission (e.g., quality of inpatient care and discharge planning, race, education, blood pressure control, HbA1c and LDL levels, smoking, obesity) that were not controlled for in the multivariate analyses.

Conclusions

We found that patients who received at least a 90-day supply of statins or an LDL test as an outpatient in the year prior to hospital admission were significantly less likely to be readmitted to the hospital within 30 days. This is a strong affirmation to the value of statins among all patients with diabetes in the real world outside the confines of a rigorous randomized control trial. In addition, this finding should be good news for the majority of payers that adopted some form of quality-based incentive program to target the increase receipt of LDL testing for patients with diabetes. Findings of this study also suggest that incentive-based quality programs to increase the use of and adherence to statins among all patients with diabetes regardless of LDL level may be worthy of consideration. Although we did not find a positive association between receipt of HbA1c testing and decreased likelihood of hospital readmission, future studies can focus on HbA1c control and hospital readmission. Similarly, although we did not find a positive association between persistence of ACEI/ARB and decreased likelihood of readmission among all patients with diabetes, future studies should focus on the benefit of ACEI/ARB among the subpopulation of diabetes patients with diabetic nephropathy or heart failure on hospital readmission.

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References:

1. Patient Protection and Affordable Care Act. http://www.gpo.gov/fdsys/pkg/PLAW-111publ148/pdf/PLAW-111publ148.pdf. Accessed November 29, 2011.
2. Rau J. Medicare prepares rule to penalize hospitals with high readmission rates. Kaiser Health News. July 30, 2011. http://www.kaiserhealthnews.org/Stories/2011/July/30/medicare-and-hospital-readmissions.aspx. Accessed November 29, 2011.
3. Wier LM, Pfuntner A, Maeda J, Stranges E, Ryan K, Jagadish P, Collins Sharp B, Elixhauser A. HCUP facts and figures: statistics on hospital-based care in the United States, 2009. Rockvill: Agency for Healthcare Research and Quality; 2011 http://www.hcup-us.ahrq.gov/reports.jsp. Accessed November 29, 2011.
4. Jiang HJ, Andrews R, Stryer D, Friedman B. Racial/ethnic disparities in potentially preventable readmissions: the case of diabetes. Am J Public Health. 2005;95(9):1561–7.
5. Robbins JM, Webb DA. Diagnosing diabetes and preventing rehospitalizations: the urban diabetes study. Med Care. 2006;44(3):292–6.
6. Ashton CM, Kuykendall DH, Johnson ML, Wray NP, Wu L. The association between the quality of inpatient care and early readmission. Ann Intern Med. 1995;122(6):415–21.
7. Ashton CM, Del Junco DJ, Souchek J, Wray NP, Mansyur CL. The association between the quality of inpatient care and early readmission: a meta-analysis of the evidence. Med Care. 1997;35(10):1044–59.
8. Niefeld MR, Braunstein JB, Wu AW, Saudek CD, Weller WE, Anderson GF. Preventable hospitalization among elderly Medicare beneficiaries with type 2 diabetes. Diabetes Care. 2003;26(5):1344–9.
9. Oddone EZ, Weinberger M, Horner M, Mengel C, Goldstein F, Ginier P, Smith D, Huey J, Farber NJ, Asch DA, Loo L, Mack E, Hurder AG, Henderson W, Feussner JR. Classifying general medicine readmissions. Are they preventable? Veterans Affairs Cooperative Studies in Health Services Group on Primary Care and Hospital Readmissions. J Gen Intern Med. 1996;11(10):597–607.
10. Chen JY, Tian H, Taira Juarez D, Hodges KA Jr, Brand JC, Chung RS, Legorreta AP. The effect of a PPO pay-for-performance program on patients with diabetes. Am J Manag Care. 2010;16(1):e11–9.
11. Stuart BC, Simoni-Wastila L, Zhao L, Lloyd JT, Doshi JA. Increased persistency in medication use by U.S. Medicare beneficiaries with diabetes is associated with lower hospitalization rates and cost savings. Diabetes Care. 2009;32(4):647–9.
12. Terry K. Pay for performance: how fast is it spreading? Medical Economics. http://medicaleconomics.modernmedicine.com/memag/article/articleDetail.jsp?id=190108. Accessed August 11, 2008.
13. Campion FX. Medicare's P4P program aims to improve care. Managed Healthcare Executive. http://managedhealthcareexecutive.modernmedicine.com/mhe/P4P/Medicares-P4P-program-aims-to-improve-care/ArticleStandard/Article/detail/585253?contextCategoryId=45197. Accessed March 20, 2012.
14. Rosenthal MB, Landon BE, Normand SL, Frank RG, Epstein AM. Pay for performance in commercial HMOs. N Engl J Med. 2006;355(18):1895–902.
15. Elixhauser A, Steiner C, Harris DR, Coffey RM. Comorbidity measures for use with administrative data. Med Care. 1998;36(1):8–27.
16. Collins R, Armitage J, Parish S, Sleigh P, Peto R; Heart Protection Study Collaborative Group. MRC/BHF Heart Protection Study of cholesterol-lowering with simvastatin in 5963 people with diabetes: a randomised placebo-controlled trial. Lancet. 2003;361(9374):2005–16.
17. McMurray JJ, Ostergren J, Swedberg K, Granger CB, Held P, Michelson EL, Olofsson B, Yusuf S, Pfeffer MA; CHARM Investigators and Committees. Effects of candesartan in patients with chronic heart failure and reduced left-ventricular systolic function taking angiotensin-converting-enzyme inhibitors: the CHARM-Added trial. Lancet. 2003;362(9386):767–71.
18. Pfeffer MA, Swedberg K, Granger CB, Held P, McMurray JJ, Michelson EL, Olofsson B, Ostergren J, Yusuf S, Pocock S; CHARM Investigators and Committees. Effects of candesartan on mortality and morbidity in patients with chronic heart failure: the CHARM-Overall programme. Lancet. 2003;362(9386):759–66.
19. Berl T, Hunsicker LG, Lewis JB, Pfeffer MA, Porush JG, Rouleau JL, Drury PL, Esmatjes E, Hricik D, Parikh CR, Raz I, Vanhille P, Wiegmann TB, Wolfe BM, Locatelli F, Goldhaber SZ, Lewis EJ; Irbesartan Diabetic Nephropathy Trial. Collaborative Study Group. Cardiovascular outcomes in the Irbesartan Diabetic Nephropathy Trial of patients with type 2 diabetes and overt nephropathy. Ann Intern Med. 2003;138(7):542–9.
20. UK Prospective Diabetes Study Group. Tight blood pressure control and risk of macrovascular and microvascular complications in type 2 diabetes: UKPDS 38. BMJ. 1998;317(7160):703–13.
21. Psaty BM, Smith NL, Siscovick DS, Koepsell TD, Weiss NS, Heckbert SR, Lemaitre RN, Wagner EH, Furberg CD. Health outcomes associated with antihypertensive therapies used as first-line agents. A systematic review and meta-analysis. JAMA. 1997;277(9):739–45.
22. Chen JY, Tian H, Taira Juarez D, Hodges KA Jr, Brand JC, Chung RS, Legorreta AP. The effect of a PPO pay-for-performance program on patients with diabetes. Am J Manag Care. 2010;16(1):e11–9.
23. Chen JY, Kang N, Juarez DT, Hodges KA, Chung RS, Legorreta AP. Impact of a pay-for-performance program on low performing physicians. J Healthc Qual. 2010;32(1):13–21.
24. Min JK, Kang N, Shaw LJ, Devereux RB, Robinson M, Lin F, Legorreta AP, Gilmore A. Costs and clinical outcomes after coronary multidetector CT angiography in patients without known coronary artery disease: comparison to myocardial perfusion SPECT. Radiology. 2008;249(1):62–70.
25. O'Connor RD, Rosenzweig JR, Stanford RH, Gilmore AS, Ryskina KL, Legorreta AP, Stempel DA. Asthma-related exacerbations, therapy switching, and therapy discontinuation: a comparison of 3 commonly used controller regimens. Ann Allergy Asthma Immunol. 2005;95(6):535–40.