Journal of HOSPITAL MEDICINE www.journalofhospitalmedicine.com

ORIGINAL RESEARCH

Compliance With Joint Commission Measures in State-Designated Stroke Centers

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BACKGROUND: Comparison of state-designated primary and comprehensive stroke centers (PSCs and CSCs) with regard to adherence to nationally accepted performance standards are scarce. The objective of this study was to examine if a significant association exists between level of designation and fulfillment of Joint Commission (JC) stroke core measures.

METHODS: A retrospective comparative data analysis of the New Jersey acute stroke registry for the calendar years 2010 and 2011 was performed. JC core measures were compared by hospital level (PSCs vs CSCs). Adjusted odds ratios (aOR) were estimated for association between hospital levels and fulfillment of JC core measures. Median door-to-thrombolytic time was also compared.

RESULTS: There were 36,892 acute stroke admissions. PSCs had 60% of the patients, whereas CSCs had 40%. Hemorrhagic stroke admissions were about 2 times more frequent at CSCs than PSCs (13.3% and 7.1%, respectively). CSCs adhered better to 6 of the 8 JC measures than PSCs. Of eligible patients, 19.5% received thrombolytic therapy at CSCs compared to 9.6% at PSCs, with a 44% difference in provision of thrombolytic therapy (aOR = 0.28, 95% confidence interval: 0.24-0.34). Median door-to-thrombolytic drug times was 65 minutes at CSCs compared to 74.0 minutes at PSCs ($P < 0.0001$).

CONCLUSIONS: New Jersey state-designated CSCs are better at adhering to the JC core stroke measures and have shorter door-to-thrombolytic drug times. *Journal of Hospital Medicine* 2014;9:88–93. © 2013 Society of Hospital Medicine

Stroke is the fourth leading cause of death in the United States.[1] Though actual stroke-related death has declined nationally by 19.4%, stroke-related morbidity is still a significant burden.[2,3] Hospital certification programs have been developed to improve the quality of stroke care on state and national levels. The Brain Attack Coalition (BAC) proposed 2 levels of stroke hospitals: primary stroke centers (PSCs) and comprehensive stroke centers (CSCs).[3,4] Although most stroke patients can be cared for at PSCs, CSCs are able to care for more complex stroke patients.[4,5] Using BAC recommendations the Joint Commission (JC) and American Heart Association/American Stroke Association created a certification program for PSCs. Eight evidence-based performance measures are currently required for JC PSC certification.[6]

At the state level, New Jersey and Florida began designating PSCs and CSCs.[7,8] New Jersey PSC and CSC designation criteria incorporate the elements of JC PSC certification, despite preceding them by several years.[6,9] New Jersey CSC certification consists of more comprehensive requirements (Table 1). All New Jersey-designated stroke centers submit data in the New Jersey Acute Stroke Registry (NJASR),[7] which closely matches the Centers for Disease Control and Prevention's Paul Coverdell National Acute Stroke Registry and includes the JC-required core measures.

There is a paucity of data comparing state-designated CSCs and PSCs, largely because few states have state designation programs. Although a recent observational study from Finland showed better outcomes in patients treated at CSCs, measures in that study were limited to mortality and institutionalization at 1 year.[10] In this study, we examined adherence of all New Jersey state-designated stroke centers to the JC PSC measures and compared CSCs to PSCs in this regard. We posited that better compliance with these evidence-based measures might translate into better quality of stroke care in the state and may lend support to future, larger studies that may be conducted because of the recent certification of CSCs by the JC.

METHODS

Components of the NJASR, key components of PSCs and CSCs in the BAC report, and the 8 JC's core stroke measures for PSC certification were assessed.[3,4,6]

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Additional Supporting Information may be found in the online version of this article.

Received: July 17, 2013; **Revised:** November 15, 2013; **Accepted:** November 20, 2013
2013 Society of Hospital Medicine DOI 10.1002/jhm.2133
Published online in Wiley Online Library (Wileyonlinelibrary.com).

TABLE 1. New Jersey State Stroke Center Designation Criteria

Primary Stroke Center (N = 53)	Comprehensive Stroke Center (N = 12)
Must have acute stroke teams in place at all times that can respond to the bedside within 15 minutes of patient arrival or identification	Must meet all criteria for primary stroke centers
Must maintain neurology and emergency department personnel trained in the treatment of acute stroke	Must maintain a neurosurgical team capable of assessing and treating complex stroke
Must maintain telemetry or critical care beds staffed by physicians and nurses trained in caring for acute stroke patients	Must maintain on staff a neuroradiologist (boarded) and a neurointerventionalist
Must provide for neurosurgical services within 2 hours either at the hospital or under agreement with a comprehensive stroke center	Must provide comprehensive rehabilitation services either on site or by transfer agreement
Must provide acute care rehabilitation services	Must provide MRI, CTA, and digital subtraction angiography
Must enter into a written transfer agreement with a comprehensive stroke center	Must develop and maintain sophisticated outcomes assessment and performance improvement capability
	Must provide graduate medical education in stroke and carry out research in stroke

NOTE: **Abbreviations:** CTA, computed tomography angiography; MRI, magnetic resonance imaging.

First responders in New Jersey are required to bring suspected stroke patients to the nearest stroke-designated hospital, regardless of whether it is a PSC or CSC, unless the patient is too medically unstable and needs to be taken to the nearest hospital. From there, decisions can be made to transfer a patient to a higher level hospital (CSC) depending on the complexity of the patient's condition.

New Jersey state-designated PSCs and CSCs are required to abstract patient-level data, evaluate outcomes, and initiate quality improvement activities on all patients evaluated for ischemic stroke, hemorrhagic stroke, transient ischemic attack (TIA), and those who undergo acute interventional therapy. Data are submitted quarterly to the New Jersey Department of Health and Senior Services (NJDHSS).[7] Hospital data are imported into the Acute Stroke Registry Database. The NJASR statewide dataset used for this analysis included all stroke admissions for the calendar years 2010 and 2011 and contains patient demographic information, health history, clinical investigations performed, treatments provided, and outcome measures that allow for risk-adjusted assessment of outcomes.

The JC core stroke measures (STK-1 thru 10 [except STK-7 and 9]: venous thromboembolism [VTE] prophylaxis, discharged on antithrombotic therapy, anticoagulation therapy for atrial fibrillation/flutter, thrombolytic therapy, antithrombotic therapy by the end of hospital day 2, discharged on statin medication, stroke education, and assessment for rehabilitation) (except STK-7 [dysphagia screening] and STK-9 [smoking cessation/advice counseling]) apply only to acute ischemic and/or hemorrhagic stroke patients.

In our analysis, transferred patients and patients with a diagnosis of TIA, stroke not otherwise specified, and non–stroke-related diagnoses were excluded. Hospital identity was kept anonymous through assignment of random numeric codes by the NJDHSS. Hospitals were categorized as CSC or PSC based on NJDHSS designation. Stroke severity on admission was assessed by categorizing National Institutes of Health Stroke Scale (NIHSS) scores into: "no stroke" when NIHSS = 0, "mild stroke" when NIHSS = 1–4, and "moderate to severe stroke" when NIHSS > 5. Median door-to-thrombolytic drug times were assessed for both patients who arrived to the hospital within 2 hours of stroke symptom onset and received thrombolytic therapy within 3 hours, as well as patients who arrived within 3.5 hours (210 minutes) and received treatment within 4.5 hours (270 minutes).

Inclusion and Exclusion Criteria for JC Performance Measures

Excluded from all measures are patients who were discharged to hospice, left against medical advice (AMA), expired, were transferred to another short-term care facility, had an unknown discharge location, comfort measures only (CMO), or enrolled in clinical trials. Other exclusions are listed below each measure. VTE prophylaxis included nonambulatory ischemic and hemorrhagic stroke patients who received VTE prophylaxis by end of hospital day 2 and excluded patients discharged prior to hospital day 2 and with length of stay >120 days. Antithrombotics at discharge included ischemic stroke patients discharged on antithrombotics and excluded those with documented reason for not receiving antithrombotics. Anticoagulation for atrial fibrillation included ischemic stroke patients with documented atrial fibrillation/flutter who received anticoagulation therapy and excluded those with documented reason for not receiving anticoagulation. Thrombolytic therapy included acute ischemic stroke patients who arrived at the hospital within 2 hours from time last known well and for whom intravenous (IV) tissue plasminogen activator (tPA) was initiated at that hospital within 1hour of hospital arrival. Excluded were patients with valid reason for not getting tPA, length of stay >120 days, and time last known well >2 hours. We also looked at thrombolytic therapy for patients who arrived by 3.5 hours from time last known well and received IV-tPA within 1 hour.

Antithrombotics by the end of hospital day 2 included ischemic stroke patients who received antithrombotic medication by the end of hospital day 2 and

TABLE 2. Descriptive Statistics of Acute Stroke Patients by Hospital Levels (PSCs vs CSCs)

Variables	PSCs, N = 22,305	CSCs, N = 14,587	*P* Value*
Race, n (%)			<0.0001
White	16,586 (74.4)	10,419 (71.4)	
Black	3,930 (17.6)	2,875 (19.7)	
Asian	511 (2.3)	519 (3.6)	
All others†	1,278 (5.7)	774 (5.3)	
Age, y, median (IQR)	75.0 (22.0)	73.0 (23.0)	<0.0001‡
Gender, female, n (%)	12,552 (56.3)	7,757 (53.2)	<0.0001
Comorbidities			
Hypertension, n (%)	17,405 (78.1)	10,535 (72.2)	<0.0001
Atrial fibrillation/flutter, n (%)	3,762 (16.9)	2,237 (15.3)	0.0001
Diabetes mellitus, n (%)	7,219 (32.4)	4,220 (28.9)	<0.0001
History of smoking, n (%)	2,924 (13.1)	1,706 (11.7)	<0.0001
Heart failure, n (%)	1,733 (7.8)	749 (5.1)	<0.0001
Myocardial infarction, n (%)	6,138 (27.5)	2,945 (20.3)	<0.0001
Dyslipidemia, n (%)	10,106 (45.6)	5,161 (35.4)	<0.0001
Prior stroke/TIA/VBI, n (%)	7,085 (31.8)	3,874 (26.6)	<0.0001
NIHSS on admission, n (%)			<0.0001
No stroke (NIHSS = 0)	2,747 (27.4)	913 (18.3)	
Mild stroke (NIHSS = 1–4)	4,010 (40.0)	1,811 (33.3)	
Moderate–severe (NIHSS >5)	3,272 (32.6)	2,271 (45.4)	
Door-to-tPA time, min, median (IQR)			
Arrived within 120 minutes	74.0 (35.0)	65.0 (33.0)	<0.0001‡
Arrived within 210 minutes	76.0 (37.0)	65.0 (34.0)	<0.0001‡
Stroke diagnosis, distribution			<0.0001
Ischemic	11,145 (50.0)	8,235 (56.5)	
Hemorrhagic	1,587 (7.1)	3,270 (13.3)	
Subarachnoid	219 (13.8)	397 (20.4)	
Intracerebral	1,368 (86.2)	1,545 (79.6)	
Transient ischemic attack	8,116 (36.4)	4,162 (28.5)	
Stroke not otherwise specified	1,145 (5.1)	130 (0.9)	
No stroke-related diagnosis	293 (1.3)	118 (0.8)	

NOTE: **Abbreviations:** CSCs, comprehensive stroke centers; IQR, interquartile range; NIHSS, National Institutes of Health Stroke Scale; PCSs, primary stroke centers; TIA, transient ischemic attack; tPA, tissue plasminogen activator; VBI, vertebral-basilar insufficiency.

*χ^2 *P* values.

†"All others" race category includes: Native American/Alaska Native, Hawaiian/Other Pacific Islander and Other.

‡Median 2-sample test.

excluded patients who were discharged before hospital day 2, had a documented reason for not receiving antithrombotic medication, had a length of stay greater >120 days, were CMO by day 2, and patients who received IV or intra-arterial tPA. Statin therapy included ischemic stroke patients with low-density lipoprotein exceeding 100 mg/dL or not measured, or on cholesterol-reducing medication prior to admission. Excluded were those with length of stay >120 days and a documented reason for not receiving medication. Stroke education on discharge included all stroke patients being discharged home who received education during the hospitalization addressing the following: patient's stroke-specific risk factors, warning signs and symptoms, emergency medical services activation, follow-up, and discharge medications. Those with length of stay >120 days were excluded. Assessment for rehabilitation included ischemic and hemorrhagic patients assessed for rehabilitation services.

Statistical Analysis

Patient characteristics were summarized using frequencies and percentages for categorical variables as well as median and interquartile range for continuous variables. χ^2 tests and median 2-sample tests were used to compare patient characteristics between the 2 hospital levels. The likelihood that a patient received a particular JC core measure service in relation to hospital level (PSC vs CSC) was estimated using a multiple logistic regression analysis for both the crude/unadjusted and adjusted odds ratios, and their 95% confidence intervals were estimated. Gender, age, race, stroke type, medical history (hypertension, atrial fibrillation, diabetes mellitus, and history of smoking), and severity of stroke as measured by NIHSS were included in the model. Institutional review board approval to evaluate the data for this analysis was obtained from John F. Kennedy Medical Center in Edison, New Jersey. All analyses were performed using SAS software package version 9.3 (SAS Institute, Cary, NC).

RESULTS

There were 36,892 acute stroke cases treated at the 53 New Jersey PSCs and 12 CSCs in the calendar year 2010 and 2011 (Table 2). Sixty percent were treated at PSCs and 40% at CSCs. There were significant differences in the distribution of patients' characteristics (race, age, and gender) between the 2 hospital levels. At both PSCs and CSCs, the majority of patients were white, distantly followed by blacks. Patients at PSCs were statistically significantly older than CSCs. The most prevalent comorbid conditions in both PSCs and CSCs were hypertension, diabetes mellitus, and dyslipidemia. Based on our categorization, we found that 45% of patients admitted to CSCs had moderate-to-severe stroke (NIHSS > 5). The median door-to-thrombolytic drug times were significantly shorter at CSCs than PSCs for both the 3-hour (65 vs 74 minutes, $P < 0.0001$) and 4.5 hour (65 vs 76 minutes, $P < 0.0001$) IV tPA time windows.

The incidences of stroke diagnosis types are also detailed in Table 2. Seventy percent of patients at CSCs had either an ischemic or hemorrhagic stroke diagnosis versus 57.1% of patients admitted at PSCs. Hemorrhagic stroke patients were twice as likely to be admitted at CSCs compared to PSCs.

After excluding 13,964 patients with a diagnosis of TIA, stroke not otherwise specified, and those with non–stroke-related diagnosis, the likelihood of stroke patients' receiving the JC's performance measure services at either of these hospital levels was assessed (Table 3). In general, the adjusted odds ratio estimates of patients receiving a JC core performance measure at PSCs were lower than CSCs, indicating better compliance with the measures at CSCs. For example, 19.5% of eligible patients received thrombolytic therapy at CSCs compared to 9.6% at PSCs. CSCs also were more likely to provide VTE prophylaxis,

TABLE 3. Frequencies and Odds Ratio for the Likelihood of Eligible Stroke Patients Receiving Joint Commission's Performance Measure Services in PSCs vs CSCs

	Hospital Levels*		Odds Ratio (95% CI)	
Variables	PSCs, N (%)	CSCs, N (%)	Unadjusted	Adjusted†
VTE prophylaxis	4,745 (92.1)	5,455 (94.2)	0.72 (0.61–0.83)	0.47 (0.33–0.67)
Discharged on antithrombotic therapy	8,835 (98.1)	6,873 (99.2)	0.42 (0.31–0.56)	0.46 (0.27–0.78)
Anticoagulation therapy for atrial fibrillation/flutter	1,464 (95.1)	1,144 (97.6)	0.48 (0.31–0.74)	0.38 (0.17–0.86)
Thrombolytic therapy				
Time window = 3.0 hours	484 (9.6)	666 (19.5)	0.44 (0.39–0.50)	0.28 (0.24–0.34)
Time window = 4.5 hours	564 (11.0)	792 (22.4)	0.43 (0.38–0.48)	0.28 (0.23–0.33)
Antithrombotic therapy by end of hospital day 2	7,575 (97.4)	5,396 (98.2)	0.69 (0.54–0.88)	1.01 (0.60–1.68)
Discharged on statin medication	6,035 (97.9)	4,261 (98.7)	0.59 (0.43–0.80)	0.69 (0.42–1.13)
Stroke education, for home discharge (overall)	3,823 (97.7)	3,072 (95.7)	1.93 (1.47–2.53)	1.78 (0.92–3.45)
Risk factors for stroke	3,480 (88.9)	3,026 (94.4)	0.49 (0.41–0.59)	0.43 (0.28–0.66)
Warning sign and symptoms	3,514 (89.8)	3,019 (94.1)	0.56 (0.46–0.67)	0.52 (0.34–0.79)
Activation of EMS	3,539 (90.5)	3,023 (94.2)	0.59 (0.49–0.70)	0.44 (0.28–0.69)
Follow–up after discharge	3,807 (97.3)	3,064 (95.5)	1.73 (1.34–2.23)	1.18 (0.65–2.20)
Medications prescribed at discharge	3,788 (96.8)	3,067 (95.5)	1.42 (1.11–1.82)	0.44 (0.28–0.70)
Assessed for rehabilitation	9,725 (95.2)	8,199 (97.5)	0.51 (0.43–0.61)	0.37 (0.26–0.53)

NOTE: **Abbreviations:** CI, confidence intervals; CSCs, comprehensive stroke centers; EMS, emergency medical services; PCSs, primary stroke centers; VTE, venous thromboembolism.

*Performance measurements are based on the Joint Commission Stroke Performance Measures.

†Adjusted for sex, age, race, and type of stroke (as appropriate).

anticoagulation for atrial fibrillation, and assessment for rehabilitation. Stroke education and antithrombotic therapy by the end of hospital day 2 were more likely to be provided at PSCs, but the results were not statistically significant.

DISCUSSION

In New Jersey, CSCs were more likely to adhere better to JC core performance measures than PSCs. Median door-to-thrombolytic drug times were also significantly lower at CSCs. Such differences may be due to several factors including the fact that CSCs have generally been state designated for a longer period of time than PSCs. CSCs are likely to have higher volumes of stroke admissions, are more likely to be JC certified, provide more staff education, and have more staff and resources. The New Jersey stroke designation program began in 2006, and 11 of the 12 CSCs were designated by the end of 2007. However, the PSC designation process has been more gradual, with several of them designated in 2010 and 2011 as the data for this study were being collected.

The New York State Stroke Center Designation Project prospectively showed that stroke center designation improved the quality of acute stroke patient care and administration of thrombolytic therapy; however, differing levels of hospital designation were not present in New York at that time.[11] Participation in a data measurement program such as Get With The Guidelines has also been examined. It is evident that the amount of time in a program is predictive of process measure compliance.[12] JC certification as a PSC is also associated with increased thrombolytic rates for acute stroke over time.[13] New Jersey does not require that stroke-designated hospitals have JC stroke certification. Although 11 New Jersey CSCs have been certified as JC PSCs since 2009, only 21 of the 53 state-designated PSCs are JC certified. It may be that the highest performing sites pursue state CSC designation and JC PSC certification/recertification repeatedly. CSCs in New Jersey may also have a greater focus on quality measures by virtue of having been in quality programs such as Get With The Guidelines or by having been state designated and JC certified for a longer period of time.

The New Jersey requirements for CSCs, like those of the JC, include a large number of highly trained stroke experts, which ensures more continuous coverage. Although a disparity in mortality on weekends versus weekdays has been reported,[14] such a difference in mortality has not been seen at CSCs in New Jersey.[15] This lack of a "weekend effect" is felt to be related to the 24/7 availability of stroke specialists, advanced neuroimaging, ongoing training, and surveillance of specialized nursing care available at CSCs.[4,16]

In our study, New Jersey CSCs overall had significantly higher rates of thrombolysis compared to PSCs (19.5% vs 9.6%) when looking at the 3-hour window. This is higher overall than the national rate of 3.4% to 5.2%.[17] The number of patients treated in the expanded thrombolytic window were also significantly higher at CSCs, increasing thrombolysis rates to 22.4% at CSCs versus the 11% at PSCs. Door-to-drug times were also shorter at CSCs than PSCs in the 3- and 4.5-hour windows (65 vs 74 minutes and 65 minutes vs 76 minutes, respectively). After we excluded transferred patients and those with a diagnosis of TIA, stroke not otherwise specified, and those

with non–stroke-related diagnoses, the total number of ischemic and hemorrhagic stroke patients seen at each of the 12 CSCs (n = 11,505) was on average 4 times higher than the number seen at each of the 53 PSCs (n = 12,732). High annual hospital stroke volume has been shown to be associated with higher rates of thrombolysis and lower stroke mortality.[14] A study of US academic centers found that although the same percentage of patients presented within 2 hours of stroke symptom onset in 2001 and 2004, the use of IV tPA more than doubled over this time period.[18] Improved system organization at the prehospital and hospital levels as well as greater comfort and experience with use of thrombolytic therapy likely contribute to all of these findings.[11]

CSCs did not outperform PSCs with regard to stroke education and antithrombotics by end of hospital day 2, but these results were not statistically significant. The former measure includes only stroke patients who are discharged home and is considered complete when all 5 of the following are addressed: risk factors for stroke, warning signs and symptoms for stroke, activation of emergency medical systems, follow-up after discharge, and medications prescribed at discharge. CSCs were more likely to provide education for the first 3 and last component but less likely for the fourth element. These findings should be considered in the context of CSCs having higher volumes of more ill and complex patients who are more likely to be discharged to a rehabilitation hospital, nursing home, or other facility than to home. In our registry, CSCs discharged 46% of patients' to home versus 54% at PSCs. We speculate that CSCs may be less likely to habitually address follow-up care and discharge medications as compared to PSCs. As far as provision of antithrombotics by hospital day 2, it is possible again that because CSCs have a higher number of complicated stroke patients, many may have had contraindications to use of antithrombotics in that time period.

Limitations of this study include the fact that this was a retrospective analysis of a database. Although the 2010 and 2011 NJASR dataset was sizeable, it was not possible to capture all potentially confounding variables that may have affected our point estimates. We were not able to perform a hierarchical analysis to account for clustering at the hospital level because of limited data available in the registry. Errors in recording data, coding, and documentation cannot be excluded. The fact that not all PSCs were necessarily JC certified may have contributed to the observed differences. Also, because pursuing PSC or CSC status is voluntary, it is not clear if the hospitals that chose CSC status were different in other unmeasured factors than those that chose PSC status, and the difference may have existed even in the absence of the designation program. Over the years, there have been changes in the criteria required by the state and the JC for PSC designation, although the larger differences between hospital levels remained intact. This may have limited our findings as well. The goal for hospitals is to continue strict adherence to policies and measures and thus improve quality of care for stroke patients. Future prospective studies should be conducted to ascertain validity and generalizability of our findings. Association of stroke measure adherence and functional outcomes would also be of interest. We were not able to measure this consistently in our study because not all patients at PSCs had admission and/or discharge NIHSS or modified Rankin Score. Although some studies have not shown an association between improved outcomes and higher performance on quality measures, we would like to look at this more closely in the stroke population.[19] As our database gets larger, we would like to reexamine our findings after correcting for more specific characteristics of each hospital. In the future, if additional states designate centers by level of stroke care, it will be important to compare how such designations compare to nonprofit organization certifications in terms of impacting performance on a larger scale.

CONCLUSION

This study shows better compliance of New Jersey state-designated CSCs with the JC PSC core stroke measures and better mean door-to-thrombolytic drug times. Because these measures are evidence based, these results may translate into better stroke care and outcomes for patients treated at state-designated CSCs.

Disclosures: Jawad Kirmani, MD: Consultant to Joint Commission on Performance Measure Development (modest). Martin Gizzi, MD, PhD: Consultant to Joint Commission on Performance Measure Development (modest), New Jersey Department of Health and Senior Services as chair of the Stroke Advisory Panel (significant). No other potential conflicts to report.

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