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Original Contribution

Regional disparities in the quality of stroke care

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ABSTRACT

Background and purpose: There is widespread geographic variation in healthcare quality, but we often lack clear strategies for improving quality in underserved areas. This study characterized geographic disparities in stroke care quality to assess whether improved access to neurological services has the potential to bridge the care quality gap, particularly in terms of alteplase (rt-PA) administration.

Methods: This was a retrospective study using quality performance data from the 2015 Hospital Compare database linked to information on certification status from the Joint Commission and information on local access to neurological services from the Area Health Resources File. We used these data to compare stroke care quality according to geographic area, certification, and neurologist access.

Results: Non-metropolitan hospitals performed worse than metropolitan hospitals on all assessed stroke care quality measures. The most prevalent disparity occurred in the use of rt-PA for eligible patients (52.2% versus 82.7%, respectively). Certified stroke centers in every geographic designation provided higher quality of care, whereas large variation was observed among non-certified hospitals. Regression analyses suggested that improvements in hospital certification or access to neurologists were associated with absolute improvements of 44.9% and 21.3%, respectively, in the percentage of patients receiving rt-PA.

Conclusions: The large quality gap in stroke care between metropolitan and non-metropolitan areas could be at least partly addressed through improved procedural efforts by stroke center certification increasing the supply of neurological services, (i.e. through training and hiring new neurologists) or by adopting decision support systems such as telemedicine.

1. Introduction

While decades of research have demonstrated regional variation in the quality of healthcare in the United States, it is especially pronounced in stroke care [1]. Rural and underserved areas are associated with a higher prevalence of stroke, as well as worse care and patient outcomes [2,3]. In these areas it is challenging to provide prompt stroke treatment and clinical expertise that can prevent stroke-related disability and mortality [4].

A number of factors contribute to these geographic disparities. Prompt treatment with clot-dissolving thrombolytic drugs, such as alteplase (rt-PA), within 3 h of an acute ischemic stroke (AIS) can restore blood flow in the brain before substantial damage occurs [5,6]. While rt-PA administration is the standard of care for patients with AIS and is recommended by organizations such as the American Heart Association and American Stroke Association [7-9], fewer than 5% of patients who suffer from an AIS in the US receive rt-PA [10]. Even fewer patients living in regions with limited stroke-systems of care are administered rt-PA, which may be due to long distances these patients must travel to stroke centers [11-13].

Further, clinical expertise is essential to rapid diagnosis and treatment. Receiving care at a specialized stroke center, such as a Joint Commission (JC)-certified Primary Stroke Center (PSC), is associated with improved outcomes, as emergency physicians (EPs) often lack experience with rt-PA and are reluctant to use it [12]. Only 1% of individuals in rural areas, however, live within a 60-minute ground ambulance ride of a PSC [14].

Given the need for prompt evaluation and treatment, often including a neurological consult, there is concern that rt-PA is especially underused in rural or underserved urban areas. More generally, improving access to neurological services likely can improve the quality of care and outcomes for many patients with stroke, but it is unknown to what extent regional disparities in stroke care are related to disparities in access to neurological services [15]. In light of this, the objective of our study

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was to document the quality gaps that exist in stroke care, particularly as measured by rt-PA administration, between metropolitan and non-metropolitan areas and quantify the extent to which these gaps are associated with disparities in access to neurological services. We also explored the impact of potential approaches to bridge these gaps.

2. Methods

Data based on 2013–2014 discharges were obtained from the fiscal year (FY) 2015 Hospital Compare, a database operated by the Centers for Medicare & Medicaid Services that provides information on hospital performance by measuring the percentage of patients within each hospital who meet a set of quality criteria [16,17]. The data are collected through the Hospital Inpatient Quality Reporting (Hospital IQR) program [18].

CMS began collecting data on eight stroke quality measures (STK-1 through STK-6, STK-8 and STK-10) in calendar year 2013 (the relevant data year for FY 2015) [19]. Hospitals reporting performance data on at least one stroke measure were assumed to provide stroke care to patients on at least a semi-regular basis and were included.

We used information from the US Department of Agriculture Rural–Urban Continuum Codes to classify hospitals (within the 50 states only) into different categories based on the size of metropolitan area or proximity to urban areas [20]. Specifically, we categorized hospitals as large-metropolitan, medium-metropolitan, small-metropolitan, or non-metropolitan based on continuum codes of 1, 2, 3 and 4–9, respectively. Geographic information was assigned to hospitals using Federal Information Processing Standard (FIPS) codes. Institutions were further characterized by their JC stroke center certification status, which is offered at multiple levels. Requirements for PSC and Comprehensive Stroke Center (CSC) status are described in Table I in the Online-only Supplement. The list of certified hospitals was obtained from the JC website [21].

Finally, to measure the level of access to neurological services in a given geographic area, we used the per-capita number of neurologists from the 2013 Area Health Resources Files (AHRF) [22]. Patients living in areas with a larger number of specialists per capita are more likely to receive specialist care, making the number of neurologists per capita a proxy variable for access to neurological stroke services [23]. One limitation to this measure is that many neurologists practice in an outpatient setting or do not provide acute stroke care regularly [24]. To test the sensitivity of our results, we also used the per-capita number of neurosurgeons to measure the level of access to acute neurological services. Physician data by specialty are based on counts from the American Medical Association Masterfile, while the population counts by county are based on 2013 estimates from the US Census Bureau.

To document the gap in care quality among hospitals according to geographic designation and JC certification, average performance levels on stroke measures were calculated. Mean differences in performance were tested for significance by paired *t*-tests.

The association between access to neurological services and quality of care was assessed using multivariable regression analysis, in which hospitals were stratified by access to neurological services and JC certification status after controlling for location, and for an indicator of volume as a sensitivity analysis. Additionally, to understand systematic differences in reporting that may bias our results, the qualitative level of stroke care was estimated as the probability of hospitals reporting stroke quality measures, controlling for location, access to neurological services, and certification level. In these analyses, counties were identified as having high access to neurologists if they were in the top 25% of all counties based on their per-capita number of neurologists, or low access for those in the bottom 25%.

To measure the clinical significance of different policies addressing gaps in care quality, we simulated the impact on patient outcomes under three hypothetical scenarios according to their association with rt-PA administration: an uncertified non-metropolitan hospital becoming certified; a low-access non-metropolitan hospital becoming high access (based on the number of neurologists per capita); and a non-metropolitan hospital adopting telemedicine. Changes in rt-PA administration rates informing the simulations above were estimated from the Hospital Compare data for the first two scenarios and from observational studies for the third scenario (Online-only Supplement Table II) [25-28]. The clinical relationship between rt-PA use and patient outcomes was obtained from a recent meta-analysis [29].

3. Results

Performance measures reported between April 1, 2013 and March 13, 2014 were examined for 4765 US institutions in the FY 2015 Hospital Compare dataset. A total of 2758 (57.9%) reported at least one stroke measure and were included in our analysis. Large metropolitan hospitals were about twice as likely to report a performance indicator for stroke as non-metropolitan hospitals (75.4% and 36.3%, respectively; Table 1), with a more pronounced difference in STK-4 reporting (32.6% vs. 2.3% among all hospitals, and 41.7% vs. 6.3% among hospitals reporting any STK measure; Online-only Supplement Table III).

Of the eight STK measures assessed, the reported performance of hospitals was lowest for STK-4, which measures administration of rt-PA in eligible patients (Table 2). On average, only 77.9% of eligible patients received rt-PA across all hospitals, whereas the reported performance for all other stroke quality measures was over 87%.

When examining hospitals by geographic area, performance on all eight stroke indicators was higher in metropolitan hospitals than non-metropolitan hospitals (Table 2; differences were statistically significant at 5%). The greatest disparity observed was for the administration of rt-PA. At large, medium and small metropolitan area hospitals, the average rt-PA administration rates were 82.7%, 77.2%, and 68.4%, respectively, and these rates were 30.5% (82.7% vs. 52.2%), 25.0% (77.2% vs. 52.2%), and 16.2% (68.4% vs. 52.2%) higher than the average rt-PA administration rate in non-metropolitan areas (Fig. 1). Aside from rt-PA use, quality gaps were also pronounced for access to stroke education (STK-8) and statin medication (STK-6), with between-group absolute differences of 9.1% and 9.6%, respectively.

Hospitals in different geographic areas were also analyzed by their level of stroke center certification (Fig. 1). We found a positive association between quality of stroke care and JC certification status, as evidenced by greater rt-PA administration among eligible patients at JC-certified hospitals, regardless of geographic area.

Although reported quality was higher at JC-certified hospitals in all areas, some treatment gaps were evident between rural and urban settings. In particular, the gap in rt-PA administration between a certified and non-certified hospital was 13.2% (86.2% vs. 73.0%) at large metropolitan area hospitals, compared with 44.9% (83.2% vs. 38.3%) in non-metropolitan areas.

The association between rt-PA administration and per-capita number of neurologists at the county level (i.e., low, moderate, and high access to neurological services) was also assessed for both certified and non-certified hospitals. We found the rate of neurologists per capita was associated with increased rt-PA administration, even after controlling for hospital location. The absolute difference in rt-PA use of 21.3% (70.4% vs. 49.1%) between low and high access non-certified hospitals equals approximately half of the gap between certified and non-

Table 1
Characteristics of institutions included in the analysis.

Location	Number of institutions	Number of institutions reporting ≥1 stroke performance measure, n (%)
Large metropolitan	1585	1195 (75.4%)
Medium metropolitan	814	561 (68.9%)
Small metropolitan	526	335 (63.7%)
Non-metropolitan	1840	667 (36.3%)
Total	4765	2758 (57.9%)