

Racial/Ethnic Disparities in Potentially Preventable Readmissions: The Case of Diabetes

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Diabetes, which affects about 18 million people in the United States,¹ is 1 of the 6 priority conditions that the federal Department of Health and Human Services has targeted to remediate the considerable disparities among racial/ethnic groups.² Results of national surveys reveal that the major differences between non-Hispanic Whites and racial/ethnic minorities in diabetes care are in the treatment and self-management of the disease, patient education, and health status.^{3–5} For instance, non-Hispanic Blacks and Hispanics were found to be less likely to self-monitor blood glucose level and more likely to have poor glycemic control (i.e., blood glucose levels higher than the targeted range for diabetes patients). Poor glycemic control is the most significant predictor for hospitalization among people with diabetes.⁶

Few studies have compared diabetes-related hospitalizations by race/ethnicity. Two recent studies derived from hospital discharge abstract data and census population data in California showed higher hospitalization rates for diabetes among Blacks and Hispanics than among Whites.^{7,8} This finding held after adjustment for variation in diabetes prevalence across racial/ethnic groups. The National Healthcare Disparities Report, which was based on data from 16 states, showed that Blacks and Hispanics had higher hospitalization rates than Whites for uncontrolled diabetes and long-term complications.⁹ Blacks also had higher admission rates for short-term complications from diabetes. However, these studies failed to take into account multiple hospitalizations by the same individuals, which have been found to be common among patients with diabetes.¹⁰

One would expect that after a person has been hospitalized for a diabetes complication, the patient or the attending physician would better manage the condition against further deterioration. Effective follow-up care can help prevent some readmissions and associ-

Objectives. Considerable differences in prevalence of diabetes and management of the disease exist among racial/ethnic groups. We examined the relationship between race/ethnicity and hospital readmissions for diabetes-related conditions.

Methods. Nonmaternal adult patients with Medicare, Medicaid, or private insurance coverage hospitalized for diabetes-related conditions in 5 states were identified from the 1999 State Inpatient Databases of the Healthcare Cost and Utilization Project. Racial/ethnic differences in the likelihood of readmission were estimated by logistic regression with adjustment for patient demographic, clinical, and socioeconomic characteristics and hospital attributes.

Results. The risk-adjusted likelihood of 180-day readmission was significantly lower for non-Hispanic Whites than for Hispanics across all 3 payers or for non-Hispanic Blacks among Medicare enrollees. Within each payer, Hispanics from low-income communities had the highest risk of readmission. Among Medicare beneficiaries, Blacks and Hispanics had higher percentages of readmission for acute complications and microvascular disease, while Whites had higher percentages of readmission for macrovascular conditions.

Conclusions. Racial/ethnic disparities are more evident in 180-day than in 30-day readmission rates, and greatest among the Medicare population. Readmission diagnoses vary by race/ethnicity, with Blacks and Hispanics at higher risk for those complications more likely preventable with effective postdischarge care. (*Am J Public Health*. 2005;95:1561–1567. doi:10.2105/AJPH.2004.044222)

ated medical expenditures. Efforts to reduce potentially preventable hospitalizations for diabetes should therefore address not only the general population with diabetes but also, and more specifically, those who already have had at least 1 hospital stay.

Using hospital discharge data from 5 states, we examined racial/ethnic differences in hospital readmissions for diabetes-related conditions. In our study, we extended previous research by looking at both early (30-day) and long-term (180-day) readmission rates. The literature suggests that readmissions observed within a longer follow-up period are mostly related to the progression of chronic disease and are thus a gauge of the quality of outpatient care, while readmissions occurring soon after a hospital stay are related to quality-of-care problems during the initial admission.^{11,12}

Unlike researchers who have focused on a single payer (e.g., Medicare, Medicaid), we took advantage of the Healthcare Cost and Utilization Project (HCUP) all-payer databases. Payer category is not only an indicator

of socioeconomic status but also a reflection of the unique demographic and clinical characteristics of each subpopulation. More importantly, each payer has its distinctive financing mechanism, delivery models, and provider networks. Comparing findings separately by payer allows policymakers, program managers, and practitioners to better target specific subpopulations.

METHODS

Subjects and Databases

The study sample was derived from the 1999 HCUP State Inpatient Databases. Sponsored by the Agency for Healthcare Research and Quality, HCUP is a federal–state–industry partnership formed to build a multistate health care data system. The State Inpatient Databases include discharge abstracts on all inpatient stays from virtually all community hospitals in participating states. Community hospitals are defined as short-term, nonfederal facilities (either general or specialty); they

include academic medical centers but exclude long-term care and psychiatric hospitals. We selected patients from 5 states—California, Missouri, New York, Tennessee, and Virginia—which together provide a relatively high representation of Blacks and Hispanics. Additionally, these 5 states provide patient numbers, encrypted from a patient's name and social security number, that allow linkage of multi-

ple admissions by distinct patients across hospitals within the same state.

Nonmaternal patients aged 18 years and older who had at least 1 admission for diabetes-related conditions during the first 6 months of 1999 were included in the study. We defined the first admission (including subsequent transfers, if any) as the index admission and used the patient number to identify

any readmissions for diabetes-related conditions within 30 or 180 days after discharge from the index admission. Patients who died at the index admission were excluded because they were no longer available for follow-up. We removed records with missing patient numbers and sets of records with the same patient number but inconsistent age (different by more than 1 year) or gender. If a patient had 2 consecutive admissions, with the second admission occurring either on the day of discharge from the previous admission or 1 day earlier, the second admission was considered a transfer rather than a readmission.

We defined admissions for diabetes-related conditions as those meeting 1 of 2 conditions: (1) a principal diagnosis of diabetes, with an *International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)*¹³ code beginning with 250, or (2) a secondary diagnosis of diabetes but a principal diagnosis of a condition for which individuals with diabetes are at high risk (Table 1).

Using such an approach to identify admissions for diabetes-related conditions allowed us to overcome the limitations found in earlier research, which defined diabetes admission on the basis of a principal diagnosis of diabetes or presence of diabetes in any diagnosis field (i.e., principal or secondary diagnosis).^{7–10,14,15} The former definition is too narrow (in our data, only 10% of admissions with diabetes have diabetes as a principal diagnosis), while the latter could be so broad that even conditions completely unrelated to diabetes are included. The *ICD-9-CM* codes for diabetes do not have a separate category to report cardiac complications; consequently, diabetes is seldom listed as the principal diagnosis if the admission is for cardiac conditions. Diabetes is a significant risk factor for cardiovascular disease,^{16,17} which in turn is the main cause of hospital use¹⁴ and premature deaths among diabetes patients,¹⁸ and therefore needs to be captured in our analysis.

Because we were examining the relationship between race/ethnicity and the likelihood of readmission by payer, it was necessary to reduce potential overlap between payers while improving patient homogeneity within payers. We therefore added age restrictions to each payer, confining Medicare patients to those

TABLE 1—International Classification of Diseases, Ninth Revision, Clinical Modification (ICD-9-CM)¹³ Codes for Identifying Diabetes-Related Admissions

Condition	ICD-9-CM Codes ^a
Diabetes	
Diabetes, no mention of complications	2500
Diabetes with acute complications	2501-2503
Diabetes with renal complications	2504
Diabetes with eye complications	2505
Diabetes with neurological complications	2506
Diabetes with peripheral circulatory disorders	2507
Diabetes with other or unspecified complications	2508-2509
Cardiovascular disease	
Ischemic heart disease	410-414, V4581, V4582
Congestive heart failure	39891, 428
Cardiac arrhythmia	426, 427, 7850, 7851, V450, V533,
Cerebrovascular disease	430-438
Hypertension	401-405, 4372
Other cardiovascular disease	415-417, 429, 440-444 (except 4402, 4423, 4438, 4439, 44422), 446-448, 451-453 (except 4510, 4512), 458, 459, 557, 7859, 7865, 7943, 7962, V125, V151, V421, V434, V717
Renal disease	
End-stage renal disease	585-586, V420, V451, V56
Other renal disease	580-584, 590, 595, 597, 59800, 59801, 5990
Lower extremity disease	
Neurological complications	337, 342-344, 354, 355, 3568, 3569, 3572, 3581
Peripheral vascular disease related to lower extremities	4402, 4423, 4438, 4439, 44422, 44502, 4510, 4512, 454, 711, 7184, 7271, 730, 735, 736, 7396, 7854
Skin infections and chronic ulcer	0201, 0210, 0220, 0311, 03285, 035, 0390, 680-682, 684-686, 690, 694-698, 700-703, 707, 709, V133, V423
Eye disease—cataract, retinal, glaucoma, blindness, and vision defects	361, 362, 365-369, V431, V410
Other conditions	
Mycoses	110-112, 1141, 1143, 1149, 11500, 11509, 11510, 11519, 11590, 11599, 116-118
Fluid and electrolyte disorders	276

^aThe fourth and fifth digits are not listed for those codes for which the specifications apply only to the first 3 or 4 digits. Diabetes-related admissions are defined as those (1) having a principal diagnosis of diabetes (beginning with 250) or (2) having diabetes as a secondary diagnosis, with a principal diagnosis of one of the nondiabetes conditions listed in this table.

aged 65 or older (thus excluding the smaller group of younger, disabled Medicare enrollees) and restricting Medicaid or private patients to those aged 18 to 64 years. The uninsured and those covered by other government programs were excluded from this study owing to small sample size, especially when stratified by race/ethnicity.

Patient Demographic, Socioeconomic, and Clinical Characteristics

Among various confounding factors discussed in the Institute of Medicine report *Unequal Treatment*¹⁹ and in other models^{20,21} that influence access to care and health outcomes, 3 factors derived from data availability were employed in this study: (1) patient clinical, demographic, and socioeconomic characteristics that reflect the need for and likelihood of hospitalization; (2) hospital structural attributes that may relate to differences in severity of illness and quality of care; and (3) availability of inpatient and outpatient care resources.

Patient demographic and socioeconomic characteristics included age, gender, race/ethnicity (White, Black, Hispanic), payer, median household income of the patient's zip code, and rural/urban location. All these variables were available in the discharge data except for income and urban/rural location. We determined whether the patient lived in a rural or urban area through the patient's county or zip code. Rural areas were defined as areas outside a metropolitan statistical area (MSA). We categorized the median household income of the patient's zip code area into 3 levels by quartiles specific to each state (i.e., below 25th percentile, 25th–75th percentile, and above 75th percentile).

Patient clinical characteristics at the index admission that could have an impact on the likelihood of readmission were measured by a number of variables, including the presence of 10 specific diabetes-related complications and comorbidities (derived from the comorbidity index of Elixhauser et al.),²² admission through the emergency room, performance of major surgical procedures, length of stay, discharge status (e.g., home, other health care facilities), and month of admission. Previous studies on hospital readmission show that a longer hospital stay at the index admission

and discharge to long-term or other nonacute care facilities are associated with lower likelihood of readmission.^{23,24} The admission month of the index admission was included to control for potential seasonal effects and possible hospitalizations in the previous year not captured by the data.

Hospital Attributes and County Health Care Resources

Information on hospital attributes for the index admission, which was obtained from the American Hospital Association Annual Survey, included number of beds (<100, 100–299, ≥300), teaching status (resident-to-bed ratio ≥0.25), and ownership (non-profit, for-profit, public). Four county resources variables, derived from the Area Resource File of the Health Resources and Services Administration, were selected: number of hospital beds per capita, number of primary care physicians per 1000 county residents, number of internal medicine specialists per 1000 county residents, and number of outpatient visits per capita. Bed supply and availability of primary care and specialist physicians have been found in other studies to be related to hospitalization rates, particularly for ambulatory care-sensitive conditions such as diabetes.^{25–27}

Statistical Analysis

We conducted all the analyses by payer in order to examine how the pattern of racial/ethnic differences might vary across payers. First, we performed stratified analyses to compare differences among racial/ethnic groups in patient demographic, socioeconomic, and clinical characteristics, as well as observed readmission rates for diabetes-related conditions. We used the χ^2 test to determine the statistical significance of the differences. We then used logistic regressions to estimate the relationship between race/ethnicity and the likelihood of readmission, controlling for patient characteristics (demographic, socioeconomic, and clinical), hospital attributes, and county health care resources.

Variables that were significant at the $P < .10$ level were retained in the final models. None of the county resources variables was significant at the $P < .10$ level, and these were thus removed from the analysis. For variables re-

tained in the final models, interactions between select variables (e.g., race and income) were also tested. If a significant interaction was found between race and another variable, we estimated additional models by using new categorical variables created from both variables (e.g., Hispanics from low-income zip code areas).

Among the readmissions, differences in reason for hospitalization were also compared across racial/ethnic groups. We focused on 6 major disease categories based on the principal diagnosis: (1) acute complications of diabetes (e.g., ketoacidosis, hyperosmolality, diabetic coma), (2) lower extremity disease, (3) renal disease, (4) congestive heart failure, (5) ischemic heart disease, and (6) cerebrovascular disease. Some of these diseases are more likely to be preventable than others, and the risk of developing a particular condition may vary by race/ethnicity.

RESULTS

Differences in Patient Characteristics

Table 2 shows differences in patient characteristics across 3 racial/ethnic groups by payer. Among patients with private or Medicare insurance, Blacks and Hispanics were more likely than Whites to be in the youngest age groups. Among Medicaid patients, Blacks were younger than Whites and Hispanics. Across all 3 payers, the percentage of female patients was highest for Blacks and lowest for Whites.

Regardless of payer status, Blacks and Hispanics were more likely to reside in low-income communities than Whites. The differences between Whites and the other 2 racial/ethnic groups were greater among non-Medicaid patients. Blacks and Hispanics were also more concentrated in large MSAs (≥1 million residents) than Whites, who were spread out more evenly across rural areas, small MSAs (<1 million residents), and large MSAs.

The presence of various clinical conditions at index admission differed by race/ethnicity. Blacks had the highest rates of acute complications and hypertension, while Hispanics had the highest rate for renal disease. Whites had the highest percentages of ischemic heart disease and depression. The percentage of patients with lower extremity disease was also

TABLE 2—Characteristics of Diabetes Patients by Type of Payer and Race/Ethnicity: Healthcare Cost and Utilization Project, 1999

	Type of Payer								
	Private Insurance (Age = 18–64)			Medicaid (Age = 18–64)			Medicare (Age ≥ 65)		
	White	Black	Hispanic	White	Black	Hispanic	White	Black	Hispanic
No. of patients	21 077	5920	3371	9001	6055	4663	61 614	10 545	8505
Sociodemographic characteristics, %									
Age, y									
18–44	16.6	22.2	22.3***	23.7	27.1	22.8***			
45–54	32.4	34.2	33.6	31.0	31.0	30.8			
55–64	51.0	43.6	44.1	45.3	41.9	46.4			
65–79							67.7	75.8	78.1***
≥ 80							32.3	24.2	21.9
Female	39.4	50.7	41.2***	56.4	62.4	57.4***	52.6	64.0	57.0***
Median family income of zip code area ^a									
High	37.2	20.4	20.8***	15.4	9.5	7.1***	30.2	13.9	14.2***
Medium	50.4	48.3	53.7	55.9	38.2	42.1	52.5	42.1	50.4
Low	12.4	31.3	25.5	28.7	52.3	50.8	17.4	44.1	35.3
Residence									
Large MSA (≥ 1 million residents)	59.4	78.3	81.9***	40.3	80.9	84.4***	56.8	75.6	78.5***
Small MSA (< 1 million residents)	24.6	15.7	15.5	29.3	13.0	13.3	24.4	15.7	17.5
Rural	16.0	6.0	2.7	30.4	6.1	2.3	18.9	8.7	4.0
Clinical conditions present at index admission, %									
Diabetes, acute complications	8.4	12.4	9.3***	9.8	12.7	8.3***	2.1	3.7	3.1***
Ophthalmic disease	7.9	7.3	7.6	8.0	7.6	9.1**	7.1	9.3	8.9***
Lower extremity disease	26.6	20.4	24.0***	32.0	25.2	26.0***	27.3	28.2	29.8***
End-stage renal disease	2.7	3.3	3.9**	4.3	5.1	5.7**	3.6	5.6	5.8***
Other renal complications	6.8	8.9	9.5***	9.0	11.0	12.8***	7.3	10.7	14.0***
Congestive heart failure	15.5	19.0	13.7***	22.9	23.8	19.7***	38.3	36.2	34.7***
Hypertension	54.7	64.7	54.5***	52.8	65.3	58.8***	61.7	76.2	69.8***
Ischemic heart disease	47.2	25.3	34.8***	39.2	22.8	28.0***	55.1	38.7	46.7***
Cerebrovascular disease	9.9	10.4	10.1	9.2	9.6	9.5	20.7	21.5	19.6**
Depression	5.7	2.8	3.7***	10.1	5.2	5.8***	5.4	2.8	3.5***

Note. MSA = metropolitan statistical area. For each sociodemographic characteristic, statistical significance was tested for the overall difference across all categories among the 3 racial/ethnic groups. Data are from State Inpatient Databases for 5 states (California, Missouri, New York, Tennessee, and Virginia) of the Healthcare Cost and Utilization Project, Agency for Healthcare Research and Quality.

^aIncome categories correspond to below 25th percentile (low), 25th to 75th percentile (medium), and above 75th percentile (high).

P* < .01; *P* < .0001.

highest for Whites among those aged younger than 65, but the percentage was lowest for Whites among those aged 65 or older.

Readmissions for Diabetes-Related Conditions

Table 3 provides the observed 30-day and 180-day readmission rates as well as the risk-adjusted odds ratios for Blacks and Hispanics compared with Whites. Hispanics had the highest observed 180-day readmission rates within each payer. The observed 180-

day readmission rate was also higher for Blacks than for Whites in the Medicare subpopulation.

Racial/ethnic differences in the risk-adjusted likelihood of readmission were stronger when the follow-up period was extended from 30 days to 180 days after discharge. In the 30-day follow-up, only among Medicare patients did Hispanics have a significantly higher risk of readmission than for Whites (odds ratio [OR]= 1.21), while in the 180-day follow-up, the risk of being readmit-

ted was significantly higher for Hispanics than for Whites across all 3 payers (OR= 1.12, 1.14, and 1.29 for the private, Medicaid, and Medicare subpopulations, respectively). Blacks also had a significantly higher risk of 180-day readmission than Whites in the Medicare subpopulation.

Income of the patient's zip code area was a significant moderator of the relationship between ethnicity and risk of 180-day readmission among the privately insured (results not presented in the table). Compared

TABLE 3—Observed 30-Day and 180-Day Readmission Rates for Diabetes-Related Conditions and Risk-Adjusted Odds Ratios, by Payer and Race/Ethnicity: Healthcare Cost and Utilization Project, 1999

	Observed Readmission Rate, %		Risk-Adjusted Odds Ratio ^a (95% Confidence Interval)	
	30-Day	180-Day	30-Day	180-Day
Private insurance (age = 18-64)				
White ^b	7.78	21.4	1.00	1.00
Black	6.76**	20.2	0.93 (0.82, 1.05)	1.01 (0.93, 1.09)
Hispanic	8.93*	23.1*	1.13 (0.98, 1.30)	1.12 (1.03, 1.23)*
Medicaid (age = 18-64)				
White ^b	11.08	32.5	1.00	1.00
Black	11.63	33.0	1.07 (0.95, 1.21)	1.08 (1.00, 1.17)
Hispanic	11.28	34.2*	1.05 (0.92, 1.20)	1.14 (1.05, 1.24)**
Medicare (age ≥ 65)				
White ^b	10.48	27.9	1.00	1.00
Black	11.06	30.7**	1.04 (0.97, 1.12)	1.12 (1.07, 1.18)**
Hispanic	12.83**	34.0**	1.21 (1.12, 1.30)**	1.29 (1.23, 1.36)**

^aThe odds ratios were adjusted for patient demographic (age, sex), socioeconomic (income at zip code, rural/urban residence), and clinical characteristics (comorbidities, complications, emergency room admission, major surgical procedure, length of stay, discharge status) during the index admission; hospital attributes (number of beds, teaching status, ownership); and dummy variables for individual states. Full results of the final models are available from the authors. Data are from State Inpatient Databases for 5 states (California, Missouri, New York, Tennessee, and Virginia) of the Healthcare Cost and Utilization Project, Agency for Healthcare Research and Quality.

^bWhite is the reference group for comparison and testing of statistical significance.

*P < .05; **P < .01.

groups, they had a significantly higher percentage of readmissions for ischemic heart disease. By comparison, among nonelderly adults with private or Medicaid coverage, Blacks were more likely to be readmitted for acute complications or congestive heart failure, while Hispanics were more likely to be readmitted for renal disease. Among Medicare patients, both Blacks and Hispanics were more likely than Whites to be readmitted for acute complications, lower extremity disease, or renal disease.

DISCUSSION

The results of our study revealed several significant findings. First, racial/ethnic differences in risk-adjusted likelihood of readmission for diabetes-related conditions were more evident when observed over a longer follow-up period (i.e., 180 vs 30 days). This suggests that disparities in diabetes-related outcomes are more likely due to differences in outpatient management of the disease than to the quality of inpatient care. It also confirms the findings of prior literature that monitoring long-term readmission rates is particularly relevant for chronic disease.^{11,12}

Second, the pattern of racial/ethnic disparities in risk-adjusted 180-day readmission rates for diabetes-related conditions was found to vary by payer. Compared with Whites, Blacks had a significantly higher likelihood of readmission only among Medicare

with Whites, Hispanics had a significantly higher risk of readmission only among those from lower-income communities. For patients covered by Medicaid or Medicare, the pattern of ethnic disparities was consistent across income levels despite lower income being sig-

nificantly associated with a higher risk of readmission.

Table 4 compares differences in readmission diagnoses across racial/ethnic groups by payer. Although Whites tended to have lower readmission rates than the other racial/ethnic

TABLE 4—Principal Diagnosis Among Diabetes Patients at Readmission,^a by Payer and Race/Ethnicity: Healthcare Cost and Utilization Project, 1999

Principal Diagnosis	Private Insurance, % (Age = 18-64)			Medicaid, % (Age = 18-64)			Medicare, % (Age ≥ 65)		
	White ^b	Black	Hispanic	White ^b	Black	Hispanic	White ^b	Black	Hispanic
Diabetes acute complications	15.2	18.9*	12.4*	20.7	22.3	17.4*	5.2	8.1*	6.5*
Lower extremity disease	18.0	17.5	17.9	18.5	17.2	17.6	11.2	13.3*	14.2*
Renal disease	5.0	5.6	8.2*	6.6	6.9	9.5*	7.2	8.2*	8.9*
Congestive heart failure	10.7	14.9*	9.8	14.7	18.7*	16.0	25.9	23.9*	23.2*
Ischemic heart disease	24.8	14.0*	23.3	15.8	8.8*	12.9*	18.6	11.6*	15.9*
Cerebrovascular disease	5.6	5.7	6.4	3.3	3.4	3.9	8.6	8.2	7.2*

Note. Data are from State Inpatient Databases for 5 states (California, Missouri, New York, Tennessee, and Virginia) of the Healthcare Cost and Utilization Project, Agency for Healthcare Research and Quality.

^aReadmissions were captured within 180 days after discharge from the index admission.

^bWhite is the reference group for comparison and testing of statistical significance.

*P < .05, by the Dunnett t test that controls for type I error.

patients. In contrast, Hispanics had a significantly higher risk for readmission across all 3 payers. The amount of additional risk associated with Hispanics was twice as high among Medicare patients as among patients with private insurance or Medicaid coverage. These findings suggest that race/ethnicity was more likely to affect health incomes among Medicare patients than among non-Medicare patients.

It could be that racial/ethnic differences in insurance coverage for outpatient care and prescription drugs were greater in the Medicare population, leading to larger differences in the management of diabetes and outcomes. Previous studies have found that among the elderly, Blacks and Hispanics were less likely than Whites to have coverage of Part B services (physician services), and those Medicare patients without private insurance coverage of Part B services were less likely to self-monitor their blood glucose, have regular checkups, or receive treatment for hypertension or dyslipidemia.^{28,29} In this study, we were unable to test the effects of dual Medicare and Medicaid enrollment or private supplements to Medicare owing to data limitations.

Nevertheless, we controlled for median household income of the patient's zip code area as a proxy for socioeconomic status. Our results showed consistent patterns of racial/ethnic disparities across income levels among Medicare patients. Therefore, it is very likely that some noneconomic factors not captured in this study also contributed significantly to the observed variation by race/ethnicity.

Another finding worth discussion is that in examining the readmission diagnoses, we found significant differences by payer and race/ethnicity. In the Medicare subpopulation, Blacks and Hispanics had higher percentages of readmissions for acute and microvascular complications (e.g., lower extremity disease, renal disease), while Whites had higher rates for macrovascular conditions (e.g., heart attack, stroke). This pattern was less evident in the private or Medicaid subpopulations. Across payers, the signature condition—that is, the condition for which a particular racial/ethnic group had a higher percentage of readmissions compared with other groups—was acute complications for Blacks, renal dis-

ease for Hispanics, and ischemic heart disease for Whites.

These findings are consistent with the results of other studies on racial/ethnic differences in the incidence of diabetes complications.^{30,31} Clinical trials have shown that the risk of developing microvascular complications can be effectively reduced through intensive control of blood glucose.^{32,33} Acute complications can also be prevented through improved access to care and patient education on compliance with specific therapy such as insulin injections.^{34,35} Therefore, the higher readmission rates for Blacks and Hispanics, particularly among Medicare patients, could be reduced through appropriate interventions to prevent acute complications and microvascular disease.

Our study has a few limitations. By using hospital discharge data, we were unable to measure the type and duration of diabetes, which are important predisposing factors for particular types of complications. The incidence of type 1 vs type 2 diabetes may vary by race/ethnicity.^{36,37} Unfortunately, the fifth digit of the ICD-9-CM codes, which specifies insulin dependence, is not accurate in identifying type 1 and type 2 diabetes for adults. Another caveat is related to the use of readmissions as an outcomes measure for the continuum of inpatient and outpatient care. While our final models included a significant number of patient characteristics and 1 or 2 hospital attributes, the *c*-statistic (an index of the discriminatory power of the models) ranged from 0.62 to 0.66, which is relatively low. None of the county health care resources variables was significant. It is possible that the county may not be the appropriate geographic unit to reflect use of health care services. These results suggest that factors associated with the quality of outpatient care, including care provided by physicians as well as patient self-management of the condition, could explain most of the variation. Further research is needed to identify what those factors are.

In summary, the results of this study showed that Blacks and Hispanics have higher hospital readmission rates, even with control for demographic, clinical, and socioeconomic characteristics and hospital attributes. Among the 3 largest racial/ethnic

groups, Hispanics have the highest likelihood of readmission across the entire adult population. The differences across racial/ethnic groups are greater among Medicare patients than among patients with private insurance or Medicaid coverage. Readmission diagnoses also vary by race/ethnicity, with Blacks and Hispanics at higher risk for those complications that are more likely preventable with effective postdischarge care. The findings presented here suggest that interventions should be designed for racial/ethnic minorities, particularly among the elderly, to improve the quality of outpatient care and reduce potentially preventable readmissions for diabetes complications. ■

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Contributors

H. J. Jiang conceived the study, conducted the analyses, and led the writing. R. Andrews and D. Stryer assisted with the study and analyses through their expertise on racial/ethnic disparities. D. Stryer also helped with identification of diabetes-related conditions. B. Friedman assisted with the study and analyses through his expertise on preventable hospitalizations. All authors contributed to the conceptualization of the study, interpretation of findings, and revision of the article.

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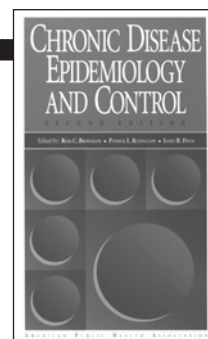
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