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Regional Variation in Stroke Rehabilitation Outcomes

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Abstract

Objective—To examine and describe regional variation in outcomes for persons with stroke receiving inpatient medical rehabilitation.

Design—Retrospective cohort design.

Setting—Inpatient rehabilitation units and facilities contributing to the Uniform Data System for Medical Rehabilitation (UDS_{MR}) from the United States.

Participants—143,036 patients with stroke discharged from inpatient rehabilitation during 2006 and 2007.

Interventions—Not applicable.

Main Outcome Measures—Community discharge, length of stay, discharge functional status ratings (motor, cognitive), across ten geographic service regions defined by the Centers for Medicare and Medicaid Services (CMS).

Results—Approximately 71% of the sample was discharged to the community. After adjusting for covariates, the percentage discharged to the community varied from 79.1% in the southwest (CMS 9) to 59.4% in the northeast (CMS 2). Adjusted length of stay varied by 2.1 days with CMS 1 having the longest length of stay at 18.3 days and CMS 5 and 9 being the shortest at 16.2 days.

Conclusion—Rehabilitation outcomes for persons with stroke varied across CMS regions. Substantial variation in discharge destination and length of stay remained after adjusting for demographic and clinical characteristics.

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Keywords

Rehabilitation; Quality of healthcare; Health services

Persons with stroke represent the largest impairment group of Medicare beneficiaries receiving inpatient medical rehabilitation services in the U.S.¹ These services are provided in different settings governed by a variety of rules and regulations. The settings operate using diverse admission policies, staffing ratios and service delivery patterns. For example, inpatient rehabilitation facilities (IRFs) have a Centers for Medicare and Medicaid Services (CMS) compliance requirement that identifies 13 conditions as eligible for services within an IRF.¹ Stroke has consistently been the most common Medicare rehabilitation impairment group receiving services in IRFs over the past five years and represents between 16% and 21% of all IRF Medicare cases.¹

There is variation nationally in the availability of inpatient rehabilitation facilities. The four states with the highest number of IRFs are Texas, California, Pennsylvania, and New York.¹ Each have between 70 and 90 facilities, while Wyoming, West Virginia, Vermont and Delaware each have less than 5.² State level differences in the number of IRF beds per Medicare beneficiary are different than the geographic distribution of IRF settings by state.² The impact of these geographic differences on rehabilitation outcomes is largely unknown.

Regional variation has been reported in healthcare for more than 20 years.^{3–5} The majority of regional variation studies examine acute care services. Researchers have found variation across diagnostic groups from cardiac to cancer.^{6–9} The presence and reasons for regional variation in the use of health services nationally have been debated in healthcare reform discussions.^{10–13} Not only does regional variation exist in service use, but it has also been noted in healthcare spending.^{14–17}

A common concern is that higher service use and costs do not translate into better quality or higher satisfaction with care.¹¹ There is currently a heightened emphasis on reducing regional variation as part of health care reform. This discussion is described as a “win-win,” where focused strategies can lead to cost savings while improving quality of care. Regional variation is an important issue for providers, payers and policy makers as they attempt to improve efficiency and maximize the quality of healthcare delivery systems.¹⁸

A few studies have examined regional differences in post-acute rehabilitation services and outcomes.^{19,20–26} Researchers studying the use of post-acute-care following stroke and other common diagnoses found significant regional variation, which they attributed, in part, to practice styles, facility availability and regulations.²² A study of disparities in post-acute care including Arizona, Florida, New Jersey, and Wisconsin, by Freburger and colleagues²⁶ found significant regional differences in IRF and skilled nursing facility (SNF) use after adjusting for individual, facility, and state differences. Other studies examining SNF rehabilitation following hip replacement found significant regional differences in the amount of treatment provided.^{27–29} Regional differences in physical and occupational therapy services in stroke rehabilitation have also been reported.^{23,30}

Understanding how geographic variability is associated with outcomes will help rehabilitation professionals and administrators implement practice guidelines and quality improvement programs designed to improve care in areas with poor outcomes.³¹ An important step in this process is to describe region specific outcomes of rehabilitative care at the national level.

The purpose of this study was to examine regional differences in stroke rehabilitation outcomes in a large national sample including: a) length of stay (LOS), b) functional status (discharge motor and cognitive status, overall functional change), and c) the percentage of patients discharged to the community. Conceptually, variation in health service use and rehabilitation is linked to geography as well as demographic, clinical, and other factors that influence care decisions and resource utilization.^{26;32–34} Our study was guided by Kane and Radosevich's³⁵ conceptual model for health outcomes research. We categorized variables that influence rehabilitation outcomes into demographic, clinical, and regional factors (Figure 1).

Our main focus was to provide basic descriptive information regarding regional variation in outcomes for persons receiving inpatient rehabilitation following a stroke. Based on the conceptual model, our previous research and clinical experience, and the existing literature, we hypothesized that differences in outcomes would be present across regions after adjusting for demographic and clinical factors.

METHODS

Data Source

We used a retrospective cohort design to examine inpatient rehabilitation records across ten geographic regions. Data were obtained from the Uniform Data System for Medical Rehabilitation (UDSMR). The UDS_{MR} database is the largest non-governmental data repository for inpatient medical rehabilitation information in the U.S.³⁶ The UDS_{MR} database includes patient records from 1987 for 850 to 900 rehabilitation hospitals or facilities across the nation. For this study, we used patient demographics, clinical information, and rehabilitation outcomes from 2006 and 2007 contained in the UDS_{MR} database.

Study Sample

The sample included individuals with stroke based on ICD-9 codes (430 to 433.9, 436 & 439). The eligible sample included adults between the age of 18 and 100 years living at home prior to their acute stroke and were discharged from an IRF in 2006 or 2007 (N = 167,450 patient records). A patient record was excluded if it was not an IRF admission for initial rehabilitation (n = 9,700). Records were also excluded if they reflected an atypical course of rehabilitation. For example, greater than 30 days from acute event to IRF admission (n = 11,577), an IRF stay under 3 days (n = 2,997), or greater than 3 standard deviations of the logarithm for length of stay (n = 1,523). Records with missing data for key variables, e.g., age, discharge setting, were excluded (n=1,859). We included patients with program interruptions (n=1,340). These records represented 1% of the sample and in our

sensitivity analysis did not influence the results. Given that program interruptions represent patient stays that were distributed across regions we chose to leave these records in our analysis. The final sample included 143,036 patients, which represents approximately 85% of the eligible patient records.

Study Variables

Based on our experience with stroke outcomes studies using large national datasets,^{37–40} we examined three common stroke rehabilitation outcomes. Consistent with our conceptual model, we entered demographic characteristics, clinical factors, and geographic region as covariates.

Community discharge—Discharge settings in the UDS_{MR} database are grouped into categories. Community includes home, board-and-care settings, transitional living and assisted living. Long-term care includes nursing home, skilled nursing facilities, chronic hospitals and other alternate care settings. Acute care includes discharges to units in the same facility as well as other acute facilities. Rehabilitation includes settings in other facilities or sub-acute settings within the same IRF. In this study, we dichotomized discharge settings into those returning to community and those needing institutional levels of care.

Length of stay—Rehabilitation length of stay was calculated as the total number of days spent in the inpatient medical rehabilitation unit or hospital.

Functional status—Motor and cognitive function at discharge and overall functional gain were assessed with the FIM instrument (FIMTM). In 2002, the items from the FIM instrument were incorporated into the *Inpatient Rehabilitation Facilities-Patient Assessment Instrument* (IRF-PAI).⁴¹ The FIM instrument is a standardized measure of disability and burden of care that is used in inpatient rehabilitation facilities across all geographic regions.⁴²

The FIM instrument is administered within 3 days of admission and 3 days of discharge and includes 18 items that cover 6 functional subscales: self-care, sphincter control, transfers, locomotion, communication, and social cognition. The first four subscales denote the motor domain and the latter two denote the cognitive domain. All items are measured on a seven point scale from 1 (total assistance) to 7 (complete independence). Motor domain ratings range from 13 to 91 with cognition ratings ranging from 5–35. Overall FIM ratings range from 18 to 126. Functional change was defined as the difference between admission and discharge FIM ratings.^{37;43;44} The reliability and validity of the FIM instrument have been studied extensively in patients with stroke and other impairments.⁴⁵

Demographic Factors—Demographic variables known to influence rehabilitation outcomes^{46;47} were used as covariates. These factors included age, gender, race/ethnicity, marital status, and insurance status. Race/ethnicity was coded as non-Hispanic white, Black, Hispanic and other. Marital status was dichotomized as married versus unmarried/single. Insurance status was classified as Medicare, Medicare managed care, Medicaid, managed care, commercial insurance, and other.

Clinical Factors—Clinical factors include stroke type, comorbidities, and admission functional status. Stroke types included ischemic, hemorrhagic, and other. We used the CMS tier system to classify comorbidity level. CMS tiers reflect specific comorbidities that influence rehabilitation service use.^{42;48} Studies of inpatient rehabilitation including stroke have shown that tier levels influence outcomes of care.^{49;50} We considered the sum of each patient's comorbid conditions included in the IRF-PAI to reflect medical severity. This approach has a potential ceiling effect because IRF-PAI limits the number of comorbid diagnoses to ten. We considered the Elixhauser and Charlson indices, but were not able to use these methods because we did not have access to acute-care records and could not develop an accurate score based on a “look-back” period.

Geographic Region—The geographic region variable was the Centers for Medicare and Medicaid Services (CMS) regions. CMS has 10 offices monitoring healthcare at the regional, state and local level.⁵¹ Consistent with CMS regions UDS_{MR} patient records were categorized into the following regions by state: CMS 1 = CT, MA, ME, NH, RI, VT; CMS 2 = NJ, NY; CMS 3 = DC, DE, MD, PA, VA, WV; CMS 4 = AL, FL, GA, KY, MS, NC, SC, TN; CMS 5 = IL, IN, MI, MN, OH, WI; CMS 6 = AR, LA, NM, OK, TX; CMS 7 = IA, KS, MO, NE; CMS 8 = CO, MT, ND, SD, UT, WY; CMS 9 = AZ, CA, HI, NV; and CMS 10 = AK, ID, OR, WA. We dummy coded CMS region for inclusion in our models.

Data Analysis

Demographic and clinical characteristics, along with outcomes, were stratified by CMS region and examined descriptively using measures of central tendency and proportions. Linear regression was used with continuous outcome measures to determine region specific LOS and discharge FIM ratings (motor, cognitive, change). Logistic regression was used for community discharge by region. Reference categories for nominal covariates were identified based on unadjusted descriptive percentages: the most frequent category was selected for all variables. For the region variable, CMS 10 was used as the reference category because that region had the lowest unadjusted LOS with the highest community discharge percentage and highest mean admitting functional status ratings across all regions (see Table 2).

We used an ordinary least squares method to adjust for demographic, clinical factors at admission to calculate region specific outcomes. Standard regression diagnostics (goodness-of-fit, multicollinearity, homoscedasticity, outliers) were computed for each of the models examining a primary outcome.⁵² Finally, we constructed maps showing regional outcomes for the typical stroke patient using ArcGIS 10 Software.⁵³ All other analyses were conducted using SPSS ver. 19.

RESULTS

The sample was 51.6% female with a mean age of 70.6 ($\pm$ 13.6) years. Fifty percent of the sample was married. The sample was 71.9% non-Hispanic white. The portion of non-Hispanic white varied from 59.1% in CMS region 2 to 88.5% in CMS region 8. The most common stroke type was an ischemic event (76.7%) which varied across CMS regions from 71.8% for region 9 to 81.5% for region 1. CMS region 4 (southeast) had the highest number of patients with stroke ($n = 28,522$) representing 21% of the sample (see Table 1). Overall,

17.9% of the sample was classified with low-level tier comorbidity with 1.7% moderate and 2.0% high tier. Mean admission FIM ratings ranged from 52.9 in CMS region 1 to 64.5 in CMS 10. The pattern across the regions was similar for both cognitive and motor domains at admission. The two largest primary insurance carriers were Medicare at 62% and private commercial insurance at 16%. Insurance status varied across CMS regions with the Medicare percentages ranging from CMS 6 = 67.5% to CMS 2 = 54.9%.

The unadjusted mean LOS varied across regions from 14.5 days (CMS 10) to 18.9 days (CMS 1) (Table 2). The regression analyses for the continuous outcome measures indicated that LOS for region CMS 5 was significantly lower than CMS 10 (16.6 days) which was at the national median (CMS 5: $b = -0.37$, CI $-0.62, -0.12$), while CMS 8 ($b = 1.15$ CI $0.82, 1.48$) and CMS 1 ($b = 1.70$, CI $1.40, 2.00$) were significantly above. Overall, adjusted LOS varied by 2.1 days across the 10 CMS regions (see Figure 2 and Table 3). Compared to persons who were non-Hispanic white, persons who were Hispanic had shorter LOS ($b = -1.03$; CI $-1.21, -0.85$). For clinical characteristics, higher admission motor ratings were associated with shorter LOS ($b = -.39$; CI $-0.4, -0.39$). Compared to non-tier comorbidities, both medium tier ($b = 2.36$; CI $2.05, 2.67$) and high tier ($b = 0.99$; CI $0.70, 1.29$) groups had longer LOS.

The unadjusted community discharge percentages ranged from 62.0% to 81.9% regionally. For persons who were institutionalized, the largest percentage (44.1%, $n = 18,351$) were in long-term-care settings. After entering covariates the average community discharge percentage across all CMS regions was 69.0% percent. The adjusted percentage of individuals discharged to the community varied from 79.1% in the southwest (CMS 9) to 59.4% in the northeast (CMS 2). Figure 3 shows a map of the adjusted differences in community discharge across CMS regions.

The logistic regression analysis indicated that married patients were more likely to return to community (OR = 1.70; CI 1.65, 1.75). Compared to non-Hispanic white patients, other race/ethnic groups had greater odds of community discharge. The OR for African Americans was 1.20 (CI 1.16, 1.25), and 1.41 (CI 1.33, 1.50) for Hispanics. Higher FIM instrument motor and cognitive ratings at admission significantly increased the likelihood of community discharge (motor OR = 1.08; CI 1.08, 1.08; cognitive OR = 1.03; CI 1.02, 1.03), while patients with comorbid conditions were less likely to return to the community (see Table 3).

Unadjusted mean total FIM discharge ratings ranged from 78.0 (CMS 4) to 89.6 (CMS 10) across regions. After controlling for covariates, the mean FIM change was 26 points with a 4.7 point difference across regions. The majority of this difference was due to changes in motor ratings which varied by 3.5 points across regions. In the adjusted analyses, persons in the Black and Hispanic race/ethnic groups demonstrated significantly less change in function compared to non-Hispanic whites. Likewise, persons in a tier comorbidity category had significantly less change in FIM ratings than patients without a tier comorbidity. Table 3 shows the regression coefficients for discharge motor and overall change in FIM instrument ratings.

DISCUSSION

The purpose of our study was to explore regional variation in post-acute medical rehabilitation outcomes. The findings suggest there are regional differences, most notably in community discharge rates and LOS. Regional variation in rehabilitation outcomes remained after controlling for the extensive variability in observed patient characteristics and clinical factors across regions.

Discharge to the community has been identified as an important outcome and quality indicator for inpatient rehabilitation.⁵⁴ The finding of a 20% difference in community discharge rates across CMS regions suggests that complex environmental and social factors along with patient demographics and clinical factors contribute to discharge outcomes for patients receiving stroke rehabilitation in ways we currently do not understand. The region with the highest percent of community discharge after adjusting for basic patient and clinical variables was the southwest (CMS 9 = 79.1%) while the lowest region was the northeast (CMS 2 = 59.4%). These two regions represent diverse geographic areas with different types and availability of resources to assist individuals attempting to reintegrate into the community following a stroke. There were obvious differences in demographic and clinical factors across regions; e.g. CMS region 2 included fewer Medicare patients and demonstrated greater racial/ethnic diversity. Both of these factors can influence discharge decisions with persons from underrepresented groups discharged home at higher rates.⁵⁵ Recent research has also suggested that Medicaid beneficiaries from underrepresented groups are less likely to receive institutional care than non-Hispanic whites.²⁶ Differences among racial/ethnic groups and health insurance status highlight the need to adjust for demographic and clinical factors in our analyses. These are complex issues involving many potential confounds. Howard et al. examined these complex relationships in the REGARDS (Reasons for Geographic and Racial Differences in Stroke) study. REGARDS is a prospective population-based observational study of 30,239 adults > 45 years of age.⁵⁶ We are also exploring regional variation using a small-area analysis approach based on hospital referral regions (HRR) rather than the large-area analysis involving CMS regions reported in this study. We believe HRRs will provide a more sensitive approach to examine the influential factors identified in the current study.

We considered whether the difference in community discharge might be attributable to access or volume, but discarded these hypotheses since the two regions with the largest disparity in community discharge had comparable numbers of facilities capable of treating an equivalent volume of patients. With respect to facility networks and referral patterns, we were unable to examine availability of alternate post-acute care venues, which has been shown to influence admission to inpatient rehabilitation.⁵⁷ Information regarding alternative post-acute care facilities was not available in our dataset and this is an important area for future research.

When examining LOS, regional differences have important resource and cost implications. The median LOS across the ten regions was 16.6 days (CMS 3 and 10). Based on the regression analyses the two regions with the shortest length of stay (CMS 5 and 9) are approximately half a day shorter than the median. After adjusting for relevant covariates

there is a 2.1 day difference between the regions with the lowest and highest mean LOS. In fiscal year 2006, the mean cost per patient day for inpatient medical rehabilitation for stroke ranged from \$900 to \$1,100 depending on severity and estimated service use.⁵⁸ In 2010 the mean per-day cost for inpatient medical rehabilitation across all impairment groups was \$1,304.¹

Our results indicate that functional status and change in function as measured by the FIM instrument are relatively stable across regions. All CMS regions demonstrated functional change of approximately 25 points from admission to discharge reflecting improvement in functional independence during rehabilitation for persons with stroke.⁵⁹ Across regions, the mean difference in functional change was less than five points suggesting that change did not vary substantially. The stability of functional assessment data is consistent with prior research showing acceptable reliability for the FIM instrument across IRF impairment groups and treatment settings.⁴⁵

The goal of identifying differences in rehabilitation outcomes across geographic regions is to ultimately develop programs, and identify administrative processes or structural changes that can be implemented to improve individual patient independence. In the Donabedian⁶⁰ framework of Structure - Process - Outcomes; process measures are often preferred because they are closer to outcomes, and may lead more directly to interventions to enhance outcomes.^{34;61} In general, rehabilitation outcome researchers are limited by a lack of accepted process measures.⁶¹ This is true for our investigation as well.

Minimizing regional variation by improving care in lower performing regions has been demonstrated to lead to higher quality and patient satisfaction in acute care settings.¹¹ It is logical that similar improvements might be seen in post-acute care venues including inpatient rehabilitation. Our study is an initial step to better understanding how process, structure, and outcomes vary geographically for inpatient medical rehabilitation services. This is a complex issue that cannot be resolved by a single investigation. We have started the exploration of post-acute geographic variation in rehabilitation outcomes at a macro level by focusing on CMS regions. We realize this is a crude approach but it provides important information in identifying areas and directions for future research. For example, we are currently examining discharge setting and length of stay information in the CMS MedPAR (medical provider annual review) and the IRF-PAI files using hospital referral regions.

Study Limitations

In addition to the limitations associated with the CMS regions and the lack of process measures in the UDS_{MR} dataset, our study has some other weaknesses. The UDS_{MR} data provides excellent information regarding the person's inpatient rehabilitation experience. It does not, however, include information about services received prior to rehabilitation admission or treatment provided in the acute care setting. We also did not have detailed facility level information, such as number of beds, type of staff, or hours and intensity of services provided to patients. As with all large administrative datasets involving secondary data analysis, there are potential issues with coding accuracy and data integrity. Facilities that submit information to the UDS_{MR} are required to complete a credentialing process.

Previous research has demonstrated excellent reliability for the collection of the functional status information included in the UDS_{MR} data files.⁴⁵

Discharge to community is an area where we found substantial variation across CMS regions. We believe discharge destination and transition to the community are important topics for future research. Previous studies have demonstrated the central role of clinical, social, environmental and functional performance factors in successful home and community reintegration.^{57;62–64} Proximity and availability of rehabilitative facilities is an obvious factor potentially influencing discharge destination that we were not able to examine at the level of the CMS regions²⁰ and this is another important topic for future research.

Conclusions

Understanding regional variation related to community discharge is an essential step in developing strategies for care transition. Future research to define and establish these strategies will be important for medical rehabilitation and other post-acute care settings as components of the Affordable Care Act, including accountable care organizations, medical homes, and bundled payments are implemented as part of health care reform. Rehabilitation investigators should be active contributors to this process.

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Abbreviations

CMS	Centers for Medicare and Medicaid Services
FIM	Functional Independence Measure
IRF	Inpatient Rehabilitation Facility
IRF-PAI	Inpatient Rehabilitation Facility-Patient Assessment Instrument
ICD-9	International Classification of Diagnoses
LOS	Length of Stay
SNF	Skilled Nursing Facilities
UDS_{MR}	Uniform Data System for Medical Rehabilitation

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Figure 1.

Conceptual model for variation in stroke rehabilitation dependent on three components: Demographic factors, clinical factors, and geographic region.

Figure 2.

Regional differences in LOS after adjusting for demographic and clinical factors across CMS regions. National median was 16.6 days (CMS 10). Lighter areas reflect shorter LOS. LOS varied by two days across the CMS regions.

Figure 3.

Percentage of individuals discharged to the community following stroke rehabilitation after adjusting for demographic and clinical factors. Community discharge varied by 20% across the CMS regions.

Table 1

Sample demographic characteristics by CMS region (unadjusted)

Variables	CMS 1	CMS 2	CMS 3	CMS 4	CMS 5	CMS 6	CMS 7	CMS 8	CMS 9	CMS 10	Total
Number of Patients	6159	13357	18846	28522	21918	22618	8501	4004	13717	4394	143036
Age (mean, sd)	72.1(13.4)	70.7(13.7)	71.3(13.3)	69.9(13.5)	70.8(13.5)	70.9(13.1)	70.3(13.8)	70.6(14.0)	69.6(14.1)	70.1(13.6)	70.6(13.5)
Female %	50.9	52.0	52.5	52.1	51.5	53.2	50.3	50.5	49.2	47.5	51.6
Race/Ethnicity %											
White	83.8	59.1	80.9	68.6	79.5	63.6	83.3	88.5	60.1	80.5	71.9
Black	6.7	21.4	14.5	20.6	15.8	18.1	10.8	2.2	8.1	2.7	15.3
Hispanic	2.8	10.4	0.8	3.2	1.8	12.3	0.9	4.6	13.0	2.6	5.6
Other	6.7	9.1	3.7	7.5	2.9	6.1	5.0	4.6	18.8	14.3	7.3
Unmarried %	50.7	55.0	51.3	50.4	50.7	49.1	49.0	44.3	46.9	44.1	50.0
Primary Insur. %											
Medicare	64.2	54.9	57.9	64.5	64.1	67.5	64.3	66.0	54.0	56.1	61.9
Medicaid	4.1	4.9	2.8	3.4	3.7	2.6	4.7	2.5	8.4	52.3	4.0
Medicare managed	4.3	11.6	9.9	5.0	6.6	5.0	5.0	3.2	7.5	11.2	6.9
Commercial	15.3	14.0	15.7	16.4	15.5	15.9	16.0	17.3	16.3	16.4	15.8
Managed Care	8.0	6.7	7.7	3.7	4.5	2.4	4.4	3.5	8.3	5.4	5.1
Other	4.3	7.9	6.1	7.0	5.6	6.6	5.6	7.3	5.5	5.8	6.3

Continuous variables presented as mean (standard deviation), categorical variables as percent (%).

Table 2

Sample clinical characteristics and outcomes by CMS region (unadjusted)

Variables	CMS 1	CMS 2	CMS 3	CMS 4	CMS 5	CMS 6	CMS 7	CMS 8	CMS 9	CMS 10	Total
Stroke Type											
Ischemic %	81.5	75.0	74.6	79.2	77.0	77.3	77.3	73.3	71.8	80.3	76.7
Hemorrhagic	15.7	14.6	13.7	12.5	13.8	11.2	15.5	20.3	17.8	15.2	14.0
Other	2.8	10.4	11.7	8.3	9.2	11.5	7.2	6.4	10.4	4.5	9.3
Tier Level											
Comorbidity											
None %	75.8	82.3	76.9	76.9	79.0	78.2	79.4	78.6	78.4	83.3	78.4
Low	18.4	13.9	18.6	19.4	18.0	18.2	16.9	18.9	17.6	14.7	17.9
Medium	3.5	1.7	2.2	1.6	1.3	1.4	1.8	1.2	2.1	0.9	1.7
High	2.3	2.0	2.2	2.1	1.8	2.2	1.9	1.3	1.9	1.0	2.0
FIM Admission											
Cognitive	19.0(7.9)	21.9(8.2)	20.5(7.8)	19.2(7.8)	21.2(7.6)	19.4(7.8)	20.1(7.6)	19.9(7.7)	19.2(7.5)	22.2(7.0)	20.1(7.8)
Motor	32.4(13.9)	33.7(13.3)	34.8(13.1)	32.0(12.5)	36.4(13.1)	33.0(13.0)	35.8(13.3)	36.8(14.4)	32.8(12.4)	39.6(12.7)	34.1(13.1)
Total	52.9(20.0)	57.3(19.5)	57.1(19.1)	53.1(18.5)	59.6(18.7)	54.8(19.4)	58.1(19.1)	59.2(20.3)	54.2(18.3)	64.5(17.7)	56.2(19.1)
FIM Discharge											
Cognitive	29.0(16.8)	23.8(14.9)	24.7(14.3)	24.8(14.4)	24.3(14.2)	25.4(15.2)	25.1(14.9)	26.5(16.6)	26.1(14.8)	24.6(13.8)	25.1(14.8)
Motor	24.7(7.2)	25.5(7.5)	24.6(7.2)	23.6(7.4)	25.2(7.0)	23.8(7.4)	24.4(6.9)	24.5(7.2)	23.8(7.3)	26.1(6.4)	24.4(7.3)
Total	54.2(18.9)	52.4(18.4)	53.8(17.0)	50.8(16.9)	54.9(16.4)	52.2(17.0)	54.8(16.9)	56.9(17.6)	52.4(16.3)	58.9(15.7)	53.2(17.1)
FIM Change											
Total	81.9(25.3)	81.2(24.8)	81.8(23.3)	78.0(23.3)	83.9(22.3)	80.2(23.6)	83.2(22.8)	85.7(23.8)	80.3(22.5)	89.6(20.9)	81.3(23.4)
Length of Stay											
Community Discharge %	18.9(11.2)	17.3(9.4)	16.3(9.9)	17.1(8.7)	15.2(8.5)	16.6(8.9)	16.3(9.2)	16.6(10.7)	16.7(8.9)	14.5(8.2)	16.5(9.2)
	62.0	63.3	70.5	73.2	70.6	72.4	68.6	72.0	78.1	81.9	71.4

Continuous variables presented as mean (standard deviation), categorical variables as percent (%).

Table 3

Regression coefficients and confidence intervals across stroke outcomes

	Length of Stay			Discharge Motor			Functional Gain			Community Discharge		
	b	95 %	CI	b	95 %	CI	b	95 %	CI	OR	95 %	CI
Age	-0.07	-0.07	-0.06	-0.14	-0.15	-0.14	-0.20	-0.20	-0.19	0.98	0.98	0.98
Male	0.34	0.26	0.43	0.01	-0.11	0.13	0.00	-0.15	0.16	0.86	0.84	0.88
Married	-0.42	-0.51	-0.34	-0.23	-0.35	-0.10	-0.21	-0.37	-0.05	1.70	1.65	1.75
Race/Ethnicity (White)												
Black	-0.68	-0.80	-0.56	-1.42	-1.59	-1.25	-2.06	-2.28	-1.84	1.20	1.16	1.25
Hispanic	-1.03	-1.21	-0.85	-1.34	-1.60	-1.08	-1.83	-2.17	-1.49	1.41	1.33	1.50
Other	-0.20	-0.36	-0.04	0.05	-0.18	0.28	-0.20	-0.50	0.10	1.27	1.20	1.34
Stroke Type (Ischemic)												
Hemorrhagic	0.02	-0.10	0.14	1.02	0.84	1.19	1.19	0.97	1.42	0.97	0.93	1.01
Other	-0.77	-0.91	-0.63	-0.87	-1.07	-0.67	-1.19	-1.45	-0.93	1.06	1.01	1.11
Insurance (Medicare)												
Medicaid	0.71	0.48	0.93	0.16	-0.16	0.48	0.00	-0.42	0.42	1.21	1.12	1.30
Medicare managed	0.08	-0.08	0.25	-0.41	-0.64	-0.17	-0.55	-0.85	-0.24	1.08	1.03	1.14
Commercial	0.86	0.73	0.99	1.04	0.84	1.23	1.47	1.22	1.72	1.45	1.38	1.51
Managed Care	1.10	0.91	1.29	1.30	1.01	1.58	1.65	1.29	2.02	1.40	1.31	1.50
Other	0.45	0.26	0.64	0.27	0.00	0.54	0.42	0.06	0.77	1.40	1.31	1.50
Admission FIM												
Motor	-0.39	-0.40	-0.39	0.88	0.88	0.89	-0.09	-0.09	-0.08	1.08	1.08	1.08
Cognitive	0.04	0.04	0.05	0.20	0.19	0.21	-0.05	-0.06	-0.04	1.03	1.03	1.03
Comorbidity (non-Tier)												
Tier low	-0.20	-0.31	-0.09	-1.31	-1.46	-1.16	-1.49	-1.69	-1.29	0.82	0.80	0.85
Tier medium	2.36	2.05	2.67	-2.46	-2.90	-2.01	-2.79	-3.37	-2.21	0.77	0.70	0.84
Tier high	0.99	0.70	1.28	-2.89	-3.31	-2.47	-3.38	-3.92	-2.84	0.61	0.56	0.66
Region (CMS 10)												
CMS 1	1.70	1.40	2.00	2.76	2.32	3.19	4.13	3.57	4.70	0.62	0.56	0.69
CMS 2	0.67	0.41	0.94	-0.69	-1.08	-0.31	-0.56	-1.06	-0.07	0.50	0.45	0.55
CMS 3	0.08	-0.18	0.33	-0.05	-0.41	0.32	0.22	-0.26	0.70	0.76	0.69	0.83

	Length of Stay			Discharge Motor			Functional Gain			Community Discharge		
	b	95 %	CI	b	95 %	CI	b	95 %	CI	OR	95 %	CI
CMS 4	-0.21	-0.45	0.04	-0.35	-0.71	0.01	-0.07	-0.54	0.39	1.07	0.98	1.18
CMS 5	-0.37	-0.62	-0.12	-0.48	-0.84	-0.12	-0.11	-0.58	0.36	0.65	0.60	0.72
CMS 6	-0.14	-0.39	0.11	0.49	0.12	0.85	0.96	0.49	1.44	0.96	0.88	1.05
CMS 7	0.39	0.11	0.67	-0.08	-0.49	0.33	0.26	-0.27	0.79	0.62	0.56	0.69
CMS 8	1.15	0.82	1.48	1.09	0.61	1.57	1.60	0.98	2.22	0.74	0.66	0.83
CMS 9	-0.32	-0.58	-0.06	0.43	0.05	0.81	0.99	0.50	1.49	1.29	1.18	1.43

Reference category for logistic regression in ().

b = regression coefficient

OR = odds ratio

CI = confidence interval