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The Quality of Diabetes Care following Hospitalization for Ischemic Stroke

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Cerebrovascular accident · Diabetes mellitus · Quality of care

Abstract
Background: Follow-up is critically important for stroke survivors with diabetes, yet there is limited research about the quality of diabetes care that these patients receive. We investigated performance on diabetes quality of care indicators for stroke survivors overall and by race. ***Methods:*** Claims data was extracted for 1,460 Medicare beneficiaries with preexisting diabetes who survived hospitalization for acute ischemic stroke in 2000. Adjusted probabilities of receiving HbA1c, LDL and dilated eye exams were estimated using logistic regression. ***Results:*** 53% had a dilated eye exam, 60% received an LDL check, 73% percent had their HbA1c checked at least once and only 51% received two or more HbA1c checks. In the unadjusted results, blacks were significantly less likely than whites to receive these tests. ***Conclusions:*** Care of stroke survivors, particularly blacks, shows gaps according to guidelines.

Introduction

Patients with diabetes mellitus are at high risk for ischemic stroke and suffer from a high stroke morbidity and mortality burden. For patients without diabetes, prevention of poststroke complications has been identified as one of the most important goals for stroke follow-up care, particularly prevention of cardiovascular complications (e.g. recurrent stroke and myocardial infarction) [1, 2] and immobility-related complications such as infections and ulcers [3]. For example, approximately 23% of stroke patients develop urinary tract infections within 6 months of discharge, while 23% develop chest infections and 8% develop pressure sores or skin breaks [3]. However, because diabetes itself increases the risk of these complications [4, 5], patients with both diabetes and stroke are at significantly higher risk. Complications of diabetes and stroke are often preventable with aggressive follow-up care for diabetes and cardiovascular risk factors [6]. Yet only 20% of patients with diabetes who experience a stroke survive 5 years [7]. In the United Kingdom Prospective Diabetes Study (UKPDS), each percentage increase in HbA1c increased mortality by 37% for patients with diabetes who were healthy enough to qualify for this trial [8]. Given this large and preventable disease burden, it is critical to evaluate the follow-up care that stroke survivors with diabetes receive.

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Prior studies indicate the inadequacy of diabetes follow-up in general populations [9, 10], but only a limited number of studies have examined the management of diabetes after stroke. These studies have found poor diabetes follow-up after stroke in Canada [11] and suboptimal medical management of diabetes in the United States [12]. To our knowledge, no studies have examined the follow-up of quality of care indicators after stroke for patients with diabetes in the United States.

Blacks, as compared to whites, have a higher prevalence of diabetes mellitus [13] and are more likely to have recurrent stroke [14]. The presence of racial disparities in stroke follow-up may further magnify the disproportionate stroke burden. Christian et al. [15] found in a United States nursing home population that blacks were less likely than non-Hispanic whites to receive anticoagulation or antiplatelet therapies. However, medical management of diabetes was not examined.

This study examines the quality of ambulatory diabetes care in Medicare patients with diabetes during the year following hospitalization for acute ischemic stroke. To examine diabetes care quality, we investigate whether or not patients received recommended diabetes follow-up care including HbA1c, LDL and dilated eye exams. Additionally, the receipt of this recommended follow-up care is examined by race to determine if a disparity exists.

Methods

Population and Sampling

Black and non-Hispanic white Medicare beneficiaries 65 years of age or older who were discharged directly to the community after acute ischemic stroke during 2000 in 11 metropolitan regions of the country were identified. Patients were included if they had diabetes prior to their hospitalization and were alive 1 year after discharge. Acute ischemic stroke was identified through an International Classification of Diseases, 9th edition (ICD-9) diagnosis code of 434 or 436 in the first position on the discharge list from an acute care hospitalization. Patients with diabetes were identified if they had at least two Part B claims or one hospitalization claim with a diabetes-related ICD-9 diagnosis code (250.xx) in the year prior to index hospitalization. The sensitivity for these definitions is 89–90% for acute ischemic stroke [16] and 99% for diabetes [17]. The final sample size was 1,460. This study was approved by the Institutional Review Board at the University of Wisconsin.

Data Extraction

We obtained enrollment and claims data for all patients for 1 year before and after the index hospitalization. The Medicare denominator file was used to determine age, sex, race, ZIP code, Medicaid enrollment and date of death. It was also used to exclude fee-for-service beneficiaries who were missing Medicare Part A or Part B coverage, had end-stage renal disease or received railroad retirement benefits.

Variables

The main dependent variables were the receipt of HbA1c testing, an LDL cholesterol test and a dilated eye examination in the 12 months following discharge after hospitalization for acute stroke. According to methods proposed by Halanych et al. [18], we selected these measures from the Diabetes Quality Improvement Project (DQIP). Additionally, following current American Diabetes Association (ADA) guidelines [19], the receipt of multiple HbA1c checks during this year was examined.

It is critical to control for preexisting differences in comorbidities and stroke severity. We identified 30 comorbid conditions that incorporated information from the index hospitalization, all hospitalizations during the prior year and all physician claims during the prior year using methods proposed by Klabunde et al. [20]. We also coded dementia and recurrent stroke and controlled for length of hospital stay. The Centers for Medicare and Medicaid Services hierarchical condition categories (CMS-HCC) score for the year prior to admission was calculated for each subject and also included in models as a comprehensive risk adjustment measure [21].

Other control variables included individual and neighborhood sociodemographic characteristics. Individual sociodemographic characteristics were age, gender, race, HMO membership and an indicator identifying beneficiaries with low to modest income who were fully enrolled in Medicaid or received some help with Medicare cost-sharing through Medicaid. Classification of race using Medicare claims data has been found to be accurate within 10% for blacks and non-Hispanic whites [22]. Neighborhood socioeconomic characteristics were identified by using ZIP+4 data to link patient data to the corresponding Census 2000 block group and included the percentage over 24 years of age with a college degree, as well as the percentage below the poverty line.

Analysis

Adjusted predicted probabilities were calculated for each dependent variable overall and by race. We also calculated unadjusted predicted probabilities by race in order to determine the absolute difference between groups. The unadjusted results indicate the actual racial disparity that exists, and the adjusted results indicate how much of this disparity can be explained by sociodemographic variables, comorbidities, and disease severity. Analyses were conducted using SAS version 9.1 and Stata 9.0. Results of analyses are reported in predicted probabilities and 95% confidence intervals (CI). All CI and significance tests were calculated using robust estimates of the variance that allowed for clustering of patients within hospitals and are significant at $p < 0.05$. Models included age (65–69, 70–74, 75–79, 80–85 and 85+ years), gender, race, Medicaid, HMO membership, percent of the census block group aged 25+ with college degrees, percentage of persons in the census block group below the poverty line, length of index hospital stay, prior hospitalization, prior stroke, cardiac arrhythmias, congestive heart failure, chronic pulmonary disease, complicated diabetes mellitus, hypertension, fluid and electrolyte disorders, valvular disease, peripheral vascular disorders, hypothyroidism, solid tumor without metastasis, deficiency anemias, depression, dementia, other comorbidity count and CMS-HCC score.

Table 1. Key characteristics of hospitalized acute stroke patients with diabetes overall and by race (n = 1,460)

	Overall population	By race		
		white (n = 1,183)	black (n = 277)	p value
Sociodemographic parameters				
Age (mean), years	75	76	74	<0.001
Females	52	48	68	<0.001
Medicaid	17	12	40	<0.001
In block group below the poverty line (mean)	12	9	24	<0.001
Adults age 25+ years in block group with college degree (mean)	22	24	15	<0.001
Prior medical history				
HCC score prior to index hospital discharge	2.45	2.42	2.59	0.03
Prior hospitalization	46	43	56	<0.001
Prior stroke	9	9	11	0.18
Cardiac arrhythmias	31	33	21	<0.001
Congestive heart failure	22	20	27	0.02
Chronic pulmonary disease	17	18	15	0.28
Diabetes, complicated	26	27	26	0.66
Hypertension	81	78	91	<0.001
Fluid and electrolyte disorders	18	16	28	<0.001
Valvular disease	14	15	12	0.09
Peripheral vascular disorders	15	16	12	0.13
Hypothyroidism	13	14	10	0.10
Solid tumor without metastasis	13	14	8	0.01
Deficiency anemias[1]	14	13	19	0.01
Depression	8	9	7	0.42
Dementia	20	17	31	<0.001
Other comorbidity count	41	40	46	0.17
Index hospitalization				
Length of stay (standard deviation), days	4.58 (5.01)	4.26 (3.58)	5.95 (8.71)	<0.001

Values represent percentages unless otherwise specified.
[1] Includes anemias due to a nutritional deficiency (e.g., iron, vitamin B_{12}, folate, protein, etc.).

Results

Population Characteristics

Table 1 indicates study population characteristics overall and stratified by race.

Significant demographic differences existed between black and white patients. As compared to black patients, whites were significantly less likely to be female (48 vs. 68%), to have Medicaid insurance (12 vs. 40%) and to live in a block group below the poverty line (9 vs. 24%) and more likely to live in a block group with a higher percentage of individuals having at least a college degree (24 vs. 15%).

Blacks were significantly more likely than whites to have longer hospital stays and comorbidities. These comorbidities included congestive heart failure, hypertension, fluid and electrolyte disorders, deficiency anemias, dementia, and other comorbidities. Whites were significantly more likely than blacks to have cardiac arrhythmias and solid tumors without metastasis.

Overall Achievement of Diabetes Follow-Up Quality Measures

As shown in table 2, three quarters or less of the sample received follow-up care that met diabetes quality standards. Only 53% received a dilated eye exam in the year following discharge from acute stroke (95% CI 50–56%) and 60% had their LDL checked (95% CI 57–63%). Seventy-three percent had their HbA1c checked at least once (95% CI 70–76%). Similarly, frequency of HbA1c follow-up in the year following stroke did not meet ADA standards. About half of the sample received the two mini-

mum HbA1c checks per year which are recommended by the ADA for individuals with stable glycemic control.

Achievement of Diabetes Follow-Up Quality Measures by Race

Blacks were significantly less likely than whites to receive a dilated eye exam, HbA1c check or LDL check in the year following hospital discharge for acute stroke (table 3). In the unadjusted results, 56% of whites (95% CI 53–60%) as compared to 40% of blacks (95% CI 34–46%) received a dilated eye exam. Seventy-four percent of whites (95% CI 72–77%) as compared to 62% (95% CI 56–68%) of blacks received an HbA1c check. Likewise, 63% of whites (95% CI 61–66%) as compared to 43% of blacks (95% CI 37–49%) had an LDL check. Adjustment decreased the differences between the groups which were no longer significant for eye exams and an HbA1c check. Having an LDL check remained significantly different with 64% of whites (95% CI 60–67%) as compared to 44% of blacks (95% CI 36–52%) having had an LDL check.

There were significant differences between whites and blacks in the receipt of multiple HbA1c checks in the year following discharge for acute stroke (table 4). In the unadjusted results, whites were significantly more likely than blacks to have one or more HbA1c checks in this year. This difference decreased but remained significant for blacks in the adjusted results for two or three HbA1c checks. The receipt of one or four or more HbA1c checks did not differ significantly between groups.

Table 2. Adjusted probabilities and 95% CIs of eye exam, LDL, and HbA1c checks for overall sample

	%	95% CI
Dilated eye exam	53.3	50.2–56.4
LDL check	60.1	56.9–63.3
HbA1c check	72.9	69.9–75.8
0–90 days		
1 HbA1c check	36.8	33.8–39.7
0–180 days		
1 HbA1c check	55.3	51.9–58.5
2 or more HbA1c checks	21.4	18.9–23.9
0–270 days		
1 HbA1c check	66.5	63.4–69.6
2 HbA1c checks	38.0	35.0–41.0
3 or more HbA1c checks	11.9	10.2–13.6
0–365 days		
1 HbA1c check	72.9	69.9–75.8
2 HbA1c checks	51.2	47.8–54.7
3 HbA1c checks	29.5	26.7–32.3
4 or more HbA1c checks	9.3	7.8–10.9

Discussion

We found that follow-up care for a large proportion of stroke patients with diabetes does not meet quality of care guidelines. Diabetes quality of care measures were achieved by three quarters or less of patients in the year following discharge after an acute stroke. Fifty-three percent of patients received a dilated eye exam, while 60 and 73%, respectively, had their LDL and HbA1c checked. Only 51% of patients received the minimum two HbA1c checks recommended by ADA guidelines. Blacks were significantly less likely than whites to receive a dilated eye exam, HbA1c check or LDL check in the year following hospital discharge for acute stroke (40 vs. 56%, 62 vs. 74% and 43 vs. 63%, respectively). In adjusted analyses, blacks were significantly less likely than whites to receive an LDL check (44 vs. 64%) or two (40 vs. 54%) or three (21 vs. 32%) HbA1c checks in this year.

Patients in our study received follow-up measurement at proportions lower than general samples drawn from patients with diabetes, which is concerning given the significant additional morbidity and mortality burden experienced by patients with diabetes who are stroke survivors. In these national studies [9, 10], estimates for an annual eye exam range from 68 to 91%, lipid screening from 63 to 85% and an HbA1c check from 83 to 93%. Patients with diabetes and stroke have increased risk for cardiovascular and immobility complications [1–3, 5], and therefore prevention of these complications through aggressive follow-up care that addresses diabetes and cardiovascular risk [6] is of utmost importance.

Our finding of a significant disparity between white and black stroke survivors in receipt of an eye exam, LDL check, and HbA1c checks further magnifies the disproportionate burden of stroke by race and indicates the need for better diabetes management in this high-risk group. Our results contrast with those of Asch et al. [23], who recently found that racial disparities in recommended care were small compared to the overall gap between observed and desirable care in a large community-based sample. Although we too found this large gap between observed and desirable care for patients with diabetes after stroke, we additionally found substantially lower rates of recommended care for blacks. Adjustment for several comorbidities, disease severity and sociodemographic characteristics did not fully explain why these disparities

Table 3. Unadjusted and adjusted probabilities and 95% CIs for dilated eye exam, LDL, and HbA1c checks by race

	Unadjusted				Adjusted			
	whites		blacks		whites		blacks	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
Dilated eye exam	**56.4**	53.3–59.5	**39.9**	33.8–45.9	54.9	51.3–58.5	46.7	38.5–54.9
LDL check	**63.4**	60.5–66.3	**42.9**	37.0–48.8	**63.8**	60.4–67.2	**44.3**	36.4–52.1
HbA1c check	**74.3**	71.5–77.0	**61.7**	55.6–67.7	74.0	70.8–77.1	68.3	60.8–75.8

Percentages in bold indicate significant differences.

Table 4. Unadjusted and adjusted probabilities and 95% CIs of intensity of HbA1c follow-up by race

	Unadjusted				Adjusted			
	whites		blacks		whites		blacks	
	%	95% CI	%	95% CI	%	95% CI	%	95% CI
0–365 days								
1 HbA1c check	**74.3**	71.5–77.0	**61.7**	55.6–67.7	74.0	70.8–77.1	68.3	60.8–75.8
2 HbA1c checks	**56.0**	52.8–59.3	**31.4**	25.3–37.6	**54.0**	50.3–57.7	**40.0**	31.4–48.7
3 HbA1c checks	**33.5**	30.6–36.3	**18.0**	13.2–22.8	**32.1**	28.9–35.2	**20.5**	14.1–26.9
4 or more HbA1c checks	**14.8**	12.6–17.1	**9.2**	5.9–12.5	9.8	7.86–11.6	7.7	4.2–11.3

Percentages in bold indicate significant differences.

exist. This result is consistent with other studies in populations with diabetes, which suggests that blacks are less likely than whites to achieve adequate glycemic control or receive screening eye exams and cholesterol exams [24]. Finally, our study adds to the literature describing racial disparity in secondary prevention after stroke [14]. The presence of less desirable poststroke care for blacks is of significant concern and represents a potential opportunity for high-yield interventions.

Our findings should be considered in light of several limitations. Our sample was limited to Medicare patients in certain metropolitan regions of the country and may not be generalizable to other groups. We were unable to include minority groups other than blacks as the numbers would have been too low to interpret the results meaningfully. Future studies may need to over-sample areas with high proportions of other racial/ethnic minorities to better understand these population groups.

Our study also has several limitations inherent in the use of administrative data. It is possible that our reliance on administrative data may have resulted in misclassification of disease [25]. However, we minimized this risk by using codes that have been previously shown to accurately identify ischemic stroke [16] and diabetes [17]. Administrative data only allows for measurement of processes of care, and not outcomes. However, process measures have an advantage over outcome measures of readily and expeditiously indicating those areas of care that need attention [26]. As we were unable to measure intermediate outcomes such as actual HbA1c values, it is possible that blacks had better glycemic control than whites and were less likely to require more than two HbA1c checks. This is unlikely to be the case, however, given the recent meta-analysis findings by Kirk et al. [27] which showed higher HbA1c values for blacks across studies. Finally, administrative data cannot account for the fact that the differences we observed are due to patient preference versus provider or other health system factors.

In conclusion, our findings have several implications for stakeholders interested in the care of stroke survivors. Overall, the care of stroke survivors with diabetes shows significant deficits in the quality of care (according to consensus guidelines) that are even greater than has been shown for patients with diabetes in large national studies.

Significant potential exists for preventing or reducing complications during the year after stroke [6], despite the perception by health professionals that aggressive care for stroke patients may have limited impact [28]. Given that the measurement of diabetes care indicators appears inadequate when compared to guidelines, future research should evaluate interventions for stroke patients with diabetes and blacks in particular that measure quality of care and follow-up with appropriately targeted preventive strategies.

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