TITLE PAGE

Title: Inpatient stroke care quality for Veterans: Are there differences between VA medical centers in the stroke belt and other areas?

Authors' Name, Affiliation, and Address: Huanguang Jia, PhD[1], Michael S. Phipps, MD[2,3], Dawn M. Bravata, MD[4,5,6], Jaime Castro, MS[1], Xinli Li, PhD[7], Diana L. Ordin, MD[8], Jennifer Myers, MSW[4,5], W. Bruce Vogel, PhD[1], Linda S. Williams, MD[4,5,6,9], Neale R. Chumbler, PhD[4,5,6,10]

[1]Rehabilitation Outcome Research Center (RORC), North Florida/South Georgia Veterans Health System (NF/SG VHS), 1691 SW Archer Road, Gainesville, FL 32608, U.S.A.

[2]Robert Wood Johnson Foundation Clinical Scholars Program and the Department of Neurology, Yale University School of Medicine, New Haven, CT 06520, U.S.A.

[3]VA Connecticut Healthcare System, VA Connecticut, 950 Campbell Avenue, West Haven, CT 06516, U.S.A.

[4]Veterans Affairs (VA) Health Services Research and Development (HSR&D) Center of Excellence on Implementing Evidence-Based Practice (CIEBP), Richard L. Roudebush VA Medical Center, 1481 West 10th Street, Indianapolis, IN 46202, U.S.A.

[5]VA HSR&D Stroke Quality Enhancement Research Initiative (Stroke QUERI), 1481 West 10th Street, Indianapolis, IN 46202, U.S.A.

[6]Regenstrief Institute, 410 West 10th Street, Indianapolis, IN 46202, U.S.A.

[7]VA National Surgery Office, 4100 E Mississippi Ave, Suite 300, Denver, CO 80246, U.S.A.

[8]Department of Veterans Affairs (VA), Veterans Health Administration, Office of Analytics and Business Intelligence, 1717 H Street, NW, Washington, DC 20006-3901, U.S.A.

[9]Department of Neurology, Indiana University School of Medicine, 545 Barnhill Drive, Indianapolis, IN 46202, U.S.A.

[10]Department of Sociology, Indiana University School of Liberal Arts, Indiana University Purdue University Indianapolis, 425 University Blvd, Cavanaugh Hall 303, Indianapolis, IN 46202, U.S.A.

Corresponding Author:
Huanguang Jia, PhD
NF/SG VHS RORC (151b)
1601 SW Archer Road
Gainesville, FL 32608

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Phone: (352)376-1611 Extension 4926
Fax: (352)271-4540
Email: Huanguang.Jia@va.gov

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ABSTRACT

Background: Stroke mortality has been found to be much higher among residents in the Stroke Belt region than in the rest of United States, but it is not known whether differences exist in the quality of stroke care provided in Department of Veterans Affairs medical centers (VAMCs) in states inside and outside this region. **Objective:** We compared mortality and inpatient stroke care quality between VAMCs inside and outside the Stroke Belt region. **Methods:** Study patients were Veterans hospitalized for ischemic stroke at 129 VAMCs. Inpatient stroke care quality was assessed by 14 quality indicators. Multivariable logistic regression models were fit to examine differences between in quality between facilities inside and outside the Stroke Belt, adjusting for patient characteristics and VAMC clustering effect. **Results:** Among the 3,909 patients, 28.1% received inpatient ischemic stroke care in 28 Stroke Belt VAMCs, and 71.9% obtained care in 101 non-Stroke Belt VAMCs. Patients cared for in Stroke Belt VAMCs were more likely to be younger, black, married, have a higher stroke severity, and less likely to be ambulatory pre-stroke. We found no statistically significant differences in short- and long-term post-admission mortality and inpatient care quality indicators between the patients cared for in Stroke Belt versus non-Stroke Belt VAMCs after risk adjustment, **Conclusions:** These data suggest that a Stroke Belt does not exist within the VA healthcare system in terms of either post-admission mortality or inpatient care quality.

INTRODUCTION

A large body of research has demonstrated that stroke mortality is much higher among residents in the Stroke Belt region of the United States. [1, 2] The Stroke Belt region has traditionally been defined as including 11 states: Mississippi, Louisiana, Kentucky, Georgia, Tennessee, North Carolina, Alabama, South Carolina, Arkansas, Indiana, and Virginia.[3] Although higher death rates from stroke have been consistently observed in the Stroke Belt region for several decades, [1, 2] there is little agreement as to its underlying cause or causes.[4] It is not clear whether Stroke Belt exists within the Department of Veterans Affairs (VA) healthcare system, how much of the quality of stroke care in medical facilities vary according to their location within or outside the Stroke Belt, and whether care quality variation explains some of the variance in mortality. [4]

Several researchers have examined the quality of acute stroke care in individual Stroke Belt states such as North Carolina[5] and Georgia.[6, 7] In a recent study on quality of acute stroke care, Reeves et al [7] reported variations in eight performance indicators for acute stroke care between hospitals in Georgia and other non-Stroke Belt states (Massachusetts, Michigan, and Ohio). We found no literature reports that systematically compared inpatients stroke care performance between Stroke Belt and non-Stroke Belt states. The primary purpose of the present study is to compare post-admission mortality and inpatient stroke care quality between Veterans Affairs medical centers (VAMCs) inside and outside the 11-state Stroke Belt region.

METHODS

Material and Patients: This is a retrospective, observational study. Research data were obtained from an ischemic stroke care database that was developed as part of the VA Office of

Quality and Performance (OQP) Stroke Special Project.[8] The OQP database consists of quality indicators, sociodemographic and clinical information for a national sample of 5,000 Veterans who were hospitalized for ischemic stroke at any of the 131 VAMCs during fiscal year (FY) 2007 (October 1, 2006 – September 30, 2007). These patients were initially identified from the FY2007 VA Medical SAS Patient Treatment File by using high-sensitivity International Classification of Diseases (ICD)-9 codes for ischemic stroke.[9] The sample included 100% of cases at small volume VAMCs (≤55 ischemic stroke admissions in FY2007) and a random sample of 80% of cases at high volume VAMCs (>55 ischemic stroke admissions in FY2007). An extensive chart review was conducted by trained chart abstractors to verify the patients' ischemic stroke diagnosis and collect other clinical and process information during the patients' inpatient stay.

In this study, we excluded patients who did not have acute ischemic stroke as the primary diagnosis (n=534), were already admitted for a non-stroke condition when the ischemic stroke event occurred (n=200), were admitted only for post-stroke rehabilitation (n=190), were admitted for elective carotid endarterectomy (n=89), did not have an acute ischemic stroke ICD-9 codes (n=22), and those patients who left against medical advice (n=56). As a result, our final study sample consisted of 3,909 patients at 129 VAMCs.

Outcome Measures

Mortality refers to all deaths that occurred within the initial 30 days and during the 12 months from the patients' stroke hospitalization admission date. Patient vital information was obtained from the Beneficiary Identification and Records Locator Subsystem (BIRLS) death file, a commonly used source for VA healthcare enrollees' vital status by VA investigators.

Furthermore, the VA Medical SAS inpatient dataset was used to verify the findings from the BIRLS death file.[10]

Quality Indicators: In-hospital stroke care quality was assessed using 14 quality indicators: dysphagia screening, documentation of the National Institute of Health Stroke Scale (NIHSS), thrombolysis (tPA), antithrombotic therapy by hospital day two and at discharge, deep vein thrombosis (DVT) prophylaxis, early ambulation, fall risk assessment, pressure ulcer risk assessment, rehabilitation needs assessment using the Functional Independence Measure (FIM), atrial fibrillation management, lipid management, smoking cessation counseling, and stroke education. A detailed description of the 14 indicators can be found elsewhere.[11] These indicators were developed by a multidisciplinary panel of VA stroke and performance measure experts based on evidence-based clinical guidelines for inpatient stroke care and existing performance measures developed by The Joint Commission. [12-19] For each of the 14 quality indicators, a passing or compliance rate was calculated (the number of patients with the process of care present divided by the total number of eligible patients for each component of care).

Independent Variable and Other Covariates

Independent Variable: Stroke Belt status was determined by the location of the VAMCs providing the inpatient ischemic stroke care. In other words, a VAMC was designated as a Stroke Belt facility if it was located within the 11 southeastern states (i.e., Mississippi, Louisiana, Kentucky, Georgia, Tennessee, North Carolina, Alabama, South Carolina, Arkansas, Indiana, and Virginia).[3] Otherwise, the VAMC was coded as non-Stroke Belt.

Risk Adjustment: The covariates of interest for this study can be presented in two broad categories: patient characteristics and facility characteristics. Patient characteristics included age, gender, race/ethnicity, marital status, Charlson Comorbidity Index, the retrospective

National Institutes of Health Stroke Scale (NIHSS), the modified Acute Physiology and Chronic Health Evaluation III (APACHE III) score, oxygen saturation, smoking status, code status, and pre-stroke ambulatory status. Information for these variables was obtained from the VA national Medical SAS database as well as chart review from the electronic medical record.

In this study, race/ethnicity was categorized as white, black, and all other. Marital status was coded as married, divorced, and all other. Charlson Comorbidity Index was used to assess the patients' medical comorbidity where the higher the weighted summary score, the more severe the burden of comorbidity.[20] The NIHSS, a stroke severity measurement, was calculated retrospectively from the admission neurological examination in the medical record. Stroke severity was categorized as mild (NIHSS $\leq$ 2), moderate (NIHSS = 3-9), or severe (NIHSS $\geq$ 10).[21] The modified APACHE III score, a measure of overall disease severity and a predictor of an individual's risk of dying, was used to assess the admission clinical status of the patients.[22] Hypoxia was defined as either an oxygen saturation <90% or PaO_2 <60 mm Hg at any time during the first 4 days of the hospital stay. Smoking status was classified as current smoker (any smoking in the year prior to admission) versus other (no smoking or no documentation). Admission code status was classified as full code versus other (e.g., do not resuscitate/do not intubate or DNR/DNI). The patient's level of independence prior to stroke was classified as either ambulatory or non-ambulatory, with ambulatory defined as living at home without assistance, and non-ambulatory being at home on bed rest or with assistance.

Facility characteristics included VAMC facility complexity. VA has classified all of its VAMCs as low, medium, or high complexity based on patient risk, level of intensive care, number of residency slots, amount of research dollars, and number of physician specialists.[23]

This study was approved by the institutional review board and the local VA Research and Development Committee both at Indianapolis, IN and Gainesville, FL, U.S.A.

Statistical Analysis: All statistical analyses were performed using SAS version 9.13 (SAS Institute, Cary, NC, U.S.A.). First, descriptive statistics were obtained on all the variables. Statistical inference (Chi-square test on categorical variables and ANOVA or Kruskal-Wallis test on dimensional variables) was performed to compare Stroke Belt and non-Stroke Belt VAMCs. Second, descriptive statistics for each quality indicator were calculated, and chi-square test was applied to compare each quality indicator between the two types of facilities. Finally, a multivariable logistic regression model was fit to examine the difference in 30-day and 12-month mortality as well as each quality indicator between the two types of facilities, adjusting for patient and facility characteristics as well as VAMC clustering factors. Given the large number of comparisons made in our final analyses, we used a Bonferroni correction (dividing the 0.05 significance level by the number of covariates), resulting in a significance level of 0.0042 for each of the quality indicator model.

RESULTS

In Table 1, we summarized the comparison of patient and facility characteristics between Stroke Belt and non-Stroke Belt VAMCs. Among the 3,909 patients at 129 VAMCs, 28.1% received inpatient ischemic stroke care in the 28 (21.7%) Stroke Belt VAMCs and 71.9% received the inpatient care in the 101 (78.3%) non-Stroke Belt VAMCs. Patients who were admitted to the Stroke Belt VAMCs compared with patients at non-Stroke Belt VAMCs were younger (mean age: 67.1 vs. 68.3), more likely to be married (47.4% vs. 42.2%) and black (32.8% vs. 19.1%), had more severe strokes (mean NIHSS score: 4.9 vs. 4.5), and were less likely to be ambulatory pre-stroke (91.3% vs. 94.1%). We did not find a significant difference in

30-day or 12-month post-admission mortality outcome between the patients in the Stroke Belt versus the patients in the non-Stroke Belt regions (30-day mortality rate: 7.6% for Stroke Belt vs. 6.1% for non-Stroke Belt; 12-month mortality rate: 18.7% for Stroke Belt vs. 18.6% for non-Stroke Belt).

In Table 2, we presented the number of eligible patients and the passing rate for each inpatient quality indicator, as well as the bivariate comparison for each indicator between the two types of VAMCs. There were statistically significant unadjusted differences in performance on 8 of the 14 quality indicators. Compared to non-Stroke Belt facilities, Stroke Belt VAMCs had a significantly higher passing rate in dysphagia screening before oral intake (23.6% vs. 16.2%), documenting the NIHSS (29.1% vs. 24.5%), providing DVT prophylaxis (pharmacologic or mechanical) by the end of hospital day 2 (78.4% vs. 72.2%), providing smoking cessation counseling (97.2% vs. 92.4%), and documenting stroke education (20.6% vs. 14.1%). On the other hand, Stroke Belt facilities had a significantly lower passing rate than non-Stroke Belt facilities on three indicators: completing fall risk assessment by the end of hospital day 2 (75.9% vs. 78.9%), pressure ulcer assessment within 24 hours before or after hospital admission (90.2% vs. 92.1%), and documenting patient functional independence measure (FIM) score as means of assessing rehabilitation needs (77.4% vs. 80.2%).

As shown in Table 3, there appeared no significant difference in 30-day and 12-month mortality between the VAMCs located inside and outside the Stroke Belt regions, even after controlling patients' sociodemographics, stroke severity, and facility complexity. Other factors significantly associated with short- and long-term mortality included older age and severity measures such as NIHSS score, APACHE III score, comfort measure, and DNR/DNI. In addition, being white, diagnosed with hypoxia and low-level hospital complexity were also

associated with 30-day mortality; heavier burden of comorbid conditions and pre-stroke admission independence at non-ambulatory level were also associated with 12-month mortality, respectively.

We presented the results from our multivariable logistic regression analyses in Table 4. For Stroke Belt facilities, the odds of providing smoking cessation counseling were three-times (aOR=3.3, 95% and CI=1.3-8.5) higher than at the non-Stroke Belt facilities, even after adjusting for patient and facility characteristics as well as VAMC clustering effect. It should be noted that although our smoking cessation consulting model showed a p-value of 0.0136 and adjusted odd ratio of 3.3 (Stroke Belt VAMCs vs. non-Stroke Belt VAMCs), this significance, however, disappeared after Bonferroni correction. The rest of the seven significant bivariate differences were no longer significant after adjusting for the patient and facility level characteristics. The patient characteristics which were significantly associated with the quality indicators included patient pre-stroke ambulatory status, race/ethnicity, stroke severity, age, hypoxia, marital status, Charlson comorbidity score, and facility complexity.

DISCUSSION

This is the first examination of whether a Stroke Belt exists within the VA healthcare system. We did not find evidence to support the concept of a Stroke Belt within the VA healthcare system either in terms of post-admission mortality or stroke quality of care.

Our finding that post-admission mortality was similar for patients cared for at Stroke Belt and non-Stroke Belt VAMCs differs with most non-VA research reports, which have found higher mortality rates in the Stroke Belt region (vs. non-Stroke Belt region). [1, 2, 24] The difference between the VA and non-VA findings could be due to the unique characteristics of the VA healthcare system. The Veterans Health Administration under the Department of Veterans

Affairs is an integrated healthcare system, with coordination of inpatient and outpatient care and administrative focus on consistent quality of care across the entire national system. The distinctive structure, administration and clinical practice of the VA healthcare system may explain why geographic variation in mortality among the ischemic stroke patients was not observed across VAMCs.

In the unadjusted analyses, Stroke Belt VAMCs provided higher quality of care for five quality indicators (dysphagia screening, NIHSS, DVT prophylaxis, smoking cessation counseling, and smoking education) and lower quality of care for three quality indicators (fall risk assessment, pressure ulcer risk assessment, and rehabilitation consultation). After risk adjustment, however, Stroke Belt VAMCs were three-times as likely to provide smoking cessation counseling and no other differences in quality of care were observed. Because we are unaware of any reports comparing Stroke Belt versus non-Stroke Belt inpatient stroke care, we are unable to compare our findings to those outside the VA. Given that the proportion of patients who smoked was similar in Stroke Belt and non-Stroke Belt VAMCs (36.2% versus 34.8%, p=0.41), it is unlikely that a difference in the prevalence of smoking can account for the observed difference in the smoking cessation counseling process of care.

It should be noted that our chart review data were collected through remote review of patients' electronic medical records. Electronic records may sometimes not include information that is included in the paper chart. To ensure the quality of our data, the extracted data were sent to all VAMCs (which had access to the paper charts) for review, confirmation, and correction if needed.

In summary, we did not find a significant difference in either adjusted post-stroke mortality or inpatient quality of care between Stroke Belt and non-Stroke Belt VAMCs.

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Table 1. Univariable Comparisons of Patient and Facility Characteristics by Stroke Belt Facility

Characteristics	Sample	Stroke Belt VAMCs	Non-Stroke Belt VAMCs	p†
Patient level	**N=3909**	**n=1098**	**n=2811**	
Age, mean±SD	68.0±11	67.1±12	68.3±11	**0.0023**
Female, %	2.4	1.7	2.7	0.0757
Marital status, %				**0.0118**
Married	43.7	47.4	42.2	
Divorced	30.3	28.0	31.2	
All other	26.0	24.6	26.5	
Race/Ethnicity, %				**<0.0001**
White	63.0	60.8	63.8	
Black	22.9	32.8	19.1	
All other	14.1	6.4	17.1	
Charlson Index, mean±SD	4.8±2	4.7±2	4.8±2	0.0822
NIHSS, mean±SD	4.6±6	4.9±6	4.5±6	**0.0373**
APACHE III, mean±SD	12.6±7	12.7±8	12.6±7	0.4186
Hypoxia, %	2.4	2.7	2.2	0.3653
Smoking status, %	35.1	36.2	34.8	0.4052
Comfort measure, %	3.7	4.5	3.4	0.1194
Do not resuscitate/do not intubate, %	13.6	15.0	13.1	0.1129
Prestroke ambulatory, %	93.3	91.3	94.1	**0.0047**
30-day mortality, %	6.5	7.6	6.1	0.1100
12-month mortality, %	18.6	18.7	18.6	0.9832
Facility level	**N=129**	**n=28**	**n=101**	
Facility complexity, %				0.0984
High	74.8	73.8	75.3	
Medium	18.5	20.4	17.8	
Low	6.6	5.8	6.9	

† All p-values were results from bivariate comparisons (ANOVA or Kruskal-Wallis tests for numerical variables and chi-square tests for categorical variables) between Stroke Belt VAMCs and non-Stroke Belt VAMCs.

VAMCs=Veterans Affairs Medical Centers, SD=standard deviation, NIHSS=retrospective National Institute of Health Stroke Scale, APACHE=modified Acute Physiology and Chronic Health Evaluation

Table 2. Univariable Comparisons of Inpatient Stroke Quality Indicators by Facility Type

	Sample		Stroke Belt VAMCs		Non-Stroke Belt VAMCs		
Quality Indicators	Eligible	Compliant	Eligible	Compliant	Eligible	Compliant	p[†]
Dysphagia screening before oral intake	3594	656(18.2%)	987	233(23.6%)	2607	423(16.2%)	**<0.0001**
NIH Stroke Scale documented	3607	930(25.8%)	1004	292(29.1%)	2603	638(24.5%)	**0.0049**
Thrombolysis (tPA) given	306	19(6.2%)	76	4(5.3%)	230	15(6.5%)	0.6934
Antithrombotics: by hospital day 2	3496	3324(95.1%)	966	917(94.9%)	2530	2407(95.1%)	0.7966
Deep vein thrombosis prophylaxis	1043	773(74.1%)	320	251(78.4%)	723	522(72.2%)	**0.0339**
Early ambulation	3009	2537(84.3%)	822	681(82.8%)	2187	1856(84.9%)	0.1749
Fall risk assessment	3638	2840(78.1%)	1016	771(75.9%)	2622	2069(78.9%)	**0.0480**
Pressure ulcer assessment	3749	3433(91.6%)	1050	947(90.2%)	2699	2486(92.1%)	**0.0577**
Rehabilitation needs assessment/FIM	3531	2806(79.5%)	975	755(77.4%)	2556	2051(80.2%)	**0.0649**
Antithrombotic therapy: discharge	3529	3373(95.6%)	979	936(95.6%)	2550	2437(95.6%)	0.9596
Atrial fibrillation management	447	307(68.7%)	121	80(66.1%)	326	227(69.6%)	0.4763
Lipid management	3044	2452(80.6%)	859	695(80.9%)	2185	1757(80.4%)	0.7556
Smoking cessation counseling	1272	1193(93.8%)	364	354(97.2%)	908	839(92.4%)	**0.0012**
Stroke education	2526	403(15.9%)	727	150(20.6%)	1799	253(14.1%)	**<0.0001**

[†] All p-values were from χ^2 tests comparing Stroke Belt VAMCs vs. non Stroke Belt VAMCs.

VAMC=Veterans Affairs Medical Center, NIH=National Institute of Health, FIM=functional independence measure

Table 3: Mortality Results from Multivariable Logistic Regression Analyses

	30-day Post-Admission Mortality			12-month Post-Admission Mortality		
Factors	Odds Ratio	95% CI	p	Odd Ratio	95% CI	p
VAMC Stroke Belt: yes vs. no	0.9	0.5-1.5	0.6261	0.9	0.8-1.2	0.7456
Age: numerical	1.1	1.0-1.1	**<0.0001**	1.0	1.0-1.1	**<0.0001**
Married: yes vs. no	1.0	0.8-1.1	0.6485	1.3	1.2-1.4	0.9202
White: yes vs. no	1.1	1.0-1.1	**0.0414**	1.1	1.0-1.1	0.2918
Charlson Index: Numerical	1.0	1.0-1.1	0.8901	1.0	1.0-1.1	**<0.0001**
NIHSS: numerical	0.9	0.5-1.5	**<0.0001**	1.0	0.8-1.3	**<0.0001**
APACHE III: numerical	1.9	1.0-3.4	**0.0085**	1.1	0.9-1.4	**<0.0001**
Hypoxia: yes vs. no	4.0	1.5-10.3	**0.0045**	1.7	0.9-3.5	0.1137
Smoking status: yes vs. no	1.0	0.5-1.9	0.9665	1.2	0.9-1.5	0.2507
Comfort measure: yes vs. no	34.4	14.7-80.6	**<0.0001**	28.4	8.3-97.3	**<0.0001**
DNR/DNI: yes vs. no	2.3	1.2-4.1	**0.0067**	1.7	1.3-2.3	**0.0003**
Prestroke ambulatory: yes vs. no	1.1	0.5-2.4	0.7553	0.6	0.4-0.9	**0.0081**
Hospital complexity:						
low vs. medium and high	0.2	0.1-0.8	**0.0183**	1.1	0.7-1.8	0.5398

CI=confidence interval, VAMC=Veterans Affairs medical center, NIH=National Institute of Health,

APACHE=modified Acute Physiology and Chronic Health Evaluation, DNR/DNI= Do not resuscitate/do not intubate.

Table 4. Inpatient Care Indicators Results from Multivariable Logistic Regression Analyses[†]

Indicators	Stroke Belt VAMCs (Control = Non-Stroke Belt VAMCs) Odds Ratio (95% CI)	p [‡]
Dysphagia screening	1.5(0.9-2.6)	0.1094
NIH Stroke Scale completed	1.3(0.3-7.1)	0.7230
Thrombolysis (tPA) given	0.8(0.2-2.6)	0.6959
Antithrombotic therapy day 2	1.0(0.6-1.5)	0.8802
Deep vein thrombosis prophylaxis	1.3(0.8-2.1)	0.3430
Early ambulation	0.7(0.3-1.3)	0.2509
Fall risk assessment	0.9(0.2-3.3)	0.8838
Pressure ulcer risk assessment	0.9(0.5-1.7)	0.7989
Rehabilitation consultation/FIM	0.7(0.5-1.2)	0.1827
Antithrombotic therapy at discharge	1.1(0.7-1.9)	0.6087
Atrial fibrillation management	0.9(0.5-1.5)	0.6645
Lipid management	1.0(0.8-1.6)	0.4493
Smoking cessation counseling	3.3(1.3-8.5)	0.0136
Stroke education	1.0(0.3-3.8)	0.9606

[†] The results for each quality indicator in this table were adjusted for patient age, gender, race/ethnicity, marital status, Charlson Index sum score, APACHE III score, retrospective NIH Stroke Scale, DNR/DNI, prestroke ambulatory, hypoxia, comfort measure only, and hospital complexity.

[‡] SAS proc GLIMMIX was applied to adjust for the clustering of patients within VAMCs.

VAMC=Veterans Affairs medical Center, CI=confidence interval, FIM= functional independence measure