

Telestroke to Improve Acute Stroke Care in North Carolina

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Effective, albeit time-limited, treatment is available for acute ischemic stroke but is underutilized in North Carolina. There is a mismatch between stroke resources and expertise and the services available at many hospitals where patients seek initial care. Video telecommunications can improve access to stroke expertise and to potentially life-saving therapies.

Stroke remains a worldwide health burden, causing high morbidity, mortality, and medical costs. The American Heart Association reports that in the United States there is a death due to stroke every 4 minutes, and stroke accounts for approximately 1 out of every 18 deaths [1]. In 2010, the estimated direct and indirect costs of stroke in the United States was \$73.7 billion [2]. The use of stroke units and thrombolysis has been strongly recommended for treatment of acute ischemic stroke in order to improve patient outcomes [3]. Intravenous recombinant tissue plasminogen activator (tPA) was first approved by the US Food and Drug Administration in 1996, with recent widespread acceptance in clinical practice of a slightly expanded window of 4.5 hours for possible use. Yet the overall rate of thrombolytic usage has remained very low in the United States. This is especially true for small hospitals, as well as for those in rural or underserved areas, and those located in the South or the Midwest [4].

North Carolina has been identified as 1 of 11 states included in the stroke belt, and the eastern part of the state is actually in the region known as the buckle of the stroke belt, where overall average stroke mortality is more than 40% higher than in the rest of the nation [1]. In 2010, stroke was the fourth leading cause of death in the state. That year, the overall stroke death rate was 44.9 per 100,000, and there were 3,588 stroke deaths from among the 56,039 deaths from all causes among those aged 65 and over [5].

Asimos and colleagues reported that in 2008, 56% of patients in North Carolina who died of stroke (3,482 of 6,204) lived within a 40-minute drive of a Primary Stroke Center certified by the Joint Commission [6]. According to a study of the availability of stroke prevention and treatment services in North Carolina from 1998-2008 [7], in 2008 41% of North Carolina residents lived in a county with at least 1 primary stroke center, and an additional 40% lived in a county that used telemedicine or had a transfer plan in place for patients with acute stroke. Nearly 20% of North

Carolinians resided in a county without a primary stroke center and without any facility that used telephone or telemedicine support or had a transfer plan or policy [7]. Data from the North Carolina Stroke Care Collaborative and the North Carolina Division of Public Health (Figure 1) show that the 29 hospitals that have achieved designation as primary stroke centers from the Joint Commission are primarily located in the center portion of the state and along major highways [8]. As a result, many counties, and thus people, are quite a distance from a primary stroke center.

This is important, because effective therapies for acute ischemic stroke, such as thrombolysis with tPA, are time-limited. Physicians in rural hospitals are often reluctant to even consider the use of such treatments due to lack of experience managing acute stroke, the risks associated with thrombolysis, and lack of neurological backup. Thus there is a mismatch, or gap, between populations with significant clinical stroke needs, especially in rural regions of the state, and the expertise and resources needed to provide high-quality care for acute stroke.

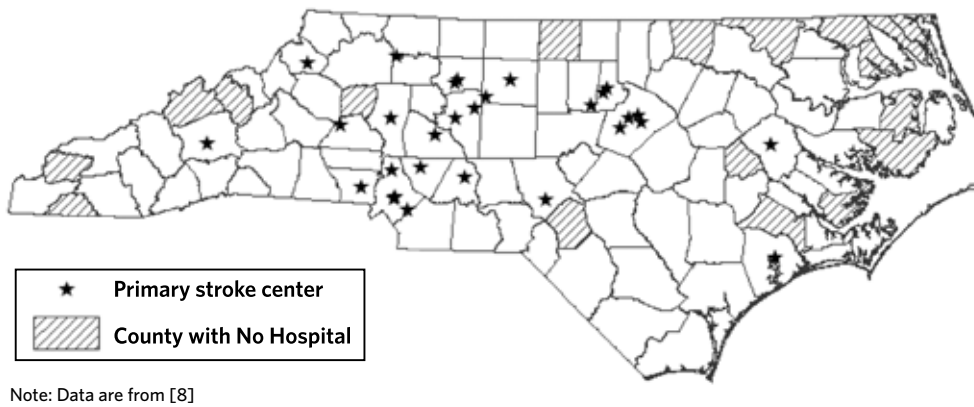
Technology has long been used in medicine to try to overcome geographic barriers and mismatches between patient need and the necessary expertise and resources. For stroke, it has been common to use telephone communications to connect rural facilities with stroke centers in order to facilitate acute care. Advances in technology have created opportunities for more robust interactions. Telemedicine for stroke, for which the term *telestroke* has been coined, was first proposed in the 1990s, by Levine and Gorman [9], as a method for overcoming barriers to effective stroke care. Telestroke can be beneficial during both acute and subacute stroke care. It is useful for providing expert opinions not only when decisions are being made regarding the initiation of intravenous thrombolysis with tPA, but also when patients are being selected for other treatments or for further investigations. It can also be used to recruit patients for studies [10]. In 2009, the American Heart Association / American

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FIGURE 1.
Map Showing the Location of Each of the 29 Joint Commission Primary Stroke Centers in North Carolina



Stroke Association recommended implementation of telestroke consultation, using high-quality video teleconferencing, in conjunction with stroke education and training for health care providers, as being helpful for increasing the use of intravenous tPA at community hospitals without access to adequate on-site stroke expertise. The recommendation regarding the use of telestroke consultation to assist with decisions about the use of intravenous tPA was categorized as class I, level of evidence B, meaning the recommendation is based on evidence from a single randomized trial or evidence from nonrandomized studies [11].

The use of telestroke has grown significantly over the past decade. In a recent survey in which 97 potential programs across 43 states in the United States were contacted, 56 programs confirmed telestroke activity, and 38 of them participated in the survey [12]. Telestroke has been shown to increase the thrombolysis rate, with mortality rates and functional outcomes comparable to those of stroke referral centers providing the telemedicine consultations [13, 14]. Additionally, using a lifetime horizon, telestroke appears to be cost-effective compared with usual care [15].

There are now many options and models for telestroke, with solutions available to meet varying hospital needs and clinical situations. There are multiple choices for technology, provider, relationship between hospitals, credentialing, costs, and billing. The most common approach has been for a primary stroke center to establish a hub-and-spoke relationship with smaller, usually rural, hospitals, or those in which on-site neurological coverage is difficult to obtain or is lacking. Technology is deployed at the "spoke" hospitals, allowing the remote presence—for purposes of consultation—of those with greater stroke or neurological expertise. Equipment used for telestroke consultation includes a variety of devices ranging from cart-based (eg, computer/camera on wheels) to self-propelled robotic systems. The common thread has been the capability for high-quality video teleconferencing. Hospitals may also contract directly with third-party vendors for telestroke services without being tied to a hub hospital.

Consultations may be provided by stroke physicians at the hub hospital, or they may be outsourced to commercially available services that provide access to neurological consultation for such patients. The spoke hospital may be a subsidiary or satellite facility of the hub hospital, or it may be part of a different health system. Consultants must be licensed in the state in which the service is provided and must also be credentialed at the spoke hospital. This can be a rather costly and time-consuming process, but recent changes in Medicare rules now allow spoke hospitals to use the credentialing process at the hub hospital as the basis for conferring telemedicine-consulting privileges at the spoke hospital.

There are also many variations in the type of financial relationship the hub hospital has with the spoke hospital. In general, if the hub and spoke are in the same region, so that it is possible for the hub hospital to receive hospital transfers of patients requiring higher levels of care from the spoke hospital, then the costs for technology and consultation services are borne by the hub hospital and are provided without charge to the spoke hospital. In that scenario, the technology is considered to enhance the ability of the hub hospital to manage patients in a preexisting consultation relationship. Legal stipulations require that patients needing transfer to higher levels of care retain the right to go to any hospital they choose after consultation. Spoke hospitals that are so distant from the hub as to practically preclude transfers usually pay the hub hospital a monthly or annual fee for the equipment and professional services. Such spoke hospitals typically transfer patients to a different stroke center that is geographically closer to them. Under Medicare rules, billing for telemedicine services, including telestroke, is possible only when the spoke hospital is in a county designated as rural. There is a national effort under way to try to modify Medicare rules to allow reimbursement for telemedicine services irrespective of a hospital's rural or metropolitan status. Even if that effort is successful, billing by hub hospitals for consultations may cause conflict when a local neurologist assumes care of a stroke patient remaining at the

spoke hospital and tries to bill for consultation. Thus, most telestroke hubs are not currently billing patients for acute stroke consultations.

The focus of telestroke has been consultations in the emergency department for acute stroke, but there is growing interest in using the technology in outpatient settings for hospital follow-up, rehabilitation, and preventive services.

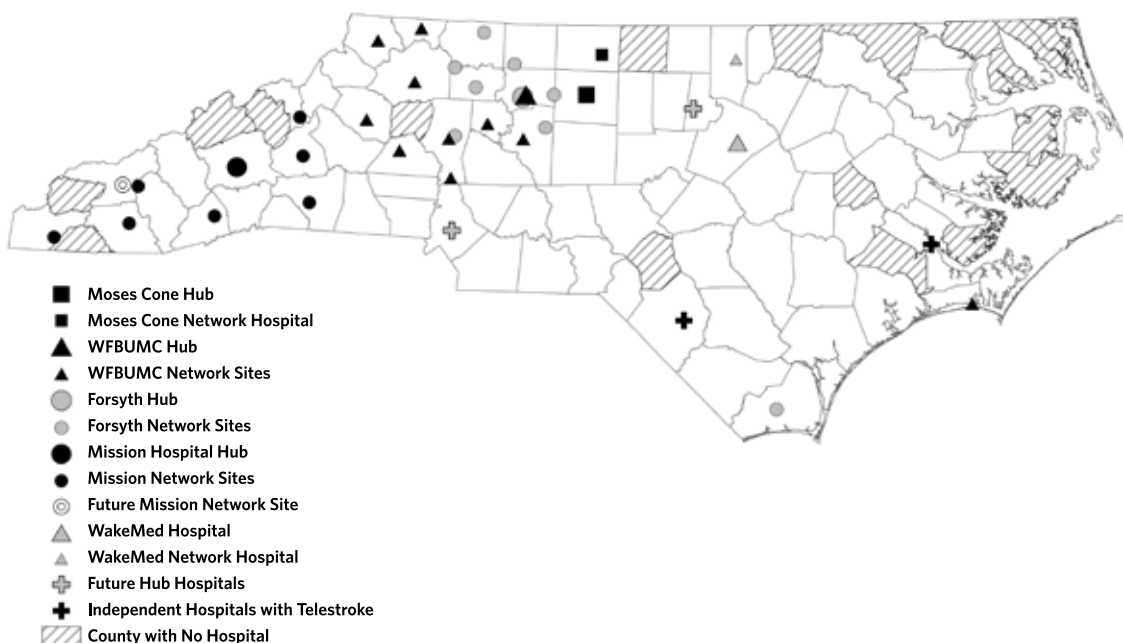
Telestroke provides an opportunity to improve stroke care across North Carolina, especially access to acute therapy with thrombolysis for rural hospitals lacking the resources to be able to offer such services without telestroke consultation. Since 2009, the use of telestroke has grown rapidly in North Carolina. There are now 27 sites that have been identified as spoke hospitals, with 2 additional sites independently contracting for telestroke services (Figure 2). One of the duties of the telestroke subcommittee of the North Carolina Stroke Advisory Council is to help facilitate dissemination of telestroke across the state, with a vision that every hospital will someday have access to telestroke services as a means of improving stroke care in the state.

The Wake Forest Baptist Hospital Telestroke Network (WFBHTN), which was established in November 2009, illustrates the impact a telestroke program can have. The *a priori* objectives of the WFBHTN were to improve stroke care across North Carolina, improve access to local stroke expertise, increase access to acute stroke treatments such as tPA, avoid unnecessary transfers, and encourage local care while facilitating appropriate transfer of those who require

higher levels of care. In addition to offering remote consultation in the emergency department, the WFBHTN strives to improve the quality of stroke care offered at network hospitals by sharing protocols and order sets (evidence-based lists of standardized orders for patients with stroke) and by providing assistance with raising community awareness, education of hospital staff and providers of emergency medical services, and regular review of outcomes for quality improvement purposes. WFBHTN also provides encouragement and consultative assistance when a network hospital decides to move toward applying for designation as a primary stroke center.

There are now 10 spoke hospitals across North Carolina in the WFBHTN, extending from Jefferson in the mountains to Morehead City on the coast. Physicians from the WFBHTN also provide acute stroke consultative services for a hospital that is part of another telestroke network. The WFBHTN provides 24/7 access to stroke consultation with a vascular neurologist. As of October, 2012, there had been 505 network activations, with 311 remote-presence consultations. When remote-presence consultation was provided, 34% of the patients received treatment with acute thrombolysis (C.T. unpublished data, 2012). Because the use of intravenous tPA is known to improve outcomes after acute ischemic stroke, and tPA was not even available in some of these network hospitals prior to the implementation of telestroke, we believe this service is directly improving stroke care in North Carolina.

FIGURE 2.
Map Showing the Locations of Facilities in North Carolina That Are Using High-Quality Video Teleconferencing for Stroke Care or Have Announced Plans to Do So



Note. Figure is based on North Carolina Heart Disease and Stroke Prevention Branch data current as of November 8, 2012.

When no local neurological follow-up care is available, those who have received thrombolysis are transferred to a facility offering a higher level of care. Of the patients who have been seen using a WFBHTM remote-presence consultation, 59% have been able to remain at the network hospital. When this can be done safely, it not only is preferable for the patient and his or her family but also may be financially beneficial for the network hospital. Both patients and families have uniformly embraced the telestroke process; they appreciate direct, visual access to stroke expertise. Another important benefit is that in 2011, 5 patients at a WFBHTN network hospital, who would have otherwise received tPA, were identified by the vascular neurology consultant as having a condition mimicking stroke, and were thus able to avoid the cost and potential risk of tPA treatment. Telestroke can have a positive effect on patient safety.

Telestroke has changed the landscape for acute stroke care in North Carolina, providing a viable solution to a glaring problem. Residents in areas served by telestroke now have access both to stroke expertise and to acute therapies not previously offered in many of those locations, helping to decrease the burden of stroke in North Carolina. Many areas of the state remain without such services, but growing awareness of the capabilities, further advances in technology, and changes in reimbursement policies are expected to support continued growth in the use of telestroke. Research efforts are under way to confirm the beneficial impact of telestroke based on objective clinical and financial outcomes. NCMJ

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