

North Carolina Stroke Prevention and Treatment Facilities Survey

Statewide Availability of Programs and Services

Larry B. Goldstein, MD; Lloyd A. Hey, MD; Ronnie Laney, BS

Background/Purpose—The aim of this study was to determine the statewide availability of facilities and programs for stroke prevention and treatment to identify underserved regions and target educational efforts.

Methods—A single-page survey was mailed to the directors of each inpatient medical facility in North Carolina. Data collected included the availability of selected diagnostic tests, programs, and services. Facilities were categorized as providing basic (emergency department, brain CT, treatment with rtPA, transthoracic echocardiography, carotid ultrasonography, cerebral angiography, carotid endarterectomy) or advanced (basic services plus brain MRI, MR angiography, transesophageal echocardiography, transcranial Doppler ultrasonography, interventional radiology) services. The availability of other programs and services, including having a neurologist on staff, organized anticoagulation clinics, inpatient rehabilitative services, diffusion-weighted MRI, community awareness and rapid stroke identification programs, stroke teams, stroke acute care units or an equivalent, and the use of stroke-care maps, were also determined.

Results—Complete responses were obtained from all of the state's 125 inpatient medical facilities. Overall, 97% of the state's population resided in counties with a hospital providing at least some stroke prevention or treatment procedures or services. Full basic services were provided by 23 facilities located in 19 of the state's 100 counties and were available to 52% of the state's population based on county of residence; advanced services were provided by 8 facilities located in 7 counties and were available to 26% of the state's population based on county of residence. Stroke-care maps were used in 83% of basic or advanced centers versus 23% of other hospitals ($P<0.001$), stroke teams were organized in 48% versus 12% ($P=0.001$), stroke units or equivalents were available in 61% versus 9% ($P<0.001$), rapid patient identification programs were in place in 57% versus 9% ($P<0.001$), and community awareness programs were in place in 57% versus 21% ($P=0.005$).

Conclusions—Only 52% of the state's population reside in counties with hospitals providing full basic services; by expanding these services to only 6 additional facilities and thereby encompassing the state's 50 most populous counties, this proportion would be increased to 84%. Services that may improve outcomes and reduce costs (eg, stroke teams, stroke units, care maps) are not widely used, even in centers with full basic capabilities. Targeting educational efforts to these centers could improve the overall level of stroke care for the majority of the state's population. The study serves as a model that can be applied to other states and regions. (*Stroke*. 2000;31:66-70.)

Key Words: cerebrovascular disorders ■ data collection ■ diagnosis ■ emergency medical services ■ prevention

Data from randomized controlled trials demonstrate that specific secondary-preventive treatments can reduce the incidence of stroke in high-risk populations and can improve the outcome of patients who have had a stroke. For example, a series of studies show that the careful use of warfarin reduces the risk of stroke in selected patients with atrial fibrillation.¹ The performance of carotid endarterectomy can decrease stroke risk in selected individuals with high-grade stenosis of the extracranial carotid artery.² In the setting of acute ischemic

stroke, the NINDS rt-PA trial found that administration of recombinant tissue-type plasminogen activator to selected patients significantly reduces disability 3 months and 1 year later.^{3,4} Emerging data suggest that judicious use of this drug in a variety of community settings results in outcomes similar to that found in this clinical trial.⁵⁻⁸ Other promising hyperacute therapies are currently under development. Organization of care may also affect outcome after stroke. Management by neurologists,^{9,10} treatment by an organized team,¹¹ and the use of stroke-care

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From the Departments of Medicine (Neurology) (L.B.G.) and Surgery (L.A.H., R.L.), Duke Center for Cerebrovascular Disease (L.B.G.), Center for Clinical Health Policy Research (L.B.G.), and Center for Clinical Effectiveness (L.A.H., R.L.), Duke University, and the Durham VA Medical Center (L.B.G.), Durham, NC.

Correspondence to Larry B. Goldstein, MD, Box 3651, Duke University Medical Center, Durham, NC 27710. E-mail golds004@mc.duke.edu

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maps^{12,13} have been associated with shorter hospital stays, fewer complications, and improved functional outcome.

The available data suggest that there is a gap between existing stroke prevention and treatment practices and those supported by the results of clinical trials. Several recent studies show that only about one half of the individuals in the United States with atrial fibrillation who are candidates for anticoagulant therapy are being prescribed this medication.^{14–18} Carotid endarterectomy may be underutilized, even for patients most likely to benefit from the procedure.¹⁹ For a variety of reasons, only a small proportion of patients with acute ischemic stroke are treated with rtPA.^{5,7,8} Although a variety of factors may influence medical practices, both the actual and perceived availability of programs and services can affect their utilization by health care providers and their access by patients. For example, the US National Survey of Physician Practices for the Secondary and Tertiary Prevention of Ischemic Stroke found that physicians in the southeastern part of the country viewed certain services such as cerebral arteriography as being relatively unavailable²⁰ and were relatively less likely to recommend the procedure for their patients.¹⁹ North Carolina lies in this portion of the country in a region known as the “Stroke Belt,” and cerebrovascular disease is a major public health problem in the state.²¹ Based on data from 1990, the age-adjusted stroke mortality rate in the Stroke Belt was 262/100 000 population, which represents a 43% excess over the remainder of the United States. The purpose of the present study was to determine the statewide availability of services and programs for stroke prevention and treatment in North Carolina to identify underserved regions and to target provider educational efforts.

Subjects and Methods

The study methodology has been reported previously.²² Briefly, a list of all inpatient medical facilities in North Carolina (n=125) was obtained from the state’s Division of Facilities. In January 1998, a 1-page survey (Appendix) was mailed to the medical directors of each facility with a cover letter explaining its purpose and signed by the study principal investigator and the deputy director of the state Department of Health and Human Services. Nonresponders were sent a second mailing that again asked them to complete the survey. The survey was then sent by fax to those not responding to the second mailing, with telephone follow-up as necessary.

Several categories of data were collected relating to the availability of basic and advanced stroke prevention and treatment facilities and programs. These included a variety of diagnostic studies and a series of programs and services useful in stroke prevention and treatment (anticoagulation clinic, the performance of carotid endarterectomy, community stroke awareness programs, the availability of an emergency department, an acute stroke team, hospital stroke-care map, an acute stroke identification program, stroke rtPA protocol, Stroke Acute Care Unit or its equivalent, and whether the hospital had a neurologist). In addition, individual facilities were categorized as providing full basic or advanced stroke prevention and treatment services. We defined basic stroke prevention and treatment centers as those providing emergency department services and treatment with rtPA (discussed in a separate publication²²); having brain CT scan, carotid ultrasonography, cerebral angiography, and transthoracic echocardiography; and performing carotid endarterectomy. In addition to all basic services, advanced centers were defined as also offering brain MRI, MR angiography, transesophageal echocardiography, transcranial Doppler ultrasonography, and interventional radiology services.

TABLE 1. Availability of Programs and Services

Program or Service	Facilities		Proportion of Population, %
	No.	%	
Diagnostic tests			
Brain CT scan	109	88	94
Carotid ultrasonography	102	82	93
Brain MRI scan	97	78	92
Transthoracic echocardiography	77	62	82
MR angiography	71	57	80
Transesophageal echocardiography	56	45	74
Cerebral angiography	48	38	70
CT angiography	44	35	55
Transcranial Doppler ultrasonography	34	27	55
Diffusion-weighted MRI	25	20	44
Services			
Emergency department	110	88	96
Neurologist on staff	69	55	81
tPA protocol	54	43	74
Carotid endarterectomy	54	43	72
Interventional radiology	29	23	51
Programs’ organizational features			
Stroke-care map	42	34	58
Community awareness program	34	27	57
Inpatient rehabilitation	31	25	47
Stroke acute care unit or equivalent	23	18	45
Organized stroke team	23	18	42
Rapid patient identification program	22	18	38
Anticoagulation clinic	8	6	23

The table gives the number and proportion of inpatient medical facilities in North Carolina offering the indicated programs or services. The last column gives the proportion of the state’s population residing in counties with at least 1 facility offering each service.

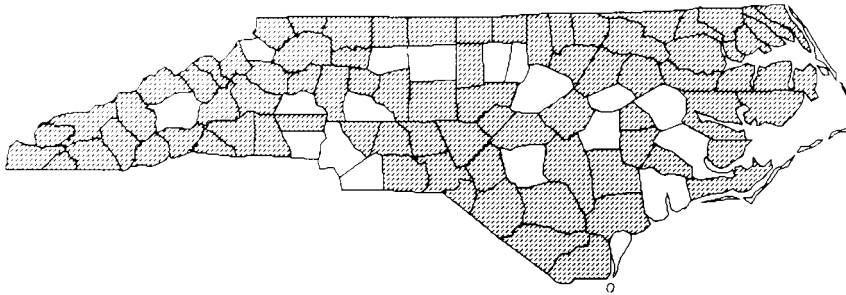
Population data were obtained from the last available census,²³ which permitted the calculation of the proportion of the state’s population residing in counties with hospitals providing each program or service. χ^2 statistics were used to compare specific programs provided in basic or advanced centers with those offered in other facilities.

Results

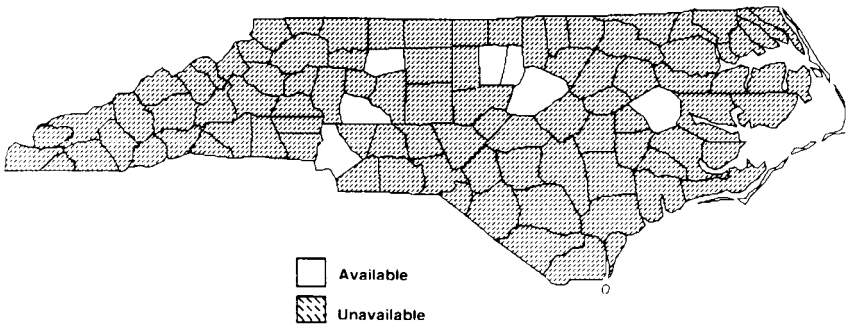
Responses were obtained from every inpatient medical facility in North Carolina, which provided comprehensive, statewide data. These 125 facilities were located in 84 of the state’s 100 counties.

Table 1 gives the number and proportion of facilities and the proportion of the state’s population residing in counties with each of the indicated programs and services. Overall, 97% of the state’s population resided in counties with a medical facility providing at least some stroke prevention or treatment procedures or services.

Basic Stroke Prevention and Treatment Centers



Advanced Stroke Prevention and Treatment Centers



Maps of North Carolina showing counties with medical facilities having full basic (top) or advanced (bottom) stroke prevention and treatment programs and services (see text).

The Figure gives the geographic distribution based on county of facilities having basic or advanced stroke prevention or treatment centers. Full basic services were provided by 23 facilities (18% of all facilities in the state) located in 19 counties and were available to 52% of the state’s population based on county of residence. Advanced services were provided by 8 hospitals (6% of facilities) located in 7 counties and were available to 26% of the state’s population based on county of residence.

Table 2 compares various organizational features in centers providing basic or advanced services compared with the other facilities in the state.

TABLE 2. Comparison of Organizational Features of Hospital Providing Full Basic or Advanced Stroke Prevention and Treatment Services and Other Facilities

Programs or Organizational Features	Basic/Advanced, %	Other, %	P
Stroke-care map	83	23	<0.001
Stroke acute care unit or equivalent	61	9	<0.001
Community awareness program	57	21	=0.005
Rapid patient identification program	57	9	<0.001
Organized stroke team	48	12	=0.001

Discussion

This study provides comprehensive data describing the availability of hospital-based stroke prevention and treatment services in an entire state. The usefulness of the data would have been compromised if less than 100% of centers responded to the survey. This extraordinary response rate was likely obtained by directing the questionnaire to hospital senior management (with the understanding that they would obtain the necessary information from appropriate members of their staff), keeping the survey short (1 page, with a limited number of directed questions), by having the survey mailed with a cover letter from the state’s Department of Health and Human Services, and by again surveying the nonresponders by mail, then fax, and finally by telephone.

Overall, 97% of the state’s population resided in counties with a medical facility that provided at least some stroke prevention or treatment procedures or services. Hospitals providing full basic or advanced services were available to a more limited proportion (52%) of the population. Although local referral patterns could alter these estimates, this proportion would be increased to 84% by expanding these services to only 6 additional facilities, thereby encompassing the state’s 50 most populous counties. Inspection of the Figure shows that there are no basic or advanced facilities in the northeastern or western areas of North Carolina. Targeting

hospitals in these regions could be prioritized in a statewide effort to improve access to stroke-related preventive and treatment services.

The optimal methods for translating the best available evidence into clinical practice is uncertain²⁴; however, it is clear that the availability of services affects their use.¹⁹ As shown in Table 1, specific diagnostic tests and procedures are variably available to the state's population based on their county of residence. Depending on the specific modality, this could lead to either underutilization or overutilization. For example, a variety of potential barriers exist that may limit the appropriate use of anticoagulants for patients with atrial fibrillation. Organized anticoagulation services were offered in only 8 hospitals located in the counties of residence of less than 25% of the population. Such services can improve the efficiency of chronic anticoagulation, and more widespread use may lead to improved anticoagulation practices.^{25–27} A formal study of the impact of organized anticoagulation services is in progress.²⁸ In contrast, carotid endarterectomy, another nonemergency stroke preventive intervention, was available in 54 hospitals. The benefit of carotid endarterectomy is highly dependent on surgical risk; however, formal monitoring of carotid endarterectomy complication rates is commonly lacking.²⁹ Data are available that suggest complication rates are generally related to surgical volume.³⁰ Given the number of facilities performing carotid endarterectomy in the state, the operation is likely being performed in low-volume centers, at least some of which may have relatively elevated complication rates. Only prospectively collected data will permit accurate assessment of this potential problem.

Emergency department services and brain CT scan were available in the county of residence of approximately 95% of the population. However, tPA protocols were available to only 74%. Because of the narrow treatment window for tPA, targeting hospitals in underserved regions without tPA protocols that are otherwise equipped to offer this therapy would make it potentially available to all but a small minority of patients.

Some of the new acute stroke interventional strategies under development will require specific technologies or expertise. Studies evaluating the utility of advanced diagnostic imaging such as diffusion-weighted MRI (DW-MRI) are in progress.^{31,32} Although only 44% of the state's population resided in counties with hospitals that currently perform DW-MRI, brain MRI scan was available to 92%. Because the DW-MRI can be performed with updated software on most MRI scanners, more widespread availability could be achieved relatively easily should the use of this diagnostic study prove useful for optimal patient management. In contrast, interventional radiology services were available in only 29 facilities, which were located in the counties of residence of 51% of the population. If time-dependent treatments requiring interventional radiology services, such as the intra-arterial administration of thrombolytic agents, were approved for routine clinical use, it will be logistically difficult and relatively expensive to extend this service.

These data have several other implications for the current organization of hospital-based, stroke-related care. For exam-

ple, treatment by an organized team,¹¹ and the use of stroke-care maps^{12,13} have been associated with shorter hospital stays, fewer complications, and improved functional outcome. As expected (Table 2), hospitals that provided full basic or advanced stroke prevention and treatment services more commonly had rapid stroke patient identification programs, stroke teams, stroke-care maps, and stroke acute unit care units (or their equivalents). However, even within the more comprehensive centers, these organizational programs were frequently not being utilized. Stroke-care maps were not used in 20%, and approximately 40% to 50% did not have rapid patient identification programs, stroke teams, or stroke units. In addition, the International Stroke Trial found that only 4% of patients with acute ischemic stroke presented to the hospital within the first 3 hours after the onset of symptoms,³³ and delayed presentation remains a major barrier to the use of tPA. Yet, only 57% of medical facilities providing basic or advanced services had community stroke awareness programs (only 20% of other hospitals had these types of programs). Based on these data, educational efforts aimed at improving the organization of stroke-related care could first be targeted at hospitals otherwise providing basic or advanced services that currently lack these programs.

Although the availability of programs and services is a prerequisite for their use by both healthcare providers and patients, mere availability does not mean that the services are being used, or that their use is appropriate. This, and the impact of specific programs and services on patient outcomes, can be determined only through ongoing quality and outcomes assessments. However, understanding the availability of services is an important first step in improving the level of stroke-related care within a geographic region and permits targeting of selected centers for development of stroke-treatment capabilities. This study serves as a model that can be applied to other states and regions.

Appendix

North Carolina Stroke Prevention and Treatment Facilities Survey

Please mark below to indicate the availability of the indicated programs or procedures at your facility:

Diagnostic Tests and Procedures

- Carotid duplex ultrasonography
- Transcranial Doppler ultrasonography
- Cerebral angiography
- Brain CT scan
- Brain MRI scan
- Diffusion-weighted MRI
- MR angiography
- CT angiography
- Transthoracic echocardiography
- Transesophageal echocardiography

Programs and Services

- Community stroke awareness program
- Carotid endarterectomy
- Emergency department
- Acute stroke team
- Stroke-care map
- Acute stroke identification program
- Stroke rtPA protocol
- Neurologist

Clinics/Facilities

- Anticoagulation clinic
- Stroke Acute Care Unit (or equivalent)
- Inpatient Rehabilitation Unit

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