THE JOURNAL OF RURAL HEALTH

ORIGINAL ARTICLE

Rural-Urban Differences in Inpatient Quality of Care in US Veterans With Ischemic Stroke

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Abstract

Purpose: Differences in stroke care quality for patients in rural and urban locations have been suggested, but whether differences exist across Veteran Administration Medical Centers (VAMCs) is unknown. This study examines whether rural-urban disparities exist in inpatient quality among veterans with acute ischemic stroke.

Methods: In this retrospective study, inpatient stroke care quality was assessed in a national sample of veterans with acute ischemic stroke using 14 quality indicators (QIs). Rural-Urban Commuting Areas codes defined each VAMC's rural-urban status. A hierarchical linear model assessed the rural-urban differences across the 14 QIs, adjusting for patient and facility characteristics, and clustering within VAMCs.

Findings: Among 128 VAMCs, 18 (14.1%) were classified as rural VAMCs and admitted 284 (7.3%) of the 3,889 ischemic stroke patients. Rural VAMCs had statistically significantly lower unadjusted rates on 6 QIs: Deep vein thrombosis (DVT) prophylaxis, antithrombotic at discharge, antithrombotic at day 2, lipid management, smoking cessation counseling, and National Institutes of Health Stroke Scale completion, but they had higher rates of stroke education, functional assessment, and fall risk assessment. After adjustment, differences in 2 QIs remained significant—patients treated in rural VAMCs were less likely to receive DVT prophylaxis, but more likely to have documented functional assessment.

Conclusions: After adjustment for key demographic, clinical, and facility-level characteristics, there does not appear to be a systematic difference in inpatient stroke quality between rural and urban VAMCs. Future research should seek to understand the few differences in care found that could serve as targets for future quality improvement interventions.

Key words geography, health disparities, health services research, quality, veterans.

Funding: This research was supported by a grant from the Department of Veterans Affairs Health Services Research and Development (VA HSR&D Grant RRP 09-184). The opinions contained in this paper are those of the authors and do not necessarily reflect those of the US Department of Veterans Affairs. The authors have no disclosures to report.

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doi: 10.1111/jrh.12029

Almost one-fifth of ischemic stroke patients are diagnosed and treated in rural areas.[1] Acute stroke management and outcomes differ between rural and urban areas.[1-4] Rural areas have been found to have the following factors that serve as barriers for timely and high-quality care for stroke: limited EMS training; limited

availability of specialists; time delays in triage, diagnostic testing, and treatment of potential stroke patients; limited technology at rural hospitals; lower awareness and recognition of stroke symptoms and risk factors; and lack of adherence to published clinical guidelines or clinical trial results.[5,6] Although these prior studies have been informative, they have focused primarily on availability of resources in rural versus urban areas, and on patient-level, prehospital, and emergency room factors. Less is known about potential differences in in-hospital acute ischemic stroke care delivery between rural and urban hospitals, especially within the Veterans Health Administration (VHA). Such a void in the literature is concerning because it is estimated that about 3 million veterans, or slightly more than one-third of the veterans who are enrolled in the Department of Veterans Affairs (VA), live in rural areas, and many of these individuals are diagnosed with or are at risk of stroke.[7] To our knowledge, there are currently no studies examining rural versus urban facility performance on inpatient stroke quality measures. The purpose of this study was to determine whether rural-urban disparities exist in in-hospital stroke care quality among veterans admitted to a Veteran Administration Medical Centers (VAMC) with acute ischemic stroke. To determine whether ascertainable patient or facility factors might impact rural-urban disparities, we also examined quality indicator (QI) rates adjusted for selected patient and facility characteristics.

Material and Methods

Patients and Setting

This was a retrospective study of a national VHA sample of inpatient stroke care quality conducted by the VHA Office of Analytics and Business Intelligence (formally the Office of Quality and Performance) and the Stroke Quality Enhancement Research Initiative. The methods of that retrospective chart review project have been described previously.[8] Briefly, a national sample of 5,000 veterans with a discharge diagnosis of ischemic stroke was identified from administrative data from fiscal year 2007 (FY07: 10/1/06-9/30/07). All stroke admissions were included from VAMCs with $\leq$55 admissions in FY07 and a random 80% of patients were included at VAMCs with >55 admissions in FY07. Trained abstractors conducted chart reviews to verify ischemic stroke diagnosis and collect clinical and process measure data. Patients who were not eligible for any QI were excluded from the analyses. A total of 3,939 veterans with ischemic stroke from 129 VAMCs were eligible for one or more QIs. Fifty patients were excluded due to lack of Rural-Urban Commuting Areas (RUCA) codes for Caribbean locations, leaving a total of 3,889 patients in 128 VAMCs that were included in the analysis.

Quality Indicators

The quality of inpatient stroke care was assessed by 14 QIs addressing processes of care: thrombolytic therapy, dysphagia screening before oral intake, documentation of stroke severity using the National Institutes of Health Stroke Scale (NIHSS), antithrombotic therapy by hospital day 2, deep vein thrombosis (DVT) prophylaxis, early ambulation, fall risk assessment, pressure ulcer risk assessment, rehabilitation needs assessment based on the Functional Independence Measure (FIM) documentation, antithrombotic therapy at discharge, atrial fibrillation (afib) management, lipid management, smoking cessation counseling, and stroke education.[8] The QIs were constructed so that for each indicator only eligible patients were included in the denominator, and ineligible patients were excluded for that indicator. For this study, the 14 QI rates were calculated as the proportion of eligible patients in each of the rural and urban groups who received the guideline-based process of care.

Patient and Facility Characteristics

RUCA codes were used to define each VAMC's rural-urban status, using the ZIP code of the facility to classify it according to RUCA definitions.[9] For this study, facilities whose ZIP code fell into the typical RUCA "urban" classification were designated "urban," and all other facilities (sometimes classified as "large rural," "small rural," or "isolated") were designated "rural."

The following patient characteristics were obtained from chart review and were included in the risk adjustment for the final model: age, race/ethnicity, retrospective NIHSS (rNIHSS),[10] Charlson score,[11] modified Acute Physiology and Chronic Health Evaluation III (APACHE III),[12] admission code status, and prestroke independence. Race was obtained from the VA Functional Status Outcomes Database and classified as black, non-Hispanic white, or other. The Charlson Comorbidity score[11] was included as a measure of comorbidity, and the rNIHSS as a measure of stroke severity[10] and was categorized as mild (rNIHSS $\leq$2), moderate (rNIHSS 3-9), or severe (rNIHSS $\geq$10).[13] The physiology component of the modified APACHE III score was employed to evaluate the clinical status of the patients at admission (ranges from 0 to 213 with high values indicating greater disease severity); this instrument is a measure of overall disease severity and a predictor of an individual's risk of dying.[12] Admission code status was dichotomized as "full code" versus "other" (ie, do not resuscitate [DNR] or do not

intubate [DNI]). The patient's level of independence prior to stroke was classified as either ambulatory or nonambulatory, with ambulatory being defined as a patient living at home without assistance, and nonambulatory defined as being at home on bed rest or with assistance. In addition to the above patient characteristics, facility complexity was included in risk adjustment. The VHA classified the VAMCs into 3 levels of complexity (low, medium, and high), determined by the number of veterans treated, patient risk, number of residency slots, amount of research dollars, and number of physician specialists. Therefore, a low complexity site has fewer veterans treated, low patient risk, fewer residency slots and physician specialists, and less research.[14] This study was approved by the institutional review board at Indiana University and the Research and Development Committee at the Roudebush VAMC in Indianapolis, Indiana.

Statistical Analysis

Patient and facility characteristics were compared between patients at urban and rural facilities using chi-square tests for categorical variables and ANOVA or Kruskal-Wallis tests for continuous variables. As the QIs were originally designed for use without risk adjustment (similar to Joint Commission QIs), we compared unadjusted pass rates between rural and urban facilities using chi-square tests. Multivariate logistic regression models assessed the associations between rural-urban admission status and the 14 performance indicators, adjusting for patient- and facility-level characteristics. Hierarchical Linear Models were applied to adjust for the within-hospital clustering effect. All tests were 2-tailed, and $P < .05$ was considered statistically significant. All statistical analyses were performed using SAS version 9.2 (SAS Institute Inc., Cary, North Carolina). No imputations were made for missing data.

Results

Baseline patient and hospital characteristics and the bivariate associations of these characteristics between rural-urban groups are presented in Table 1. Among 128 VAMCs, 18 (14.1%) were classified as rural and admitted 284 (7.3%) of 3,889 study patients. Examples of rural VAMCs included VA Northern Indiana in Marion, Indiana, and VAMC in Dublin, Georgia. Compared with their urban counterparts, patients admitted to a rural VAMC were older (mean age: 69.4 vs 67.6 years) and more often white (88.6% vs 67.4%). They also had higher NIHSS scores (average NIHSS: 5.2 vs 4.4), were more likely to be diagnosed with dementia (11.0% vs 7.3%), were less likely to have hyperlipidemia (42.8% vs 49.3%), and had shorter duration from symptom onset to Emergency Department visit (1 vs 1.8 days). There were no rural-urban differences in inpatient mortality, Charlson or APACHE III scores, or other comorbidities such as hypertension, diabetes, afib, congestive heart failure, or cancer (Table 1).

Table 1 Patient and Facility Characteristics by Rural-Urban Status Among US VAMCs, FY 2007[a]

Variables	Overall	Rural	Urban	*P* value
Patients (n,%)	3,889	283 (7.3)	3,606 (92.7)	
VAMCs (n,%)	128	18 (14.1)	110 (85.9)	
Age: mean (SD)	67.7 (11.5)	69.4 (11.1)	67.6 (11.5)	.013
Race: white (%)	68.9	88.6	67.4	<.0001
NIHSS: mean (SD)	4.5 (6.0)	5.2 (7.8)	4.4 (5.9)	.033
Charlson: mean (SD)	4.8 (2.0)	4.9 (2.0)	4.8 (2.0)	.141
APACHE: mean (SD)	12.6 (7.5)	12.6 (7.1)	12.6 (7.5)	.977
Symptom onset to ED in days: mean (SD)	1.7 (3.3)	1.0 (1.6)	1.8 (3.4)	.0008
Medical history: (%)				
Hypertension	78.9	75.6	79.2	.161
Diabetes	39.4	39.6	39.4	.955
Hyperlipidemia	48.9	42.8	49.3	.033
afib	10.3	12.4	10.1	.225
HF	11.8	15.2	11.5	.066
Cancer	2.2	3.2	2.2	.265
Dementia	7.6	11.0	7.3	.026
TIA	6.9	6.4	7	.689
Facility complexity: (high%)	74.9	81.6	56.4	<.0001

HF, heart failure; TIA, transient ischemic attack.
[a]The rural-urban classification was based on VAMC ZIP code.

In unadjusted analysis (Table 2), eligible veterans with acute ischemic stroke admitted to rural facilities were less likely to receive DVT prophylaxis (44.8% vs 76.8%); lipid management (70.4% vs 81.2%); antithrombotic by day 2 (90.7% vs 95.3%); antithrombotic at discharge (93.0% vs 95.8%); and smoking cessation counseling (85.2% vs 94.5%). Fewer eligible rural patients had the NIHSS completed than urban ones (5.7% vs 27.7%). In contrast, patients at rural facilities more often had a fall risk assessment (85.2% vs 77.2%), had a FIM assessment documented (86.4% vs 78.7%), and were provided stroke education (22.0% vs 15.8%). No differences were found in eligible patients receiving tPA, afib management, dysphagia screening, early ambulation, or pressure ulcer risk assessment.

After adjustment for patient- and facility-level characteristics, only 2 rural-urban differences in quality remained statistically significant; there was no significant difference in stroke care delivery on 12 of the 14 QIs

Table 2 QI Pass Rates (Unadjusted)

Quality Indicator	Overall Eligible (n,% passed[a])	Rural (n,% passed[a])	Urban (n,% passed[a])	*P* value
DVT Prophylaxis	1,041 (74.2)	87(44.8)	954(76.8)	<.0001
Rehabilitation assessment (FIM)	3,487 (79.3)	243 (86.4)	3,244 (78.7)	.004
Antithrombotic by discharge	3,487 (95.6)	241 (93.0)	3,246 (95.8)	.034
Antithrombotic by day 2	3,494 (95.0)	257 (90.7)	3,237 (95.3)	.0009
NIHSS completed	3,596 (26.1)	262 (5.7)	3,334 (27.7)	<.0001
Lipid management	3,007 (80.5)	203 (70.4)	2,804 (81.2)	.0002
Smoking cessation counseling	1,269 (93.9)	88 (85.2)	1,181 (94.5)	.0005
Fall risk assessment	3,627 (77.8)	264 (85.2)	3,363 (77.2)	.003
Stroke education	2,487 (16.2)	159 (22.0)	2,328 (15.8)	.034
Thrombolysis given	307 (6.2)	27 (3.7)	280 (6.4)	.575
afib management	444 (68.7)	41 (61.0)	403 (69.5)	.263
Dysphagia screening	3,601 (18.0)	248 (16.9)	3,353 (18.0)	.661
Early ambulation	3,006 (84.2)	204 (83.8)	2,802 (84.2)	.890
Pressure ulcer risk assessment	3,742 (91.4)	273 (91.2)	3,469 (91.4)	.896

HD2, hospital day 2.

[a]Percent passed refers to the percentage of patients that received all requirements for a particular quality indicator.

Table 3 Unadjusted and aOR of Passing QI: Rural versus Urban VAMCs

	Unadjusted		Adjusted[a]	
Quality Indicator	OR (CI)	*P* value	aOR (CI)	*P* value
DVT prophylaxis	0.25 (0.16-0.38)	<.001	0.35 (0.15-0.81)	.014
Rehabilitation assessment (FIM)	1.7 (1.2-2.5)	.005	2.8 (1.3-5.9)	.009
Antithrombotic by discharge	0.57 (0.34-0.96)	.036	0.76 (0.30-1.9)	.555
Antithrombotic by hospital day 2	0.48 (0.30-0.75)	.001	0.46 (0.20-1.1)	.075
NIHSS completed	0.16 (0.10-0.27)	<.001	0.35 (0.02-5.1)	.441
Lipid management	0.55 (0.40-0.76)	<.001	1.1 (0.60-2.0)	.736
Smoking cessation counseling	0.33 (0.20-0.64)	<.001	1.0 (0.30-3.7)	.993
Fall risk assessment	1.7 (1.2-2.4)	.003	3.0 (0.42-21.9)	.270
Stroke education	1.5 (1.0-2.2)	.041	0.59 (0.10-4.6)	.609
Thrombolysis given	0.56 (0.10-4.4)	.580	1.1 (0.10-15.8)	.929
afib management	0.69 (0.35-1.3)	.265	0.61 (0.22-1.7)	.334
Dysphagia screening	0.93 (0.66-1.3)	.661	0.85 (0.36-2.0)	.715
Early ambulation	0.97 (0.66-1.43)	.889	0.79 (0.23-2.7)	.700
Pressure ulcer risk assessment	0.97 (0.63-1.57)	.895	1.2 (0.43-3.3)	.742

OR, odds ratio; CI, 95% confidence interval.

[a]QIs were adjusted for age, race, rNIHSS, Charlson index, modified APACHE III score, admission code status, prestroke ambulatory status, and hospital complexity.

between rural and urban facilities (Table 3). Patients admitted to rural VAMCs were significantly less likely to receive DVT prophylaxis (adjusted Odds Ratio [aOR] 0.35, 95% CI: 0.15-0.81). However, these same veterans were more likely to have FIM assessments documented (aOR 2.8, 95% CI: 1.3-5.9).

Discussion

In this study, US veterans with ischemic stroke admitted to rural VAMCs were older and had more severe strokes, and although there were differences in unadjusted process measures, there were no systematic differences in stroke care provided to rural and urban patients after adjustment for key demographic, clinical, and facility-level characteristics. The overall performance on the QIs that were measured in this cohort have been reported elsewhere[8] and ranged from a high of 96.4% for antithrombotic at discharge to a low of 8.4% for tPA administration. Before adjustment, urban facilities were shown to provide better DVT prophylaxis, lipid management, antiplatelets in the hospital and at discharge, NIHSS documentation, and smoking cessation counseling, while rural facilities were better at assessing falls and FIM assessments and providing stroke education; however, in-hospital stroke care quality within VAMCs varied very little with adjustment for patient and facility differences—only 2 of 14 QIs showed significant differences in performance. As described above, the QIs were designed to exclude patients who were not eligible for the particular process measure being evaluated; and therefore the differences that were observed on the basis of the unadjusted data should be considered. In general, urban facilities provided better quality of care for domains that involved physician processes (eg, medication prescription) whereas rural facilities provided better quality for domains that involved nursing and rehabilitation staff processes (eg, fall risk assessment, FIM documentation). However, if relevant differences in patients (such as age and disease severity) and facility complexity are considered, then there is little evidence from this study that rural and urban VAMCs are providing markedly different care to veterans admitted for acute ischemic stroke.

Some research has found that rural hospitals caring for stroke patients might have different levels of quality than urban facilities.[1-3] Geographic disparities in stroke outcomes are well documented for regions of the country (eg, the "stroke belt"), but much of the disparity has been linked to demographic/socioeconomic factors and

prevalence of risk factors/chronic diseases[15]; the contribution of in-hospital quality to these inequalities is unclear. A hospital's performance on QIs for ischemic stroke is an important measure of stroke care quality, as this performance has been associated with improved outcomes.[16]

The 2 differences in QIs that were found after adjustment are potentially important: the provision of DVT prophylaxis being superior at urban facilities, and rehabilitation assessment being better at rural ones. The difference in DVT prophylaxis provision is especially important because it is a process of care that has been associated with improved mortality/morbidity of stroke patients.[17] It is unknown why an urban-rural difference in DVT prophylaxis exists. Nevertheless, given that acute stroke patients often have limited mobility, DVT prophylaxis continues to be an important component of ischemic stroke therapy during hospitalization.[18] Tooher et al reviewed strategies to increase DVT prophylaxis and found that computer-based decision support tools appear to be the most effective strategy. However, audit and feedback incorporating an iterative process may also be successful; most likely, more than one strategy would maximize benefit.[19] The VA is ideal for computer-based decision support, as it has an integrated electronic medical record at all facilities. It may also be that this observed disparity in care may ameliorate over time because the VA is now evaluating the use of DVT prophylaxis for high-risk in-patients[20]; this ongoing performance evaluation may improve DVT prophylaxis across the VA system at both rural and urban facilities. The reason for the higher rate of rural FIM assessment is possibly due to the higher severity of stroke patient presenting to rural facilities; therefore, they may have had greater rehab needs. Even so, the absolute difference in the rates between rural and urban facilities is small; nonetheless, evaluation of the need for rehabilitation remains important for the majority of patients following stroke. The FIM is a widely accepted scale used to measure the functional abilities of patients undergoing rehabilitation. Scores on the FIM scale correlate with length of stay and discharge disposition,[21] and therefore may be an important measurement assisting discharge decisions. The process of documenting the FIM for patients with stroke has been measured for quality improvement purposes within the VA system for several years, although it is not currently a VA performance measure. Future research should investigate further why these differences were identified.

Rural-urban differences in stroke care that have been studied previously have primarily focused on acute stroke management and poststroke rehabilitation, including prehospital care, rural emergency department care, interhospital transfer of patients, and access to poststroke rehab.[3,22] Disparities in care that were observed in these prior studies were more likely related to local resources and geography, such as access to rehabilitation services. Quality of care during the inpatient setting was the focus of this study, and it may also be related to factors such as local resources (eg, expertise to perform the NIHSS) or geography (eg, delays in presentation reducing eligibility for thrombolysis).[23] However, the VA health care system is a national organization with system wide efforts in both quality measurement and improvement, which may help explain the relative lack of differences found in the quality of care between rural and urban facilities.[24] Disparities in care due to socioeconomic status are possible,[25] but probably less likely in the inpatient setting of the VA. It should be noted that there was a significant delay for most patients in arriving at either a rural or urban VAMC (1 and 1.8 days, respectively). There are currently no system wide patient education programs encouraging veterans with stroke to present in a timely fashion, but some facilities have locally developed programs. This difference in presentation delay at the facility level might be used by facilities to identify the need for such education programs.

We acknowledge a few limitations. The urban/rural designation was made at the facility level, and because the majority of VAMCs were urban, there were relatively few rural VAMCs. We could have used an urban/rural designation based on patient addresses (ie, where the patients lived), but we were more interested in examining potential differences in the provision of care in rural facilities, rather than the care received by rural patients, which involves many other factors for which we did not have data, such as availability of transportation and location of providers. We were interested in assessing the care provided once the patient was admitted to the facility, and whether there were differences between rural and urban facilities; but because we were only studying patients who were admitted to VAMCs, there is a potential for bias toward those veterans who were: (1) closest to the VAMC and (2) were able to travel to the VAMC. Other research has shown that many rural patients present to an urban facility for acute stroke care.[26] If anything, our data demonstrate that veterans admitted to rural facilities were older and sicker, and we adjusted for these factors, which should mitigate against possible bias. In terms of external validity, due to the demographics of the population and characteristics of the system, this study may not be generalizable outside the VA system. Another limitation to this study is the aggregation of our data to the rural-urban facility level. There was broad variation across both urban and rural hospitals on many QIs, so the actual quality of care for individual patients is not uniform within the 2 categories.

Conclusion

In summary, there appear to be few systematic differences in acute ischemic stroke care for veterans admitted to rural or urban VAMCs. Although we identified only 2 significant differences out of 14 QIs, these differences in processes of care are potentially clinically important. Future research should seek to understand the facility characteristics that result in these differences in care that can serve as targets for future quality improvement interventions.

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