TENNESSEE STROKE REGISTRY REPORT, 2014

A partnership between East Tennessee State University College of Public Health, the Tennessee Department of Health and the American Heart/American Stroke Association.
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Executive Summary

In 2008, the Tennessee General Assembly passed a bill that requires East Tennessee State University’s College of Public Health to maintain a statewide stroke database and requests for hospitals to report data on stroke quality metrics beginning in 2009. Currently, six hospitals are enrolled in the Tennessee Stroke Registry (TSR). Based on the data reported, ischemic strokes account for approximately 75% of all strokes in Tennessee. There is an equal distribution of males and females who had a stroke, however, gender distribution varies with stroke subtypes. For instance, the data reported suggest that 65% of subarachnoid hemorrhage patients are female. Patients over the age of 66 make up approximately 56% of stroke patients, but again, this distribution varies with subtype. Patients of subarachnoid hemorrhages tend to be younger with an average age of 60.2 years compared to the overall average age of 67.1 years for all strokes. As supported by many other studies, these data also show that hypertension is the most common co-morbidity of stroke and is therefore an important stroke risk factor to control. Arrival mode (EMS, private transport, or transfer from another hospital) is approximately evenly distributed among all stroke types, but shows a much higher percentage (53%) of TIA patients arriving to the hospitals by means of private transportation. A greater percentage of stroke patients who traveled to the hospital via EMS, as opposed to private transportation, arrived in less than 3 hours (the window of time from initial stroke symptoms in which tPA can be administered). This emphasizes the importance of seeking prompt medical assistance in the case of a stroke. Of all stroke cases reported to the TSR, 61.3% of patients had Medicare insurance. Increasing reporting to the TSR would strengthen the quality of the data and produce a more comprehensive report.
Introduction to the Tennessee Stroke Registry

The Tennessee Stroke Registry was established in 2008 through a bill enacted by the 105th General Assembly of the State of Tennessee. The Stroke Registry Act of 2008* calls for East Tennessee State University’s College of Public Health to maintain a statewide stroke database and report statistics on stroke prevalence, mortality, and performance metrics based on American Heart Association’s Get With the Guidelines standards beginning in 2009. The report is compiled with data input by Tennessee hospitals into Get With the Guidelines, American Heart’s suite of quality improvement registry programs, and is released on an annual basis. Participation in the stroke registry is voluntary and helps to gain a comprehensive picture of stroke in Tennessee. The purpose of the registry is to shed light on the impact and burden of stroke in Tennessee.

*Public Chapter No. 1186/Senate Bill No. 4011 of the 105th General Assembly of the State of Tennessee
Overview of Stroke

A cerebrovascular accident, often referred to as a “stroke” occurs when blood flow to the brain is interrupted, depriving brain tissue of oxygen and nutrients. This interruption can be the result of either the blockage (ischemic) or rupture (hemorrhagic) of a blood vessel supplying blood to the brain.¹ ²

In 2013, stroke dropped from the number four to the number five spot in leading causes of death in the United States. Stroke had a national age-adjusted mortality rate of 36.2 per 100,000 in 2013, with 128,978 people dying from stroke.³ Stroke was the fifth leading cause of death in Tennessee in 2013 with an age-adjusted mortality rate of 43.9 per 100,000, which amounts to a total of 3,123 people in the state.⁴ Tennessee is currently ranked number 45 in overall health outcomes according to America’s Health Rankings.⁵ It ranks 44 in deaths due to cardiovascular disease, including heart disease and stroke⁶ and 45 in occurrences of stroke.⁷

Ischemic Strokes

Ischemic strokes are the most common type of cerebrovascular attack, making up approximately 87% of stroke cases.¹ In an ischemic stroke, blood flow to the brain is inhibited by the blockage of a blood vessel. In a process called atherosclerosis, fatty deposits of plaque collect in the inner lining of a vessel, reducing the amount of blood and oxygen delivered to vital organs. Plaque can rupture and break off into the blood stream, leading to thrombosis, the clotting of blood at the site of plaque rupture. Occlusion occurs when thrombosis leads to a complete blockage of the vessel, and when this vessel is responsible for supplying blood to the brain, can lead to an ischemic stroke. Blockage can also occur through cerebral embolism in which the blood clot forms at another, larger vessel in the circulatory system. Plaque then breaks off and can become lodged in a smaller vessel. When plaque gets lodged in the brain a stroke can occur. An irregular heartbeat, known as atrial fibrillation, is a common cause of clots that form in the heart, then dislodge and travel to the smaller vessels of the brain where they can become lodged, causing cerebral embolism.¹ An estimated 30-40% of ischemic strokes are cryptogenic strokes, or strokes of unknown cause.⁸

Hemorrhagic Strokes

Hemorrhagic strokes result from the rupture of a blood vessel in the brain which can be caused by a variety of factors including aneurysms and arteriovenous malformations (AVMs).² Aneurysms are regions of blood vessels that enlarge or “balloon” at a weakened site. People generally are not born with aneurysms, but develop them due to a constant pressure from blood flow. Aneurysms are associated with other vascular disorders such as fibromuscular dysplasia, cerebral arteritis and arterial dissection.⁹ They may also develop due to infections, drugs or direct brain trauma.⁹ AVMs occur as a result of the clustering of abnormally formed blood vessels. The cause of AVMs is unknown, but thought to be congenital, though not hereditary.¹⁰

There are two types of hemorrhagic strokes: subarachnoid hemorrhage (SAH) and intracerebral hemorrhage (ICH). SAHs occur when a blood vessel on the surface of the brain ruptures and bleeds into the space between the brain and the skull. ICHs occur when the blood vessel that ruptures is deep within the brain.²
Risk Factors:

The American Heart Association/American Stroke Association (AHA/ASA) recognizes the following risk factors for stroke:

- High blood pressure*
- Tobacco use
- Diabetes
- High blood cholesterol
- Physical inactivity and obesity
- Previous stroke/Transient Ischemic Attack (TIA)
- Sickle cell anemia
- Age – stroke risk increases with age
- Gender – each year, more women have strokes than men, and more women die of stroke
- Heredity
- Race – African Americans have a much higher risk of death from stroke than do Caucasians

*According to the Centers for Disease Control and Prevention (CDC) and AHA/ASA, hypertension, or high blood pressure, is the single most important risk factor of stroke to control.

AHA includes the following as other risk factors for stroke that require further research to determine the extent of the association:

- Excessive alcohol intake
- Geographic location – higher risk of stroke in the southeastern region of the US
- Socioeconomic factors – higher risk of stroke in low-income groups
- Drug abuse – increased risk of stroke has been associated with abuse of drugs including cocaine, amphetamines, and heroin

According to the AHA/ASA, about 80% of strokes are preventable. Understanding risk factors and taking the necessary precautions can help to minimize the occurrences of stroke. It has been estimated that more than half of strokes are caused by hypertension, making it one of the most important risk factors to control. People with hypertension, or high blood pressure, may be prescribed antihypertensive medication to control blood pressure and/or anticoagulant medications to prevent blood clotting. Some other risk factors to address when dealing with stroke prevention are tobacco use, physical inactivity and atrial fibrillation.

Stroke Symptoms

Time to treatment is critical to a stroke patient and can greatly impact recovery and survival. It is important to quickly recognize the signs and symptoms of stroke. The AHA/ASA recommends the F.A.S.T. technique to help people remember which signs to look for: Face drooping, Arm weakness, Speech difficulty, Time to call 911.
Other symptoms of stroke* may include 14:

- Sudden numbness or weakness of the leg, arm, or face;
- Sudden confusion or trouble understanding people;
- Sudden vision impairment in one or both eyes;
- Sudden dizziness or loss of balance or coordination;
- Sudden severe headache;

*A key element to recognizing a stroke is noticing that these symptoms develop suddenly and with no other warning or explanation.

A Transient Ischemic Attack (TIA) can serve as a warning sign for a stroke. Often called a “mini-stroke,” a TIA is a temporary blockage of a vessel, usually lasting less than five minutes.15 The blockage dissolves on its own without medication and usually causes no permanent injury to the brain. Upon initial occurrence, a TIA cannot be distinguished from a stroke so it should be treated with the same medical promptness.

**Treatment Options**

Strokes require a variety of treatment options13 depending on their type and severity, as well as the amount of time prior to receiving medical care. Timeliness is critical in any stroke case. The longer a patient endures the symptoms of a stroke, the more brain cells are lost and the more brain tissue dies. As
brain tissue is compromised, so is the outlook for a full recovery. Although, its ranking in the leading causes of death has dropped in recent years, stroke still remains a leading cause of serious, long-term disability.\(^\text{16}\)

In the case of ischemic stroke, where the flow of blood to the brain is blocked by a clot, the only FDA-approved treatment is tissue plasminogen activator (tPA), also known as the “clot-busting drug.” This intravenous therapy works by dissolving the clot and restoring blood flow to the brain. It must be initiated within three hours (and up to 4.5 hours in certain eligible patients) of the onset of a stroke symptoms.\(^\text{13}\)

For hemorrhagic strokes, surgery to repair the damaged blood vessel is also an option.\(^\text{13}\)

The Stroke Belt

The southeastern region of the United States is notorious for its high stroke mortality rates, so pronounced in fact that the area has earned the name “The Stroke Belt.” The National Heart, Blood, and Lung Institute defines the Stroke Belt as the following 11 states with an age-adjusted stroke mortality rate more than 10% greater than the national average: Alabama, Arkansas, Georgia, Indiana, Kentucky, Louisiana, Mississippi, North Carolina, South Carolina, Tennessee, and Virginia.\(^\text{17}\) This region was defined using 1980 stroke mortality data. What is the cause of this geographic disparity? According to a study published in the AHA Journal Stroke, 64-68% of excess stroke risk in the Southeast can be explained by race/ethnicity, socioeconomic status, risk factors, and chronic diseases.\(^\text{17}\)

Image from the Centers for Disease Control and Prevention website:
http://www.cdc.gov/dhdsp/maps/national_maps/stroke_all.htm
A 1999 study reported that being born in the Stroke Belt state of South Carolina exhibited a significantly higher stroke risk as compared to those born outside of South Carolina and even more pronounced compared to those born outside of the Stroke Belt. This disparity is even more pronounced in blacks born in South Carolina compared to blacks born outside of the Stroke Belt than it is in whites born in South Carolina compared to those born outside of the Stroke Belt.

Geographic disparities may be exhibited by children as well. A study suggested that children in the Stroke Belt of the United State, like adults, exhibit a higher risk of death from stroke than children living outside of the Stroke Belt, even after adjusting for race and ethnicity. These findings seem to dispute earlier claims that the geographic variations in stroke mortality can be attributed to the differences in atherosclerotic stroke risk factors because such risk factors are not widely applicable to children.

The regional and racial differences seen in stroke mortality may be largely explained by the differences in stroke incidence. Although the incidence data for stroke is not as readily available, the REGARDS study conducted by the National Institute of Health showed that stroke incidence seemed to parallel stroke mortality data. The magnitude of the disparities among stroke incidence rate are not quite as pronounced as among mortality rates, suggesting that incidence rates only partially explain disparities in mortality rates.
Overview of GWTG-Stroke

In 2003, AHA/ASA initiated Get With the Guidelines-Stroke (GWTG-Stroke), a program which identifies the latest evidence-based guidelines for stroke treatment and care, and encourages hospitals to implement and track adherence to these guidelines through the GWTG-Stroke assessment and reporting system, the Patient Management Tool. Hospitals that participate in GWTG-Stroke are recognized for their participation and achievements.

There are currently 20 hospitals in Tennessee that participate in GWTG-Stroke.

Overview of Certified Stroke Centers

Hospitals are designated "Advanced Comprehensive Stroke Centers" or "Advanced Primary Stroke Centers" by the AHA/ASA in partnership with The Joint Commission (TJC). Primary Stroke Centers have stroke-focused programs and meet standards set by the AHA/ASA, as outlined by the Brain Attack Coalition. These standards support better outcomes for stroke care by utilizing the latest evidence-based guidelines of stroke care. Comprehensive Stroke Centers meet all the standards of Primary Stroke Centers in addition to further standards to treat the most complex stroke cases. As of October 6, 2014, there were 21 Primary Stroke Centers in the state of Tennessee and another five Comprehensive Stroke Centers. Information about stroke center certification is publicly accessible through TJC and an interactive map of certified stroke centers can be found at http://hospitalmaps.heart.org/AHAMAP/map/qimap.jsp. This map allows users to view AHA Heart-Check Hospitals with stroke-focused programs, either being TJC/AHA-certified and/or participating in GWTG-Stroke.
<table>
<thead>
<tr>
<th>Organization Name</th>
<th>City</th>
<th>Certification Program</th>
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<tbody>
<tr>
<td>Erlanger Health System</td>
<td>Chattanooga</td>
<td>Advanced Comprehensive Stroke Center</td>
</tr>
<tr>
<td>Fort Sanders Regional Medical Center</td>
<td>Knoxville</td>
<td>Advanced Comprehensive Stroke Center</td>
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<tr>
<td>The University of Tennessee Medical Center</td>
<td>Knoxville</td>
<td>Advanced Comprehensive Stroke Center</td>
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<td>TriStar Skyline Medical Center</td>
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<td>Advanced Comprehensive Stroke Center</td>
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<tr>
<td>Vanderbilt University Medical Center</td>
<td>Nashville</td>
<td>Advanced Comprehensive Stroke Center</td>
</tr>
<tr>
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</tr>
<tr>
<td>Blount Memorial Hospital, Inc.</td>
<td>Maryville</td>
<td>Advanced Primary Stroke Center</td>
</tr>
<tr>
<td>Jackson-Madison County General Hospital</td>
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<td>Johnson City Medical Center</td>
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<td>Advanced Primary Stroke Center</td>
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<tr>
<td>Saint Francis Hospital-Memphis</td>
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<td>Saint Thomas Midtown Hospital</td>
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<td>Murfreesboro</td>
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<td>Smyrna</td>
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<tr>
<td>TriStar Centennial Medical Center</td>
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</tr>
<tr>
<td>Wellmont Bristol Regional Medical Center</td>
<td>Bristol</td>
<td>Advanced Primary Stroke Center</td>
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</tbody>
</table>

*This list was last updated on October 6, 2014. Since then, a number of hospitals in Tennessee have obtained stroke center certification, therefore, this list may not reflect all of the current stroke-certified hospitals in the state. For the most up-to-date listing of certified stroke centers, please refer to The Joint Commission website or American Heart/American Stroke Association website.

Following a stroke, time to treatment can have a major impact on long-term outcome. For this reason, a map was generated to show the locations of all 26 certified stroke centers in Tennessee, and 9 centers in surrounding states, in order to illustrate the estimated travel time to a stroke center from any point in the state. This information was then overlaid onto a map of stroke mortality data for Tennessee.
Map 1: Map of Stroke Centers and Travel Time illustrates the stroke mortality rates for each county in Tennessee (A) and shows the location of the 26 certified stroke centers in Tennessee (listed on the previous page) and the 9 stroke centers in bordering states within 50 miles of the Tennessee border and travel times to each stroke center are mapped for 30, 60 and 90 minutes (B). The map of 30, 60 and 90 minute service areas were then overlaid onto the map of mortality data (C).
According to the US Census, the total population for Tennessee in 2010 was 6,346,105. Based on the projected stroke center service areas above, 45.1% of Tennessee population lived within 30 minutes ground travel time from a certified stroke center; 69.8% within 60 minutes; and 89.1% within 90 minutes. 10.9% of Tennesseans, an estimated 691,725 people, live more than 90 minutes ground travel time from a certified stroke center. Methods for the above maps can be found in the appendix (page 29) of this report.

Credit for map creation and analysis: Crystal Johnson, MS, Department of Geosciences, College of Arts and Sciences, East Tennessee State University

In 2014, six hospitals reported 3,107 cases of stroke and TIAs to the Tennessee Stroke Registry (TSR) as of March 12, 2015. The following charts and tables illustrate the data reported by 6 TSR-reporting hospitals in 2014. For the purpose of analyzing the data presented to the TSR, all reports were generated on March 12, 2015 and include all cases reported between January 1, 2014 and December 31, 2014. All analyses include TIA patients unless otherwise stated. Although not a true stroke diagnosis, understanding the dynamics of TIAs can help to identify areas of concern.

**Figure 1. Distribution of Stroke Diagnosis** illustrates the distribution of stroke types among 2,681 stroke patients, excluding TIA.

According to AHA, nationally, 87% of strokes are ischemic strokes, while 13% are hemorrhagic. Because only GWTG-Stroke participating hospitals are eligible for inclusion in the registry, this may also result in selection bias around the types and number of strokes seen in these hospitals. For instance, in Figure 1, the elevated number of hemorrhagic strokes reported by these hospitals (24% vs. AHA’s estimated 13%) may be due to more patients seeking specialized stroke care for more complicated cases, such as hemorrhagic strokes, at hospitals specializing in stroke care.

**Figure 2: Gender Distribution among Stroke Patients** shows an equal distribution of males and females across the 3,097 files with gender recorded.

According to AHA/ASA, more women than men have strokes and more women than men die from strokes each year\(^1\). Some research has attributed this to the fact that women generally have longer life expectancies and experience stroke at an older age than men\(^2\). Based on the data reported in Figure 2, strokes are evenly distributed among men and women in the TSR-reporting hospitals.
When looking at gender distributions among different stroke types, all of the stroke subtypes reported, with the exception of ischemic strokes, show statistically significant differences between proportion of males and females. Among TIA patients, there are more females than males (57% vs. 43%, $z = 4.06$, $p < 0.0001$). Among ICH patients, there are more males than females (54% vs. 46%, $z = 2.39$, $p < 0.05$). Subarachnoid hemorrhage (SAH) shows 65% of patients being female ($z = 5.75$, $p < 0.0001$). An observation of the sample sizes for each of the stroke types raises the question of potential bias due to small sample size in SAHs. Because nationally only approximately 3% of all stroke cases are SAHs, little information is available on that specific subtype. Future research may consider further investigating gender disparities within stroke subtypes, especially SAHs, as suggested in this report.
Figure 4: Age Distribution across All Stroke Types illustrates the age distribution across all stroke types of the 3,107 files with age reported for patients 18 years and older. The average age for stroke of patients seeking care at TSR-reporting hospitals in 2014 was 67.1 years old.
Figure 5: Age Distribution across Various Stroke Types illustrates the distribution of age for each stroke diagnosis and the number of patients (n) for each stroke type.
Referring to Figure 4, 56% of stroke and TIA patients are 66 or older. When broken-down by stroke type (Figure 5), only subarachnoid hemorrhage strokes (5d) exhibit a distribution with less than 50% of patients being older than 66 years. In fact, 62% of subarachnoid hemorrhages reported to the TSR were of patients younger than 66 years. The average age for SAH was 60.2 years compared with the average age for all stroke types, 67.1 years. Figure 6 shows average ages and one standard deviation for each stroke subtype which are statistically different ($F(3, 3076) = 19.95, p < 0.0001$). Various studies claim differences between the mean age of ischemic and hemorrhagic stroke patients and differences in risk factors between older (65-98 years) and younger (20-64 years) patients but few have addressed age differences between SAH and ICH strokes which were found to be significant by these analyses ($F(1, 635) = 14.62, p < 0.0001$).
Figure 7, reporting co-morbidities among stroke patients, reemphasizes the AHA claim that hypertension is the most important stroke risk factor to control for, with 72% of stroke patients having a prior diagnosis of hypertension.
Figure 8: Arrival Mode for all Stroke Types shows an approximately even distribution of arrival modes between EMS, private transport and transfer for the 3,018 files with arrival mode recorded.
Arrival Mode across Various Stroke Types

Arrival modes, whether by private transport, EMS, or transfer from another hospital, for all strokes, shown in Figure 8, are fairly evenly distributed with approximately equal thirds. Figure 9a shows a similar trend for ischemic stroke patients, but Figure 9b shows a large increase in the percentage of TIA patients who travel to the hospital by means of private transport, with very few being transferred from another hospital. Because TIAs have temporary symptoms with generally no long-term consequences, the decrease in transferred patients could be expected. Figure 9c shows nearly the exact opposite phenomenon for hemorrhagic stroke patients, with a large number, 59%, being transferred from other hospitals and only a small portion, 9%, arriving via private transportation. This greatly increased proportion of transferred patients for hemorrhagic stroke may be at least partially explained by the fact that all hospitals reporting data to the TSR are TJC/AHA-certified stroke centers, suggesting that hemorrhagic stroke patients tend to transfer to these hospitals for specialized care.
Figure 10: Time from Last Known Well to Arrival* by Mode of Transportation of Patients Arriving Within 3 Hours shows the percentages of patients of each mode of transportation (private and EMS) that arrived within the specified time period. The total number for each mode of transportation is limited to patients arriving within 3 hours of last known well (LKW). Of the 235 patients arriving by private transport within 3 hours, 30.2% arrived within 60 minutes. Of the 553 patients arriving by EMS within 3 hours of LKW, 29.8% arrived within 60 minutes.

*“Time from Last Known Well to Arrival” is defined as the amount of time between when the patient first began experiencing stroke symptoms and their arrival at the hospital.

Figure 10a: Time from Last Known Well to Arrival by Mode of Transportation of Patients Arriving within 3 Hours

Figure 10b: Time from Last Known Well to Arrival by Mode of Transportation of Patients Arriving within 5 Hours shows the percentages of patients of each mode of transportation (private and EMS) that arrived within the specified time period. The total number for each mode of transportation is limited to patients arriving within 5 hours of last known well (LKW). Of the 235 patients arriving by private transport within 5 hours, 30.2% arrived within 60 minutes. Of the 553 patients arriving by EMS within 5 hours of LKW, 29.8% arrived within 60 minutes.
Figure 10c: Time from Last Known Well to Arrival by Mode of Transportation for all Patients shows the percentage of patients arriving within each time interval for 938 patients arriving by private transportation and another 1,090 patients arriving by EMS. The “>300” group includes patients who arrived more than one day after initial stroke symptoms and patients whose time of initial stroke symptoms was unknown.

Figure 10a illustrates that of the patients arriving within 3 hours of time of last known well (the cut-off time to administer tPA for eligible patients), although more patients arrived by EMS than by private transport (454 vs. 176), a slightly larger percentage of those traveling by private transport arrived at the hospital within one hour of time of last known well. One possible explanation to this phenomenon is a delay in calling EMS. Another explanation may involve access to EMS.

When taking into consideration all patients arriving within 5 hours of time of the last time they were known to be well, (Figure 10b), again, a slightly larger percentage of those traveling by private transport arrived within one hour of time of last known well. This chart differs from Figure 10a in that compared to EMS, a greater proportion of the patients using private transportation who arrived within 5 hours, arrived more than 3 hours after time of last known well (25.1% vs. 17.9%, z = 2.31, p = 0.02). This is a critical point because patients who arrive more than 3 hours after time of last known well are generally no longer eligible for tPA.

When considering all patients’ arrival times (Figure 10c), a large percentage of patients arrive more than three hours after stroke symptoms begin, disqualifying a majority of stroke patients for tPA and further limiting their recovery outlook. Reasons for delayed arrival should be identified and addressed in order to improve stroke outcomes in Tennessee.
Figure 11: Insurance Status of Stroke Patients
shows this distribution of insurance types recorded for the 3,107 files with insurance status recorded. These percentages add up to more than 100% suggesting that some patients had more than one documented insurance type.

As shown in Figure 11, the majority (61.3%) of stroke patients accounted for in the TSR had Medicare insurance. People are generally eligible for Medicare at the age of 65 and a large proportion of stroke patients (56%) reported in the TSR are over the age of 65. The differences in these percentages may be reflected by a small number of people who are 65 or younger, but qualify for Medicare due to disabilities. It is possible that these disabilities which qualify them for Medicare are also associated with increased risk of stroke.
The GWTG-Stroke program requires reporting of the following consensus measures with descriptions extracted from the Patient Management Tool program, Quintiles:

- **IV rt-PA Arrive by 2 Hour, Treat by 3 Hours**: Percent of acute ischemic stroke patients who arrive at the hospital within 120 minutes (2 hours) of time last known well and for whom IV t-PA was initiated at this hospital within 180 minutes (3 hours) of time last known well.
- **Early Antithrombotics**: Percent of patients with ischemic stroke or TIA who receive antithrombotic therapy by the end of hospital day two.
- **VTE Prophylaxis**: Percent of patients with an ischemic stroke, or a hemorrhagic stroke, or stroke not otherwise specified who receive VTE prophylaxis the day of or the day after hospital admission.
- **Antithrombotics**: Percent of patients with an ischemic stroke or TIA prescribed antithrombotic therapy at discharge.
- **Anticoag for AFib/Aflutter**: Percent of patients with an ischemic stroke or TIA with atrial fibrillation/flutter discharged on anticoagulation therapy.
- **Smoking Cessation**: Percent of patients with ischemic or hemorrhagic stroke, or TIA with a history of smoking cigarettes, who are, or whose caregivers are, given smoking cessation advice or counseling during hospital stay.
- **LDL 100 or ND – Statin**: Percent of Ischemic stroke or TIA patients with LDL ≥ 100, or LDL not measured, or on cholesterol-reducer prior to admission who are discharged on Statin Medication.
- **Dysphagia Screen**: Percent of Stroke patients who undergo screening for dysphagia with an evidence-based bedside testing protocol approved by the hospital before being given any food, fluids, or medication by mouth.
- **Stroke Education**: Percent of patients with Stroke or TIA or their caregivers who were given education and/or educational materials during the hospital stay addressing ALL of the following: personal risk factors for stroke, warning signs for stroke, activation of emergency medical system, need for follow-up after discharge, and medications prescribed.
- **Rehabilitation Considered**: Percent of patients with Stroke who were assessed for rehabilitation services.

<table>
<thead>
<tr>
<th>Quality Measure</th>
<th>Numerator</th>
<th>Denominator</th>
<th>% of Patients</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IV rt-PA Arrive by 2 hour, Treat by 3 hour</strong></td>
<td>177</td>
<td>199</td>
<td>88.9%</td>
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<tr>
<td>Early antithrombotics</td>
<td>1213</td>
<td>1254</td>
<td>96.7%</td>
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<td>VTE Prophylaxis</td>
<td>1959</td>
<td>2074</td>
<td>94.5%</td>
</tr>
<tr>
<td>Antithrombotics</td>
<td>1659</td>
<td>1689</td>
<td>98.2%</td>
</tr>
<tr>
<td>Anticoag for Afib/Aflutter</td>
<td>265</td>
<td>293</td>
<td>90.4%</td>
</tr>
<tr>
<td>Smoking cessation</td>
<td>469</td>
<td>498</td>
<td>94.2%</td>
</tr>
<tr>
<td>LDL 100 or ND - Statin</td>
<td>1248</td>
<td>1313</td>
<td>95.0%</td>
</tr>
<tr>
<td>Dysphagia Screen</td>
<td>1888</td>
<td>2152</td>
<td>87.7%</td>
</tr>
<tr>
<td>Stroke Education</td>
<td>1016</td>
<td>1133</td>
<td>89.7%</td>
</tr>
<tr>
<td>Rehabilitation Considered</td>
<td>1878</td>
<td>1918</td>
<td>97.9%</td>
</tr>
</tbody>
</table>

*Table 2. GWTG Consensus Measures* shows the achievements of each consensus measure among eligible patients for all TSR-reporting hospitals. The goal for each measure is 100%. Because not all patients with a recorded stroke diagnosis qualify for each of the consensus measures, the numerator and denominator are given for each measure.
Limitations to the Data Presented in this Report

The Tennessee Stroke Registry reports on data input voluntarily by hospitals through the AHA’s Patient Management Tool, the GWTG assessment and reporting system. Of the 126 general acute care hospitals in the state of Tennessee, 20 hospitals participate in GWTG-Stroke and are thus eligible to input data into the Patient Management Tool for the Tennessee Stroke Registry. Nine hospitals in the state are enrolled in the registry and of those nine, six hospitals have entered data for 2014. The numbers alone prove to be a major obstacle to producing a comprehensive report. Furthermore, four of the six actively participating hospitals are geographically clustered in the Middle Grand Division of Tennessee, further limiting information about geographical representation of stroke across the state.

Six hospitals have reported 2,454 (as of 1/20/15) cases of stroke (excluding TIA) to the Tennessee Stroke Registry for 2014. The prevalence of stroke in Tennessee is greatly underreported in the TSR due to the low number of participating hospitals. This is estimated to reflect less than 10% of actual stroke occurrences in the state based on Hospital Discharge data from 2012 which shows records of 26,820 strokes\textsuperscript{25,26}. This data is publicly accessible from the TDH website, but 2013 and 2014 data has not yet been released.
How to Participate in Get With the Guidelines-Stroke


The local GWTG contact is Michelle Grazer, who can assist hospitals in enrolling in GWTG-Stroke and the Tennessee Stroke Registry.

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Appendix

**Methods for mapping mortality data:** A dataset of Tennessee counties boundaries was obtained from tngis.org and a new column was added to incorporate county-level stroke mortality data obtained from Tennessee Department of Health 2013 Vital Statistics Report. A map was generated using ArcGIS 10.2 to illustrate the rates of stroke mortality by county by varying colors for 5 intervals of mortality rates.

**Methods for mapping service areas:** The areas accessible by a road network with 30, 60, and 90 minutes of selected stroke centers were delineated using Network Analyst toolbar within ArcGIS 10.2 for Desktop. To perform the analysis, a shapefile containing all the stroke center facilities in Tennessee (TN) as well as some facilities in the neighboring states within 50 miles of the border of TN was created. These facilities were geocoded into a point shapefile in ArcGIS using the Geocode Addresses tool. Additionally, a reference layer containing the roads network for TN including the surrounding states was provided by the primary and secondary roads dataset using the TIGER Line files of the 2010 US Census data (https://www.census.gov/geo/maps-data/data/tiger-line.html). Both shapefiles were reprojected to NAD_1983_UTM_Zone_16N, a projected coordinate system to perform the analysis. Three new columns were added to the roads reference layer: length (recalculated to reflect the conversion of meters to miles), speed, and time. Length was calculated using Calculate Geometry in ArcGIS, speed limit was assigned 50 mph for all line segments, and time was calculated by dividing the length by the speed and multiplying by 60. A new Network Dataset was assigned to the reference layer using ArcCatalog 10.2. Once the Network Dataset was created in the roads file, service areas of 30, 60, and 90 minutes were generated using the Service Areas creation tool in Network Analyst.
References


15. TIA (Transient Ischemic Attack). *Am Stroke Assoc.*


25. *Number of Outpatient Visits with Emergency Department Services , by First Listed Diagnosis , Age Group and Percent of Age Group , Tennessee Short Term Hospitals 2012 ,*; 2012.

26. *Number of Inpatient Hospital Discharges with Emergency Department Services , by First Listed Diagnosis , Age Group and Percent of Age Group , Tennessee Short Term Hospitals 2012 ,*; 2012.
