VIRGINIA Cerebrovascular Disease

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Cerebrovascular Disease, more commonly known as "stroke", is one of the leading causes of both mortality and disability in the U.S. and in Virginia. The financial and social costs of acute care and rehabilitation, as well as assisted living, are high and are growing as the population ages. Prevention, emergency response, early diagnosis and treatment of stroke are important parts of the continuum of care because they prevent the chronic disease and disability that result from strokes. Rehabilitation and assisted living are essential to optimize the lives of stroke survivors and their families.

Warning Signs of Stroke – Call 911 Immediately!

F	**Face**	Ask the person to smile Does one side of the face droop?
A	**Arms**	Ask the person to raise both arms Does one arm drift downwards?
S	**Speech**	Ask the person to repeat a simple phrase Is their speech slurred or strange?
T	**Time**	**If you observe any of these signs, call 911 immediately**

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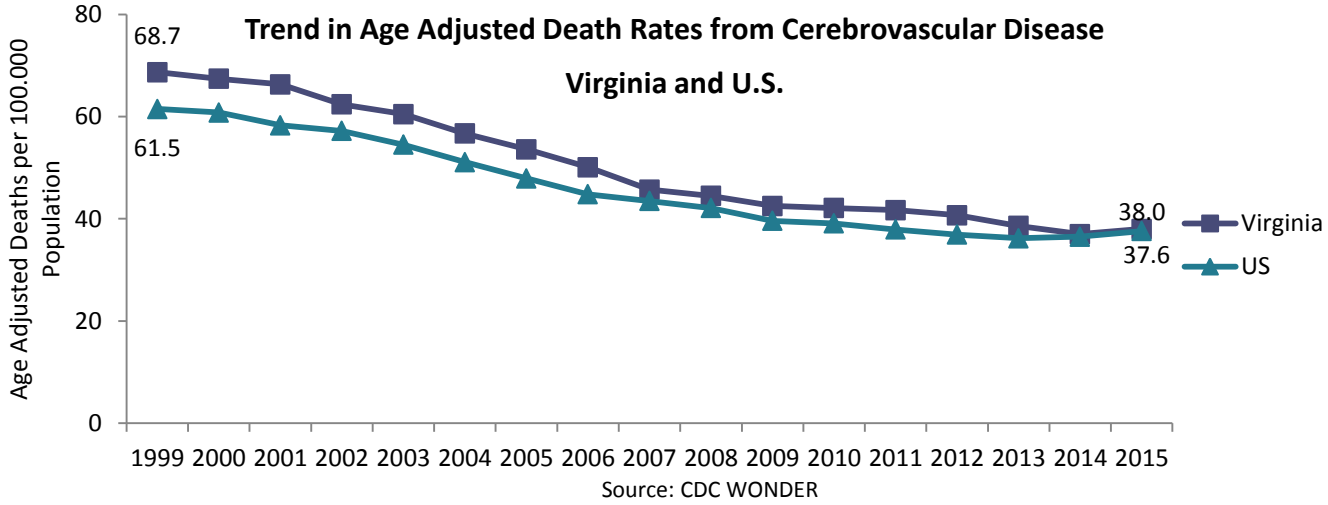
Key Cerebrovascular Disease and Cerebrovascular Accident (Stroke) Facts:

- Cerebrovascular disease represents a significant cause of death and disability in the U.S. and in Virginia; an estimated 3.0% of the population or 199,319 Virginians have had a stroke and are living with its effects (BRFSS 2015).



- Death rates from stroke have declined across the U.S. over the past decade, from 60.0 per 100,000 in 1999 to 37.6 in 2015, due to significant improvements in management of risk factors and care of stroke. However, death rate slightly increased from 36.2 in 2013 (lowest in last 15 years) to 37.6 in 2015 (CDC WONDER).
- Strokes of various types were responsible for the deaths of 3,278 individuals in Virginia in 2013, down from 4,110 in 1999, a 20.2% decline (Virginia Health Statistics, 2013).
- The 2010 age adjusted death rate per 100,000 for stroke was higher in Virginia (42.1) compared with the rest of the U.S. (39.1); the Virginia rate declined in 2015 to 38.0 (BRFSS, 2015). Virginia is part of the stroke belt, a region that crosses the southern states, where stroke is more prevalent than in other regions of the U.S.
- Cerebrovascular disease of all types resulted in 11,257 potential years of life lost (PYLL) in Virginia in 2014 (VHI, 2014).
- The age-adjusted rate of hospitalization of Virginians was 241 per 100,000 populations in 2014 (VHI, 2014).
- There were 21,867 hospitalizations of Virginia residents in Virginia hospitals for stroke and related cerebrovascular accidents in 2014, with total inpatient hospital charges of $881,973,014 indicating the significant medical cost for patients and providers (VHI, 2014).
- Inpatient stroke discharges were distributed among the various types of stroke as follows:

2014 Virginia Hospital Inpatient Discharges of Patients Diagnosed with Cerebrovascular Accidents

Type of Stroke	Discharges	% of Total	Total Charges	Average Charge per Case
Cerebral Ischemia	14,410	66%	$515,162,161	$35,750
Hemorrhagic	2,771	13%	$228,901,003	$82,606
Transient Ischemic Attack (TIA)	3,414	16%	$74,083,385	$21,700
Other Cerebrovascular accident	1,272	6%	$63,826,465	$50,178
Total	21,867	100%	$881,973,014	$40,334

VHI; Cerebrovascular Accident defined as having a primary diagnosis code between 430 and 438

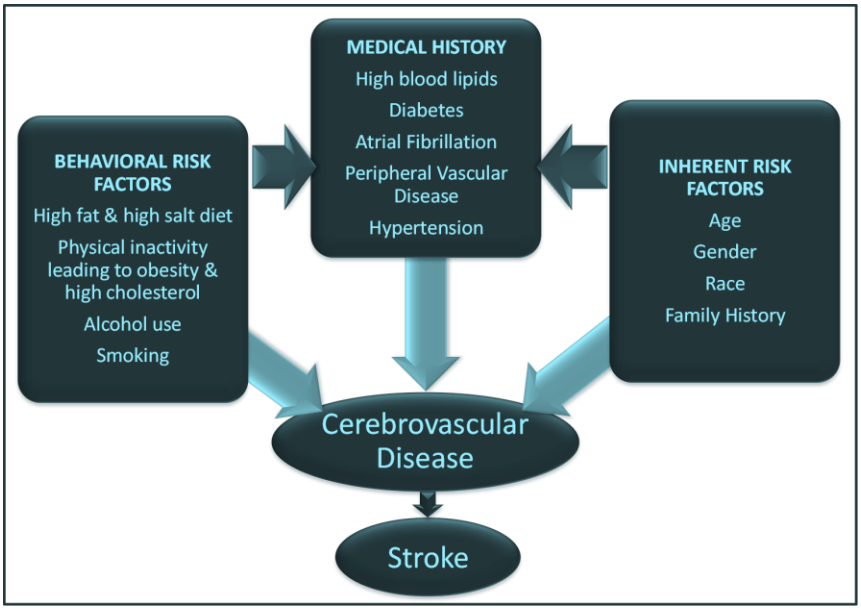
Definitions:

- **Cerebrovascular Disease (CVD)** - a group of brain dysfunctions related to disease of the blood vessels supplying the brain. CVD damages the blood vessel lining (the endothelium), exposing the underlying collagen where platelets aggregate to initiate a repairing process which is not always complete. Long term, hypertension may permanently change the structure of the blood vessels resulting in narrowing, stiffness, deformity, and vulnerability to changes in blood pressure. Cerebrovascular disease includes all disorders in which an area of the brain is temporarily or permanently affected by ischemia (lack of oxygen) or bleeding, and where one or more of the cerebral blood vessels are damaged. CVD includes stroke (cerebrovascular accident), carotid stenosis, vertebral stenosis and intracranial stenosis, aneurysms, and vascular malformations.
- **Stroke -** also known as cerebrovascular accident (CVA), results in the death of brain tissue due to the abrupt interruption of flow of blood to the any part of the brain that causes loss of neurologic function; CVA's are also known as "brain attacks" due to their similarity to a heart attack. Strokes usually fall into one of two main types, with minimal or no warning, and often devastating results:
  - **Ischemic Stroke:** a blockage in blood flow to the brain, often caused by a blood clot, resulting in death of the tissue surrounding the blockage; ischemic strokes are the cause of about 80% of strokes; There are two types of ischemic stroke, with varying amounts of damage to the brain determined by how far into the brain the blockage occurs:
    - **Thrombotic stroke** - occurs when a blood clot, or thrombus, blocks an artery to the brain, stopping the flow of blood to the brain.
    - **Embolic stroke** - occurs when a piece of plaque or thrombus travels from its original site and blocks an artery downstream; the relocated plaque or thrombus is then called an embolus.
  - **Hemorrhagic Stroke:** often more deadly than ischemic strokes, hemorrhagic strokes are caused by bleeding in the brain. Hemorrhagic strokes may be caused by hypertension (high blood pressure), rupture of an aneurysm or vascular malformation, or as a complication of anticoagulation medications.
    - **Intracerebral hemorrhage** - occurs when there is bleeding directly into the brain tissue, which often forms a clot within the brain.
    - **Subarachnoid hemorrhage** - occurs when the bleeding fills the cerebrospinal fluid spaces around the brain.
- **Ischemic penumbra** - an area that surrounds the core of dead cells caused by an ischemic stroke; the ischemic penumbra consists of cells that are impaired and cannot function, but are still alive. These cells are called "idling cells", and they can survive in this state for about three hours, after which they die. Therapies must therefore be initiated rapidly, within this three hour window, to be effective.

- **Transient Ischemic Attack –** a temporary cerebrovascular event where there is temporary blockage to an artery supplying blood to the brain resulting in stroke-like symptoms; there is no permanent damage, with rapid disappearance of symptoms. Often ignored, TIAs must be investigated because about 30% of those experiencing a stroke have had a previous TIA, and 10% of those experiencing a TIA will have a stroke within two weeks. Thus a TIA is an important warning sign that should be investigated as to its cause.
- **Other Cerebrovascular diseases –** in addition to cerebrovascular accidents (strokes), there are other cerebrovascular diseases which require attention:
  - **Carotid stenosis** – severe atherosclerosis (buildup of plaque from buildup of cholesterol and fat) of the carotid arteries which provide blood to the brain; may cause a TIA; usually initially detected during routine physical exam using a stethoscope; if found, follow-up examination is needed.
  - **Cerebral (or cranial) aneurysm** – an area of bulging of a blood vessel in the brain, often at a branch point of a blood vessel; may be congenital or caused by high blood pressure, atherosclerosis or trauma to the head; may remain un-ruptured for extended periods and not be detected as they are not symptomatic. When ruptured, 50% mortality is likely, so rapid evaluation is essential if an aneurysm is suspected. The most common result of a rupture is bleeding into the brain, causing a sub-arachnoid hemorrhage which can result in brain damage, paralysis, coma and death. Aneurysms are more common in women and prevalence increases in the 50-60 year age group.
  - **Vascular malformations** – abnormal connection of blood vessels between arteries and veins, often developing in utero, prior to birth; the cause is not known.

Risk Factors:

Most Cerebrovascular disease results from a shared group of innate and behavioral risk factors, as well as pre-existing chronic medical conditions that also lead to other chronic conditions besides cerebrovascular disease; however, these are of particular importance to stroke.



- **Inherent or innate risk factors** are those over which the individual has limited or no control, including gender, age, race (with higher risk for African Americans) and genetic predisposition as well as poverty, stress and urbanization.
- **Behavioral risk factors** are those which lead to conditions which place the individual at high risk of developing CVD; it is estimated that these behaviors are responsible for about 80% of strokes including unhealthy diet including high fat and excess salt intake, physical inactivity, smoking and alcohol use, all of which may result in conditions which can then develop into or cause CVD.

- **Medical risk factors:** behavioral or inherent risk factors may result in medical conditions which increase the risk of stroke and include obesity, high blood lipids, atrial fibrillation, peripheral vascular disease and hypertension.

Warning Signs and Symptoms of Cardiovascular Disease:

Because rapid access to medical services is essential to manage strokes, knowledge of the signs and symptoms is essential. Symptoms may be sudden and intense, or they may be mild and progressive but in either case, it is important to call for EMT assistance by dialing 911. Some typical symptoms, often occurring suddenly, include:

- Dizziness, nausea, or vomiting
- Unusually severe headache
- Confusion, disorientation or memory loss
- Numbness, weakness in an arm, leg or the face, especially on one side
- Abnormal or slurred speech
- Difficulty with comprehension
- Loss of vision or difficulty seeing
- Loss of balance, coordination, or the ability to walk

Diagnostic Tests for Cerebrovascular Disease

- **Cerebral angiogram (also vertebral or carotid angiogram)** – diagnostic imaging test using contrast dye to view the arteries of the neck to determine the condition of blood vessels leading to and within the brain; this test involves the insertion of a catheter and is somewhat invasive.
- **Carotid duplex (or ultrasound) –**ultrasound of the carotid arteries leading to the brain to detect plaque, blood clots or other problems that could block blood flow to the brain; this is a non-invasive and painless test.
- **Computed Tomography (CT or CAT scan) –** a diagnostic imaging technique, with or without contrast media, to diagnose hemorrhagic stroke; since ischemic stroke damage cannot be seen via CT scan, CT angiography, which uses dye or contrast media, can be used to visualize the blood vessels directly; this technique is replacing the more invasive angiography.
- **Doppler ultrasound -** painless and non-invasive evaluation of blood flow in deep and superficial veins of the extremities (legs and arms).
- **Electroencephalogram (EEG)** – the use of electrodes to pick up and monitor electrical signals of the brain to evaluate brain function.
- **Lumbar puncture or spinal tap** – a diagnostic test which uses a needle to remove a sample of cerebrospinal fluid to detect bleeding from a cerebral hemorrhage.
- **Magnetic Resonance Imaging (MRI)** – an imaging test that shows, in three dimensions, the condition of the tissues of parts of the brain to determine the current and historical presence of strokes; this is a noninvasive test but requires that the patient remain in the scanner for the duration of the test, which may be claustrophobic for some individuals.
- **Magnetic Resonance Angiogram (MRA)** – similar to an MRI but using contrast media to detect whether there are blockages or aneurysms in the blood vessels of the brain.

Treatment for Stroke – Short and Long Term

- **Emergency Response** – any type of cerebrovascular event is time-sensitive, since death of brain tissue is rapid and irreversible. Thus, immediate recognition of stroke or other cerebrovascular disease by family and others is essential, and requires immediate notification of emergency medical teams; fast response by these teams, and rapid transfer to a hospital capable of providing appropriate services is necessary. Many EMT teams are aware of the need for speed, although some remote geographic areas face challenges in response times and transit to appropriate facilities.
- **Acute care** – direct and rapid access to a hospital which has broad capabilities to diagnose and manage the care of stroke directly or can partner with a larger organization with advanced services is essential. At present, Virginia has 42 Primary Stroke Centers (PSCs) certified by either the Joint Commission or DNV (Det Norsk Veritas). In addition, the major cities of Virginia are serviced by several Comprehensive Stroke Centers (CSCs) which provide additional services using advanced technology and medical services, as well as multidisciplinary teams with advanced protocols for the treatment of every type of stroke. The far south and southwestern regions are less well supplied, although there are PSCs located in North Carolina, Tennessee, and Kentucky that serve these areas.
- **Telestroke services** – the recent development of technology-based relationships between small, rural hospitals and larger centers which are either PSCs or CSCs has improved access in rural areas to some of the more advanced services, particularly ischemic stroke, where use of tissue plasminogen activator (tPA) can be used to improve outcomes. In this case, the smaller hospital uses advanced technology to link with medical personnel at stroke centers (PSCs or CSCs) to diagnose and begin treatment of ischemic stroke within the three hour window required for safe administration of tPA.
- **Ischemic stroke –** removal of the blockage to restore blood flow is essential to reduce damage from ischemic stroke; tissue plasminogen activator (tPA) must be administered within three hours from stroke onset, requiring immediate stroke recognition by EMTs and transport to a hospital with the capability to rapidly diagnose and provide the full range of treatments for stroke. Very few (3-5%) of patients arrive within this time period, resulting in lower recovery rates than are optimal. Other treatments are possible outside the three hour window including intra-arterial thrombosis using medications or use of mechanical devices including the Merci Retriever to physically remove the clot; in addition treatment of blood vessels that are narrowed may be used to reduce future risk of stroke.
- **Hemorrhagic stroke –** surgery is usually needed to reduce the pressure within the skull caused by bleeding; surgery may be possible to reduce the risk of future strokes by removing defective blood vessels and redirecting the flow of blood to other vessels. Endovascular treatment using catheters is also possible to insert coils or stents into the blood vessel to prevent future strokes caused by leakage of blood from the blood vessel. Immediate diagnosis of hemorrhagic stroke and transport to a hospital with the capabilities to treat such a complex and emergent disease is essential.
- **TIA –** no treatment is needed because TIAs by definition do not result in permanent damage; however it is important that the cause of the TIA be determined to prevent the occurrence of future TIAs or future strokes, which are more likely in individuals who have previously experienced a TIA.
- **Rehabilitation -** survival of stroke frequently requires supportive treatment and rehabilitation to restore function. Areas of the brain which were not affected by the stroke can take over functions of damaged areas in many cases. Rehabilitation includes physical therapy, occupational therapy and speech therapy.

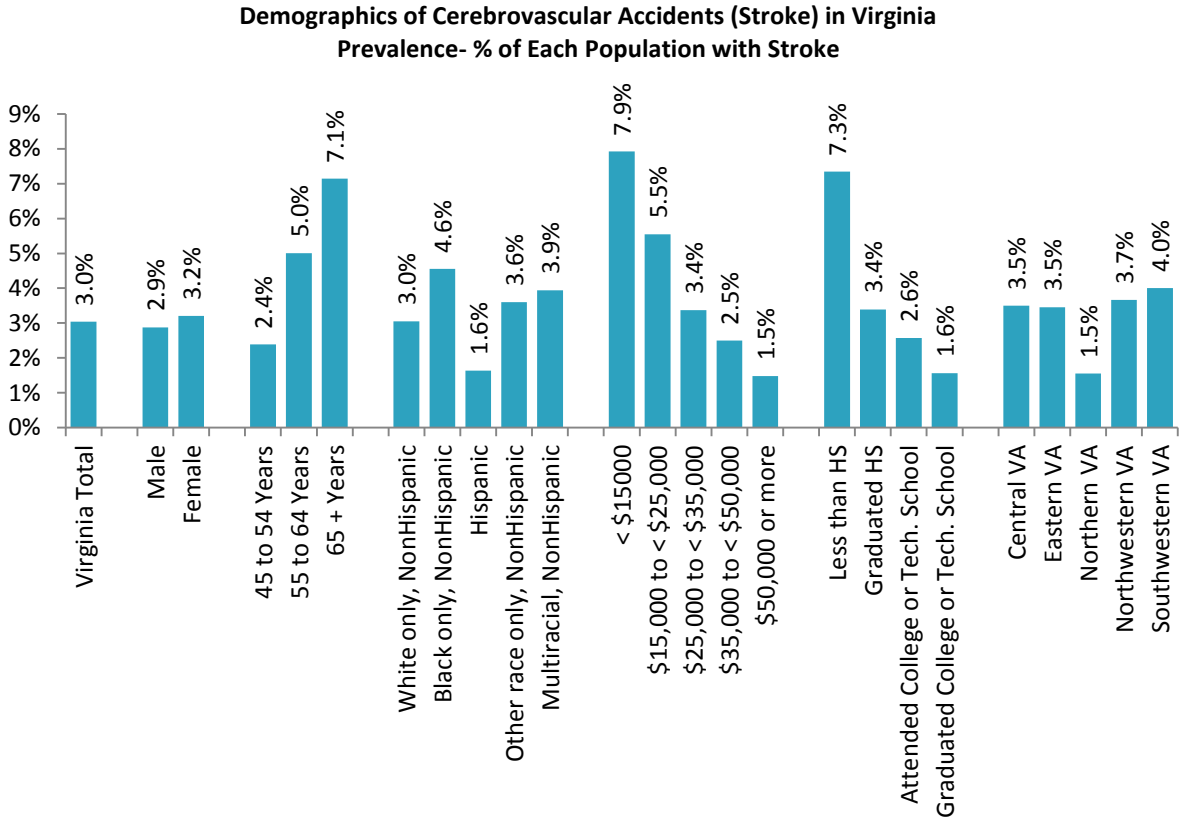
Cerebrovascular Disease Prevention – the Continuum of Care:

- Healthy diet, physical activity and smoking cessation are essential for the prevention of cerebrovascular disease and stroke in the general population; successful improvements in diet and exercise can result in reductions in obesity, high cholesterol, high blood pressure and diabetes. Reductions in smoking and excessive alcohol use are also important steps to reduce the burden of cerebrovascular disease.
- Population-based approaches include: local, regional and statewide interventions that control or influence use of tobacco, high calorie, high salt or high fat foods; encouragement of physical activity in communities through construction of walking, biking and other exercise facilities.
- Individuals at high risk of cerebrovascular disease can be identified and treated through collaboration with their primary care providers; medical interventions such as use of statins to reduce cholesterol and drugs to reduce hypertension are easily available and not costly.
- Immediate intervention is essential to the successful treatment of stroke and may include administration of clot-busting drugs such as tissue plasminogen activator, and procedures such as removal of clots using advanced technology and medications.
- Rehabilitation therapy for stroke victims can be extremely beneficial in restoring function and ability to live independently or with less support.
- Those individuals who have experienced strokes must receive ongoing care to prevent recurrence or death; combined therapies and interventions are focused on reduction in cholesterol and blood pressure, prevention of blood clots and other medical services that can reduce risk of recurrence.

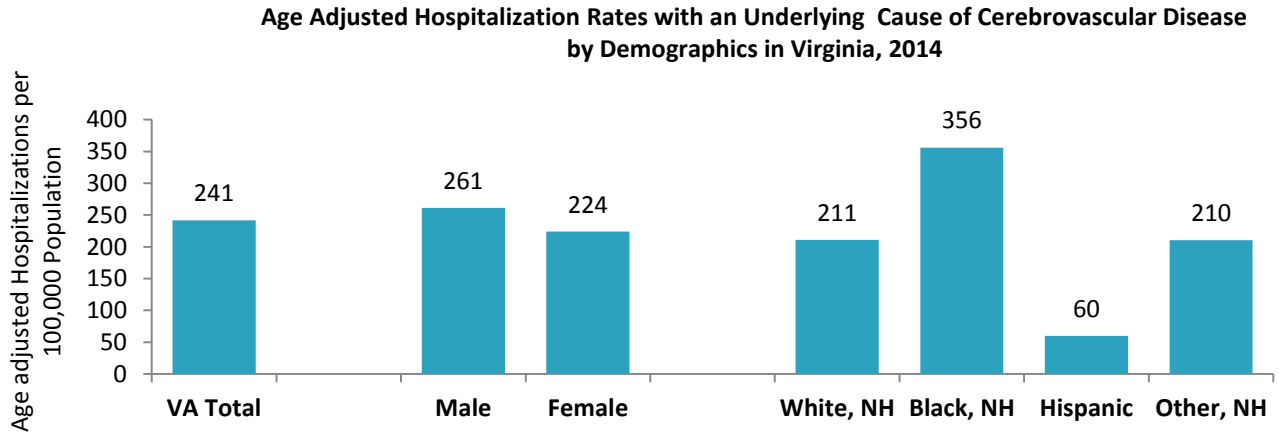
Socio-demographics of Stroke in Virginia: Overall, 3.0% of Virginians report having suffered a stroke, totaling 199,319 people in 2015 (BRFSS, 2015). However, there is a disproportionately high prevalence in certain populations, as follows:

- **Gender:** More women (3.2%) than men (2.9%) experienced stroke.
- **Aging:** Cerebrovascular disease and stroke affect older populations at significantly higher rates, with those aged 65 or more having almost triple the rate than those aged between 45 to 54 years.
- **Race:** Non-Hispanic Blacks have almost 50% higher prevalence of stroke (4.6%) compared with Non-Hispanic Whites (3.0%).
- **Income:** lower income populations have much higher prevalence of stroke, with those having annual incomes below $15,000 suffering the highest rates.

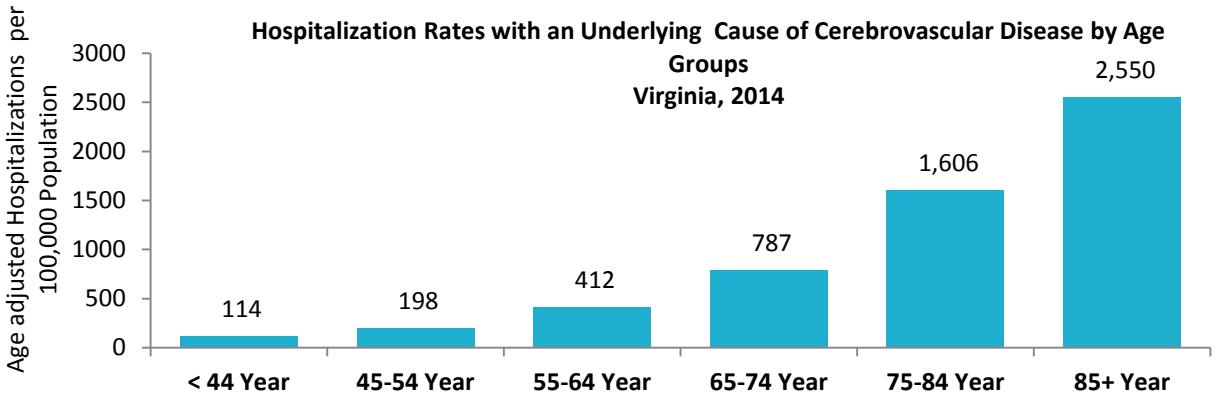
- **Education level:** education is a key factor, with much higher prevalence among those who have not graduated from high school and lower rates as educational levels increase, with the lowest rates among those who have graduated from college or technical school.
- **Location:** regions within Virginia have very different reported prevalence of stroke, with only Northern Virginia showing lower prevalence and Southwest Virginia having particularly high prevalence of stroke.



VDH Division of Population Health Data, BRFSS 2015. Percentages are weighted using population characteristics. Estimated from self report stroke. Confidence limits not shown.



Source: Virginia Department of Health, Division of Population Health Data. Virginia Health Information with a primary diagnosis of Cerebrovascular disease (Stroke).

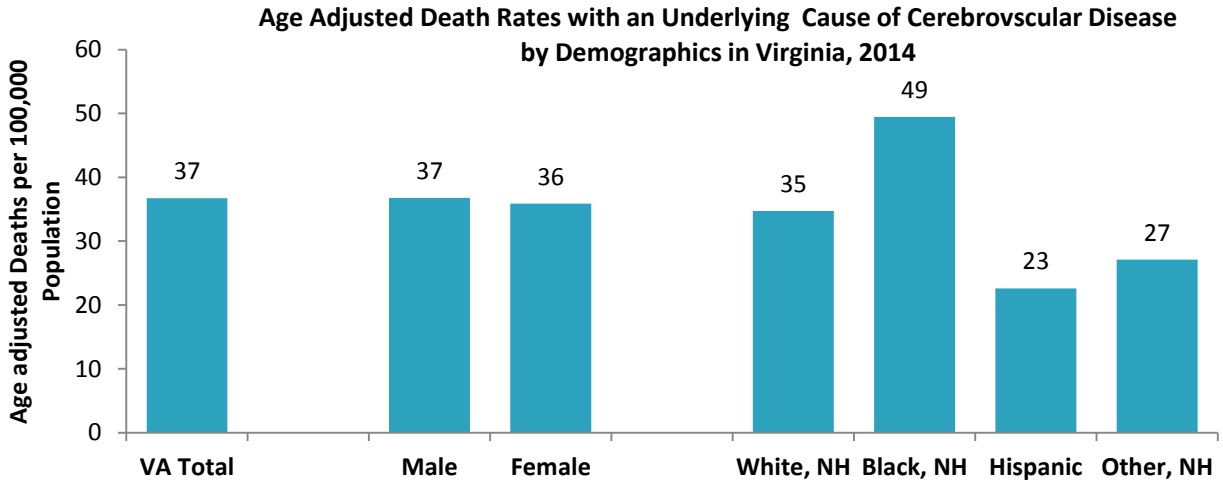


Source: Virginia Department of Health, Division of Population Health Data. Virginia Health Information with a primary diagnosis of Cerebrovascular disease (Stroke).

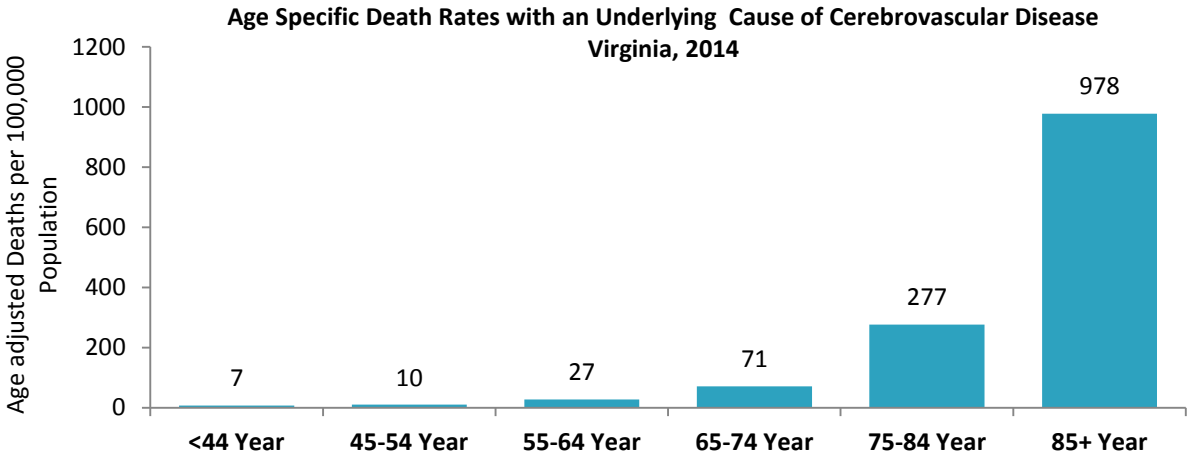
Morbidity and Mortality of Stroke:

Rates of hospitalization and death from stroke vary widely across different populations in Virginia.

- Advanced age is the strongest predictor of both hospitalization and death from stroke in Virginia, increasing with age group.
- Males show higher rates for both death and hospitalization compared with females.
- Hispanic and other racial groups have lower values compared with Non-Hispanic White Non-Hispanic Black populations; Non-Hispanic Black have the highest rates among the racial groups.



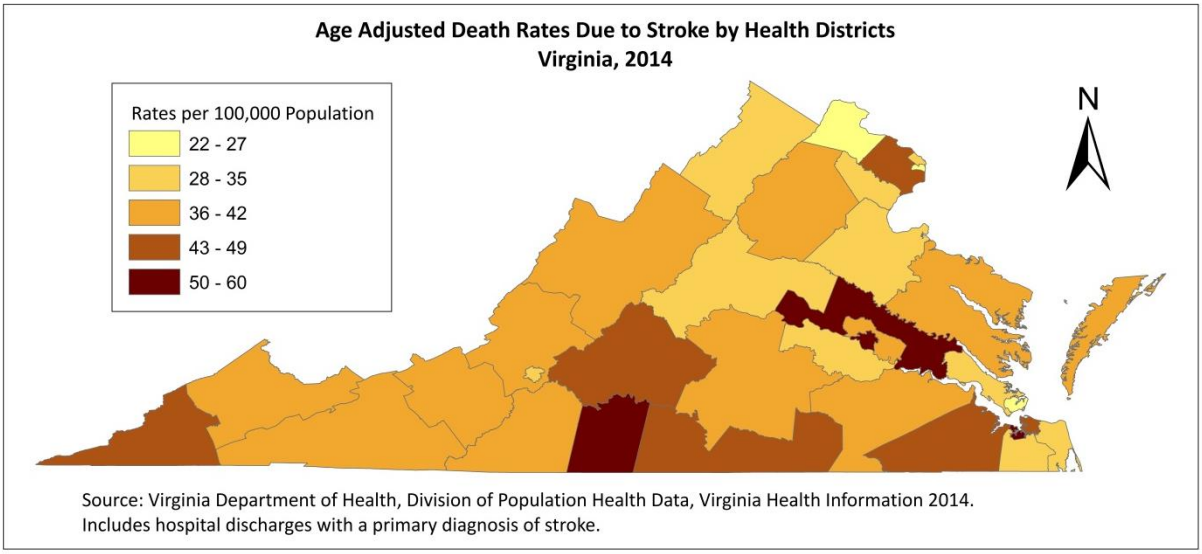
Source: VDH Division of Population Health Data, Vital Records Data, 2014; Mortality Rates are per 100,000 population and are age adjusted.



Source: VDH Division of Population Health Data, Vital Records Data, 2014; Mortality Rates are per 100,000 population.

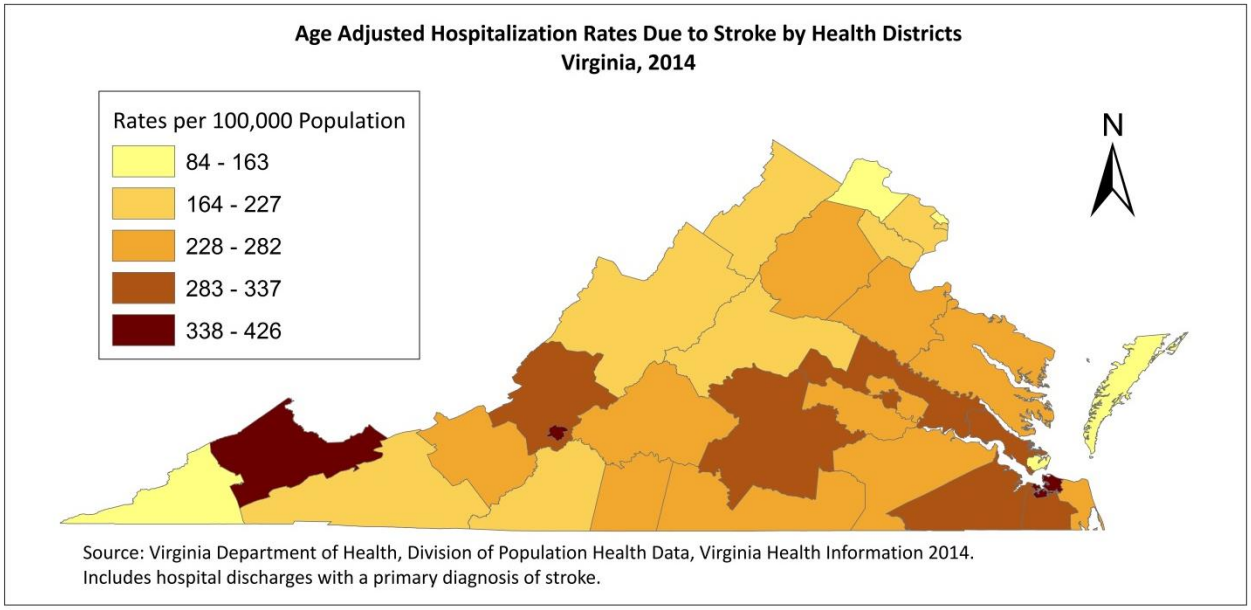
Regionality of Cerebrovascular Disease in Virginia: The distribution of stroke varies widely across Virginia, with age-adjusted rates showing some differences but also showing some shared features:

- Age-adjusted death rates due to stroke, shown below by Health Districts, is substantially higher in the southern and southeastern regions of Virginia, with rates more than double those of the northern districts (VHI, 2014).
- Age-adjusted hospitalization rates are also high in the south and southeastern districts, but also through central Virginia (VHI, 2014).
- Urban regions, particularly the Hampton, Richmond city, Portsmouth, Pittsylvania/Danville, Southside, Norfolk City and Lenowisco show higher death rates than their surrounding areas (VHI, 2014).



Source: Virginia Department of Health, Division of Population Health Data, Virginia Health Information 2014.
Includes hospital discharges with a primary diagnosis of stroke.

- Portsmouth, Norfolk City, Roanoke City, Crater, Chesapeake and Richmond City show higher hospitalization rates than their surrounding areas (VHI, 2014).



Data Sources:

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