

Jessica D. Bellinger, PhD, Zhimin Chen, MS, Saundra Glover, PhD, Karen Jones, MSPH,  
Kevin Bennett, PhD, Janice C. Probst, PhD

## **Post-discharge Rehabilitation Care Delivery for Rural Medicare Beneficiaries with Stroke**

### **Key Findings**

- Of the 12,563 Medicare beneficiaries hospitalized for stroke in 2009, 6,524 (51.9%) were discharged home with only self-care. Rural beneficiaries were more likely to be discharged without post-discharge rehabilitation care (PDRC) than urban beneficiaries (54.0% vs. 51.1% respectively).
- Overall, white beneficiaries were more likely to be discharged without PDRC (53.2%) than were African American (44.8%) or other (47.9%) beneficiaries. Residence-based differences were found only for white beneficiaries, with rural white stroke patients being more likely to be discharged with no PDRC than their urban peers (55.4% versus 52.9%).
- The most common forms of PDRC were institutional care (IRF or SNF, 33.0%) and home health care (15.1%).
- Distance between a patient's home and the discharge hospital was not related to the type of PDRC received among urban patients. Among rural patients, however, those discharged to IRF care lived an average 18.6 miles from the discharge hospital, versus a range of 8.0 to 12.6 miles for other post-discharge care settings.

### **BACKGROUND**

Stroke is the fourth leading cause of death and the leading cause of long-term disability in the United States (U.S.).<sup>1,2</sup> In 2010 stroke care cost an estimated \$28 billion and was associated with an estimated \$25.6 billion in lost productivity for U.S. patients.<sup>3</sup> Among more than 700,000 cases of stroke each year in the U.S., approximately two thirds survive and may suffer from temporary or permanent disabilities.<sup>4</sup> The type and severity of post-stroke disability depends upon the location and extent of brain damage. Five types of disability that are often seen in patients after stroke include paralysis or problems related to motor activities (movements), sensory deficits or disturbances, problems using or understanding language, cognitive and memory deficits, and emotional disturbances.<sup>4</sup> Stroke survivors are also at a higher risk for subsequent strokes.<sup>5</sup>

In addition to medical care, rehabilitation is the key to attaining the best possible outcomes and quality of life among stroke survivors. Rehabilitative therapy is started in the acute care hospital as soon as the patient's overall condition is stabilized, often within the first 24-48 hours post-stroke. After the initial hospitalization, stroke survivors may be discharged back to the community with self-care or may continue to receive rehabilitation services across a continuum of care settings such as inpatient rehabilitation facilities (IRF), skilled nursing facilities (SNF), or home health. Rehabilitation

services such as occupational therapy, physical therapy, and speech-language therapy help the patient regain abilities affected by stroke or develop compensatory skills that allow them to live with cognitive or physical deficits.<sup>6</sup> Post-discharge care has been shown to be vital in preventing long-term morbidity and improving functionality and quality of life for stroke patients.<sup>7,8</sup> Based on evidence from randomized controlled trials, systematic reviews, and observational studies, intensive rehabilitation that starts in the acute care hospital is associated with improved function after strokes.<sup>9-12</sup> Patients who recover well and may not need additional aggressive therapy are sent home with instructions for self care and a recommendation for follow up. Patients who show signs of persistent deficits are sent for continued rehabilitation services in various settings. The rehabilitation process can continue in these settings.<sup>13-15</sup> In a systematic review of post-acute rehabilitation services, the efficacy was strongest for stroke compared to other diagnoses.<sup>16</sup> Others have noted the cost-effectiveness of rehabilitation care for stroke rehabilitation.<sup>17,18</sup>

Stroke patients who need services after hospital discharge can receive this therapy at an IRF, SNF, long-term care hospital (LTCH), or at home through a home health agency (HHA).<sup>19,20</sup> The level of care offered at each option will vary, with HHAs providing the least intensive level of care and IRF offering the greatest intensity of care.<sup>19</sup> The most appropriate post-discharge rehabilitation care (PDRC) setting for stroke patients depends on several factors including the patient's clinical profile, patient preferences, provider recommendations, and proximity to available resources.

Limited evidence suggests geographic as well as racial and ethnic disparities in receipt of PDRC. Provider supply and distance to care, each associated with level of rurality, affect both the likelihood that a stroke patient will receive PDRC and the type of facility (e.g. IRF, SNF, or HHA) in which it will be provided.<sup>21</sup> The Centers for Medicare and Medicaid Services (CMS) reimbursement structures for PDRC settings across the care continuum are varied due to differences in intensity of care delivered and clinical staff requirements among other factors. According to analyses by the Medicare Payment Advisory Commission (MedPAC), geographic variation in spending is greater for PDRC than for acute inpatient or ambulatory care.<sup>22</sup> However, it is challenging to measure populations and outcomes across the care continuum due to variations in case-mix reimbursement structure.

We sought to examine the following research questions.

1. Are there differences in the provision and type of PDRC received post-discharge by rurality and race/ethnicity among stroke survivors?
2. Is distance between the patient's home and the discharge hospital related to the type of PDRC recommended?
3. Are factors such as initial hospital admission (transfer from other hospital vs. referral from primary care vs. direct admission from emergency departments) related to PDRC provision and type?

We studied PDRC among beneficiaries with stroke in the five percent sample of the 2009 Medicare Provider Analysis and Review File (MEDPAR). Of the 491,759 persons in the five percent MEDPAR sample, a total of 23,154 persons had a principal diagnosis of stroke for an inpatient stay. Among these persons, 13,301 met the criteria for inclusion in the analysis. Details about the methods, including sample size flow, variable definitions, and data analysis, are provided in the Technical Notes at the end of the report.

## FINDINGS

### *Demographic Characteristics of Medicare Stroke Patients*

Among the 13,301 beneficiaries with an inpatient claim with a principal diagnosis of stroke, 38.2% of the patients were male, with no significant difference by residence (Table 1, below). More rural stroke patients were in the youngest age category of 65-74 years (36.7%) than urban patients (33.5%;  $p=0.0162$ ; Table 1). Proportionately more rural patients were white (88.1 percent) compared to urban patients (81.1%,  $p<0.0001$ ; Table 1). Rural stroke patients were more likely to be dually eligible for Medicare and Medicaid (14.6%) than were urban patients (13.2%;  $p=0.0019$ ; Table 1). Overall, about 40.9% of stroke survivors had three or more comorbidities, with rural beneficiaries significantly more likely to have three or more comorbidities compared to urban beneficiaries (45.3% and 39.1% respectively,  $p<0.0001$ ). Nationally, 36.6% of stroke survivors lived in the South.

Table 1. Characteristics of Medicare beneficiaries with stroke, by rurality, 2009 (n=13,301)

Characteristics	Total (n=13,301)		Urban (n=9,623)	All Rural (n=3,678)	Within Rural:		p-value <sup>a</sup>
	n	%			Micro- politan (n=1,313)	Small/ remote (n=2,365)	
	n	%	%	%	%	%	
<b>Sex</b>							0.6378
Male	5,803	38.2	33.5	37.9	37.0	38.4	
<b>Age Group (years)</b>							0.0162
65-74	4,574	34.4	33.5	36.7	36.3	36.9	
75-84	5,398	40.6	41.2	39.0	39.5	38.7	
85+	3,329	25.0	25.3	24.3	24.1	24.4	
<b>Race</b>							<0.0001
White	11,043	83.0	81.1	88.1	90.0	87.0	
African American	1,651	12.4	14.0	8.2	8.2	8.3	
Other	607	4.6	4.9	3.7	1.8*	4.74*	
<b>Dual-Eligible</b>	1,808	13.5	13.2	14.6	13.3	15.3	0.0019
<b>Region</b>							<0.0001
Midwest	3,329	25.0	24.7	19.0	26.7	25.7	
Northeast	2,795	21.0	21.8	26.0	12.9	22.4	
South	4,873	36.6	35.9	38.5	53.9	30.0	
West	2,304	17.4	17.7	16.5	6.6	22.0	
<b>Comorbidities</b>							<0.0001
None	5,124	38.5	41.3	31.2	24.6	34.9	
One or two	2,743	20.6	19.6	23.4	25.9	22.1	
Three or four	3,150	23.7	22.4	27.1	27.4	26.1	
Five or more	2,284	17.2	16.8	18.2	22.1	16.0	

\* Sample sizes with less than 30 observations are too small for stable estimates.  
<sup>a</sup> p-value indicates significant differences between urban and all rural.

*Post-Discharge Rehabilitation Care for Stroke Patients*

Medicare claims data allowed us to trace the path from admission to an inpatient hospital with a principal diagnosis of stroke to transfer or discharge for PDRC. Stroke survivors, depending on their level of recovery from neurological and functional deficits while in the hospital, may be discharged from the hospital to their homes with self-care and without any professional post-acute rehabilitation care. Alternatively, they may be transferred to one of the four types of PDRC: inpatient rehabilitation facilities (IRF), long-term care or skilled nursing facilities (SNF), home health agencies (HHA) or some other health care facility (neither IRF nor SNF). Reflecting the methods used in previous research,<sup>23</sup> those patients discharged to “other” types of facilities (n = 738) were excluded from the analysis below.

Discharge to home with self-care was the most common outcome across urban and all levels of rural residents. Of the 12,563 Medicare beneficiaries studied, 6,524 (51.9%) were discharged home with only self-care ; this disposition was more common among rural beneficiaries (54.0%) than among urban beneficiaries (51.1%; Table 2, below). The proportion of patients discharged with no post-hospital care found in the present analysis was higher than that found in a recent study of stroke discharges among hospitals participating in the “Get with the Guidelines—Stroke” program of the American Hospital Association. Among facilities participating in that model program, principally large urban hospitals, only 43.7% of patients were sent home without services.<sup>23</sup>

**Table 2. Disposition status for PDRC of Medicare beneficiaries with stroke discharged from inpatient Hospitals, 2009 (n=12,563)<sup>a</sup>**

	Home with Self-care n=6,524 (51.9%)	Institutional PDRC n=4,149 (33.0%)	HH n=1,890 (15.1%)	P-value
	(%) <sup>b</sup>	(%) <sup>b</sup>	(%) <sup>b</sup>	
<b>By Residence</b>				0.0034
Urban	51.1	33.2	15.7	
Rural	54.0	32.5	13.4	
Micropolitan	54.9	32.7	12.4	
Small Adjacent & Remote	53.6	32.4	14.0	
<b>Race</b>				<0.0001
White	53.2	32.5	14.3	
African American	44.8	36.1	19.1	
Other	47.9	33.9	18.2	
<b>Region</b>				<0.0001
Midwest	55.8	32.1	12.1	
Northeast	46.8	34.4	18.8	
South	52.6	31.7	15.7	
West	51.2	35.4	13.4	

<sup>a</sup> Excludes stroke survivors who had “Other” as a discharge disposition (n=738).

<sup>b</sup> Row percent

Differences in disposition associated with race/ethnicity were present in both rural and urban settings, with white beneficiaries being more likely to be discharged home with self-care than African American beneficiaries (Table 3). Within each race, residence-based differences were found only for white beneficiaries, with rural white stroke patients being more likely to be discharged with no PDRC than their urban peers (55.4% versus 52.9%;  $p = 0.0042$ ). There were no significant residence-based differences among African American or other beneficiaries.

**Table 3. Disposition status by race and residence of Medicare beneficiaries with stroke (n=12,470)**

	Home with Self-Care (n=6,524)	IRF or SNF (n=4,056)	Home Health (n=1,890)	p-value <sup>b</sup>
	(%) <sup>a</sup>	(%) <sup>a</sup>	(%) <sup>a</sup>	
<b>Urban</b>				
White	52.9	32.1	15.0	<0.0001
African American	45.5	35.5	19.0	
Other	47.4	34.0	18.6	
<b>Rural</b>				
White	55.4	32.0	12.6	0.0006
African American	43.6	35.7	21.7	
Other	51.6	31.0 <sup>c</sup>	17.4 <sup>c</sup>	

Note: Excludes stroke survivors who had “Other” as a discharge disposition (n=738).

a Indicates row percent

b P value for differences in race within residential category.

c Estimate is based on fewer than 50 observations and may be unstable.

#### *Disposition Settings and Estimated Distances between Discharging Hospital and Beneficiaries’ Residences*

We had hypothesized that providers might be more likely to refer patients who lived further from the hospital for institutional PDRC rather than self-care or home health services. Thus, we estimated the distance between discharge hospital and beneficiary residence to determine if distance was a factor in deciding where stroke survivors were sent after discharge. Travel distance in miles was calculated from the ZIP Code centroid of the discharge hospital to the stroke patient’s home ZIP Code.

As would be expected, rural stroke survivors lived farther from the discharge hospital compared to their urban peers for all types of disposition except “other” (Table 4). Among urban patients, the range of distances by disposition varied only slightly, from an estimated 6.2 miles for patients discharged to an IRF to 7.2 miles for patients discharged to “other;” these differences were not significant. Among rural patients, however, living a greater distance from the hospital was associated with discharge to an IRF versus other facilities (Table 4).

**Table 4. Estimated median distance in miles between discharge hospital and beneficiary residence among stroke survivors, by type of PDRC, 2009 (n=13,301)**

	Home With Self-care	IRF	SNF	Home Health Care	Other	P-value <sup>a</sup>
Urban	6.6	6.2	6.8	6.2	7.2	0.0930
Rural	12.6	18.6	9.0	10.8	8.0	<0.0001

<sup>a</sup>Non-parametric tests (Wilcoxon Scores and Kruskal-Wallis Test) used to test differences between medians.

We had hoped to ascertain if patients discharged from a critical access hospital (CAH) experienced different PDRC outcomes from other patients. Because the data set included only 255 CAH discharges, we were unable to examine CAH patients separately from other patients.

Types of PDRC were examined by the type of hospital admission, categorized as admitted through the emergency department (ED), through referral from an outpatient provider, and transferred from another hospital (See Table 5, at right). Nationally, 77.8% of stroke patients had been admitted through the emergency room; this proportion was lower among rural stroke patients (72.8%) than among urban patients (79.9%;  $p < 0.001$ ; data not in table). Conversely, rural patients were more likely to have been admitted as a transfer from another hospital (12.0% rural versus 8.6% urban) or as a direct referral (15.0% rural versus 11.8% urban).

Admission status was related to PDRC nationally and within both urban and rural residents. Patients admitted from an ED were least likely to be sent home with no PDRC (48.6% nationally), while those referred from outpatient care were most likely to be sent home with self-care only (55.9%). Rural patients admitted through the ED were slightly more likely than urban patients to be sent home without PDRC (50.1% versus 48.1%;  $p < .001$ ). Patients admitted as a referral from outpatient care were more likely to be sent home with no PDRC (55.9% nationally; rural/urban differences not significant). Finally, patients who had transferred to the discharging hospital from another hospital were least likely to be sent home without PDRC (43.2% nationally). Rural patients, compared to their urban counterparts, were more likely to be sent home with only self-care, but also more likely to be discharged to an IRF. They were correspondingly less likely to be discharged to a SNF, to home health, or to “other” destinations.

<b>Admission source and disposition</b>	Total N=13,210	Urban N=9,535	Rural N=3,648
	(%) <sup>b</sup>	(%) <sup>b</sup>	(%) <sup>b</sup>
<b>Emergency Department<sup>c</sup></b>			
Home with self-care	48.6	48.1	50.1
IRF	15.1	15.3	14.2
SNF	16.3	16.5	15.9
Home health care	15.2	15.9	13.5
Other	4.8	4.3	6.3
<b>Referral from outpatient care</b>			
Home with self-care	55.9	56.5	50.1
IRF	10.5	10.2	14.2
SNF	15.2	15.3	15.9
Home health care	10.4	11.0	13.5
Other	8.1	6.9	6.3
<b>Transfer from other hospital<sup>c</sup></b>			
Home with self-care	43.2	41.7	46.1
IRF	15.2	12.4	20.3
SNF	15.6	17.4	12.3
Home health care	11.4	11.9	10.5
Other	14.6	16.7	10.7
<sup>a</sup> The number of patients studied excludes 91 patients; 90 patients had missing data while one was admitted from court/law enforcement.			
<sup>b</sup> Percentages sum to 100% within each category.			
<sup>c</sup> Rural/urban differences significant at $p < .001$			

## CONCLUSIONS

*More than half of Medicare beneficiaries hospitalized for stroke were discharged home with self-care*

Over half of the stroke survivors in the sample were discharged home with self-care. This finding was consistent across urban and all levels of rurality for Medicare beneficiaries. The proportion of patients discharged without PDRC, 51.9%, exceeded the 43.7% reported for a model stroke program suggesting that best practices have not fully disseminated to all hospitals. In

addition, barriers to PDRC cannot be ruled out completely. Rural patients admitted through the ED or transferring from another hospital were more likely than urban patients to be discharged home with no PDRC. Further research is needed to assess if any other barriers exist that prevent delivery of PDRC and whether patient outcomes over the long term are worse in the absence of such care.

*Rural residents live farther from discharging hospitals; distance associated with IRF use*

Rural patients, as would be anticipated, lived farther from discharging hospitals compared to their urban counterparts. Jia and colleagues documented similar travel disadvantages for stroke care among rural veterans compared to their urban counterparts.<sup>24</sup> The most interesting finding was an apparent relationship between distance from home to hospital and discharge to IRF care among rural patients. This distance averaged 18.6 miles among rural patients sent to an IRF versus a range of 8.0 to 12.6 miles for other care settings. Further work is needed to explore this issue.

*African-American stroke survivors were more likely to receive PDRC*

African American stroke survivors, whether in rural or urban settings, were more likely than white survivors to receive PDRC. This may stem from different levels of perceived support in the home, greater severity of illness, patient preferences, or greater availability of IRFs in areas with a high concentration of African American residents. The preliminary results shown here suggest areas for additional work.

## **IMPLICATIONS FOR POLICY AND PRACTICE**

The care continuum for rural stroke survivors is complex. Many are unable to be treated at a local hospital, as it may not offer the necessary services to adequately treat their condition, and are thus transferred to larger, urban facilities.<sup>25</sup> Factors such as transfer status, treatment received while in the hospital, functional status upon discharge, local area resources, personal resources (such as insurance and caregiver support), and other characteristics (such as age, gender and comorbidity) all affect the type and the intensity of PDRC a stroke survivor will receive. The impact of the creation of Accountable Care Organizations under the Patient Protection and Affordable Care Act (PPACA) and incentives to provide PDRC in institutional (IRF and SNFs) and home (HHC) settings will need to be monitored over time to determine effects on patient outcomes,<sup>20</sup> in addition to monitoring clinical care provided in acute care hospitals. The PPACA also established “minimal essential services” inclusive of rehabilitative service; however, without a clear definition or standardization of these services, the recommended levels of PDRC for stroke survivors could remain ambiguous for some time.<sup>20</sup>

Given the variations in stroke PDRC practice patterns, coordinated health systems, and care teams as well as payment reform may improve health outcomes for stroke survivors following acute care. For example, previous studies have found significant errors in summary discharge data which can negatively affect coordinated care.<sup>26</sup> The Health Information Technology for Economic and Clinical Health (HITECH) Act incentivized the adoption of electronic health records (EHR) in acute and ambulatory care settings to allow more efficient transfer of clinical records across the continuum of care.

Variations in utilization of and sites for PDRC delivery affect Medicare spending for such services. Some experts and organizations have suggested site-neutral payment for PDRC.<sup>28</sup> Linking payment to patient needs rather than site of care may address the variations in delivery of PDRC among Medicare beneficiaries.<sup>22</sup> It may also allow more seamless care continuation for stroke survivors as they transition across inpatient and community-based PDRC settings.

---

More research is needed to identify potential barriers to PDRC for Medicare beneficiaries with stroke discharged from acute care hospitals. In addition to behavioral and environmental factors, geographic differences in PDRC may be influenced by variations in provider practices. This suggests an opportunity to improve the standardization of care delivered to Medicare beneficiaries which may improve clinical outcomes. Involvement of a multidisciplinary care team with integrated health care professionals (e.g. physicians, nurses, social workers, and patient navigators etc.) in discharge planning may also improve stroke survivors' awareness about the importance of PDRC for improving quality of life upon discharge. It has been suggested by other researchers examining post-stroke care that creating a system of PDRC access indicators that includes financial barriers, personal barriers, structural barriers, and attitudinal barriers may be a key to understanding variations in receipt of PDRC among stroke survivors.<sup>22</sup> These indicators could provide answers to questions on the influence of geography, race, and education on physician referrals to PDRC; or how inappropriately designed or inflexible institutional referral processes limit access to PDRC.<sup>22</sup> Finally, our findings suggest, perhaps, the need to ensure use of best practices for PDRC in the post discharge treatment plan for stroke survivors.<sup>22</sup>

## Appendix A. Definitions

We used Medicare claims data to determine whether rural stroke victims are as likely as urban patients to receive various types of post-acute care, including rehabilitation hospital services, skilled nursing care, and home based rehabilitative care. Below is a glossary of terms and acronyms associated with post-acute care used extensively in this report. See the technical notes for detailed information on study variables of interest.

Term/Acronym	Definition
<b>Dual Eligible</b>	Dual eligible beneficiaries are individuals who are entitled to Medicare Part A (hospitalization) and/or Part B (for physician services, lab and x-ray services, durable medical equipment, and outpatient and other services) <u>and</u> are enrolled in Medicaid.
<b>Home Health (HHA)</b>	Medicare Parts A and B cover part-time or intermittent skilled nursing care, physical therapy, occupational therapy, speech therapy, home health aide services, medical social services, durable medical equipment (such as wheelchairs, hospital beds, oxygen, and walkers) and medical supplies, and other services.
<b>Inpatient Rehabilitation Facility (IRF)</b>	Inpatient rehabilitation hospital or part of a rehabilitation hospital, which provides an intensive rehabilitation program to inpatients with 24-hour skilled nursing care under the supervision of a physician and a registered professional nurse.
<b>Post-discharge rehabilitation care (PDRC)</b>	Refers to a range of medical care services that support the continued recovery from illness or management of a chronic illness or disability following a period of acute hospitalization. These patients are likely to encounter multiple care settings, either at home or in specialized facilities.
<b>Skilled Nursing Care</b>	Care given or supervised by Registered Nurses. Nurses provide direct care; manage, observe, and evaluate a patient's care; and teach the patient and his or her family caregiver. Examples include: giving IV drugs, shots, or tube feedings; changing dressings; and teaching about chronic disease care.
<b>Skilled Nursing Facility (SNF)</b>	A nursing facility with the staff and equipment to give skilled nursing care and, in most cases, skilled rehabilitative services and other related health services.

## Appendix B. Technical Notes

Data for the report were obtained from the 2009 Medicare Provider Analysis and Review File (MEDPAR), 5% sample. Behavioral Risk Factor Surveillance System (BRFSS) data were linked to the Area Resource File and National Provider Index for contextual variables.

### **Data Sources**

**MEDPAR.** The Medicare Provider Analysis and Review (MEDPAR) file contains data from claims for services provided to beneficiaries admitted to Medicare certified inpatient hospitals and skilled nursing facilities (SNF). The accumulation of claims from a beneficiary's date of admission to an inpatient hospital where the beneficiary has been discharged, or to a skilled nursing facility where the beneficiary may still be a patient, represents one stay. A stay record may represent one claim or multiple claims. This file allows researchers to track inpatient history and patterns/outcomes of care over time.

We linked the 5% sample of Medicare administrative data from MEDPAR acute hospital claims data that can trace the path of care for each patient and discharge status of post-discharge rehabilitation care (PDRC) to multiple patient-level Medicare claims data, Medicare beneficiary summary data.

**AHRF.** The Area Health Resource File (AHRF) is a family of health data resource products drawn from an extensive county-level database assembled annually from over 50 sources. The AHRF data elements are in three categories: (a) healthcare professions; (b) hospitals and healthcare facilities, and (c) the Census, population data, and the environment. We linked data from the Area Resource File to generate rural/urban and regional characteristics in the sample.

**NPI.** The National Provider Identifier (NPI) file has key data elements about healthcare providers based on a unique identification number. The data elements include the type of entity (individual or organization), provider name and business mailing address, and provider business location address.

Data from the National Provider Identifier (NPI) data file were used to identify the provider's ZIP code. This information was used to calculate the distance between patient residence and discharging hospitals. The file was also used to obtain the Healthcare Provider Taxonomy for identifying hospital types including Critical Access Hospitals and other hospitals.

### **Population Studied**

We analyzed data on all eligible Medicare stroke beneficiaries (age 65 years or older) who were hospitalized on or before August of 2009 and discharged from an acute care hospital in the year. We examined the use of PDRC in patients discharged from acute care hospitals in 2009 only. We focused on patients with a primary stroke diagnosis defined by International Statistical Classification of Diseases and Related Health Problems (ICD-9) codes: intracerebral hemorrhage (431.xx); occlusion and stenosis of pre-cerebral arteries with infarction (433.x1); occlusion of cerebral arteries with infarction (434.x1); and acute but ill-defined cerebrovascular disease (436.xx); and by Diagnostic-Related Groups classification system (DRG) coded from 61 to 72: acute ischemic stroke with use of thrombolytic agent; intracranial hemorrhage or cerebral infarction; nonspecific CVA and pre-cerebral occlusion without infarction; transient ischemia; and nonspecific cerebrovascular disorders.

We identified 33,985 discharges with stroke as a principal diagnosis from the MEDPAR files. As noted earlier, stroke patients who were 65 years or older, had a diagnosis of stroke in the year 2009, who did not die in the hospital and were alive after discharge for at least 30 days, and who did not meet the exclusion criteria were included in the analysis. Exclusion criteria included:

- 1) Age less than 65 (n = 2,673);
- 2) Not discharged at the end of 2009 (n = 861);
- 3) Death during hospitalization or within 30 days of discharge (n=4,296), as they would not have had a complete opportunity for PDRC
- 4) Patients who were admitted from SNF were excluded because these patients were likely to be discharged back to their nursing homes rather than other PDRC alternatives (n=406);
- 5) Any second or higher admission for stroke for the same patient (n=4,392);
- 6) Alzheimer's disease or other dementia (n=6887);
- 7) Distance of 200 miles or more between patient's home and discharge hospital, as these patients may reflect unusual circumstances such as travel (n = 1,169)

After applying the inclusion and exclusion criteria and merging the MEDPAR data set with the Beneficiary Summary File, the final sample size was 13,301.

## Measures

There are several key analytical variables we used for the analysis. Discharge status of PDRC was defined by the CMS with five categories: discharge to Home, discharge to inpatient rehabilitation facility (IRF), discharge to skilled nursing facility (SNF), discharge to home health care, or discharge to all other type facilities.

Rural residence was defined at the county level using Urban Influence Codes (UICs) in two levels (rural or urban) and four levels (urban, micropolitan rural, small adjacent rural, or remote rural). Region was defined as: Midwest, Northeast, South and West.

The measure of the distance traveled from patients' residences to the discharge facilities was calculated by the patients' residence ZIP codes and the hospitals' ZIP codes using Google Map and SAS Macros. We excluded patients residing more than 200 miles from the discharge hospital, as these hospitalizations may be associated with unique circumstances (e.g., travel).

Other predictor variables were age group of patients (65-74, 75-84, 85+), race/ethnicity of patients (non-Hispanic white, non-Hispanic African American, and others); sex (male and female) and dual-eligibility status for Medicare and Medicaid.

## Statistical Analysis

We used standard statistical analysis procedures to estimate frequencies and means for categorical variables and continuous variables respectively. Bivariate analyses and linear regression models were carried out to detect statistical significance between variables using Chi-square test or F-test. Tukey multiple comparison tests were used to detect differences in driving distances by rurality and race. The significant level was defined as p-value <0.05.

A limitation to the study findings is the relatively small sample size. This study uses an extract of 2009 Medicare data to examine stroke PDRC with a principal stroke diagnosis in approximately seven percent of the beneficiaries. As such, the findings may be rather conservative. The study also does not distinguish the type of acute care delivered in the inpatient hospital setting. Acute care delivered by multidisciplinary teams in inpatient stroke units compared to non-stroke units in hospitals is associated with better clinical outcomes such as survival and functional ability.<sup>6,28,29</sup> Finally, the study did not examine clinical outcomes or patient adherence to post-acute care treatment.<sup>30</sup>

## References

1. Go AS, Mozaffarian D, Roger VL, et al. Heart disease and stroke statistics--2014 update: a report from the American Heart Association. *Circulation*. Jan 21 2014;129(3):e28-e292.
2. *Prevalence of Stroke --- United States, 2006--2010*. March 25, 2012 2012.
3. Heidenreich PA, Trogon JG, Khavjou OA, et al. Forecasting the future of cardiovascular disease in the United States: a policy statement from the American Heart Association. *Circulation*. Mar 1 2011;123(8):933-944.
4. National Institute of Neurological Disorders and Stroke (2014). Post-Stroke Rehabilitation. National Institutes of Health Publication, Department of Health and Human Services. Publication No. 14 1846. Bethesda, MD 20892.
5. Sacco RL, Adams R, Albers G, et al. Guidelines for prevention of stroke in patients with ischemic stroke or transient ischemic attack: a statement for healthcare professionals from the American Heart Association/American Stroke Association Council on Stroke: co-sponsored by the Council on

- Cardiovascular Radiology and Intervention: the American Academy of Neurology affirms the value of this guideline. *Circulation*. Mar 14 2006;113(10):e409-449.
6. Duncan PW, Zorowitz R, Bates B, et al. Management of Adult Stroke Rehabilitation Care: a clinical practice guideline. *Stroke*. Sep 2005;36(9):e100-143.
  7. Gosselin S, Desrosiers J, Corriveau H, et al. Outcomes during and after inpatient rehabilitation: comparison between adults and older adults. *J Rehabil Med*. Jan 2008;40(1):55-60.
  8. Schmidt JG, Drew-Cates J, Dombovy ML. Severe disability after stroke: outcome after inpatient rehabilitation. *Neurorehabilitation and Neural Repair*. 1999;13(3):199-203.
  9. Kwakkel G, Wagenaar RC, Koelman TW, Lankhorst GJ, Koetsier JC. Effects of intensity of rehabilitation after stroke. A research synthesis. *Stroke*. Aug 1997;28(8):1550-1556.
  10. Foley N, Pereira S, Salter K, Meyer M, McClure JA, Teasell R. Are recommendations regarding inpatient therapy intensity following acute stroke really evidence-based? *Top Stroke Rehabil*. Mar-Apr 2012;19(2):96-103.
  11. Jette DU, Warren RL, Wirtalla C. The relation between therapy intensity and outcomes of rehabilitation in skilled nursing facilities. *Arch Phys Med Rehabil*. Mar 2005;86(3):373-379.
  12. Kwakkel G, Wagenaar RC, Twisk JW, Lankhorst GJ, Koetsier JC. Intensity of leg and arm training after primary middle-cerebral-artery stroke: a randomised trial. *Lancet*. Jul 17 1999;354(9174):191-196.
  13. Buntin MB, Colla CH, Deb P, Sood N, Escarce JJ. Medicare spending and outcomes after postacute care for stroke and hip fracture. *Med Care*. Sep 2010;48(9):776-784.
  14. Gillen R, Tennen H, McKee T. The impact of the inpatient rehabilitation facility prospective payment system on stroke program outcomes. *Am J Phys Med Rehabil*. May 2007;86(5):356-363.
  15. Wang H, Camicia M, Terdiman J, Hung YY, Sandel ME. Time to inpatient rehabilitation hospital admission and functional outcomes of stroke patients. *Pm r*. Apr 2011;3(4):296-304; quiz 304.
  16. Prvu Bettger JA, Stineman MG. Effectiveness of multidisciplinary rehabilitation services in postacute care: state-of-the-science. A review. *Arch Phys Med Rehabil*. Nov 2007;88(11):1526-1534.
  17. Keith RA. Rehabilitation after stroke: cost-effectiveness analyses. *J R Soc Med*. Nov 1996;89(11):631-633.
  18. Keith RA, Wilson DB, Gutierrez P. Acute and subacute rehabilitation for stroke: a comparison. *Arch Phys Med Rehabil*. Jun 1995;76(6):495-500.
  19. Buntin MB. Access to postacute rehabilitation. *Arch Phys Med Rehabil*. Nov 2007;88(11):1488-1493.
  20. Ottenbacher KJ, Graham JE. The state-of-the-science: access to postacute care rehabilitation services. A review. *Arch Phys Med Rehabil*. Nov 2007;88(11):1513-1521.
  21. Buntin MB, Garten AD, Paddock S, Saliba D, Totten M, Escarce JJ. How much is postacute care use affected by its availability? *Health Serv Res*. Apr 2005;40(2):413-434.
  22. (MedPAC) MPAC. Report to Congress: Regional Variation in Medicare Service Use. 2011; [http://www.medpac.gov/documents/reports/Jan11\\_RegionalVariation\\_report.pdf](http://www.medpac.gov/documents/reports/Jan11_RegionalVariation_report.pdf).
  23. Prvu Bettger J, McCoy L, Smith EE, Fonarow GC, Schwamm LH, Peterson ED. Contemporary trends and predictors of postacute service use and routine discharge home after stroke. *J Am Heart Assoc*. 2015 Feb 23;4(2).
  24. Jia H, Cowper DC, Tang Y, Litt E, Wilson L. Postacute stroke rehabilitation utilization: are there differences between rural-urban patients and taxonomies? *J Rural Health*. Summer 2012;28(3):242-247.
  25. Leira EC, Hess DC, Torner JC, Adams HP, Jr. Rural-urban differences in acute stroke management practices: a modifiable disparity. *Arch Neurol*. Jul 2008;65(7):887-891.
  26. van Walraven C, Seth R, Austin PC, Laupacis A. Effect of discharge summary availability during post-discharge visits on hospital readmission. *J Gen Intern Med*. Mar 2002;17(3):186-192.
  27. DeJong G. Site-neutral payment for postacute care: framing the issue. *Arch Phys Med Rehabil*. Jun 2014;95(6):1212-1216.
  28. Stroke Unit Trialists C. Organised inpatient (stroke unit) care for stroke. *Cochrane Database Syst Rev*. 2007(4):CD000197.

- 
29. Govan L, Langhorne P, Weir CJ, Stroke Unit Trialists C. Does the prevention of complications explain the survival benefit of organized inpatient (stroke unit) care?: further analysis of a systematic review. *Stroke*. Sep 2007;38(9):2536-2540.
  30. Reker DM, Duncan PW, Horner RD, et al. Postacute stroke guideline compliance is associated with greater patient satisfaction. *Arch Phys Med Rehabil*. Jun 2002;83(6):750-756.

**Funding Acknowledgement:**

**This report was prepared under Grant Award U1CRH03711  
With the Federal Office of Rural Health Policy, Health Resources and Services Administration  
Sarah Bryce, Project Officer**