What is Stroke?

- Results from blood vessel blockage or hemorrhagic rupture causing interruption of blood supply to the brain
- The loss of oxygen to affected areas causes loss of function and may lead to death
- Ischemic stroke is the most common stroke type and results from a blocked vessel which prevents proper blood flow to the brain. The second most common type is hemorrhagic stroke which results from a blood vessel rupture and consequent bleeding in the brain.
- Transient Ischemic Stroke (TIA) or “mini-strokes” are temporarily decreased blood flow and typically pre-cursors to actual strokes.

Stroke Warning Signs

- Sudden numbness or weakness of the face and/or limbs, often only on one side of the body
- Sudden confusion and trouble forming words or understanding what others are saying
- Sudden diminished vision in one or both eyes
- Sudden headache with no obvious cause

Treatment

- Immediately when a patient arrives at a hospital it is crucial that stroke is properly diagnosed as ischemic or hemorrhagic type. Prompt administration of tissue plasminogen activator (tPA) in ischemic stroke can dissolve blockages and restore blood flow. Catheterization can also be beneficial.
- Hemorrhagic strokes often require surgery to repair damage done to ruptured vessels.
- Patients that receive treatment within 4.5 hours of symptom onset have a greatly reduced risk of permanent disability.
- Age: Leading risk factor for stroke. Beginning with 55 years of age, the risk of stroke doubles every decade. This is true for both men and women.
- Sex: Stroke incidence is 1.25 times higher in men than in women. However, more women than men die of stroke, a fact attributed to the longer life expectancy of women.
- Race/Ethnicity: African Americans are over twice as likely to die from stroke than are Caucasians. That disparity increases to four times for the 45-55 year age range.
- Family History: Both genetics and common exposures increase the risk of stroke.

Modifiable Risk Factors

- High Blood Pressure: As blood pressure increases so does risk of stroke.\(^2\)
- High Blood Cholesterol: Risk of stroke can be reduced by as much as 30% by reducing blood cholesterol level by 10%\(^9\)
- Cigarette Smoking: Risk of stroke is 50% higher for smokers. Additionally, there exists a dose-response relationship between number of cigarettes smoked and risk of stroke.\(^3\)
- Diabetes: Studies have shown an increased risk of ischemic stroke ranging from 1.8 to 3.0 times higher for individuals with Diabetes Mellitus.\(^2\)
- Physical Inactivity: Studies suggest that walking briskly for 30 min. 5 times a week can significantly reduce risk of stroke.\(^10\)
- Overweight and Obesity: While obesity contributes to higher blood pressure and diabetes prevalence, it has also been shown to be independently associated with increased risk of stroke.\(^2\)

Cost of Stroke
As the 3rd leading cause of death in the United States, stroke costs an estimated $43 billion per year. The average cost per patient at 3 months following a stroke is about $15,000.\(^8\)

The 2006 Tennessee Heart Disease and Stroke Burden Report estimates total physician costs in TN for 2002 as $42 million. The same report states the per capita cost rose for Tennesseans by 45% from 1997 to 2002.

**Modifiable Risk Factors in Tennessee\(^4\)**

- **High Blood Pressure**: 32% of adult Tennesseans report having been told they have high blood pressure.
- **Cigarette Smoking**: 20% of adult Tennesseans report being current smokers compared to the national average of about 17.3%. Approximately 7.3% of those under 18 years of age report having smoked more than 10 cigarettes a day in the last 30 days.\(^7\)
- **Diabetes**: 10.3% of Tennesseans report having ever been told by a health professional that they have diabetes.
- **High Blood Cholesterol**: About 33% of Tennesseans report having ever been told they have high blood cholesterol.
- **Overweight and Obesity**: About 69% of Tennesseans are overweight or obese which is somewhat higher than the national average of 64.7%.
- **Physical Inactivity**: 31% of Tennesseans report being physically inactive.

**Hospitalization and Mortality in Tennessee**

In 2010, 3.5% of Tennesseans reported ever having been told by a health professional that they had experienced a stroke.\(^4\) Hospitalization data reveals that the highest prevalence rates are seen in men and African Americans.\(^5\)

The Tennessee Department of Health ranks stroke as the 4th overall leading cause of death in the state, 3rd in females and African Americans. Decline in these rates has been evident over the past decade. However, Tennessee remains consistently higher than the national average.\(^5\)

![Figure 1. Age Adjusted Stroke Mortality and Hospitalizations in Tennessee, 2000-2009\(^6\)](image)

**Certified Stroke Centers in Tennessee**

The Joint Commission certifies hospitals as Advanced Primary Stroke Centers and Advanced Comprehensive Stroke Centers. This designation indicates the ability of hospitals to diagnose and care for stroke patients through staffing and equipment.

![Figure 2. Portion of TN population living more than 50 miles from certified stroke center](image)

Approximately 20% of TN residents live in counties that lie either partially or entirely outside a 50 mile radius from a certified stroke center.

**Getting to a Primary Stroke Center**
The distribution of arrival times for those arriving by ambulance compared to those relying on private transportation. Those patients utilizing ambulance services tend to arrive earlier, which could be an effect of proximity to stroke centers.

In addition to effecting time-to-arrival, EMS transport allows for earlier diagnosis of stroke type, possibly affecting time to treatment. As evidenced by Figure 3, nearly 25% of stroke patients arrived by private transport in 2013.

In 2013, for the TSR sample of primary stroke center hospitals reporting, over 60% of the stroke patients were on Medicare or Medicaid, with just over 11% being admitted with no insurance at all.

Mortality

Actual in-hospital mortality rate was compared to the expected mortality generating what is referred to as the risk-adjusted mortality ratio. A ratio equal to 1 means the actual rate was equal to the expected. Values greater than one indicate an elevated mortality.

For all types of stroke in the sample hospitals, the risk-adjusted mortality ratio was approximately 1. For ischemic stroke, the ratio was 1.1, indicating a 10% uptick in mortality compared to the expected rate.

Insurance Status

In 2013, for the TSR sample of primary stroke center hospitals reporting, over 60% of the stroke patients were on Medicare or Medicaid, with just over 11% being admitted with no insurance at all.

Stroke Diagnosis

Ischemic stroke outweighs all other diagnoses in this sample. It is important to note that these data represent the distribution of stroke diagnoses in the sample population (N=3308) and may not reflect the true rates statewide.

Get With The Guidelines

“Get With The Guidelines®-Stroke is an in-hospital program for improving stroke care by promoting consistent adherence to the latest scientific treatment guidelines. Since its initiation in 2003, 1,656 hospitals have entered more than two million patient records into the Get With The Guidelines-Stroke database. Numerous published studies
demonstrate the program's success in achieving measurable patient outcome improvements.”

The following table displays adherence rates for the hospitals reporting Get With the Guidelines performance measures to the Tennessee Stroke Registry in 2013. The results indicate 86% to 98% adherence to the 10 consensus measures, grouped by acute, quality, and discharge data.

![Figure 7. Adherence rates to Get With the Guidelines consensus measures](image)

### Data Limitations

Seven hospitals reported 3308 records of stroke admissions to the Tennessee Stroke Registry from January to December 2013. Since these data come from only 7 hospitals in the state they do not represent the performance of hospitals treating stroke in Tennessee. These 7 hospitals do, however, represent the majority of primary stroke centers in Tennessee. These are the data reported from the hospitals and may not be comprehensive of all stroke incidence and mortality seen at that hospital, just what was reported.

### Conclusions

Our summary of the registry data indicates a potential effect of distance to primary stroke center on the arrival times of individuals experiencing a stroke. We recommend a thorough analysis of the statewide data including hospitals not currently reporting to the TSR. In addition, the registry has identified a need for increased reporting from Tennessee hospitals.

---


Prepared by the Department of Biostatistics and Epidemiology, East Tennessee State University College of Public Health

<table>
<thead>
<tr>
<th>Acute Measures</th>
<th>% Patient</th>
<th>Total Patient</th>
</tr>
</thead>
<tbody>
<tr>
<td>IV tPA less than 2 hours arrival, 3 hour administered</td>
<td>86.6%</td>
<td>194</td>
</tr>
<tr>
<td>Antithrombotic medication prescribed within 48 hours</td>
<td>98.0%</td>
<td>1452</td>
</tr>
<tr>
<td>DVT prophylaxis within 48 hours</td>
<td>90.3%</td>
<td>2177</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Quality Measures</th>
<th>%</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dysphagia screening</td>
<td>90.3%</td>
<td>2226</td>
</tr>
<tr>
<td>Stroke education</td>
<td>89.9%</td>
<td>1318</td>
</tr>
<tr>
<td>Rehabilitation assessment</td>
<td>98.4%</td>
<td>2086</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Discharge Measures</th>
<th>%</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antithrombotic prescribed at discharge</td>
<td>97.8%</td>
<td>1827</td>
</tr>
<tr>
<td>Anticoagulation prescribed at discharge</td>
<td>96.2%</td>
<td>318</td>
</tr>
<tr>
<td>Lipid-lowering medication prescribed at discharge, LDL ≥ 100</td>
<td>92.7%</td>
<td>1419</td>
</tr>
<tr>
<td>Smoking cessation intervention at discharge</td>
<td>98.5%</td>
<td>540</td>
</tr>
</tbody>
</table>