

An Assessment of Acute Stroke Treatment in Nebraska Hospitals

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An Assessment of Acute Stroke Treatment in Nebraska Hospitals

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The Nebraska Center for Rural Health Research, formed in 1990, is located within the Department of Preventive and Societal Medicine's Section on Health Services Research and Rural Health Policy at the University of Nebraska Medical Center.

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Executive Summary

In June 2005, the Nebraska Health and Human Services System contracted with the University of Nebraska Medical Center (UNMC) to assess the readiness of Nebraska hospitals to treat acute stroke. Tissue plasminogen activator (tPA) is the one FDA-approved drug that has proven to significantly decrease stroke-related disability. To safely administer tPA, hospitals must rapidly confirm the diagnosis of ischemic stroke by computed tomographic (CT) scan, follow protocols to determine if a patient is an appropriate candidate for tPA, and administer the drug within three hours of the onset of symptoms. Rural populations are least likely to have access to this therapy due to the distance to a hospital and the limited resources within rural hospitals. To assess the extent to which the structures and processes available to treat acute stroke were consistent with evidence-based guidelines, researchers at UNMC conducted a mail survey of the 83 acute care hospitals in Nebraska.

Key Results

- Seventeen Nebraska hospitals (21%) had the structures and processes—were *ready*—to diagnose and treat acute stroke—they could obtain and read a CT scan in a timely manner, had written protocols for administration of tPA, and had neurosurgical services available on-site or by transfer within two hours. Of these 17, 15 (88%) had administered tPA in the past year.
- Forty-four Nebraska hospitals (54%) were *near ready*—they could perform a CT scan on-site 24 hours a day but either could not do so in a timely manner, could not interpret the scan in a timely manner, lacked written protocols for administering tPA, or could not obtain neurosurgical services within two hours. Twenty (45%) of the 44 near-ready hospitals had administered tPA in the past year.
- Twenty Nebraska hospitals (25%) did not have a CT scanner on-site and were considered *not ready* to treat acute stroke.
- Thirty-five Nebraska hospitals (45%) reported having administered tPA at least once in the past year. The percentage of acute stroke patients treated with tPA was two to five times greater in the Southeast and Eastern Health Planning Regions than in the remainder of the state. Approximately one-half of responding hospitals considered lack of diagnostic support from a neurologist and resultant apprehension of adverse outcomes to be major barriers to administering tPA.
- More than 90% of Nebraska hospitals supported development of a statewide system to coordinate public education and EMS transport and education related to acute stroke.

Next Steps

This assessment can be used by Nebraska's policymakers and healthcare leaders to develop a statewide system of stroke care to decrease the incidence of stroke and the prevalence of stroke-related disability. Next steps should emphasize collaboration among these groups to improve public education regarding stroke as a medical emergency, improve EMS stroke-related transport and treatment protocols, educate providers regarding the role of acute stroke teams and care protocols, consider funding a state stroke registry, and ensure timely access to teleradiology and consultation by a neurologist for diagnostic support using Nebraska's Telehealth Network.

BACKGROUND AND PURPOSE

This study informs state policymakers and healthcare leaders about the readiness of Nebraska hospitals to treat acute stroke and determines the extent to which the structures and processes used are consistent with the guidelines developed by the Brain Attack Coalition (BAC) (Douglas et al., 2005) and the American Stroke Association (ASA) (Schwamm et al., 2005). These guidelines ensure that hospitals can determine the appropriateness of the patient for administration of intravenous tissue plasminogen activator (tPA), the only FDA-approved treatment for acute ischemic stroke. This study also considers the role of the acute care hospital in the notification and response of emergency medical services (EMS), the treatment of emergent and acute stroke, and risk reduction or primary prevention activities.

Stroke is the third leading cause of death in the United States and a leading cause of disability. In 2002, stroke was responsible for approximately one out of every 15 deaths (162,672) in the United States (American Heart Association, 2005). Approximately 700,000 new and recurrent strokes occur each year, and 5.4 million Americans are currently living with a disability due to stroke-related motor, sensory, and cognitive impairments. Stroke accounts for over 1,000 deaths in Nebraska each year (Nebraska Health and Human Services System, 2004), and in 2001, approximately 37,000 Nebraskans (3%) were living with stroke-related disabilities.

Nationally, stroke mortality has declined significantly since 1979. However, this decline was due to decreases in case fatality rates, not to a decrease in the incidence of stroke. This decrease in case fatality rates has been associated with major advances in the diagnosis and treatment of stroke (Sarti et al., 2003). A significant advancement is the 1996 FDA approval of the use of tPA for the treatment of ischemic stroke. Ischemic stroke, which is caused by a blockage in an artery within the brain, accounts for approximately 83% of all strokes (American Academy of Neurology, 1996). In contrast, hemorrhagic stroke is caused by the rupture of an artery—tPA is contraindicated for the treatment of hemorrhagic stroke (American Stroke Association, 2006a).

Treatment with tPA, often termed “thrombolytic (clot-busting) therapy,” must be initiated within three hours of the onset of an ischemic stroke to safely prevent permanent neurologic damage and reduce long-term stroke-related disability (NINDS, 1995; Kwiatkowski et al., 1999). The sooner therapy is initiated within the three-hour limit after the onset of symptoms, the greater the benefit to the patient as measured by functional status at three months after the ischemic stroke. Specifically, patients treated within 90 minutes of the onset of symptoms had approximately twice the odds of a favorable three-month outcome when compared to those patients treated between 91 and 180 minutes after onset (Marler et al., 2004). The American Academy of Neurology (1996) does not recommend thrombolytic therapy unless the diagnosis of ischemic stroke is determined by a physician who has expertise in the diagnosis of stroke, and the CT scan of the brain is interpreted by a physician who has expertise in reading these scans. It is likely that tPA is underutilized because few patients present for care within the three-hour time limit, some physicians fear complications such as hemorrhage, some hospitals have an inadequate infrastructure to appropriately administer the drug, and some providers believe that reimbursement for administration of tPA is insufficient (Alberts, 1999; Bambauer, Johnston, Bambauer, & Zivin, 2006). An estimated 2% to 8.5% of ischemic stroke patients nationwide receive intravenous tPA when ideally, 40% of all stroke patients should receive this drug (Reeves et al., 2005; Bambauer et al., 2006; Johnston et al., 2001; Reed, Cramer, Blough, Meyer,

& Jarvik, 2001). A second advancement in the treatment of stroke is the effective notification and response of EMS, which requires interaction among the public, EMS programs, and hospital emergency departments (EDs) (Schwamm et al., 2005). Integrated systems of care are needed within organizations and at state and local levels to evaluate and treat stroke patients consistent with the guidelines for administering tPA and thus decrease stroke-related death and disability.

A “stroke center” is an acute care hospital that has an integrated system of care for the treatment of acute stroke. The BAC identified 11 major elements of a primary stroke center. Six of these elements are directly associated with patient care—an acute stroke team, written care protocols, EMS, ED, stroke unit, and neurological services. Five elements are associated with support services—commitment and support of the organization, neuroimaging services, laboratory services, quality improvement activities, and continuing education (Alberts et al., 2000). The BAC collaborated with the ASA and the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) to establish criteria for certification of hospitals as “Primary Stroke Centers.” JCAHO awards certification to a hospital for one year as a primary stroke center upon successful compliance with consensus-based national standards, clinical practice guidelines, and performance measurement and improvement related to care for stroke patients (American Stroke Association, 2006b). As of July 2006, the only certified Primary Stroke Center in Nebraska listed on the JCAHO (2006) Web site is located at The Nebraska Medical Center in Omaha. In surrounding states, certified Primary Stroke Centers are located in Sioux City and Cedar Rapids, Iowa; St. Louis, Springfield, Kansas City, and Cape Girardeau, Missouri; Littleton, Pueblo, and Englewood, Colorado; and Sioux Falls, South Dakota. (For an updated listing of certified Primary Stroke Centers go to <http://www.jointcommission.org/CertificationPrograms/Disease-SpecificCare/DSCOrgs/default.htm>.)

Rural populations are least likely to have access to thrombolytic therapy for stroke due to the distance to a hospital and the limited structures (staff and equipment) and processes within rural hospitals (Okon et al., 2006; Scott, Temovsky, Lawrence, Gudaitis, & Lowell, 1999). Consequently, public health officials in rural states should assess the infrastructure in their communities to treat stroke. This assessment should include the locations of facilities capable of treating stroke according to evidence-based guidelines and the degree to which the EMS system is capable of transporting patients to an appropriate facility within two hours of the onset of stroke symptoms (Schwamm et al., 2005). The goal of this assessment is not to increase the number of hospitals certified as Primary Stroke Centers but to maximize access to essential evidence-based stroke care. By establishing coordinated systems of care at the state and local level, rural states can create the infrastructure necessary to decrease death and disability due to stroke.

STUDY DESIGN

We used the Dillman (2000) four-contact method to conduct a mail survey of providers most knowledgeable about the process of acute stroke treatment within Nebraska’s 83 acute care hospitals. In this method, the respondent is contacted four times during the survey to maximize the likelihood of response. The 16 Nebraska hospitals, such as the Regional Centers and specialty hospitals that do not provide treatment for acute stroke patients, were excluded from this study.

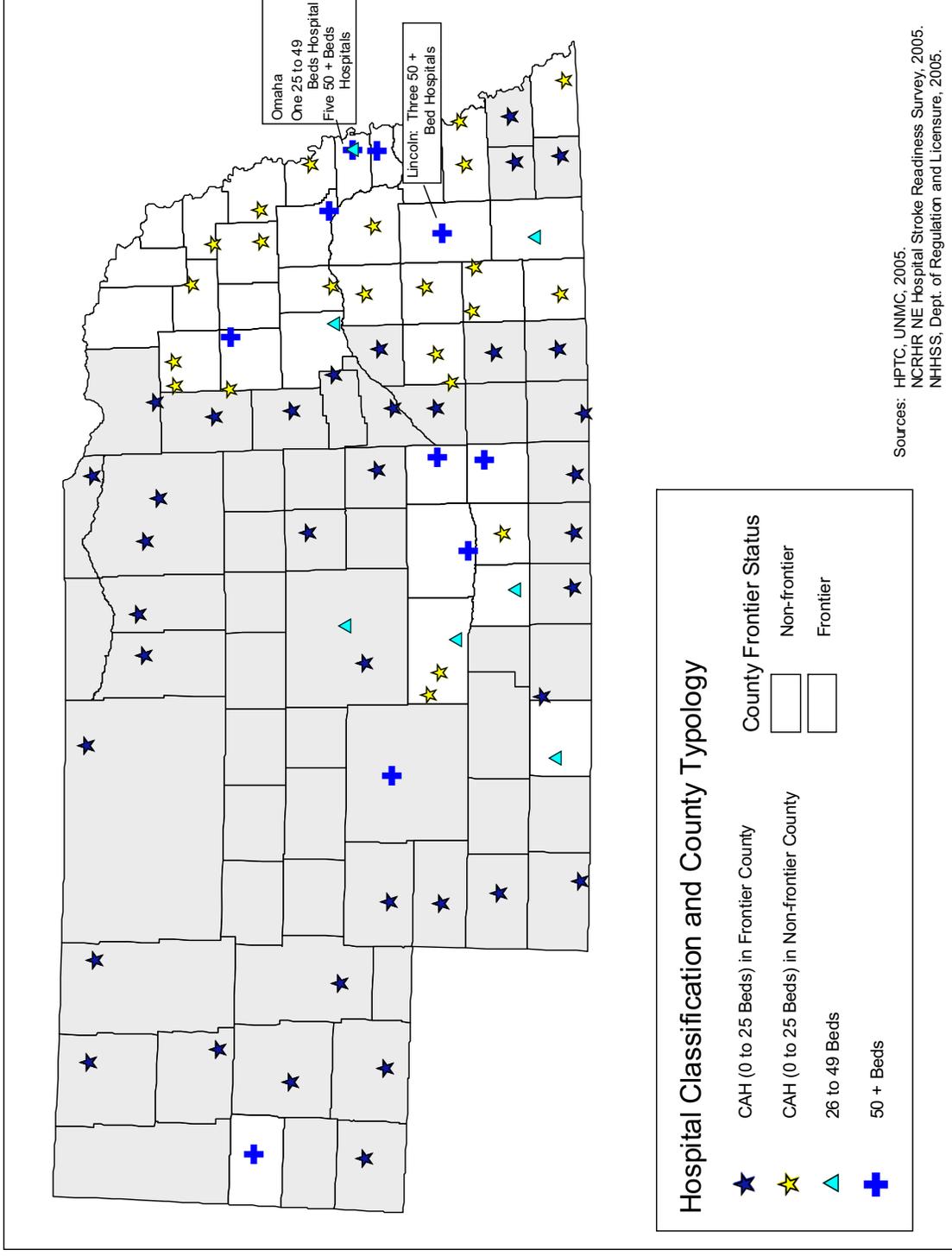
To develop the survey instrument, we reviewed the literature and recruited an advisory panel from seven hospitals and interested state agencies. The instrument was organized into domains reflecting the ASA's recommendations for stroke systems of care and the BAC's elements of a primary stroke center. The BAC consists of representatives from professional organizations involved in stroke care. These recommendations and elements encompass the structures and processes necessary to provide evidence-based care for acute stroke and include (1) EMS that assign a high priority to possible stroke patients; (2) trained ED personnel who communicate with EMS and prepare for the arrival of possible stroke patients; (3) an acute stroke team that is available within 15 minutes, 24 hours a day; (4) written care protocols for the use of tPA to treat acute ischemic stroke; (5) the capability to perform either a computed tomographic (CT) scan or a magnetic resonance image of the brain within 25 minutes and read it within 20 minutes of completion; (6) availability of standard laboratory services 24 hours a day; (7) availability of neurosurgical services within two hours; (8) organized stroke units to care for inpatients after evaluation within the ED; (9) a system for collecting and analyzing information about numbers, types, and outcomes of stroke patients for quality improvement; (10) organized educational programs regarding stroke and other types of cerebrovascular disease for hospital staff and the public; and (11) administrative commitment including a designated medical director (Alberts et al., 2000; Schwamm et al., 2005). We collected additional information about risk reduction activities, perceived barriers to delivering thrombolytic therapy, and attitudes toward a statewide system for treatment of acute stroke.

POPULATION STUDIED

From December 2005 through January 2006, we surveyed the 83 acute care hospitals in Nebraska that provide treatment for acute stroke. During 2005, there were 60 Critical Access Hospitals (CAHs), which by law are licensed for 25 or fewer beds; 7 small hospitals licensed for 26 to 49 beds; and 16 large hospitals licensed for 94 or more beds. Five of the seven small hospitals converted to CAH status in December 2005 (Nebraska Hospital Association, 2006). (Figure 1).

The U.S. Census Bureau (2006) estimates the 2005 population of Nebraska as 1,760,792. Of the 93 counties in Nebraska, 58 are considered "frontier," with extremes of low population density (0 to 20 people per square mile) and distance (30 to 90+ miles) or travel time (30 to 90+ minutes) from a service market (Frontier Education Center, 2005). Approximately 16% of Nebraskans live in frontier counties, and 6% live in the 26 counties without a hospital. Based on the 2005 categorization of CAHs, nearly one-third of Nebraskans are expected to seek initial emergency care in a CAH if they experience signs and symptoms of stroke.

Figure 1. Acute Care Hospitals in Nebraska by Number of Beds and CAH Status



RESULTS

We received completed surveys from 81 (98%) of the 83 hospitals—two CAHs located in frontier counties did not return a survey. The number of responding hospitals reported in the results below may be less than 81 because all respondents did not answer every survey item. Responses to the mail survey were used to characterize the readiness of Nebraska hospitals to treat acute stroke. Responses are presented descriptively as numbers and percentages of the responding hospitals. “Don’t know” responses were considered valid answers. Any items with a relatively large percentage of “don’t know” responses are identified in the text. Descriptive responses are presented as answers to a series of questions in the sections that follow. These sections are (1) To what extent is the treatment of acute stroke in Nebraska hospitals consistent with the guidelines developed by the Brain Attack Coalition and the American Stroke Association? (2) How many Nebraska hospitals have provided public education about stroke as a medical emergency and about primary stroke prevention? (3) Are Nebraska hospitals supportive of a statewide system to treat acute stroke? and (4) Which Nebraska hospitals are ready (have the essential structures and processes) to participate in a statewide system of stroke treatment? Open-ended comments from respondents that illustrate the descriptive data are presented in accompanying text boxes.

To what extent is the treatment of acute stroke in Nebraska hospitals consistent with the guidelines developed by the Brain Attack Coalition and the American Stroke Association?

Role of Emergency Medical Services (EMS) in Treatment of Acute Stroke

The BAC describes EMS as an “integral component” of stroke care that should be integrated into the hospital stroke center. Specifically, EMS should assign a high priority to calls for suspected stroke patients to ensure rapid transport, perform specific stroke assessments, and be able to communicate with hospital ED personnel to ensure efficient triage of patients upon arrival. Integration of EMS into hospital stroke care should include collaborative educational activities twice a year and written documentation of the role of EMS in stroke care (Alberts et. al., 2000; Schwamm et al., 2005).

Survey results regarding the role of EMS in treatment of acute stroke (Table 1):

- Fifty-two (65%) of 80 responding hospitals reported that EMS personnel assigned a high priority to patients with signs and symptoms of stroke.
- Seventy-seven (96%) of 80 responding hospitals reported that EMS personnel communicate with the hospital ED regarding the condition of suspected stroke patients, and 70 hospitals (86%) reported that ED personnel prepared for arrival of suspected stroke patients as a result of communication with EMS.
- Seventeen (21%) of 80 responding hospitals reported that EMS personnel use a standardized assessment scale to evaluate patients with signs and symptoms of stroke.

However, 32 hospitals (40%), 29 of which were CAHs, responded “don’t know” when asked about the use of a standardized scale.

- Fourteen (17%) of 81 responding hospitals reported that they have written documentation of the role of EMS in the transportation and evaluation of patients with signs and symptoms of stroke. However, 14 hospitals (17%)—9 CAHs, 4 large hospitals, and 1 small hospital—responded “don’t know” when asked about documentation of the role of EMS.
- Fourteen (17%) of 81 responding hospitals reported participating with EMS in continuing education about stroke on an annual basis—CAHs were least likely to have reported doing so. Five hospitals (6%) reported never participating with EMS in continuing education. Forty-seven hospitals (58%) did not know how frequently they participated with EMS in continuing education about treatment of acute stroke.

Table 1. Role of Nebraska Emergency Medical Services in Treatment of Acute Stroke as Reported by Acute Care Hospitals

Emergency Medical Services	Large (> 50 Beds) (n = 16)	Small (26-49 Beds) (n = 7)	CAH (Non-frontier) (n = 23)	CAH (Frontier) (n = 35)	Total
Agree that EMS assign a high priority to calls for patients with signs and symptoms of stroke	11 (69%)	3 (43%)	17 (74%)	21 (62%) ¹	52 (65%)
Agree that EMS possess communication devices that allow contact in the out-of-hospital setting	15 (94%)	6 (86%)	22 (96%)	34 (100%) ¹	77 (96%)
Agree that EMS notify the ED when transporting a patient with signs and symptoms of stroke	15 (94%)	6 (86%)	22 (96%)	31 (89%)	74 (91%)
Agree that the ED prepares for arrival of patients with signs and symptoms of stroke when notified by EMS	14 (88%)	5 (71%)	21 (91%)	30 (86%)	70 (86%)
Agree that EMS use a standardized assessment scale to evaluate patients with signs and symptoms of stroke	6 (40%) ²	3 (43%)	4 (17%)	4 (11%)	17 (21%) ³
Agree that they have written documentation of EMS role in transport and evaluation of patients with signs and symptoms of stroke	5 (31%)	1 (14%)	4 (17%)	4 (11%)	14 (17%)
Agree that hospital participates with EMS in continuing education at least annually	6 (38%)	3 (43%)	2 (9%)	3 (9%)	14 (17%) ⁴

¹ n = 34.

² n = 15.

³ Forty percent of hospitals responded "don't know" when asked if EMS used a standardized assessment scale.

⁴ Fifty-eight percent of hospitals responded “don’t know” when asked about participation with EMS in continuing education.

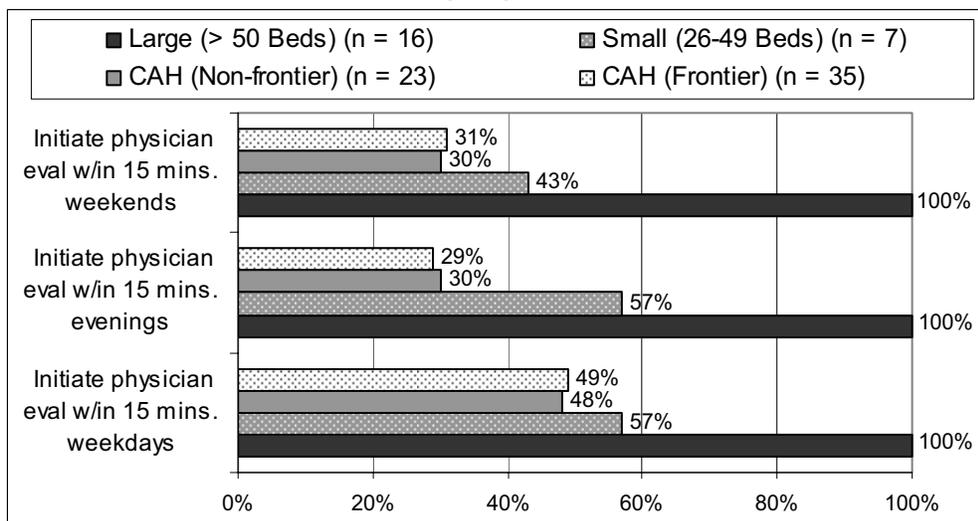
Role of the Hospital Emergency Department (ED) in Treatment of Acute Stroke

Because the ED is the first point of contact the hospital has with the suspected stroke patient, the BAC (Alberts et al., 2000) indicates that ED personnel should communicate with EMS and prepare for the arrival of a suspected stroke patient by activating an organized stroke team. In addition, ED personnel must be trained to diagnose and treat all types of acute stroke. Treatment must include following the exclusionary criteria for use of tPA to treat acute ischemic stroke that were determined in the original clinical trial of the drug (NINDS, 1995). These exclusionary criteria are referred to as the NINDS Guidelines and include (1) current use of oral anticoagulants or an INR > 1.7, (2) use of heparin in the previous 48 hours and a prolonged partial thromboplastin time, (3) platelet count < 100,000/mm³, (4) previous stroke or head injury in the past three months, (5) major surgery within the preceding 14 days, (6) systolic blood pressure > 185mm Hg or diastolic pressure > 110 mm Hg, (7) rapidly improving neurological signs, (8) isolated mild neurological deficits, (9) prior intracranial hemorrhage, (10) blood glucose < 50 mg/dl or > 400 mg/dl, (11) seizure at the onset of stroke, (12) gastrointestinal or urinary bleeding within the preceding 21 days, and (13) recent myocardial infarction.

Survey results regarding the role of the hospital ED in treatment of acute stroke:

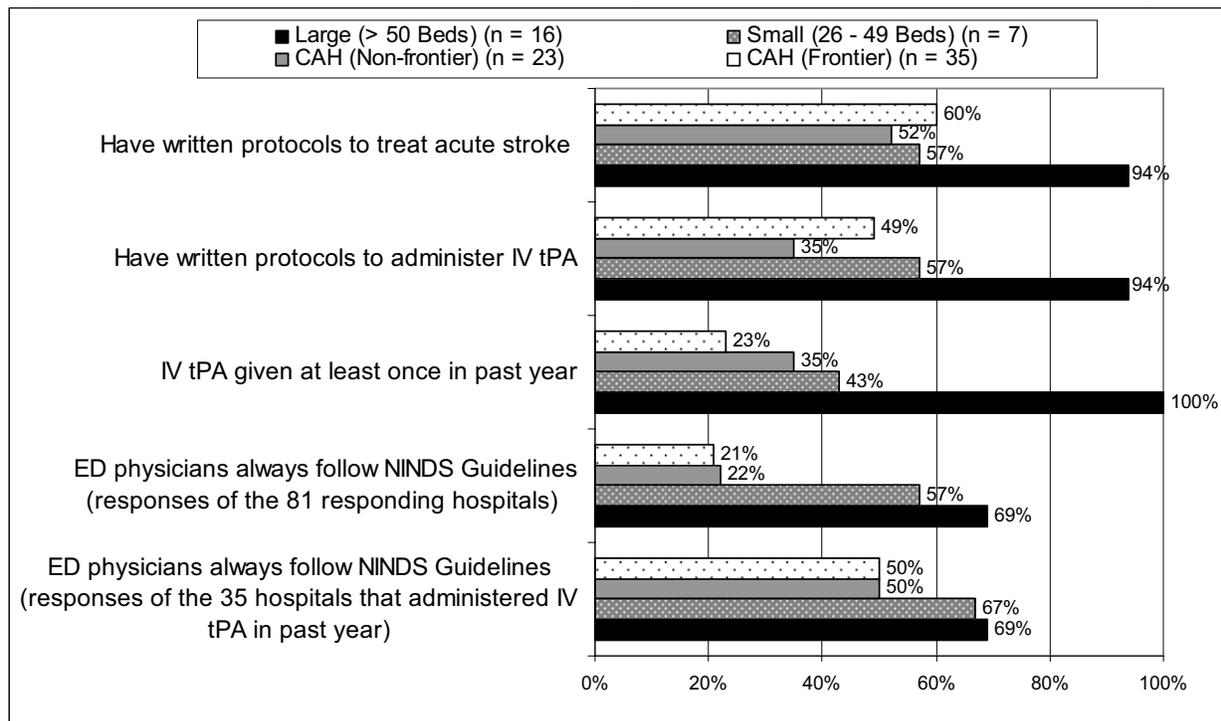
- Sixty-five (81%) of 80 responding hospitals reported that most patients with signs and symptoms of stroke were transported to the ED by EMS. One-third of the large hospitals (50 or more beds) reported that most of these patients were transported by private vehicle as compared to 14% of small hospitals (26 to 49 beds) and 9% of CAHs (25 or fewer beds).
- Sixteen (20%) of 81 responding hospitals reported that a physician is consistently able to initiate evaluation of a suspected stroke patient within 15 minutes of arrival in the ED, 24 hours a day, seven days a week; all 16 were large hospitals. Approximately one-half to one-third of the small hospitals and CAHs were able to do so (Figure 2).

Figure 2. Proportion of Acute Care Hospitals Able to Initiate Physician Evaluation of Suspected Stroke Patients Within 15 Minutes by Day and Time



- Fifty-two (64%) of 81 responding hospitals reported having written protocols in the ED for treatment of acute stroke. The range of this response varied from 52% of non-frontier CAHs to 94% of large hospitals (Figure 3).
- Forty-four (54%) of 81 responding hospitals reported having written protocols for administration of intravenous (IV) tPA. This drug is typically administered through a vein in the arm. The range of this response varied from 35% of non-frontier CAHs to 94% of large hospitals (Figure 3).
- Thirty-five (43%) of 81 responding hospitals had administered tPA for treatment of acute stroke at least once in the past year. This response varied by hospital size: 16 large hospitals (100%), 3 small hospitals (43%), 8 non-frontier CAHs (35%), and 8 frontier CAHs (23%) reported administering IV tPA at least once in the past year (Figure 3).
- Four hospitals reported administering tPA at least once in the past year despite also reporting that they did not have a written protocol for administration of the drug. Three of these hospitals had administered tPA once in the past year and the fourth had done so twice.
- Of 79 responding hospitals, 27 (34%) reported always following the NINDS Guidelines to determine appropriateness for this therapy—responses ranged from 21% of frontier CAHs to 69% of large hospitals. However, of the 35 hospitals that had administered IV tPA in the last year, 21 (60%) reported always following the NINDS Guidelines—responses ranged from 50% of frontier CAHs to 69% of large hospitals (Figure 3).

Figure 3. Proportion of Acute Care Hospitals Using Protocols/Guidelines and Administering tPA



- Thirty-five hospitals (43%) reported administering IV tPA a combined total of 160 times in the past year. The 16 large hospitals accounted for 126 or 79% of these treatments (Table 2).

Table 2. Frequency of Administration of Intravenous (IV) tPA Within Acute Care Hospitals

IV tPA Administration	Large (> 50 Beds) (n = 16)	Small (26- 49 Beds) (n = 3)	CAH (Non- frontier) (n = 8)	CAH (Frontier) (n = 8)	Total (n = 35)
Total times IV tPA given in all hospitals past year	126 (79%)	8 (5%)	12 (8%)	14 (9%)	160 (100%)
Maximum times IV tPA given within one hospital past year	30	4	2	4	
Range of times IV tPA given in past year	1 - 30	0 - 4	0 - 2	0 - 4	

Role of an Acute Stroke Team in Treatment of Acute Stroke

The acute stroke team consists of a group of providers with training and experience in stroke care who can be available 24 hours a day. Organized delivery of care for acute stroke patients has been associated with decreased delays in treatment (Gomez et al., 1994) and decreased mortality (Birbeck, Zingmond, Cui, & Vickrey, 2006). Despite these outcomes, organized acute stroke teams are rare—Birbeck et al. found that only 7.4% of California hospitals had organized acute stroke teams during 1998 to 1999. According to the BAC (Alberts et al., 2000), the team does not have to be led by a neurologist or neurosurgeon. However, at a minimum, the team should include a physician and another licensed provider such as a nurse, physician’s assistant, or nurse practitioner who can initiate evaluation of patients with symptoms of acute stroke in the ED, in other hospital units, or in adjacent clinics. By using an organized activation system, the team should initiate evaluation of suspected stroke patients within 15 minutes. There should be written documentation about team staffing, notification plans, call times, response times, patient diagnoses, treatments, and outcomes.

Survey results regarding the role of acute stroke teams in treatment of acute stroke:

- Two hospitals (2%) reported having an organized acute stroke team—both of these were large hospitals.
- The two large hospitals with acute stroke teams reported that their teams were coordinated by an advanced practice registered nurse.
- The two large hospitals with acute stroke teams reported meeting the following criteria for an organized stroke team:
 - The team was available 24 hours a day.
 - The team was activated within 15 minutes of a suspected stroke patient’s arrival.
 - There was written documentation about the administrative support, staffing, and procedure for notification of team members.
 - There were continuing education requirements, specific to stroke care, for members of the acute stroke team.

“We need to know where to find adequate staff education for stroke treatment.”—Frontier CAH Respondent

“I feel that we would be able to provide the necessary care to a stroke patient. No official stroke team but as any rural hospital with limited personnel, we are all familiar with our protocol for stroke.”—Frontier CAH Respondent

Availability of Hospital Neuroimaging and Laboratory Services in Treatment of Acute Stroke

The ability to rapidly establish an accurate diagnosis is critical for patients with acute stroke. Due to the three-hour time window for administering thrombolytic therapy, the consensus of the BAC is that hospitals treating acute stroke should be able to complete a CT scan or brain magnetic resonance image within 25 minutes of the order. In addition, the scan or image should be interpreted by an experienced physician within 20 minutes of completion. Efficient diagnosis of acute stroke also requires that standard laboratory services, electrocardiogram, and chest X-ray must be available within 45 minutes of an order, 24 hours a day (Alberts et al., 2000).

Survey results regarding availability of hospital neuroimaging in treatment of acute stroke:

- Sixty-one (75%) of 81 responding hospitals reported being able to complete a CT scan on-site 24 hours a day. The range of this response varied from 63% of frontier CAHs to 100% of small and large hospitals (Figure 4).
- Forty-four (54%) of 81 responding hospitals reported being able to complete a CT scan 24 hours a day within 25 minutes of an order. The range of this response varied from 40% of frontier CAHs to 86% of small hospitals (Figure 4).
- Twenty-five (31%) of 81 responding hospitals reported being able to interpret the results of a CT scan within 20 minutes. The range of this response varied from 20% of frontier CAHs to 56% of large hospitals (Figure 4).
- Thirty-six (44%) of 81 responding hospitals reported that the physician interpreting the CT scan was available only by teleradiology. The range of this response varied from none of the large hospitals to 71% of the small hospitals. Approximately one-third of the CAHs responded “don’t know” when asked whether the physician reading the scan was available only by teleradiology (Figure 4).
- The twenty hospitals (25%) that reported not having a CT scanner on-site reported transferring patients to 11 locations in three states to obtain a CT scan (Figure 5).

“We are 1 hour and 15 minutes from the nearest 24/7 CT scanner.”—Frontier CAH Respondent

“Our biggest problem is not having a CT scanner and someone trained to use it.”—Non-frontier CAH Respondent

“Have in-house CT, but do not always have a radiologist to read it within time frame needed.”—Frontier CAH Respondent

Figure 4. Availability and Interpretation of CT Scans in Diagnosis of Acute Stroke Within Acute Care Hospitals

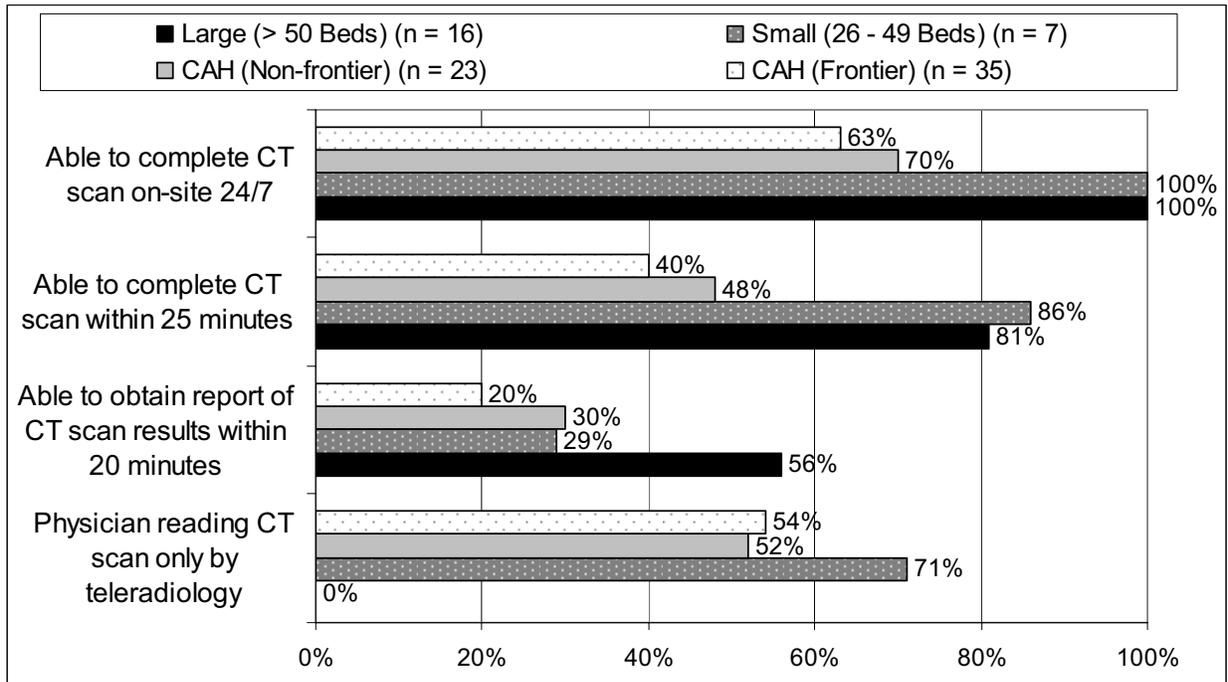
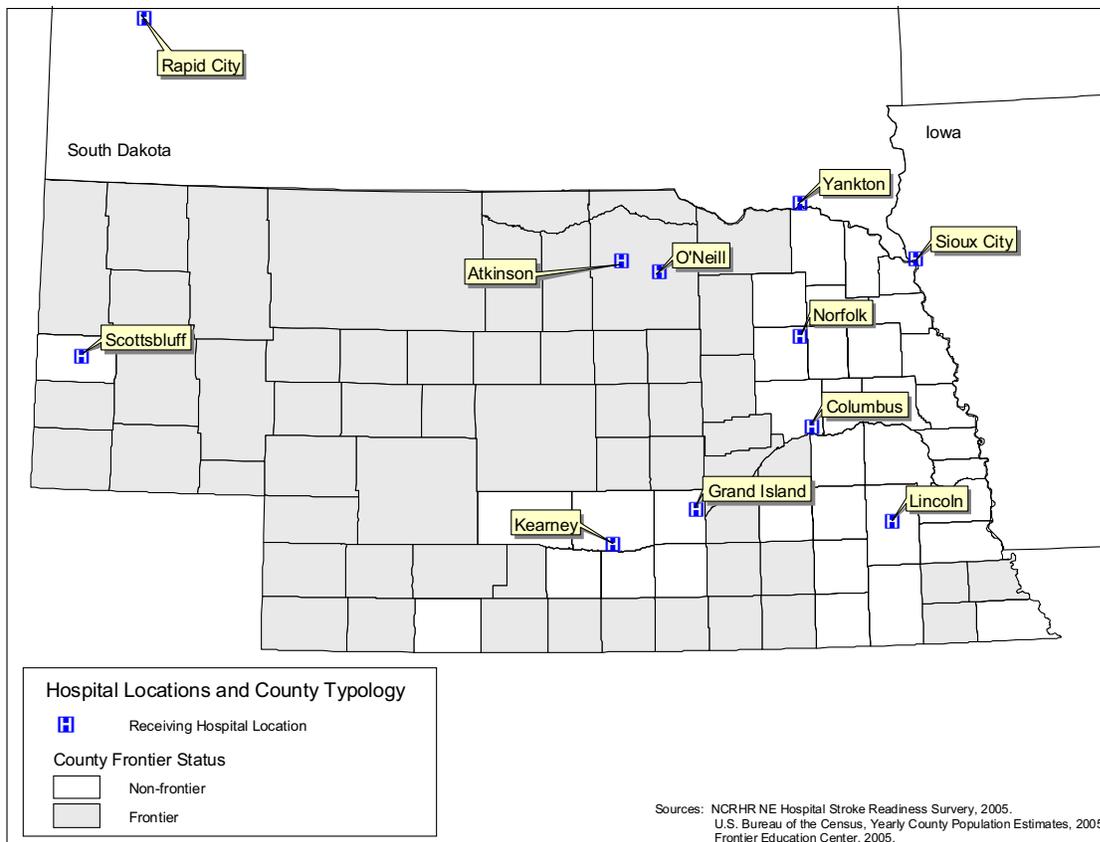


Figure 5. Locations of Hospitals That Receive Patients to Complete a CT Scan



Survey results regarding availability of laboratory services in treatment of acute stroke:

- Seventy-nine (99%) of 80 responding hospitals reported being able to perform and obtain results from standard laboratory services within 45 minutes during weekdays. However, four CAHs and one large hospital reported not being able to do so during evenings and weekends.
- Seventy-nine (99%) of 80 responding hospitals reported being able to perform and obtain results from an electrocardiogram within 45 minutes during weekdays. However, two CAHs reported not being able to do so during evenings and weekends.
- Seventy-nine (99%) of 80 responding hospitals reported being able to perform and obtain results from a chest X-ray within 45 minutes during weekdays. However, five CAHs reported not being able to do so during evenings and weekends.

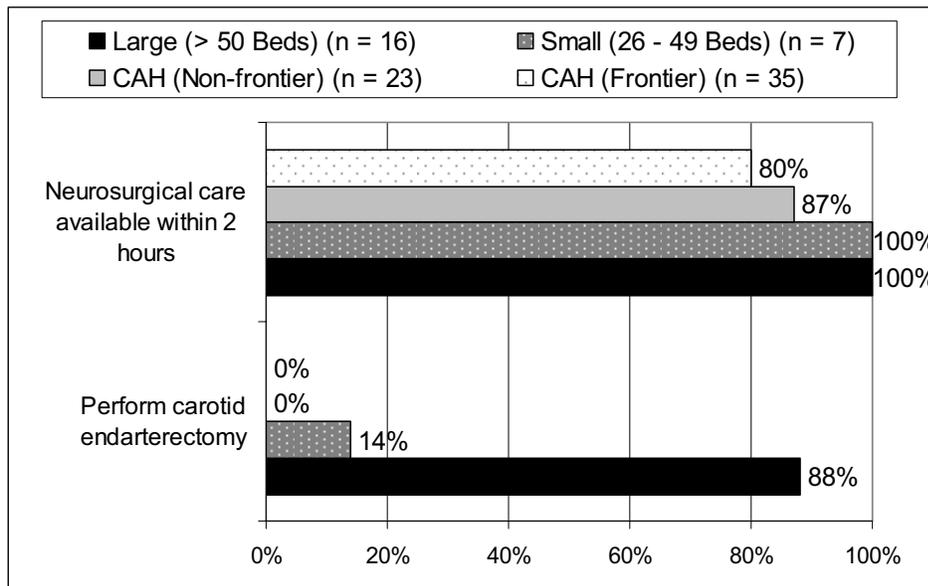
Availability of Neurosurgical Services in Treatment of Acute Stroke

Since many patients with stroke will need a neurosurgical procedure or evaluation, the BAC guidelines require that neurosurgical services be available within two hours when clinically necessary. The BAC (Alberts et al., 2000) acknowledges that the limited supply of neurosurgeons will require many hospitals to transfer patients to another facility.

Survey results regarding availability of neurosurgical services in treatment of acute stroke:

- Seventy-one (88%) of 81 responding hospitals reported being able to provide neurosurgical services within two hours either on-site or by transfer. The range of this response varied from 80% of frontier CAHs to 100% of small and large hospitals (Figure 6). Large hospitals in Lancaster and Buffalo counties were the most frequently reported transfer destinations for neurosurgical treatment.
- Fifteen (19%) hospitals reported providing neurosurgical services on-site. This response ranged from 1 (14%) of the small hospitals to 14 (88%) of the large hospitals. The most frequently reported neurosurgical procedure was carotid endarterectomy (Figure 6).

Figure 6. Availability of Neurosurgical Services and Performance of Selected Procedures Within Acute Care Hospitals



- Three of the 16 large hospitals reported administering intra-arterial tPA a total of 32 times in the past year. In contrast to IV tPA, intra-arterial tPA is delivered directly to the site of the clot within the brain by a neurovascular specialist and is considered a neurosurgical procedure.
- More complex intracranial and extracranial neurosurgical procedures such as intracranial balloon angioplasty, stenting, aneurysm clipping, and aneurysm coils were reported as available by large hospitals in Douglas and Lancaster counties.

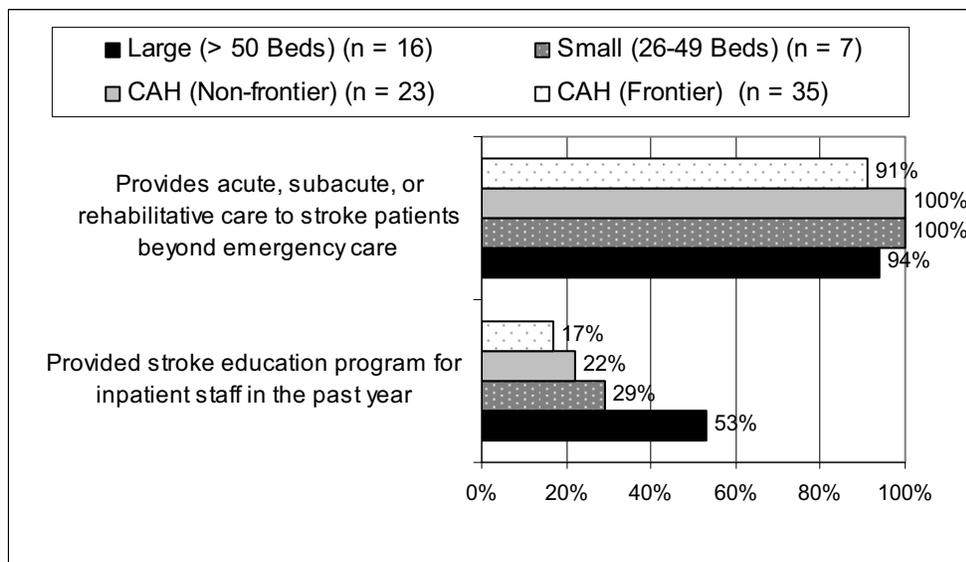
Availability of Inpatient Care Processes in Treatment of Acute Stroke

Upon completion of emergency treatment, many stroke patients must receive further inpatient care in a location where they can be continually monitored by staff with expertise and regular continuing education in caring for patients with stroke. Primary Stroke Centers provide care beyond the emergency phase in stroke units that have continuous telemetry and the capability to continuously and noninvasively monitor blood pressure. Those hospitals that admit stroke patients for inpatient care beyond the emergency phase should also have admission and discharge criteria and specific care protocols, and should track census- and patient-level outcome data (Alberts et al., 2000).

Survey results regarding availability of inpatient care services in treatment of acute stroke:

- Seventy-seven (95%) of 81 responding hospitals reported providing care for stroke patients beyond the emergency phase, although this care may be limited to either the acute, subacute, or rehabilitative phases (Figure 7).
- Twenty-one (26%) of 80 responding hospitals reported providing education about stroke to inpatient care staff in the past year. The majority (53%) of large hospitals provided this training as compared to 29% of the small hospitals, 22% of non-frontier CAHs, and 17% of frontier CAHs (Figure 7).

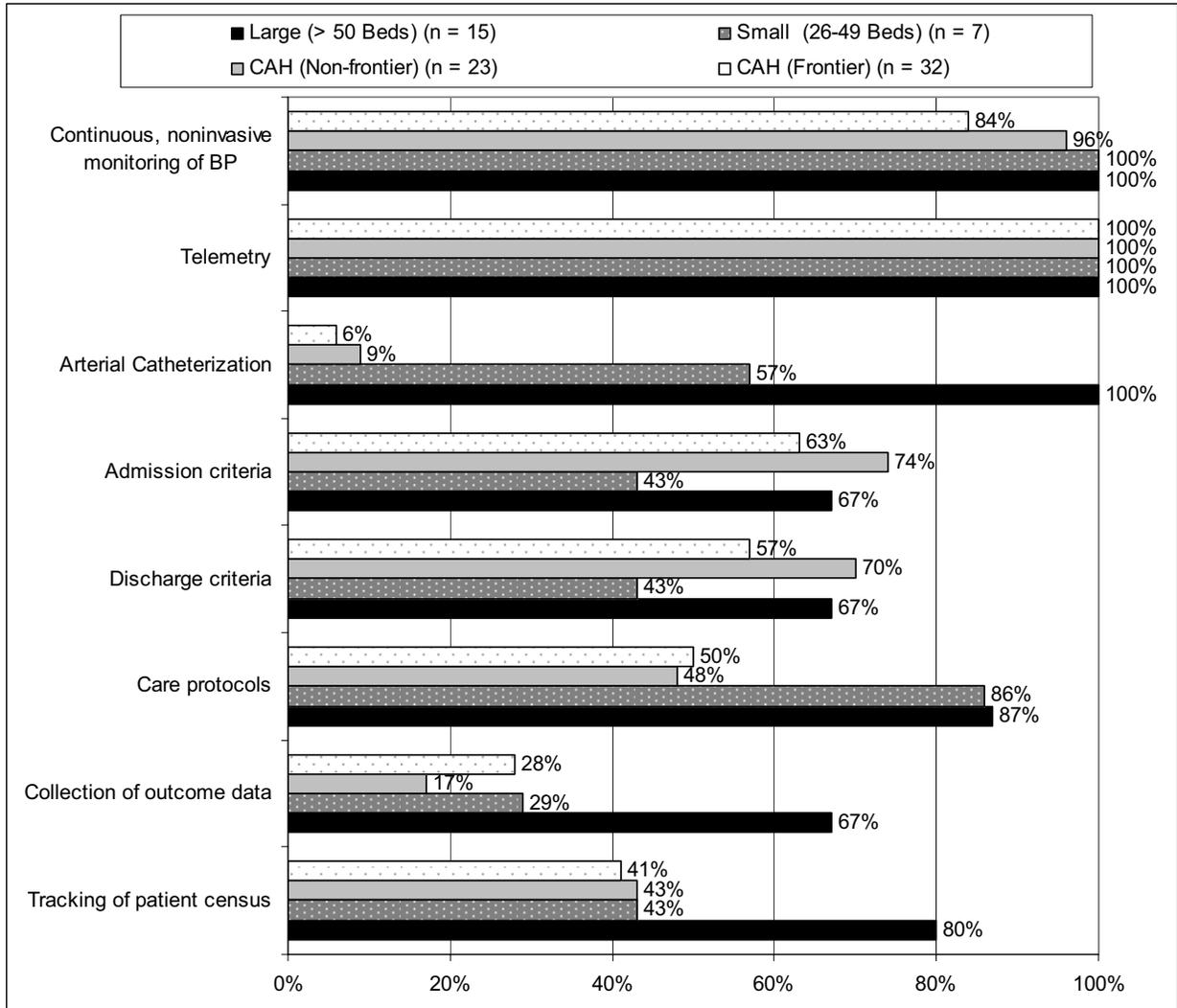
Figure 7. Prevalence of Inpatient Care and Staff Education Related to Acute Stroke



- Of the 77 hospitals that reported providing inpatient care for stroke beyond the emergency phase, nearly all performed continuous noninvasive monitoring of blood pressure and telemetry, while 23 (30%) reported performing arterial catheterization (Figure 8).

- Of the 75 hospitals that responded to items about admission and discharge criteria and care protocols, 49 (65%) reported having admission criteria, 46 (61%) reported having discharge criteria, and 45 (60%) reported having protocols for inpatient stroke care (Figure 8).
- Of the 74 hospitals that responded to items about collection of outcome data and tracking of stroke patient census, 24 (32%) reported collecting data about outcomes and 37 (50%) reported tracking the census of stroke patients (Figure 8).

Figure 8. Prevalence of Inpatient Care Processes in Acute Stroke Treatment



“We have recognition from ASA as a ‘stroke participating hospital,’ and we are seeking JCAHO’s primary stroke center recognition.”—Large-Hospital Respondent

“In the past three years, I have served on two committees trying to bring up a stroke center at the hospital, and both times neither administration nor key players (neuro and/or ED physicians) have supported it.”—Large-Hospital Respondent

Role of Quality Improvement in Treatment of Acute Stroke

The role of quality improvement activities for improving outcomes of care is well documented (Bodenheimer, 1999; Shortell et al., 1995). The BAC recommendations for these activities include performing an annual review of the number and types of stroke patients treated, the various treatments provided, the time to complete these treatments, and the outcomes of the various treatments. In addition, hospitals must engage in stroke-related quality improvement activities on a regular basis (Alberts et al., 2000).

Survey results regarding quality improvement activities in treatment of acute stroke:

- Approximately one-fourth of hospitals reported annually reviewing the number and types of stroke patients treated, the various treatments provided, the time to complete these treatments, and outcomes of care. CAHs were least likely to systematically review these elements of care (Table 3).
- Fourteen (18%) of 80 responding hospitals reported conducting a stroke-related quality improvement project in the past year. This response varied from 6% of the frontier CAHs to 53% of the large hospitals (Table 3).

Table 3. Quality Improvement in Treatment of Acute Stroke Within Acute Care Hospitals

Quality Improvement Activity	Large (> 50 Beds) (n = 16)	Small (26-49 Beds) (n = 7)	CAH (Non-frontier) (n = 23)	CAH (Frontier) (n = 35)	Total
Hospital performs annual review of the number of stroke patients treated	8 (50%)	4 (57%)	4 (17%)	9 (26%)	25 (31%)
Hospital performs annual review of the type of stroke	8 (50%)	3 (43%)	3 (13%)	6 (17%)	20 (25%)
Hospital performs annual review of the type of treatments provided to stroke patients	8 (50%)	3 (50%) ¹	2 (9%)	7 (20%)	20 (25%)
Hospital performs annual review of the time required to provide treatment to stroke patients	8 (50%)	3 (43%)	2 (9%)	7 (20%)	20 (25%)
Hospital performs annual assessment of outcomes for stroke patients	8 (50%)	2 (29%)	1 (4%)	7 (20%)	18 (22%)
Hospital has conducted a stroke-related QI project within the last year	8 (53%) ²	2 (29%)	2 (9%)	2 (6%)	14 (18%)

¹ n = 6.

² n = 15.

“The survey opened my eyes to some very real gaps in our ER and stroke patient care pathways. I will attempt to generate a performance improvement program on stroke care in-house.”—Large-Hospital Respondent

How many Nebraska hospitals have provided public education about stroke as a medical emergency and about primary stroke prevention?

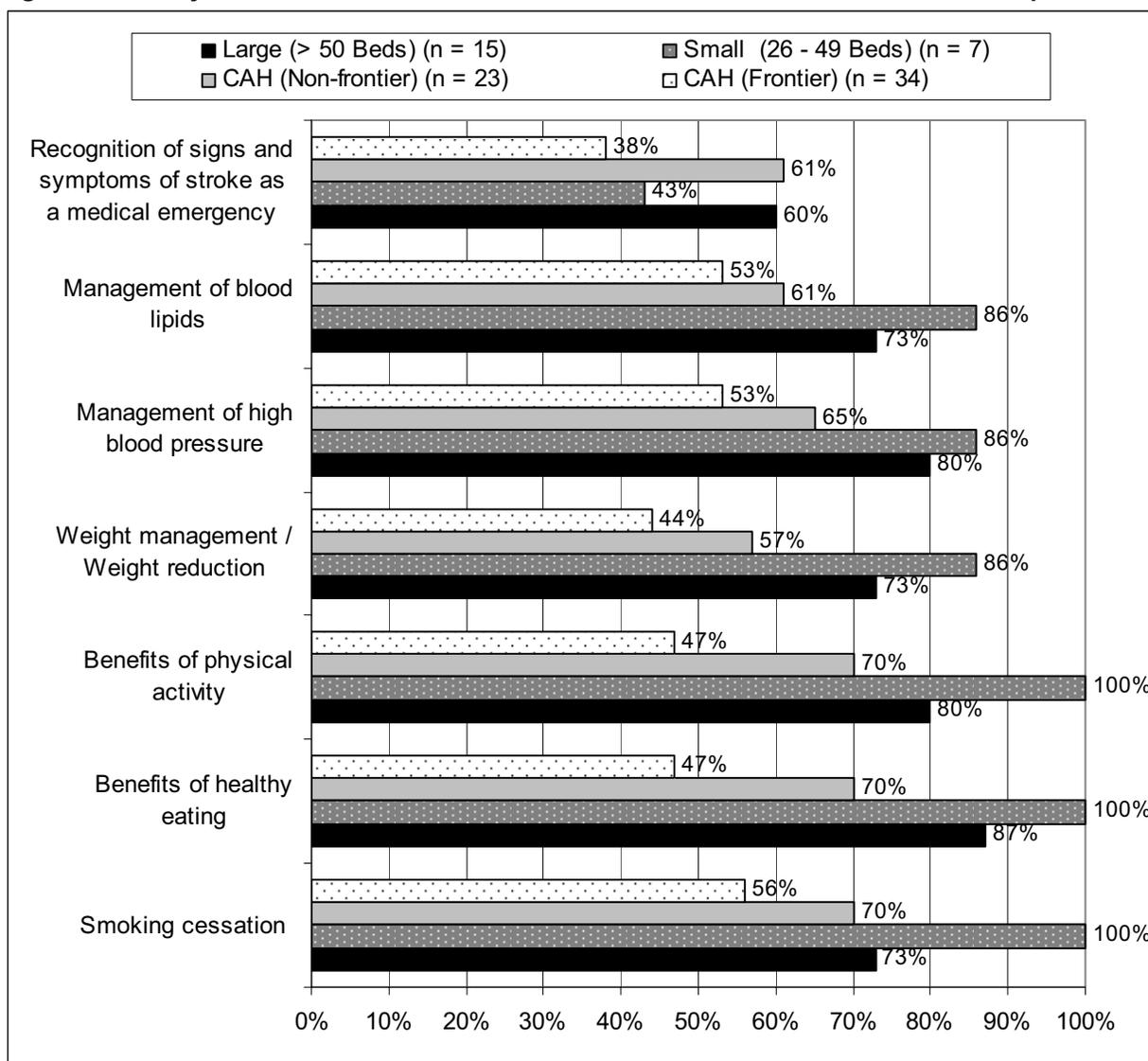
Systems of stroke care at local and regional levels should coordinate and improve access to the full range of services associated with stroke prevention, treatment, and rehabilitation. These services include public education regarding signs and symptoms of stroke as a medical emergency and primary prevention activities to minimize the development of risk factors that increase the likelihood of stroke. Primary stroke prevention includes smoking cessation, exercise promotion, and management of weight, blood pressure, and blood lipids. Improved public awareness of the common warning signs of stroke should increase the use of EMS and the probability of arrival at the ED within the three-hour time limit for use of tPA (Schwamm et al., 2005). Poor public knowledge of the signs and symptoms of stroke is a major cause of the underuse of tPA (Bambauer et al., 2006). Data from a prototype stroke registry indicate that less than one-fourth of stroke patients arrive at the ED within three hours of the onset of symptoms (Reeves et al., 2005).

Survey results regarding public education and primary stroke prevention activities:

- Thirty-nine (49%) of 79 responding hospitals reported providing public education in the past year regarding the recognition of signs and symptoms of stroke as a medical emergency. CAHs located in frontier counties were least likely to have provided this education in the past year (Figure 9).
- Approximately two-thirds of 79 responding hospitals reported providing some primary prevention activities to the public in the past year. The small hospitals (26 to 49 beds) were most likely to have provided these activities within the past year (Figure 9).
 - Forty-nine hospitals (62%) reported providing management of blood lipids.
 - Fifty-one hospitals (65%) reported providing management of high blood pressure.
 - Forty-five hospitals (57%) reported providing weight reduction.
 - Fifty-one hospitals (65%) reported providing benefits of physical activity.
 - Fifty-two hospitals (66%) reported providing benefits of healthy eating.
 - Fifty-three hospitals (67%) reported providing smoking cessation education.

“Education to the public is needed. Most patients do not come into the ED in a timely manner (within the three-hour time limit).”—Small-Hospital Respondent

Figure 9. Primary Stroke Prevention and Public Education Activities of Acute Care Hospitals



- Seventy-eight (96%) of 81 responding hospitals reported documenting a patient’s smoking history and 80 (100% of hospitals responding to this question) reported providing advice to quit (Table 4).
- Sixty-eight (84%) of 81 responding hospitals reported providing educational materials about smoking cessation (Table 4).
- Fifty-six (71%) of 79 responding hospitals reported prescribing medications to assist with smoking cessation (Table 4).
- Eleven (14%) of 78 responding hospitals reported referring patients to a telephone quit-line (Table 4).

- Thirty-four (43%) of 80 responding hospitals reported referring patients to an outpatient smoking cessation program (Table 4).

Table 4. Management of Smoking Cessation Within Acute Care Hospitals

Smoking Cessation Management	Large (> 50 Beds) (n = 16)	Small (26-49 Beds) (n = 7)	CAH (Non-frontier) (n = 23)	CAH (Frontier) (n = 35)	Total
Smoking history documented on the nursing assessment admission form	16 (100%)	7 (100%)	22 (96%)	33 (94%)	78 (96%)
Patients advised to quit smoking	16 (100%)	7 (100%)	23 (100%)	34 (100%) ¹	80 (100%)
Patients given educational materials about quitting	16 (100%)	7 (100%)	19 (83%)	26 (74%)	68 (84%)
Patients prescribed smoking cessation medication	10 (63%)	4 (57%)	15 (65%)	27 (82%) ²	56 (71%)
Patients referred to a telephone quit-line	6 (38%)	0 (0%)	2 (9%)	3 (9%) ²	11 (14%)
Patients referred to an outpatient smoking cessation program if available	10 (63%)	4 (57%)	8 (35%)	12 (35%) ¹	34 (43%)

¹ n = 34.

² n = 33.

Which Nebraska hospitals are ready (have the essential structures and processes) to participate in a statewide system of stroke treatment?

Defining Readiness

We divided the hospitals into three categories of readiness to treat acute stroke according to the availability of the essential structures and processes to rapidly diagnose acute stroke (Figure 10). To maintain anonymity, we report the readiness of Nebraska's acute care hospitals by Health Planning Region (Figure 11).

- Seventeen hospitals (21%) were *ready* to treat acute stroke—they reported being able to complete a CT scan within 25 minutes and obtain a report of the results of the scan within 20 minutes; having a written protocol for administration of IV tPA; and being able to obtain neurosurgical services within two hours, either on-site or by transfer. Fifteen (88%) of these 17 had administered tPA in the past year.
- Forty-four hospitals (54%) were *near-ready* to treat acute stroke—they reported having a CT scan available 24 hours a day but lacked at least one of the four additional elements of readiness as defined above. Twenty (45%) of these 44 had administered tPA in the past year.
- Twenty hospitals (25%) were *not-ready* to treat acute stroke—they reported not having a CT scan available 24 hours a day. None of these 20 had administered tPA in the past year.
- Of the 35 responding CAHs located in frontier counties, 5 (14%) were ready, 17 (49%) were near-ready, and 13 (37%) were not-ready. Of the 22 CAHs located in non-frontier counties, 3 (13%) were ready, 13 (57%) were near-ready, and 7 (30%) were not-ready.
- Of the 7 small hospitals, 1 (14%) was ready, and 6 (86%) were near-ready.
- Of the 16 large hospitals, 8 (50%) were ready and 8 (50%) were near-ready.

Figure 10. Readiness of Acute Care Hospitals to Treat Acute Stroke

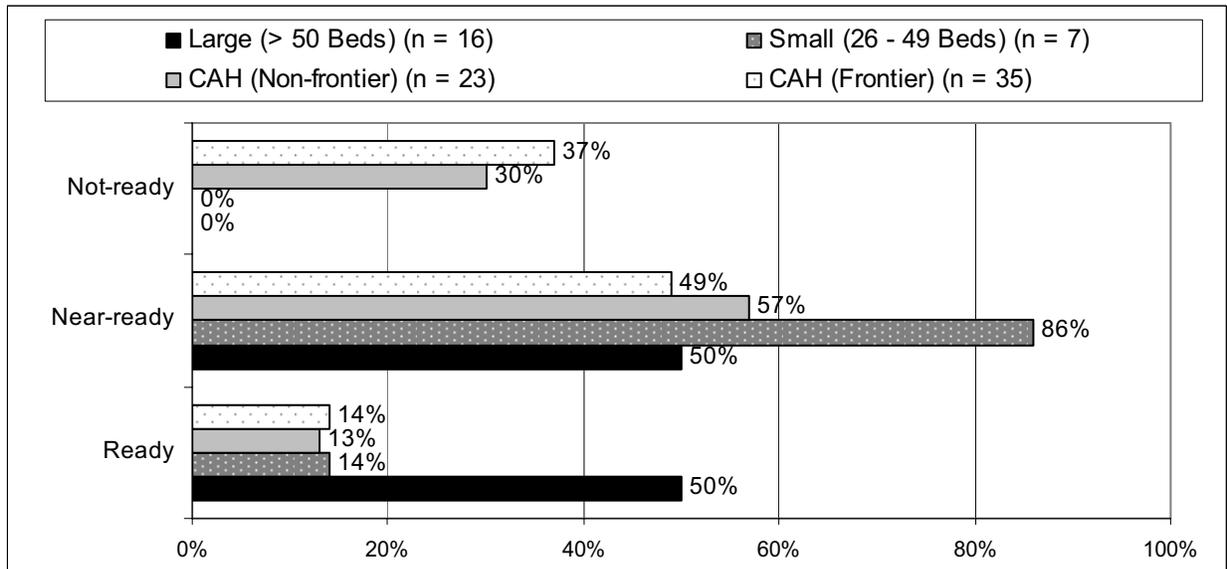
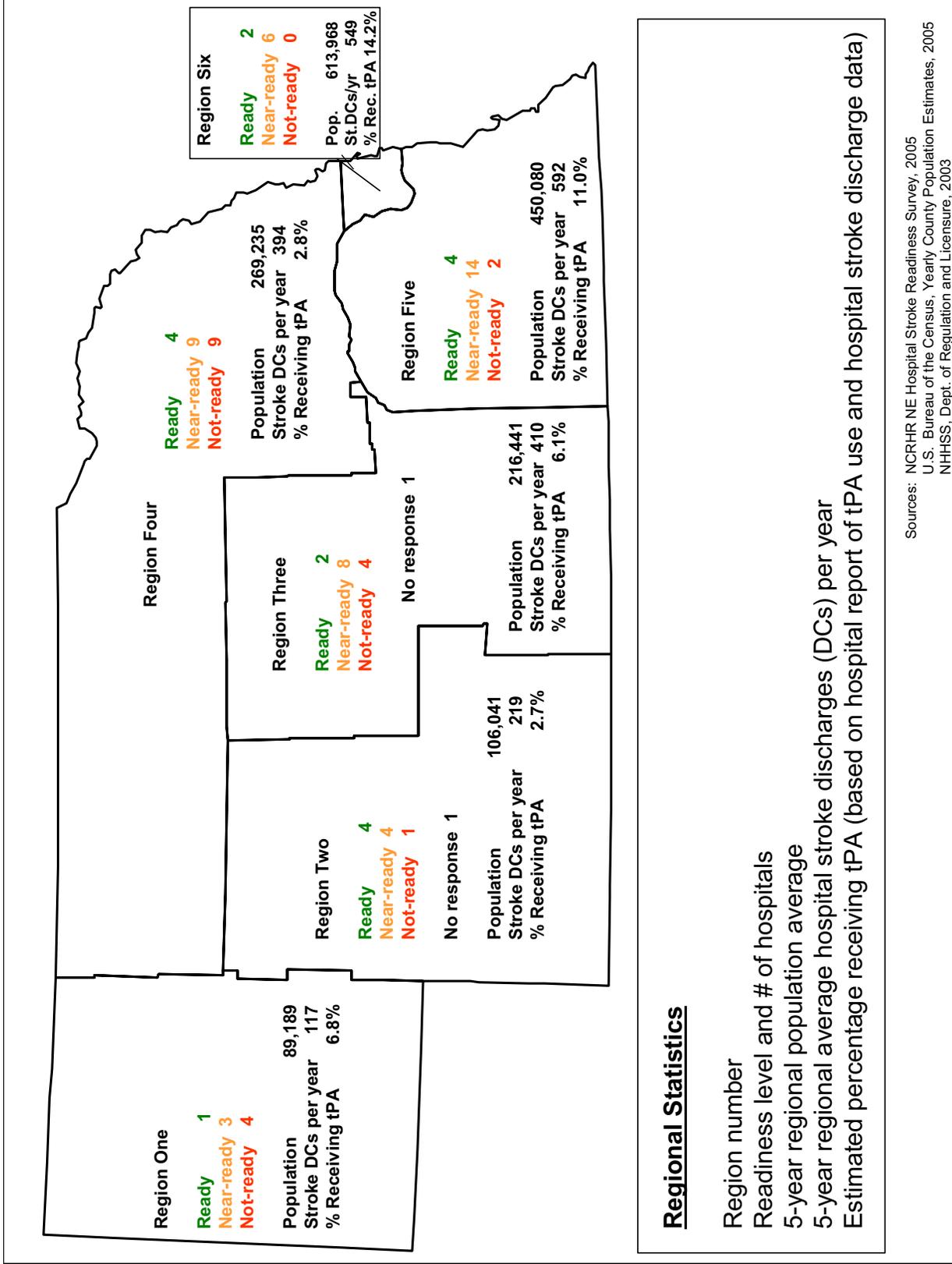


Figure 11. Readiness of Nebraska Acute Care Hospitals to Treat Acute Stroke by Health Planning Region

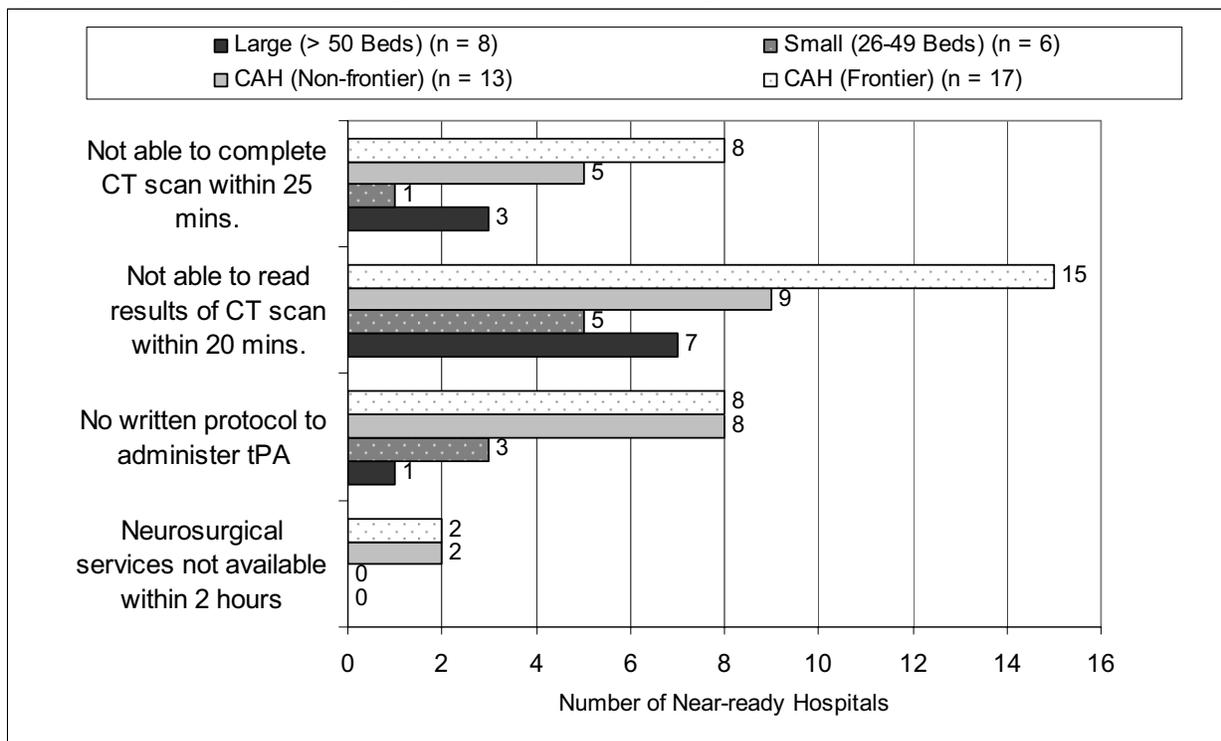


Sources: NCRHR NE Hospital Stroke Readiness Survey, 2005
 U.S. Bureau of the Census, Yearly County Population Estimates, 2005
 NHHSS, Dept. of Regulation and Licensure, 2003

The 44 near-ready hospitals need resources to develop timely diagnostic processes and treatment protocols.

- Seventeen (39%) of the 44 near-ready hospitals reported not being able to complete a CT scan within 25 minutes.
- Thirty-six (82%) of the 44 near-ready hospitals reported not being able to read the results of a CT scan within 20 minutes.
- Twenty (45%) of the 44 near-ready hospitals reported not having a written protocol to administer IV tPA.
- Four (9%) of the 44 near-ready hospitals reported not having neurosurgical services available within two hours.
- The majority of near-ready hospitals reported more than one barrier to being ready to treat acute stroke. Specifically, of the 44 near-ready hospitals, 8 (18%) reported one barrier, 19 (43%) reported two barriers, and 17 (39%) reported three barriers.

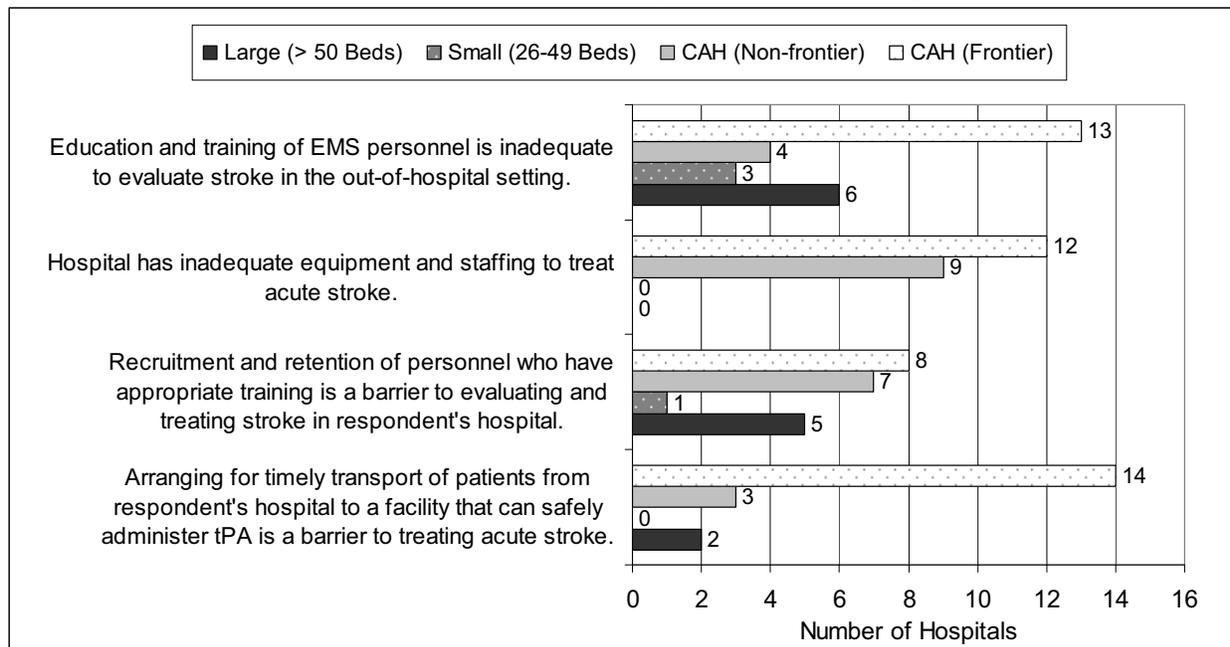
Figure 12. Number of Near-ready Acute Care Hospitals by Barrier to Readiness



Barriers to Treating Acute Stroke

- Twenty-six (33%) of 78 responding hospitals indicated that education and training of EMS personnel is inadequate to evaluate stroke in the out-of-hospital setting.
- Twenty-one (27%) of 56 responding CAHs indicated that their hospital had inadequate equipment and staffing to treat acute stroke as compared to none of the 7 small and 16 large hospitals.
- Twenty-one (27%) of 79 responding hospitals agreed that recruitment and retention of personnel who have appropriate training is a barrier to evaluating and treating stroke in their hospital.
- Nineteen (26%) of 72 responding hospitals agreed that arranging for timely transport of patients from their hospital to a facility that can safely administer tPA is a barrier to treating acute stroke. CAHs located in frontier counties were most likely to agree that timely transport was a barrier.

Figure 13. Number of Acute Care Hospitals Reporting Barriers to Treating Acute Stroke



“Another barrier is the low frequency with which we see acute stroke patients.”—Frontier CAH Respondent

“Need the knowledge of where to find adequate staff education for treatment of stroke.”—Frontier CAH Respondent

Barriers to Administering tPA to Potentially Eligible Patients for Treatment of Acute Stroke

Researchers have indicated a number of potential reasons for the underuse of tPA for treatment of potentially eligible patients. These reasons include (1) inadequate infrastructure to administer the drug, (2) physician fear of legal liability for poor patient outcomes, and (3) insufficient reimbursement for a complex treatment regimen (Alberts, 1999; Reeves et al., 2005; Bambauer et al., 2006). Bambauer and colleagues reviewed available case law pertaining to cases against physicians involving stroke treatment with tPA. All of the seven final decisions identified concerned claims for failing to administer tPA and not for adverse outcomes related to its use. Bambauer and colleagues also reported the potential for improved reimbursement for administration of tPA since the Centers for Medicare and Medicaid Services created DRG code 559 in August 2005, which provides \$11,578 for treatment of stroke patients with tPA. Nebraska hospitals of all sizes reported that physicians encounter many barriers when considering whether a patient is appropriate for thrombolytic therapy using tPA. (Table 5).

Survey results regarding barriers to administering tPA to potentially eligible patients for treatment of acute stroke (Table 5):

- Sixteen (28%) of 57 responding CAHs reported that lack of a CT scanner was a barrier to administering tPA.
- Adequate laboratory support services were not reported as a barrier by any of the hospitals, although two frontier CAHs responded “don’t know” to this question.
- Twenty-six hospitals (33%) reported that inadequate treatment protocols were a barrier to administering thrombolytic therapy. The range of this response varied from approximately 30% of the small hospitals and CAHs to 47% of the large hospitals.
- Eleven hospitals (14%) reported that lack of radiology support services was a barrier to administering thrombolytic therapy. The range of this response varied from 6% of the frontier CAHs to 26% of the non-frontier CAHs.
- Thirty-eight hospitals (48%) reported that lack of diagnostic support from a neurologist was a barrier to administering thrombolytic therapy. The range of this response varied from 29% of small hospitals to 57% of non-frontier CAHs.
- Thirty-seven hospitals (47%) reported that apprehension about adverse patient outcomes was a barrier to administering thrombolytic therapy. The range of this response varied from approximately one-third of the small hospitals and CAHs to 47% of the large hospitals.
- Twenty-eight hospitals (35%) reported that apprehension about litigation was a barrier to administering thrombolytic therapy. The large hospitals were most likely to identify potential litigation as a barrier.

- Eight (10%) of 81 responding hospitals—at least one from each size category—agreed that the cost of tPA is a barrier to treating acute stroke.

Table 5. Reported Barriers Encountered by Physicians Administering Thrombolytic Therapy to Potentially Eligible Patients Within Acute Care Hospitals

Barriers to Administering tPA	Large (> 50 Beds) (n = 16)	Small (26-49 Beds) (n = 7)	CAH (Non-frontier) (n = 23)	CAH (Frontier) (n = 35)	Total
Lack of CT scanner	0 (0%)	0 (0%)	8 (35%)	8 (24%) ¹	16 (20%)
Inadequate laboratory support services	0 (0%)	0 (0%)	0 (0%)	0 (0%)	0 (0%)
Inadequate treatment protocols	7 (47%) ²	2 (29%)	7 (30%)	10 (29%) ¹	26 (33%)
Lack of radiology support services	2 (13%)	1 (14%)	6 (26%)	2 (6%) ¹	11 (14%)
Lack of diagnostic support from a board-certified neurologist	6 (40%) ²	2 (29%)	13 (57%)	17 (50%) ¹	38 (48%)
Apprehension about adverse patient outcomes	9 (56%)	4 (57%)	9 (39%)	15 (47%) ³	37 (47%)
Apprehension about litigation	10 (63%)	1 (14%)	6 (26%)	11 (33%) ⁴	28 (35%)
Cost of tPA	1 (6%)	2 (29%)	2 (9%)	3 (9%)	8 (10%)

¹ n = 34.

² n = 15.

³ n = 32.

⁴ n = 33.

“We have never given tPA . . . reason why is that most patients delay too long . . . now have T1 line and would love to have educational training for staff.”—Frontier CAH Respondent

“Our biggest problem is not having a CT scanner and an X-ray person trained in its use.”—Non-frontier CAH Respondent

“One of the big barriers is that not all the neurologists in our area agree that small hospitals should be giving tPA, and this worries our physicians that they won't get backing if we decide to do this and there is a negative outcome.”—Non-frontier CAH Respondent

“It is the understanding of the physicians here that they cannot administer tPA without specific training in giving the medication.”—Frontier CAH Respondent

“We are anticipating the arrival of two neurologists to our community in May and June 2006. We currently have none.”—Large-Hospital Respondent

Estimate of Percentage of Acute Stroke Patients Treated With tPA

Based upon the prevalence of ischemic stroke and the guidelines for use of tPA, Bambauer et al. (2006) concluded that ideally, 40% of all stroke patients should receive this drug. However, community-based, multi-hospital studies have found that nationwide 2% to 8.5% of ischemic stroke patients receive tPA (Reeves et al., 2005; Johnston et al., 2001; Reed et al., 2001).

We used hospital discharge data for ICD-9 CM codes 430 - 437 (cerebrovascular disease, excluding late effects) from 1999 to 2003 from the Nebraska Hospital Association to determine a stable estimate of the average number of stroke patients treated per year in Nebraska hospitals. We used this five-year average and the reported number of times a hospital administered tPA in the previous year to estimate the percentage of acute stroke patients treated with tPA within each Health Planning Region (Figure 11). The estimated percentage of acute stroke patients receiving tPA ranged from 14% in Region Six (Eastern) to 3% in Regions Two (Southwest) and Four (Northern). Based upon this estimate, stroke patients in Regions Five (Southeast) and Six (Eastern) were two to five times more likely to be treated with tPA than were stroke patients in the remainder of the state.

There are limitations to this estimate of the treatment of acute stroke with tPA. Specifically, the absolute number of strokes within each Health Planning Region is most likely underestimated due to underreporting of discharge data by insurance companies to the Nebraska Hospital Association. Underestimation of the number of strokes would result in overestimation of the percentages treated. However, it is unlikely that overestimation of the treatment percentages would affect the observed relative disparities in treatment of acute stroke with tPA between Health Planning Regions.

Are Nebraska hospitals supportive of a statewide system to treat acute stroke?

The ASA states that many of the obstacles to incorporating scientific advances into clinical practice are due to fragmentation of care across multiple facilities, agencies, and providers. The ASA advocates building stroke systems of care to prevent this fragmentation and improve patient outcomes in the prevention, treatment, and rehabilitation of stroke. Systems of stroke care must include primary prevention, community education, notification and response of EMS, acute stroke treatment, subacute stroke treatment, secondary prevention, rehabilitation, and continuous quality improvement (Schwamm et al., 2005). Previous studies have found that rural populations are most likely to have limited access to evidence-based acute stroke treatment due to the limited human, technological, and financial resources available in small rural hospitals (Okon et al., 2006; Scott et al., 1998).

Survey results regarding hospital attitudes toward a statewide system of acute stroke care (Table 6):

- Seventy-two (91%) of 79 responding hospitals agreed that public education about stroke risk factors, warning signs, and activation of EMS should be improved.
- Seventy-three (92%) of 79 responding hospitals agreed that EMS educational programs and protocols should be coordinated at the state level.
- Sixty-nine (86%) of 80 responding hospitals agreed that acute care hospitals and EMS providers should develop a coordinated system to ensure that acute stroke patients within a specific area are transported to the facility best equipped and staffed to treat them.
- Seventy (89%) of 79 responding hospitals agreed that in order to economically improve treatment of acute stroke, we should ensure that at least one hospital in a specific region of the state has the equipment and staff necessary to safely evaluate and treat acute stroke.

“The majority of stroke patients we see in the ED have symptoms greater than three hours. Many of the elderly live alone and then it is impossible to determine time of symptom onset.”—Large-Hospital Respondent

“It would be helpful to have a standardized approach statewide.”—Non-frontier CAH Respondent

Table 6. Attitudes of Acute Care Hospitals Regarding a Statewide System of Acute Stroke Treatment

Hospital Attitudes	Large (> 50 Beds) (n = 16)	Small (26-49 Beds) (n = 7)	CAH (Non-frontier) (n = 23)	CAH (Frontier) (n = 35)	Total
Agree that public education about stroke risk factors, warning signs, and activation of EMS should be improved	16 (100%)	5 (71%)	20 (87%)	31 (94%) ¹	72 (91%)
Agree that EMS educational programs and protocols should be coordinated at the state level	14 (88%)	7 (100%)	20 (87%)	32 (97%) ¹	73 (92%)
Agree that acute care hospitals and EMS providers should develop a coordinated system to ensure that acute stroke patients within a specific area are transported to the facility best equipped and staffed to treat them	15 (94%)	7 (100%)	19 (83%)	28 (82%) ²	69 (86%)
Agree that in order to economically improve treatment of acute stroke, we should ensure that at least one hospital in a specific region of the state has the equipment and staff necessary to safely evaluate and treat acute stroke	11 (69%)	7 (100%)	21 (91%)	31 (94%) ¹	70 (89%)

¹ n = 33.

² n = 34.

CONCLUSIONS

Sixty-one acute care hospitals (75%) in Nebraska were ready or near-ready to treat acute stroke. These 61 included 22 CAHs located in frontier counties, 16 CAHs located in non-frontier counties, and the 23 hospitals licensed for more than 25 beds (not CAHs) in 2005. The 20 hospitals that were not-ready to treat acute stroke were all CAHs, 13 of which were located in frontier counties. Hospitals that were near-ready to treat acute stroke lacked written treatment protocols, timely access to a CT scanner, and/or timely interpretation of findings by a radiologist and neurologist. Decreasing the time required to interpret a CT scan will improve the readiness of 36 of the 44 near-ready hospitals. Readiness matters—of the 17 hospitals that were ready, 15 (88%) had administered tPA for treatment of acute stroke, and of the 44 hospitals that were near-ready, 20 (45%) had administered tPA.

Fragmentation of care across multiple organizations and providers is a significant cause of poor quality care (Institute of Medicine, 2001). In the treatment of a time-sensitive condition such as acute ischemic stroke, the delays associated with fragmented care increase the likelihood of death and disability. The results of this assessment indicate that Nebraska acute care hospitals can benefit from a statewide system to coordinate stroke care across settings, collect stroke census and outcomes data, develop transfer and treatment protocols, and provide staff education and conduct quality improvement activities related to stroke care. This conclusion is supported by the following findings:

- Seventeen percent of hospitals reported documenting the role of EMS in acute stroke care and annually participating with EMS in stroke continuing education.
- Two percent of hospitals reported having an organized acute stroke team.
- Twenty percent of hospitals—the 16 largest—reported that a physician is consistently able to initiate evaluation of a suspected stroke patient in the ED within 15 minutes.
- Seventy-five percent of hospitals reported being able to complete a CT scan on-site 24 hours a day.
- Twenty-five percent of hospitals reported collecting data about stroke treatment and outcomes.
- Eighteen percent of hospitals reported conducting a stroke-related quality improvement project.
- Twenty-six percent of hospitals reported conducting stroke education for staff in the past year.
- Thirty-four percent of hospitals reported always following the NINDS Guidelines to determine appropriateness of a patient with acute ischemic stroke for treatment with tPA.
- Fifty-four percent of hospitals reported having a written protocol for administration of tPA.
- Forty-eight percent of hospitals reported that lack of diagnostic support from a neurologist was a barrier to administering tPA.

The results of this assessment are consistent with previous studies, which identified multiple factors that contribute to the under-use of tPA: patients do not present to the ED within the three-hour time limit, there is poor coordination between EMS and acute care hospitals, hospitals lack the infrastructure to diagnose ischemic stroke and administer tPA in a timely fashion, and ED physicians lack diagnostic support and thus fear adverse outcomes and litigation. Similar to other

rural-based researchers, we also found that rural populations were most likely to have limited access to evidence-based acute stroke treatment—the percentage of acute stroke patients treated with tPA in Nebraska hospitals was two to five times greater in the Southeast and Eastern Health Planning Regions than in the remainder of the state. Systems of care are needed at multiple levels to improve stroke-related outcomes by decreasing stroke symptom onset-to-arrival time and in-hospital delays.

NEXT STEPS

The ASA encourages providers and policymakers at local, state, and national levels to build systems of care that improve outcomes related to prevention, treatment, and rehabilitation of stroke (Schwamm et al., 2005). This assessment can be used to prioritize next steps in building stroke systems of care within Nebraska. Three initial steps should be considered to decrease stroke onset-to-arrival time and in-hospital delays.

First, Nebraska Health and Human Services System (NHHSS) should widely disseminate the findings in this report to motivate EMS and hospital stakeholders to form a stroke collaborative to achieve the following: standardize and disseminate public education regarding stroke as a medical emergency; assess and standardize EMS stroke-related transfer and evaluation protocols; disseminate evidence-based ED stroke-related diagnostic, treatment, and transfer protocols including establishment of stroke teams; conduct stroke-related continuing education for providers; and assist providers to implement and measure stroke-related quality improvement programs. EMS and hospital stakeholders should facilitate regional planning to ensure that suspected stroke patients in counties served by not-ready CAHs (those that cannot perform a CT scan 24 hours a day) are transported to the hospital best equipped to evaluate and treat them. Additional regional planning should assist near-ready hospitals to decrease the time required to interpret CT scans including increasing the use of teleradiology.

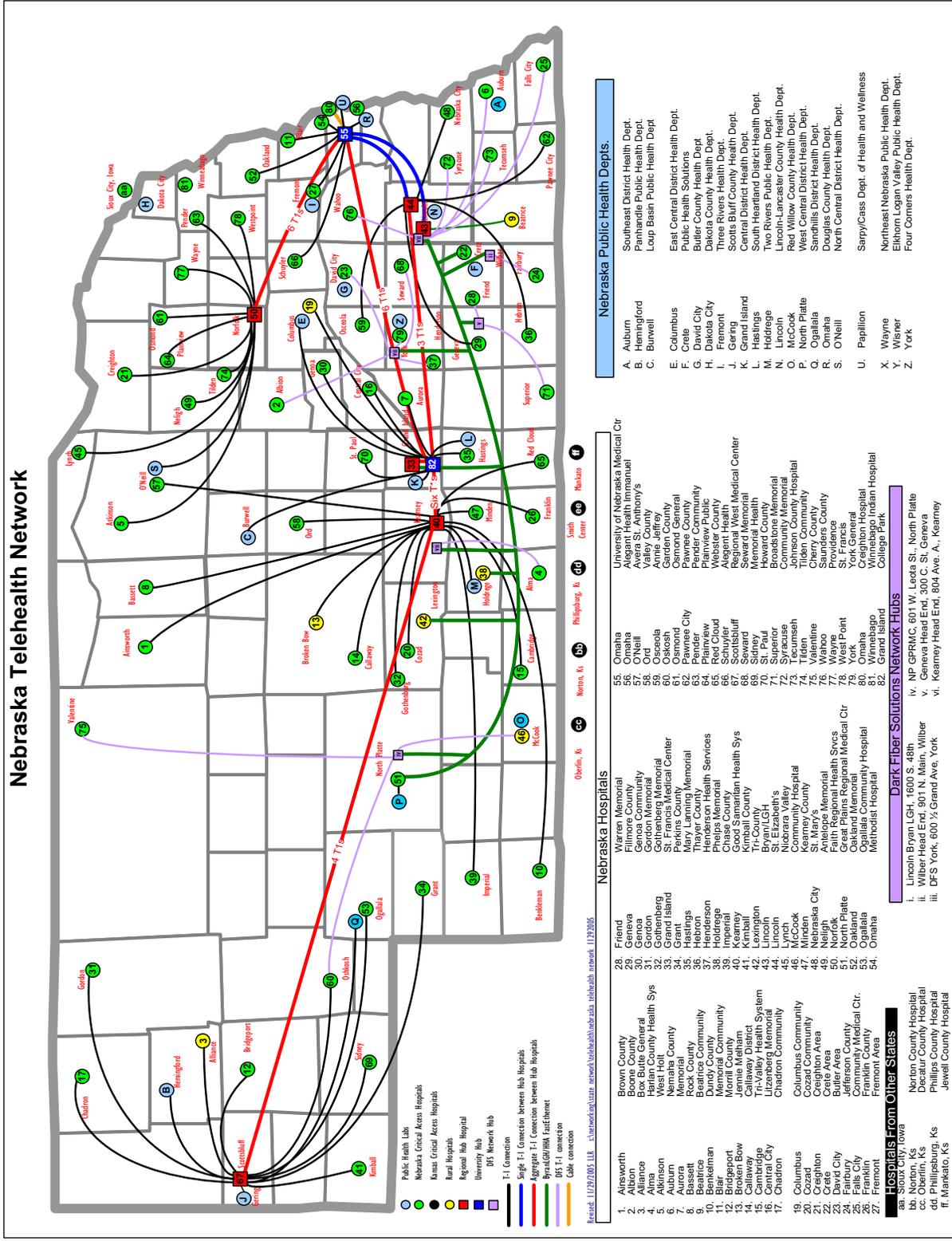
Second, NHHSS and interested stakeholders should convene hospital leaders, neurologists, and representatives from the Nebraska Telehealth Network to determine the potential for using this network to improve access to diagnostic support from the 72 neurological specialists practicing in 12 Nebraska counties (Nebraska Health Information Project, 2005). The Nebraska Telehealth Network is an interactive video and data network that integrates hospitals, public health departments, and public health laboratories across the state. The goals of the network are to minimize distance as a barrier to high quality health care; provide education to patients, providers, and the community; and provide a means of communication during emergencies. All but one of Nebraska's rural hospitals are currently connected to the network and use it for patient consultations and continuing education. Academic medical centers in Georgia, Texas, Massachusetts, and Maryland have successfully used pilot telehealth networks to enable neurologists to support ED physicians in remote areas to provide acute stroke care (Choi et al., 2006; LaMonte et al., 2003; Schwamm et al., 2004; Wang et al., 2004). (Figures 14 and 15).

Third, state policymakers should explore funding sources for a Nebraska stroke registry that will track the numbers and types of strokes within Nebraska, the treatment received, the time to provide the treatment, and outcomes of care. A statewide stroke registry is necessary to determine the impact of the collaborative activities and the use of the telehealth network. Similar to the Coverdell National Acute Stroke Registry, data from the registry could be used to support

community and professional education about stroke, support quality improvement activities for providers, and measure the outcomes of these quality improvement activities (Wattigney et al., 2003).

Most Nebraska hospitals support development of a statewide system to coordinate public education, evaluation, treatment, and transport related to acute stroke. Neurologists in particular will be required to assume a leadership role in the establishment of statewide systems of stroke care that decrease death and disability due to stroke.

Figure 15. Nebraska Telehealth Network



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