

Research Article

Comorbidity-Adjusted Stroke Hospitalization Charge Disparities: Baseline Estimates for Comparative Assessments of Health Policy Provisions

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Abstract

Purpose: To determine differences in comorbidity-adjusted stroke hospitalization charges by patient race/ethnicity, age, and income prior to the implementation of the Patient Protection and Affordable Care Act and to outline health policy provisions which may reduce future hospitalization charges among black stroke patients.

Materials and methods: The data source was the Healthcare Cost and Utilization Project (HCUP) 2008 Nationwide Inpatient Sample (NIS), a 20% stratified sample of all discharges from 705 hospitals from the 34 States which reported to HCUP data including race. Stroke inpatients aged 45 to 84 with a principal diagnosis for cerebral infarction (ICD-9 codes 362.3, 433.01, 434.01) and acute, but ill-defined, cerebrovascular disease (ICD-9 code 436), excluding secondary diagnoses of traumatic brain injury (codes 800-804, 850-854), were included in the study. Patients were stratified into two age groups: 45-64 and 65-84. Total charges were adjusted using HCUP cost-to-charge ratios. Data for 41,291 patients were analyzed.

Results: Black patients were more likely to have a secondary diagnosis of diabetes, hypertension, and longer hospital stay. Adjusted charges and the number of secondary diagnoses were significantly higher for older black patients. Younger black patients with stroke-only diagnosis had significantly higher overall adjusted charges and higher charges at lower income levels than younger white patients of similar age. Older black patients with hypertension and diabetes had significantly higher adjusted charges in all diagnosis categories and lower income levels.

Conclusions: Prevention programs and better management of diabetes and hypertension may reduce hospitalization charges among older African Americans and white/black disparities in charges.

INTRODUCTION

Racial disparities in the incidence, severity, mortality, and hospitalization charges among stroke patients in the United States (U.S.) have been extensively documented [1-9]. However, the extent and patterns of variation in clinical practice and outcomes for stroke, stroke comorbidities and residual disability, and the allocation and utilization of post-stroke rehabilitation services have not been adequately studied [1,2]. Despite sufficient data indicating a heavier comorbidity burden among African American

(henceforth also referred to as black) stroke patients, there are hardly any studies documenting recent patterns of stroke hospitalization in areas heavily populated by black Americans, or significant changes in clinical practice to reduce stroke risks and improve the health outcomes of this ethnic group. Also, little is known about how the comorbidities most prevalent among black patients (i.e. diabetes and hypertension) are associated with disparities in hospitalization charges. Some studies suggest that hospital charges for stroke treatment are primarily determined by stroke severity, rather than patient age. Other studies note

faster recovery of motor function among younger stroke patients, a reduced likelihood of discharge to rehabilitation facilities, and, consequently, lower treatment charges [3-9]. Therefore, understanding how age, economic status, and the most prevalent comorbidities are interactively associated with ethnic and racial disparities in hospitalization charges is important. This study examines differences in the prevalence of comorbidities and comorbidity-adjusted hospitalization charges among black and white American stroke patients immediately prior to the implementation of the Patient Protection and Affordable Care Act (PPACA). The study will identify the changes to the healthcare delivery system resulting from the implementation of the PPACA which were expected to affect the hospitalization costs for stroke, as well as certain aspects of clinical practice and outcomes. The study will also outline current policy provisions with the potential to reduce the risk of stroke, residual disability, and comorbidities among African Americans. The comorbidity prevalence and comorbidity-adjusted stroke hospitalization charge data presented in this study will provide baselines for post-PPACA comparisons to be conducted in future studies.

MATERIALS AND METHODS

Data from the Healthcare Cost and Utilization Project (HCUP) 2008 Nationwide Inpatient Sample (NIS) were used in this study. Although 2011 data exist, the 2008 NIS dataset was selected since it better reflected hospitalization cost structures prior to the 2008 presidential elections in the United States (U.S.) and the subsequent changes to healthcare regulation. The 2008 NIS is a 20% stratified sample of all discharges from U.S. hospitals and is the largest publicly available all-patients, all-payers, database. In 2008, only 34 States reported data which included patient race identifiers to the HCUP. This study included data from 705 hospitals located in the States which in 2008 reported to HCUP patient race identifiers in hospital discharge documents. Eight States (Georgia, Illinois, Minnesota, Nebraska, North Carolina, Ohio, Washington and West Virginia) did not report patient race and were, therefore, excluded from this study.

Patients with a principal diagnosis for cerebral infarction (ICD-9 codes 362.3, 433.01, 434.01, and acute, but ill-defined, cerebrovascular disease, ICD-9 code 436, excluding secondary diagnoses of traumatic brain injury (codes 800-804, 850-854) were included in the study. A total of 45,024 patients met the inclusion criteria. Of this number, 3,733 did not have hospitalization charges and were excluded from the analysis. Data for the remaining 41,291 patients were used in the statistical analysis for this study.

Patients were stratified by age into two groups: 45-64 years and 65-85 years. This categorization reflected which payer was affected during stroke hospitalization: charges for 45-64 year old patients were paid through private insurance or Medicaid, while charges for 65-84 year olds were paid by Medicare [10]. Total hospital charges were adjusted using HCUP cost-to-charge ratios (CCR) to calculate the estimates used in this study. Outliers were Winsorized, or down-weighted [11], where each was given the value of the 5th (\$2,980) or 95th (\$28,672) percentile depending on their relative position in the charges distribution. Adjusted charge estimates were categorized by age group, race and secondary diagnosis. These estimates were further stratified by

median household income quartiles (MHIQs). The four quartiles were defined as lowest (MHIQ1), lower (MHIQ2), higher (MHIQ3) and highest (MHIQ4). Logistic regression was used to estimate relative risks for categorical values, and a generalized linear model was used to test group differences for continuous variables [12]. Two-tailed *t*-tests were used to examine differences in means of adjusted hospitalization charge estimates across race, age and income categories. All estimates were considered statistically significant for *p*-values less than 5%. Data analysis for this study was conducted in SAS Software Version 9.2 [13].

RESULTS

Clinical characteristics

Estimates in Table (1) indicate a younger average age of black stroke patients in both the 45-64 and the 64-84 age groups. Black stroke patients in both age groups experienced significantly longer hospital stay and had more secondary (comorbidity) diagnoses than white patients of the same age. Estimates in Table (1) also indicate that black stroke patients were more likely than white patients of the same age to be diagnosed with diabetes (with and without complications) and hypertension. Furthermore, black stroke patients in both age categories were more likely than white patients to be diagnosed with anemia, congestive heart failure, drug abuse, electrolyte disorders, obesity, renal failure, and weight loss. However, the estimates indicate that black stroke patients were less likely than white patients to have chronic obstructive pulmonary disease (COPD), depression, and hypothyroidism as secondary diagnoses. Black patients aged 45-64 year were more likely than their white counterparts to have valvular disease as a secondary diagnosis. However, the risk of valvular disease declines as black patients age. Figures in the table indicate that black patients aged 65-84 years had a lower likelihood of valvular disease.

Average adjusted hospitalization charges

Younger black patients with a primary stroke diagnosis in Table (2) (upper panel) had significantly higher average adjusted hospitalization charges than younger white patients only if they were in the lower income categories (MHIQ1 and MHIQ2). Poor younger black patients in the lowest income quartile (MHIQ1) who had a primary diagnosis of stroke and secondary diagnoses of hypertension also had significantly higher charges than poor younger white patients in the same income quartile. Charges for younger black and white patients were similar across the rest of the MHIQs and diagnostic categories: stroke patients with a secondary diagnosis of diabetes, stroke patients with a secondary diagnosis of hypertension, and stroke patients with a secondary diagnosis of both diabetes and hypertension. Of note is the finding that charges for younger white patients in the highest MHIQ were significantly higher than the charges for younger black patients in the highest MHIQ. However, the charge difference at this MHIQ is statistically significant only when the data for all patients were used. When diagnostic categories were controlled, the statistical significance of this difference disappeared.

Figures in the lower panel of Table (2) show that older black stroke patients in the MHIQ1, MHIQ2 and MHIQ3 categories had overall higher average adjusted charges than white patients, and

Table 1: Clinical characteristics of black and white stroke patients by age group, 2008.

	White (45-64) N=11,051(70.6%) Proportion	Black (45-64) N=4,596(29.4%) Proportion	X² p-value
Average age	56.5	55.5	<0.0001
Average length of stay	5.2	6.2	<0.0001
Average number of diagnoses	9.4	9.6	<0.001
Anemia	6.9	13.3	<0.0001
Congestive heart failure	6.5	10.9	<0.0001
COPD	15.8	10.7	<0.0001
Depression	11.9	6.8	<0.0001
Diabetes	28.3	36	<0.0001
Diabetes with complications	6.5	9.7	<0.0001
Drug abuse	2.9	8.8	<0.0001
Electrolyte disorders	15.6	18.7	<0.0001
Hypertension	73.8	87.3	<0.0001
Hypothyroidism	8.2	3.7	<0.0001
Obesity	13	14.4	<0.05
Renal failure	6.5	15.1	<0.0001
Valvular disease	6.4	7.2	<0.05
Weight loss	1.8	2.7	<0.05
	White (65-84) N=24,952(84.9%) Proportion	Black (65-84) N=4,425(15.0%) Proportion	X² p-value
Average age	75.7	74	<0.0001
Average length of stay	5.1	6.7	<0.0001
Average number of diagnoses	10.6	10.8	<0.0001
Anemia	11.4	19.3	<0.0001
Congestive heart failure	13.6	16	<0.0001
COPD	17.9	11.8	<0.0001
Depression	10.1	5.8	<0.0001
Diabetes	26.3	38.3	<0.0001
Diabetes with complications	5.1	9.4	<0.0001
Drug abuse	0.3	0.6	<0.0001
Electrolyte disorders	18.8	24	<0.0001
Hypertension	79.4	88.8	<0.0001
Hypothyroidism	14.9	6.8	<0.0001
Obesity	6.1	8.5	<0.0001
Renal failure	10.9	19.8	<0.0001
Valvular disease	11	8.6	<0.0001
Weight loss	2.9	5	<0.0001

Table 2 (upper panel): Average adjusted charges by race and MHIQ for younger stroke patients, 2008.

	White (45-64) Mean (SD) N	Black (45-64) Mean (SD) N	t-value (p)
All Patients			
Overall	10,106 (7,021)	10,314 (6,836)	1.67 (0.0958)
	10,143	4,355	
MHIQ1	9,466 (6,763)	10,431 (6,768)	1.67 (0.0958)
	2,645	2,246	
MHIQ2	9,865 (6,931)	10,245 (6,931)	1.42 (0.1547)
	2,899	879	
MHIQ3	10,275 (7,016)	10,015 (6,852)	0.84 (0.4002)
	2,207	642	
MHIQ4	10,993 (7,321)	10,120 (6,844)	2.41 (0.0159)
	2,127	445	

Patients with Only Stroke as Diagnosis				
Overall		10,457 (7,461)	11,803 (8,057)	3.18 (0.0016)
		2,212	421	
MHIQ1		9,335 (7,084)	12,034 (8,215)	4.11 (< 0.0001)
		505	203	
MHIQ2		10,306 (7,439)	12,376 (8,104)	2.25 (0.0263)
		622	87	
MHIQ3		10,487 (7,391)	11,796 (8,289)	1.52 (0.2534)
		511	58	
MHIQ4		11,521 (7,617)	10,650 (7,409)	0.78 (0.436)
		514	49	
Stroke Patients with a Secondary Diagnosis of Diabetes				
Overall		10,220 (7,397)	10,013 (6,814)	0.28 (0.7793)
		400	114	
MHIQ1		9,243 (6,837)	11,097 (7,740)	1.54 (0.1262)
		125	56	
MHIQ2		10,367 (7,654)	10,010 (7,096)	0.21 (0.8354)
		117	21	
MHIQ3		10,339 (7,097)	6,969 (6,765)	1.86 (0.0759)
		83	17	
MHIQ4		11,375 (8,345)	9,946 (5,148)	0.88 (0.3864)
		63	17	
Stroke Patients with a Secondary Diagnosis of Hypertension				
Overall		10,099 (6,933)	10,129 (6,688)	0.18 (0.8595)
		5,015	2,339	
MHIQ1		9,340 (6,479)	10,181 (6,462)	3.25 (0.0012)
		1,294	1,207	
MHIQ2		9,830 (6,892)	10,041 (6,876)	0.59 (0.5588)
		1,453	485	
MHIQ3		10,393 (7,015)	9,783 (6,887)	1.44 (0.1518)
		1,071	352	
MHIQ4		10,947 (7,238)	10,156 (6,853)	1.58 (0.1143)
		1,070	234	
Stroke Patients with Secondary Diagnoses of Diabetes and Hypertension				
Overall		9,794 (6,720)	10,207 (6,644)	1.89 (0.0589)
		2,516	1,481	
MHIQ1		9,823 (7,018)	10,353 (6,696)	1.50 (0.1353)
		721	780	
MHIQ2		9,465 (6,392)	9,961 (6,542)	1.09 (0.2766)
		707	286	
MHIQ3		9,833 (6,632)	10,156 (6,465)	0.62(0.5387)
		542	215	
MHIQ4		10,481 (7,017)	9,904 (6,858)	0.88 (0.3781)
		480	145	

Table 2 (lower panel): Average adjusted charges by race and MHIQ for older stroke patients, 2008.

	White (65-84) Mean (SD) N	Black (65-84) Mean (SD) N	t-value (p)
All Patients			
Overall	9,424 (6,454)	10,526 (6,925)	9.49 (< 0.0001)
	22,672	4,121	
MHIQ1	8,690 (6,233)	10,510 (6,942)	10.40 (< 0.0001)
	5,628	2,024	
MHIQ2	9,008 (6,220)	10,433 (6,832)	5.74 (< 0.0001)
	6,433	838	
MHIQ3	9,744 (6,491)	10,880 (7,160)	3.97 (< 0.0001)

	5,044	697	
MHIQ4	10,421 (6,794)	10,251 (6,630)	0.55 (0.5835)
	5,139	505	
Patients with Only Stroke as Diagnosis			
Overall	9,515 (6,891)	11,780 (8,095)	5.05 (< 0.0001)
	3,754	348	
MHIQ1	8,616 (6,453)	11,089 (7,756)	3.68 (0.0003)
	992	147	
MHIQ2	9,193 (6,643)	11,650 (7,928)	3.06 (0.0028)
	1,073	104	
MHIQ3	10,315 (7,313)	14,770 (9,291)	3.42 (0.0012)
	749	53	
MHIQ4	10,236 (7,172)	11,517 (7,930)	0.94 (0.3533)
	871	35	
Stroke Patients with a Secondary Diagnosis of Diabetes			
Overall	9,393 (6,573)	11,989 (8,328)	3.18 (0.0018)
	824	113	
MHIQ1	8,146 (5,932)	12,232 (8,721)	3.26 (0.0018)
	251	53	
MHIQ2	9,541 (6,527)	9,902 (7,384)	0.25 (0.8034)
	224	29	
MHIQ3	9,761 (6,635)	14,082 (8,500)	2.29 (0.0307)
	167	22	
MHIQ4	10,692 (7,340)	10,654 (8,123)	0.01 (0.9907)
	166	7	
Stroke Patients with a Secondary Diagnosis of Hypertension			
Overall	9,332 (6,310)	10,574 (6,945)	7.73 (< 0.0001)
	12,880	2,142	
MHIQ1	8,695 (6,236)	10,654 (7,026)	8.10 (< 0.0001)
	3,028	1,082	
MHIQ2	8,839 (6,036)	10,684 (7,067)	5.01 (< 0.0001)
	3,636	398	
MHIQ3	9,578 (6,293)	10,442 (6,871)	2.28 (0.0229)
	2,943	364	
MHIQ4	10,299 (6,598)	10,041 (6,462)	0.61 (0.5407)
	3,027	256	
Stroke Patients with Secondary Diagnoses of Diabetes and Hypertension			
Overall	9,590 (6,457)	10,062 (6,429)	2.51 (0.0120)
	5,214	1,518	
MHIQ1	8,831 (6,117)	10,065 (6,469)	4.26 (< 0.0001)
	1,357	742	
MHIQ2	9,203 (6,291)	9,744 (5,974)	1.43 (0.1527)
	1,500	307	
MHIQ3	9,794 (6,388)	10,390 (6,615)	1.28 (0.2014)
	1,185	240	
MHIQ4	10,870 (6,925)	10,283 (6,574)	1.17 (0.2445)
	1075	207	

significantly higher charges at the lowest income level (MHIQ1) across all diagnostic categories. Older black patients in the MHIQ1, MHIQ2 and MHIQ3 categories had significantly higher charges when they had either a primary stroke diagnosis or a stroke diagnosis with a secondary diagnosis of hypertension. Older black and white patients diagnosed with diabetes and hypertension during an index stroke admission had similar average adjusted charges at higher income levels (MHIQ2, MHIQ3 and MHIQ4). Furthermore, figures in the lower panel of Table (2)

indicate that older black patients in the highest MHIQ (MHIQ4) had charges that were similar to those for older white patients in the same income category and across all diagnoses. All reported estimates of means differences for the highest MHIQ (MHIQ4) were statistically non-significant.

DISCUSSION AND CONCLUSIONS

Direct financial cost of stroke hospitalizations and care (direct cost) and indirect costs incurred from income losses due to

stroke-related disability and negative changes in socioeconomic status variables following a stroke cause significant financial burdens on individuals and society [3]. In 2007, the total direct and indirect cost of medical care and therapy for stroke was estimated at \$40.9 billion, with \$25.2 billion in direct costs [4]. In 2008, total direct and indirect cost for stroke increased by approximately 60% to an estimated \$65.5 billion [5-7]. Total cost estimates have steadily increased ever since [8], making stroke currently one of the most expensive chronic diseases to manage in the United States [5]. Projections in 2005 dollars for 2005 to 2050 suggest that medical treatment costs for stroke significantly differ by patient racial and ethnic background. By 2050, the total cost for non-Hispanic whites is projected at \$1.52 trillion. For Hispanics, total cost is projected at \$313 billion, and for blacks at \$379 billion. The projected per capita cost of stroke "is highest in blacks (\$25,782), followed by Hispanics (\$17,201) and non-Hispanic whites (\$15,597)" [4,9]. The higher per capita cost projections for African Americans appear to positively correlate with stroke risk and a heavier burden of comorbidities and residual disability among this racial group. Although stroke is a leading cause of death for all Americans, as a group African Americans are at nearly twice as much higher risk of having a first stroke than white Americans. Also, African Americans are more likely than whites to die following a stroke [4,14].

Comorbidities, especially diabetes and hypertension which are highly likely to be present in stroke patients [15], predict higher medical treatment charges for stroke [4]. Stroke patients with diabetes or hypertension as secondary diagnoses have higher overall inpatient hospital costs [16,17]. Black patients are almost twice as likely to suffer from diabetes [18] and have a higher prevalence of hypertension (40%) compared to white patients who have an estimated prevalence of 30% [19]. Furthermore, black patients are also more likely to live in lower income communities with limited access to primary healthcare. This reduces the likelihood of patient education on medication compliance and how to control stroke risk factors. In addition to its negative impact on primary healthcare and patient health behavior, low neighborhood socioeconomic status is also closely associated with fewer recreational facilities, less availability of healthy food and exposure to poor air quality. All of these increase the risk of stroke in general and add to the stroke risk among black Americans [20-23].

Primary and secondary preventive healthcare have been credited with decreasing the need for stroke hospitalization and with helping to reduce associated care costs [24,25]. To promote preventive healthcare and the coordination of patient care, the Patient Protection and Affordable Care Act (PPACA) included provisions that extend insurance coverage to all Americans and expand prevention and wellness programs. Preventive services are now an essential healthcare benefit. Private health insurance plans will no longer be able to deny coverage for pre-existing conditions. Under the PPACA, the cost of preventive care services will not be charged to Medicare beneficiaries' Part B coinsurance or deductible, and Medicaid coverage will be expanded in the States that adopted the PPACA's Medicaid Expansion. As such, the full implementation of the PPACA provisions and investments in public health were expected to improve access to preventive services, impact certain aspects of clinical practice, and potentially

reduce risks for strokes and other preventable morbidities [26].

The findings of this study show that disparities in the direct charges for stroke hospitalization were associated with income, and increased with age and the presence of comorbidities. At younger age, black patients with lower income levels who had a primary stroke diagnosis or a stroke diagnosis with a secondary diagnosis of hypertension had significantly higher hospitalization charges than their white counterparts. In contrast, older black stroke patients at lower income levels and across all diagnosis categories incurred significantly higher hospitalization charges than their white counterparts. Furthermore, at the three lower income levels considered in this study, the overall adjusted average charges for hospitalization for stroke for older black patients were also higher than those for younger black and white patients with similar incomes.

These findings are supported by previous research and have important implications for healthcare policy. They indicate that for healthcare policy to affect substantial reductions in hospitalization charges for stroke among poor and older black patients, it should include measures which enable greater access to quality healthcare and earlier detection and treatment of chronic diseases. The reason for this is that black patients present particular clinical characteristics which require careful consideration for effective containment of overall stroke hospitalization charges. Black stroke patients in this study not only had higher rates of diabetes with and without complications, they also had higher rates of renal failure, another complication of diabetes. This finding suggests that their diabetes had not been managed well, resulting in the long term in costlier disease management through expensive treatment modalities which may include either hemodialysis or peritoneal dialysis [27]. Black stroke patients were also more likely to present at clinic with more comorbidities and chronic illnesses than white patients of the same age. This heavier disease burden among black patients is expected [20]. Previous research indicates that race and ethnicity are strongly correlated with socioeconomic status, and that in the case of black Americans the interdependence of these variables significantly increases the risks of lower income levels, poverty, lack of health insurance, and lower levels of access to healthcare [20,28]. These are predictive of lower health status and healthcare utilization and higher payer and out-of-pocket costs as patients' age increased [20,28,29]. They are also predictors of receipt of lower quality healthcare, healthcare rationing, use of greater portions of income on healthcare, and medical debt among poor and middle class individuals and families [20,30-32]. The higher average charges for older black patients in the lower MHIQs suggest that they were relatively sicker than their white counterparts at the time of stroke diagnosis, thus, causing stroke management among them to be significantly more expensive than for white patients of the same age.

PPACA provisions and the findings of this study

This study created clinical profiles for stroke patients by race/ethnicity and age. The study also provided estimates of adjusted hospitalization charges for stroke patients across age, race, income, and two critical comorbidities (diabetes and hypertension). The findings of this study were based on data collected prior to the full implementation of the PPACA. They

constitute benchmarks which could be contrasted with findings from data collected after the full implementation of the PPACA. Such comparative assessments will determine if specific PPACA provisions impacted disparities in the prevalence of stroke, key stroke-related comorbidities, and stroke hospitalization charges across ethnic/racial and age categories and specific clinical characteristics.

The PPACA contains provisions for improving the health and well-being of individuals, community and clinical prevention, public health infrastructure, research and tracking, and public health training. Components of the PPACA with the potential to produce changes in estimates similar to the ones provided in this study include (a) the affordability provisions, (b) tying health insurance rates to age, (c) prohibitions on Medicare copayments, (d) cost containment through Accountable Care Organizations, and (e) applications of “tested” healthcare delivery system models. The following discussion outlines how each of these policy components might impact estimates of stroke and comorbidity prevalence and hospitalization charges among black patients that are derived from data collected after the full implementation of the PPACA.

The PPACA’s affordability provisions which include expanding access to affordable insurance and reducing the financial burden of medical care through income-related premium subsidies and insurance market regulation have the potential to reduce the high number of poor black stroke patients who present at clinic with hypertension, diabetes and other comorbidities [26,33]. This will be made possible by the expected increase in access to affordable early detection and chronic disease management services by poor young black patients. These policy measures may also benefit young black patients with fewer health problems and relatively higher levels of income. Although the PPACA tied health insurance premium rates to age and mandated a tight 3:1 age rating band (meaning that premium rates for individuals aged 64 years and older are no more than three times the premiums for those aged 21 years for the same coverage) instead of the current looser 5:1 alternative, this narrow rating band is not expected to increase premium rates among individuals below the age of forty (between ages 21 and 39 years). The majority of young adults who are currently purchasing nongroup insurance coverage will be financially protected by the exchange subsidies provisions of the PPACA, Medicaid expansion, and by the expansion of dependent coverage to young adults [34]. These policy provisions are expected to reduce patients’ out-of-pocket expenditures and hospitalization charges for stroke. However, insurance-mediated access to preventive and quality healthcare is just one issue of relevance to the prevalence of stroke and stroke management costs among poor young black patients diagnosed with chronic disease comorbidities. There is need for evidence-based understanding of stroke among younger patients in general, and younger black patients in particular. Such an understanding could help lead to the design of preventive programs with the potential of causing stroke hospitalization cost savings at younger age and a shift of the stroke incidence toward later years in life [3].

Prevention of stroke and better management of hypertension and diabetes have the potential to not only reduce direct and indirect healthcare costs, but also reduce the number of stroke

patients in the older age groups [35-37]. The PPACA provisions that prohibit Medicare copayments for preventive care will benefit those patients already covered by Medicare especially when it comes to screening and secondary prevention. Older black patients in all but the highest income quartile (MHIQ4) would benefit the most from the Medicare prevention and screening programs and are more likely to realize the greatest healthcare cost savings.

Reductions in stroke hospitalization charges among black Americans following the enactment of the PPACA will depend on increases in preventive healthcare utilization by this minority group. Though public health policy provisions in the PPACA are intended to increase access to healthcare services for all Americans of poor or minority background, a significant uptake in actual use of available care is likely to be tempered by individual predispositions and healthcare seeking behaviors. This highlights the urgent need for sustained implementation of PPACA plans for community-based prevention, coordination of healthcare, research and tracking, and the improvement of public health infrastructure as mechanisms for stroke hospitalization cost reduction [38,39].

Finally, the concept of supply sensitive care suggests strong correlations between income, the amount of available healthcare resources, and the amount of care patients will receive. Higher income levels are typically associated with higher levels of healthcare use. This may explain the patterns of charges for white patients in the age groups examined in this study. Hospitalization charges for both age groups increased with increases in income level. For this particular case, we expect the Accountable Care Organizations (ACOs) created as part of the Medicare Shared Savings Program of the PPACA to help curtail charges for all white patients, especially those in the highest MHIQ. The ACOs are based on a healthcare delivery and payment model in which reimbursement to care providers is tied to quality metrics and reductions in the total cost of healthcare delivered to an assigned group of patients [39]. Therefore, differences in the average charges among white and black stroke patients in the highest income categories are expected to remain small and statistically nonsignificant.

Early detection and improved disease management, which are expected to occur under the PPACA’s wellness initiatives, may help lower stroke risks among younger black patients and thus lower the hospitalization charges burden for this age group. Prevention programs and new policy provisions for healthcare coordination for those eligible for both Medicare and Medicaid (dual eligibility) may reduce hospitalization charges and the number of stroke patients in the older age group by better management of all or the most critical comorbidities. Furthermore, the PPACA includes provisions for “tested” (at the Center for Medicare and Medicaid Innovation) healthcare delivery system models that significantly enhance patient access to cardiac rehabilitation services. Also, the implementation of the “rehabilitative and habilitative services and devices” essential benefit category of the PPACA is expected to significantly improve access to cardiac rehabilitation for low-income and underinsured populations [40]. As such, the current estimates of significantly higher hospitalization charges for older African American patients, and significantly higher risks

of stroke-related mortality among African Americans of all ages may decline following the implementation of the new healthcare reform law.

LIMITATIONS

The findings of this study are tempered by a few limitations. The dataset used in this study did not provide measures of how high the blood pressure was for hypertensive stroke patients. Also, the dataset did not list medications prescribed to these patients. Hence, predictions of cost savings from disease management through medication cannot be made. More importantly, a careful assessment of medication prescription protocols and medication therapy management would allow for better understanding of some of the clinical characteristics of stroke patients, particularly the significantly higher odds of clinical presentation with hypertension, diabetes, electrolyte disorders and renal failure among black stroke patients. Such an understanding could lead to a better assessment of stroke hospitalization charge disparities, especially among older patients who typically have heavier reliance on prescription medications. Furthermore, the data did not allow for a determination of whether or not particular patients were hospitalized for a first or subsequent stroke and did not give measures indicating patients' diet and exercise habits or their use of cardiac rehabilitation services. In addition, the dataset did not provide geographic location data for cardiac rehabilitation services. Hence, this study could not estimate costs of hospitalization in terms of patients' functional capacity or quality of life following a "first" stroke and subsequent use of rehabilitation services.

CONFLICT OF INTEREST

Author Sultan, author Williams, author Ryder, author Green, author Guardado, author Jahan, author Ombengi, author Walker, and author Comins declare that they have no conflict of interest.

INFORMED CONSENT

This study did not involve human subjects. It examined public-use secondary data which had been de-identified by the agency which provided the data. The study did not require Institutional Review Board approval.

ANIMAL STUDIES

No animal or human studies were carried out by the authors for this article.

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