PEER-REVIEWED ARTICLE

Mission Hospital's Code Stroke Team:
Implications for an Aging Population

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Abstract

Objective: *To evaluate the success of an acute stroke program designed to streamline the evaluation and treatment of acute ischemic stroke patients, with particular regard to the risk of symptomatic intracerebral hemorrhage and discharge disposition based on age in those patients treated with acute stroke intervention.*

Methods: *Retrospective review of patients at Mission Hospitals in Asheville, North Carolina from January 2006 to October 2007 with sudden neurological deficit identified within six hours of onset. Data were obtained from Mission Hospital's in-house spreadsheet database and the American Stroke Association's "Get With the Guidelines" (GWTG) database. Patients were evaluated by a code stroke protocol that included early involvement of stroke-treating neurologists. A chart review of all code stroke patients established the number of patients treated with acute intervention, disposition, and follow-up information.*

Results: *Over the 22-month study period, there were 568 code stroke evaluations. Of all code stroke patients, 27.1% (n=154) were treated with an acute intervention for stroke, usually intravenous thrombolysis. We analyzed treated patients on the basis of age, with the younger age group (YAG) being 79 years or younger and the older age group (OAG) being 80 years or older. Of the patients treated with acute intervention, 58 (37.7%) were OAG. Discharge disposition varied with age: 42.7% of YAG patients went home alone or with home health assistance, whereas only 20.7% of OAG patients went home alone or with home health assistance. The inhospital mortality rate was 10.4% for YAG patients and 22.4% for OAG patients. Symptomatic intracerebral hemorrhage was noted in one patient under age 80 and one patient over age 80. This is a symptomatic hemorrhage rate of 1.3%.*

Limitations: *This was a retrospective, observational, post hoc analysis without a standardized follow-up program.*

Conclusions: *Our Code Stroke Team, with an inpatient neurology service, increased the proportion of stroke patients treated with acute intervention benchmarking with other GWTG participating hospitals in this time period. Aggressive stroke treatment with thrombolytic therapy in patients over age 80 did not show an increased rate of symptomatic intracerebral hemorrhage.*

Keywords: *stroke teams; aging population; symptomatic intracerebral hemorrhage; acute stroke intervention; thrombolysis*

Stroke is the third leading cause of death in the United States.[1] Tissue plasminogen activator (tPA) is the only FDA-approved drug therapy for acute ischemic stroke. Thrombolysis with tPA was approved for acute stroke in 1996, but this therapy is limited to patients who present within three hours of symptom onset.[2] A mechanical clot retrieval system is also FDA-approved.[3] Symptomatic intracerebral hemorrhage (SICH) is a potentially fatal complication of thrombolysis. Nationwide, less than 2% of ischemic stroke patients are treated with tPA.[4] Several reasons have been offered to explain the low acute treatment rates in acute ischemic stroke. These include lack of public awareness about stroke symptoms, reluctance of neurologists to be involved in acute stroke therapy, resistance of emergency physicians to utilize thrombolytic therapy in stroke, and poor coordination of services when the patient does arrive with stroke symptoms.[5] In North Carolina, several issues regarding stroke care in a community teaching hospital have been reported. These issues include reliance on community neurology support, the lack of acute stroke response teams (Code

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Stroke Teams), and the lack of standardized protocols for treatment of acute ischemic stroke.[6] To address these issues, Mission Hospitals in Asheville, North Carolina has made a commitment to improve public education, develop a hospitalist neurology program with a Code Stroke Team, and seek The Joint Commission (TJC) primary stroke center certification. Our acute stroke protocols were reviewed and updated through a multidisciplinary group using published guidelines.[7]

Mission Hospital's updated acute stroke protocol was launched in January 2006, and in November 2007 we reviewed our efforts to date. Mission has utilized the "Get With the Guidelines" (GWTG) program to provide a format for data collection and allow for benchmarking to other hospitals using the same system.[8] The GWTG program is an evidence-based program based on scientific guidelines for in-hospital quality improvement. GWTG stroke data is solely based on discharge principle diagnosis code. Our in-house database is a spreadsheet used to collect the Brain Attack Coalition data points and is driven by code stroke evaluation.[9] The Brain Attack Coalition is a group of professional members and organizations that are dedicated to furthering research, awareness, and treatment of stroke.[10] Code stroke evaluation patients may not have a discharge diagnosis of stroke.

Preliminary review of our patients indicated that we were intervening more frequently than other GWTG hospitals. This is a report on a retrospective, non-randomized, non-blinded case series of acute ischemic stroke patients either in-house or presenting to the emergency department in a community hospital, treated within six hours of symptom onset, and entered into our code stroke log from January 2006 through October 2007. Post hoc analysis of outcomes versus age and stroke severity will be discussed. This study was approved by the Mission Hospital IRB.

Methods

Mission is a Level II Trauma Center which receives regional referrals from across western North Carolina for specialized care. There are family medicine and obstetrics/gynecology residency programs, but there is no neurology residency program. There are two full-time neurohospitalists as part of a hospital-employed neurology service that includes outpatient neurologists who participate in covering the Code Stroke Team. Discharge facilities include skilled nursing facilities, an acute rehabilitation hospital, and hospice level care.

The Code Stroke Team is multidisciplinary and includes a neurologist, a code stroke nurse, and radiology, pharmacy, and laboratory personnel. The team is available 24 hours a day, seven days a week for acute stroke intervention. The code stroke nurse is a registered nurse from the stroke unit with additional education in acute stroke and certification in performing the NIH Stroke Scale (NIHSS). The reliability of the NIHSS by non-neurologists has been reported.[11] These nurses are on call within the hospital and respond to the bedside of a code stroke patient to facilitate evaluation per our protocol, helping to expedite treatment opportunities in conjunction with the stroke-treating neurologist. By protocol, the Code Stroke Team is notified of all patients with possible stroke symptoms presenting within six hours of symptom onset.

Emergent imaging studies include cranial computerized tomography (CT) with CT angiography (CTA) of the head and neck. In some cases the CTA is omitted due to clinical presentation or renal insufficiency or failure. Both intravenous (IV) and intra-arterial (IA) thrombolysis are considered in acute stroke as well as interventions such as angioplasty or other techniques of endovascular recanalization when deemed appropriate. Our protocol for acute stroke includes the use of standard IV tPA if the patient presents within three hours and with IA tPA/endovascular therapy if the CTA shows a proximal occlusion and the patient presents within six hours. A combined "bridging" approach with IV tPA plus endovascular therapy is considered if the patient presents within three hours and proximal intracranial occlusion is identified.

Our study population was ischemic stroke patients treated with acute intervention identified by review of our code stroke log and through chart review between January 2006 and October 2007. Code stroke patients are emergency room or in-house patients identified by staff as having a neurological deficit within the last six hours and are recorded in our in-house database. Treated acute ischemic stroke patients are a subset of code stroke patients. Treatment decisions are based on chief complaint and emergency evaluation by the Code Stroke Team. As in other reports, our percentage of acute ischemic stroke patients treated with acute intervention (numerator) out of the total number of ischemic stroke patients (denominator) was obtained by using principal discharge International Classification of Diseases, Ninth Revision (ICD-9) codes.[4] Observational post hoc results differentiated outcomes based on age.

Details of all code stroke patients are entered into an in-house database and monitored as part of our continuous quality improvement initiative. The in-house data are entered in a spreadsheet format during admission and after discharge by our data analyst (AB) who provided data management. Data entered comes from a separate code stroke log that includes code stroke evaluation as well as the medical record. Validation is provided by oversight by the code stroke coordinator (RJ). If the patient has a principal discharge diagnosis of stroke the information is also entered into the GWTG database by AB.

In November 2007, we reviewed our database for all ischemic stroke patients treated with acute intervention since the start of our updated acute ischemic stroke protocol in January 2006 through October 2007. The total number of people admitted with ischemic strokes was determined by principal discharge diagnosis code (ICD-9 codes 433.01, 433.10, 433.11, 433.21, 433.31, 433.81, 433.91, 434.00, 434.11, 434.91, and 436). Some code stroke evaluations were cancelled soon after team notification, usually due to time of onset being greater than six hours. Also, we discovered a small group of patients who presented within the six-hour window that were not designated as code stroke. Neither of these groups were included in the full analysis either because they were not

entered into the code stroke log or because their discharge ICD-9 code was not ischemic stroke.

Information on code stroke patients included age, score on the NIH Stroke Scale, and type of intervention. Trained physicians, registered nurses, or nurse practitioners performed the NIH Stroke Scale. Persons of advanced age, those with advance directives, or those living in a facility other than home were not excluded from acute intervention if the stroke symptoms decreased acceptable baseline independence in the opinion of the treating neurologist. Outcomes with respect to NIH Stroke Scale scores and ages were evaluated. NIH Stroke Scale scores were reviewed to determine if outcome at discharge varied with stroke severity. Patients 80 years old or older were classified as the older age group (OAG) with the remaining patients classified as the younger age group (YAG). Previous reports stratified age above and below 80 years.[12,13] Recorded treatment outcomes included discharge disposition, death, and presence or absence of symptomatic brain hemorrhage.

A follow-up CT scan at 24 hours is routine after treatment with IV tPA. All of the 24-hour CT scan reports were reviewed by two of the authors (RT and CB). If there was report of any hemorrhage, the scan was reviewed to confirm hemorrhage and to differentiate petechial hemorrhage from intraparenchymal hemorrhage. The clinical significance of each hemorrhage was determined by chart review. Intracerebral hemorrhage with a clinical decline was defined as symptomatic while intracerebral hemorrhage without clinical decline was defined as asymptomatic.

Discharge disposition was determined by chart review. Patients were classified as returning to home; home with home health such as physical therapy; acute rehabilitation hospital; assisted living facility; skilled nursing facility (SNF); hospice care; death; or other. Since discharge to hospice care implies imminent death, we combined discharge to hospice care and in-house death in our results and defined it as total mortality. Outpatient modified Rankin scores, a standardized scale for measuring disability in stroke patients, were determined by the follow-up neurologist.

Results

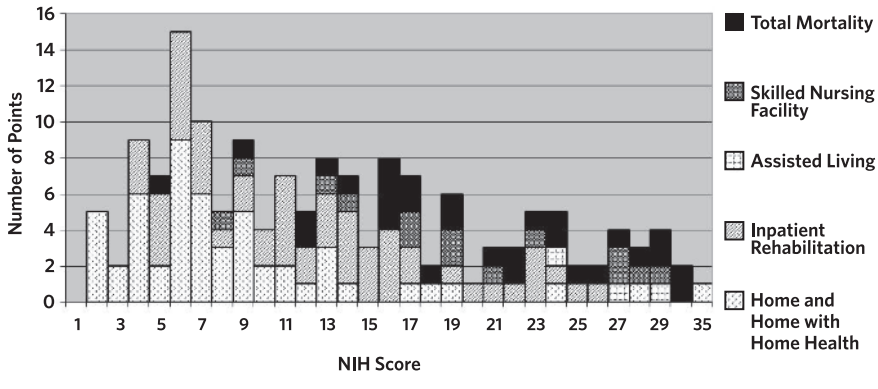
Between January 1, 2006 and October 31, 2007, there were 568 patients evaluated for code stroke. The majority (92.3%, n=524) of those patients came through the emergency department, and the remainder (7.7%, n=44) were in-house patients. This is an average of 25.8 code strokes per month. Of those code stroke patients, 154 (27.1%) were treated with an acute intervention. The reasons for patients not being treated were rapid improvement (33.1%, n=137); onset greater than three hours or uncertain time of onset (23.7%, n=98); CT findings of mass lesion or hemorrhage (16.4%, n=68); seizure at onset or probable seizure at onset (6.0%, n=25); recent surgery, procedure, or stroke (4.6%, n=19); other or unrecorded exclusion (4.6%, n=19); unclear diagnosis (3.6%, n=15); anticoagulation (International Normalized Ratio/INR>1.7) (2.2%, n=9); conversion disorder (1.9%, n=8); patient or family declined (1.9%, n=8); history of gastrointestinal bleeding or other bleeding (1.2%, n=5); and terminal illness (0.7%, n=3). There were 136 (88.3%) patients of the total 154 treated patients who were treated with IV tPA alone, 10 patients (6.5%) were treated with a "bridging" dose of IV followed by endovascular therapy, and eight patients (5.2%) were treated with endovascular therapy alone. The age range for all patients treated was 22-96 years, with a median of 75. The OAG, defined as age greater than or equal to 80, was 37.7% (n=58) of those treated with acute stroke therapy. The age range in the OAG was 80-96 years, and the median age was 85. The YAG, defined as age less than or equal to 79, was 62.3% (n=96) with an age range of 22-79 years and a median age of 67.

The NIH Stroke Scale ranged from 2-35 and the median score was 12. Post hoc evaluation of the 154 treated patients revealed that baseline NIH Stroke Scale of 15 or greater had discharge disposition of death, SNF, or hospice in 23 patients (14.9%), while scores of 14 or less had the same dispositions in only six patients (3.9%) (see Figure 1).

In-hospital mortality overall was 14.3% (n=22). The in-house mortality in OAG was 22.4% (13 out of 58), while the YAG mortality rate was 10.4% (10 out of 96). If patients discharged to hospice are presumed to die soon and those numbers are added to the patients who died in the hospital, there is a total acute mortality rate of 18.8% (29 out of 154) overall, with a rate of 29.3% (17 out of 58) in the OAG and 13.5% (13 out of 96) in the YAG.

The reports of follow-up CT scans on ischemic stroke patients done within 24 hours of acute intervention revealed that 24 patients had descriptions of hemorrhage. Petechial

Figure 1.
Discharge Disposition of all Treated Acute Ischemic Stroke Patients by Initial NIH Stroke Score Between January 2006 and October 2007 (N=154)



hemorrhage (n=15), parenchymal hemorrhage (n=8), and subarachnoid hemorrhage (n=1) were noted. Hemorrhage rates were 13.2% (18 out of 136) with IV tPA and 33.3% (6 out of 18) for endovascular-treated patients. Those patients with any hemorrhage noted on follow-up CT ranged from ages 60 to 93. The median age was 77. The median age of patients without hemorrhage on follow-up CT was 75. Of the 58 OAG patients, there were nine hemorrhages (15.5%) of any type, while of the 96 YAG patients, there were 15 hemorrhages (15.6%) of any type. The median initial NIH stroke score for all patients was 12 with the median initial NIH stroke score for hemorrhage of any type of 17. A single patient had a cardiac arrest and died without a follow-up CT and was assumed to not have a hemorrhage.

All patients with parenchymal hemorrhage on follow-up CT had large ischemic stroke, but two cases had definite clinical deterioration with the intracranial hemorrhage and were designated symptomatic intracranial hemorrhage (SICH). In one SICH a 65-year-old man presented with an NIH Stroke Scale score of 11 and was treated per protocol with IV tPA. Several hours later he was without a deficit before having an acute clinical change, and CT showed a parenchymal hemorrhage within a basal ganglia infarct. He was discharged to an assisted living facility. The other SICH was an 84-year-old woman who was also treated per protocol with IV tPA. Her presenting NIH Stroke Scale score was nine. She developed a large parenchymal hemorrhage, deteriorated, and died. These two hemorrhages give a rate of 1.3% (two out of 154 treated patients) symptomatic hemorrhages in our ischemic stroke patients with acute intervention.

Five patients were treated with IV tPA beyond 180 minutes, but none were treated beyond 190 minutes. There were no symptomatic hemorrhages in this group, but there was one petechial hemorrhage. In each of the cases the timeline was known, and a clinical decision was made to treat beyond 180 minutes.

Of the 58 patients in the OAG, 12 (20.7%) went home with or without home health, while in the 96 patients in the YAG, 41 (42.7%) went home with or without home health. Discharge to home, with or without home health, was higher in the younger age group. The majority of patients had follow-up with other health care providers and those records were not available to the study team. Within a few weeks of discharge, 59 patients had follow-up appointments with the outpatient division of Mission Neurology. Of those patients, 24 (40.7%) did not appear for follow-up appointments. Modified Rankin scores of patients who did present for follow-up revealed a range from zero to four with a mean of one. The modified Rankin scale runs from zero (asymptomatic) to six (death).

Discussion

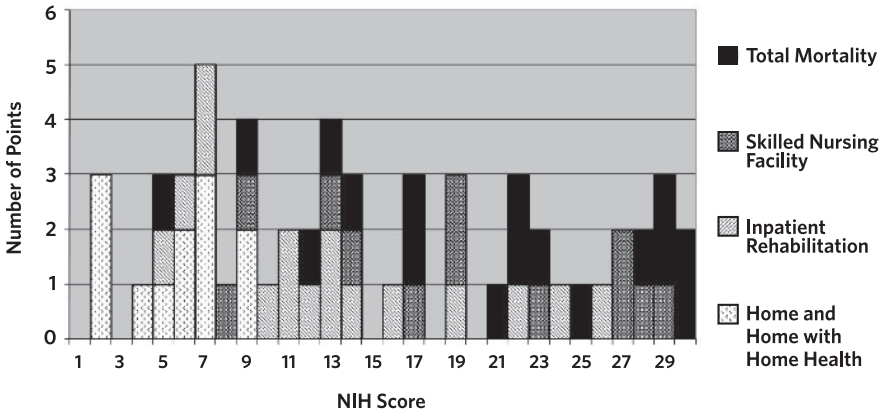
Nationwide, the use of tPA is less than 2% in all cases of stroke.[4] Using our method of dedicated staff for Code Stroke, a group pager notification to relevant clinical and laboratory services, and neurohospitalists, we intervened in 154 out of 568 code stroke patients between January 2006 and October 2007. Based on Mission Hospital's ICD-9 coding, there were 931 cases of principal diagnosis of ischemic stroke during that same period. These numbers determine the percentage of ischemic stroke-treated patients with acute intervention to be 16.5% (154 out of 931) of total ischemic stroke discharges.

Previous reports have emphasized the importance of neurologists in a successful code stroke program.[14] Since teaching institutions have residents and/or fellows within the hospital on a constant basis, neurohospitalists alone at academic medical centers would not be expected to have a large impact on the use of thrombolysis in acute stroke but may be beneficial in nonacademic hospitals. The complex variety of exclusion criteria in our patients indicates a need for neurological expertise. In addition to our neurohospitalist staff, regional education, EMS involvement, code stroke nurses, and multiple department buy-in to the acute stroke protocol process are potential explanations for our number of patients treated. GWTG, our source of information about other institutions, does not differentiate neurohospitalist versus non-neurohospitalist programs.

Discharge disposition did vary with age group and clinical severity. The frequency of in-house mortality in our ischemic stroke patients with acute intervention of all ages was 14.3%. Some patients were discharged to hospice with the expectation of death. We considered the number of in-house deaths and discharges to terminal care/hospice to be equivalent to total short-term mortality which was 18.8% (29 out of 154) in this study. The concept of total short-term mortality is important for institutions without access to hospice discharges to be able to compare outcomes to these reported numbers. Total short-term mortality was more than a two-fold increase in treated acute stroke patients over the age of 80 compared to patients younger than age 80. If the patient is over age 80 and has an NIH Stroke Scale score over 15, the expected discharge disposition is death or SNF, with few patients meeting criteria for inpatient rehabilitation. However, 20.7% of patients over 80 did well, and the hemorrhagic complication rate was not in excess compared to younger patients. We thus conclude that age alone is not an absolute contraindication to acute stroke treatment (see Figure 2).

As seen in other studies where baseline stroke severity is associated with outcome, our study shows the prognosis is better with lower NIH Stroke Scale scores.[15] Neither our database nor GWTG include data on the patient's living situation at baseline, so it is possible that some patients came from assisted living or SNFs with some level of independence and were discharged to the same level of care as baseline. It is also possible that all SNF patients moved down the continuum of discharge disposition. Until more information is available we do not consider arrival from SNF exclusion for acute intervention; decisions should be made based on saving any independent function. The risk of symptomatic intracerebral hemorrhage is well-known and often cited as a reason to avoid tPA in acute stroke.[16] Our experience validates prior reports that hemorrhage of any type on follow-up CT is no more common for people over age 80 than it is for those under 80;[13,17] there was one

Figure 2.
Discharge Disposition of all Treated Acute Ischemic Stroke Patients ≥ 80 Years Old by Initial NIH Stroke Score Between January 2006 and October 2007 (N=58)

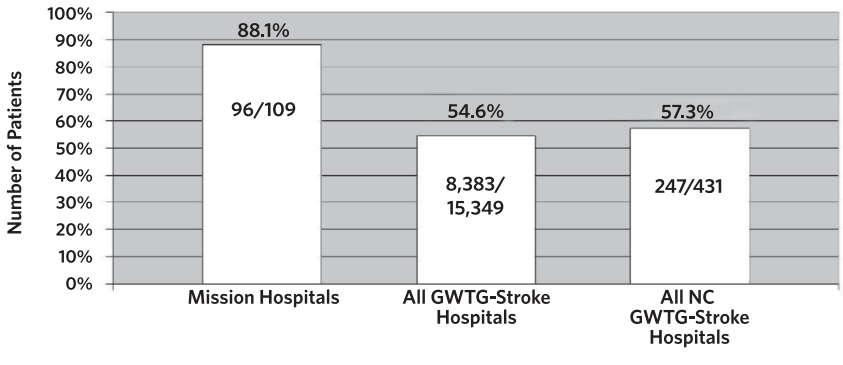


case of SICH over age 80 and one SICH under age 80. The transformation of a small deficit into a large one with thrombolytic therapy is certainly a serious concern. However, cases of parenchymal bleed in this series were seen in patients with large ischemic stroke with no clinical deterioration. Intra-arterial thrombolysis and devices for clot removal had a higher rate of intracerebral hemorrhage at follow-up CT scan, but the majority of these were asymptomatic. Our rate of symptomatic hemorrhage after acute intervention in ischemic stroke was 1.3%. This mirrors a recent report that for every 100 patients treated with IV tPA, approximately one patient will experience a severely disabling or fatal outcome from a SICH, but that analysis did not include other types of intervention.[18] Although the rate of SICH is no higher in patients over age 80, the overall outcome in this group is poor.[19]

In light of this, if acute stroke therapy in patients over age 80 does not result in clinical improvement then the goals of care should be readdressed, particularly if the baseline deficit is severe. Analysis of the efficiency of our program indicates some potential for improvement in monitoring these patients with an opportunity for cost savings. Unexpected deterioration after acute stroke treatments has been rare so our current practice of a 24-hour intensive care unit (ICU) stay may not be adding significantly to patient safety or outcomes. A low-risk monitoring unit outside the ICU would open up ICU beds and use fewer resources. Furthermore, our protocol adopted the original National Institute of Neurological Disorders and Stroke (NINDS) practice of getting a CT scan at 24 hours. The clinical implications of any asymptomatic hemorrhage are not clear, and perhaps there should be study of which patients would benefit from routine 24-hour CT scans.

With respect to follow-up information, the number of patients with primary physicians, the planned follow-up after discharge from acute rehabilitation facilities, and the travel distance to this hospital were not recorded. Only 59 of 154 treated patients (38.3%) had follow-up appointments made with our neurologists; of those patients, 24 (40.7%) did not keep the appointments. Neither age nor degree of disability stands out as issues in those patients who kept their appointments: patients with virtually no impairment got follow-up, as did some patients with severe disability. The no-show rate was similar in patients above and below age 80. Potential explanations include distance to appointment, expenses incurred by the patient, or previously established relationships with primary care doctors. The significance of this lack of neurological follow-up is unknown. Comparison of our data during the time of this review to other hospitals who participate in the GWTG database reveals that our rate (88.1%) of treatment of patients with thrombolytic therapy who arrive within three hours exceeded the pooled data of all hospitals (54.6%) and exceeded the rate in all hospitals within North Carolina (57.3%) (see Figure 3).[20] We have found this database to be easy to use, and it provides real time information for comparison to other institutions. GWTG is a proprietary database that can be used to track treatment and medication parameters. Unfortunately, it is not possible to modify the database. To monitor performance, our code stroke patients are also entered into a separate in-house spreadsheet database.

Figure 3.
Acute Stroke Patients Entered into Get with the Guidelines Database Between January 2006 to October 2007 and Treated with IV tPA within 180 Minutes of Onset of Symptoms



GWTG requires a principle discharge diagnosis ICD-9 code of stroke. Since some treated patients had different discharge ICD-9 codes, GWTG alone is not a complete reflection of treated patients. For example, an ischemic stroke patient treated acutely who had a principal discharge diagnosis code of myocardial infarction would not be included in the GWTG database.

Limitations of this case series are many and include its retrospective nature, the difficulty in merging a proprietary database with our in-house database, the relatively small number of patients, and the lack of standardized methods to compare benchmarks for percentage of treated acute stroke patients between institutions. Statistical analysis was not done, although our results mirror the experience of others with regard to age, stroke severity, and clinical outcome.[12,13,15] Recognition of our above-average treatment rate through GWTG caused a more detailed analysis, all of which was done on a post hoc basis. Important outcome parameters such as baseline, 30-, and 90-day functional levels are not always available through the code stroke log, hospital chart, or available outpatient records. Nevertheless, this article outlines the experience of a single institution making use of all resources in an economical manner.

A review of North Carolina demographics indicate that the elderly population is growing rapidly and the population aged 85 or greater is expected to double in the next 30 years.[21] This mirrors a nationwide trend that is more prevalent in southern states. Treatment protocols for many illnesses may have to be modified or reviewed for appropriate use in older age groups. Regional education, hospitalist vascular neurologists, consensus across many hospital service lines, and a dedicated Code Stroke Team that includes a code stroke nurse can increase acute intervention in ischemic stroke. The GWTG database can serve as a template for process and quality improvement. Our analysis of ischemic stroke patients treated with acute intervention at Mission Hospital by our Code Stroke Team revealed a higher rate of treatment when compared to other GWTG institutions, and the rate of symptomatic hemorrhage was less than historical reports. **NCMJ**

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