

**2008 Tennessee Geographic Information Council Annual Conference
Chattanooga, TN
March 26, 2008**

Presentation

**“Spatial Distribution of Heart Diseases, Cancer, Stroke and Diabetes in
Tennessee State Senate Districts”**

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Spatial Distribution of Heart Diseases, Cancer, Stroke and Diabetes in Tennessee State Senate Districts

INTRODUCTION

Epidemiologists collect data about the occurrence of diseases to explore possible causative factors, to elucidate the nature of epidemics, and to evaluate preventive measures. Does the distribution of a disease form a pattern in space? Understanding the spatial distribution of diseases poses great challenges in public health practice today. Such studies are becoming more and more common, due to the availability of low cost Geographic Information Systems (GIS) with user-friendly interfaces. GIS allows the spatial visualization of health-related phenomena, such as individual populations and community health indicators, by means of regional colored, or choropleth, maps.

To give an example of how choropleth maps aid us in interpreting the distribution of diseases, we present here a series of maps created in the Department of Surveillance, Epidemiology and Evaluation, which were designed utilizing a unique new set of geographic boundaries to show mortality rates for four of the leading causes of death in Tennessee. Specifically, we mapped 2004 mortality rates for heart disease, cancer, stroke, and diabetes by the Tennessee State Senate Legislative Districts, the districts from which our state senators are elected. Furthermore, these rates were broken down by race and gender to highlight disparities in mortality rates that may exist between these groups.

Geographic patterns of mortality rates in Tennessee have customarily been presented by county, or aggregated into health department regions. Because of the large difference in population sizes among counties, the mortality rates for some counties are not stable enough to present the disease burden in those areas. Based on the more evenly distributed population of our State Senate Districts, it seems a logical choice to try to utilize these areas in attempting to create a better representation of the spatial distribution of these diseases. In addition, using these districts may be useful in communicating with legislators, policy makers and the public about the burden of these diseases and serve as a guide in the development of health policy.

According to mortality data analysis by the CDC in the recent decade, heart diseases, cancer, and stroke were the three leading causes of death in the United States as well as in Tennessee. Diabetes ranked sixth among the leading causes of mortality in 2006 in Tennessee. Heart diseases, cancer, stroke and diabetes contributed nearly 60% of the total deaths from 2000 to 2006 among Tennessee residents. Since risk factors for those chronic diseases are related to a combination of lifestyle, environment, and genetic background, preventing these conditions is a great challenge to Tennessee health workers and to Tennessee residents as well.

TECHNICAL CONSIDERATIONS

Since census population data are unavailable for the State Senate Districts, we had to use a number of estimation methods to obtain denominators for our age-adjusted rates. Our main tool for doing the estimations was a shapefile of Tennessee Census Block Groups that contained detailed 2000 census population information including age, sex, and race. Furthermore, some of the districts falling into urban areas did not have boundaries that coincided precisely with the census blocks, as did all of the rural ones. Therefore, in these areas, a spatial join was performed to select block groups that had their centroid within each of the problem districts, and population totals were calculated by summing the selected block group populations.

Numerators for our rates were determined by geocoding patient data using a composite address locator which matched addresses to standardized address data taken from ESRI's StreepMap 2000 and Tennessee Centerline Data created from TeleAtlas files by the Tennessee Base Mapping Program.

Since there are large variations in the occurrence of chronic diseases by age groups, the rates had to be adjusted to a standard population in order to account for these differences. We used the standard US 2000 population to do the age-adjustment.

MAPS BY STATE SENATE DISTRICTS

GIS Mapping of heart disease, cancer, stroke, and diabetes was completed using Tennessee 2004 mortality data. For each disease, five maps were created, based on Tennessee State Senate Districts, displaying general mortality rates and specific mortality rates for whites, African-Americans, males, and females respectively. As shown by the color ramp in the map legends, the darker shade colors represent higher mortality rates, and the lighter colors correspond to lower rates. When rates were compared by race or gender, a constant scale was chosen so that absolute differences in rates would be more apparent. In some districts, mortality rates for African-Americans were based on relatively small numbers of deaths. Hence, due to confidentiality concerns, the mortality rate for heart disease among African-Americans for district 15 was suppressed.

There are 33 State Senate Districts in Tennessee. The series of maps by State Senate District for heart disease shows that Districts 1, 19, 26, and 29 have higher age-adjusted mortality rates (300 - 335 per 100,000 population), attributed to heart disease. When broken down by race, the highest mortality rates (400 – 520 per 100,000 population) due to heart disease can be seen in seven districts for African-Americans, while the mortality rates for whites are less than 300 per 100,000 in all districts except districts 1, 19, and 26. When we compare by gender, a similar disparity in the spatial distribution of heart disease mortality is also seen. The heart disease mortality rates for males are more than 325 per 100,000 population in most districts, but the mortality rates for females are less

than 275 per 100,000 population in almost all districts. The features of spatial distribution of heart disease mortality suggest that there are striking disparities by race and gender in heart disease mortality.

From the series of maps for cancer, we can see higher cancer mortality rates (235 – 255 per 100,000 population) in seven Districts. In comparing mortality rates between whites and African-Americans, African-Americans have the highest cancer mortality rates (300 - 450 per 100,000 population) in six Districts, compared to whites in three Districts. The cancer mortality rates are much higher in males than in females in almost all Senate Districts (more than 250 per 100,000 vs. less than or equal to 200 per 100,000 population). This series of maps shows that the disparities between race and gender also exist for cancer mortality in Tennessee's population.

State Senate Districts 17, 29, and 33 have higher stroke mortality rates (80 - 100 per 100,000 population), according to the series of maps for stroke. African-Americans in eleven districts have stroke mortality rates in the highest bracket (100 - 225 per 100,000 population), compared to whites with rates less than 85 per 100,000 population in almost all districts. There are twelve districts where stroke mortality rates for males are 80 - 110 per 100,000 population, while only two districts shows this high mortality rate for females. The features of spatial distribution again reveal the striking disparities by race and gender in mortality attributed to stroke.

The mortality rates due to diabetes in Tennessee residents are not as high as those of heart disease, cancer, and stroke, but the disparities between races and genders are perhaps the most striking. For the total population, districts 9 and 19 show a darker color which represents a diabetes mortality rate of 45 – 60 per 100,000 population. However if we break the rates down by race, the African-American population has a mortality rate attributed to diabetes of 100 – 190 per 100,000 population in seven districts, while whites have diabetes mortality rates less than 40 per 100,000 population in most districts. When we look at rates by gender, there are eight Districts where diabetes mortality rates for males are 45 - 65 per 100,000 population, while only two districts show such a high mortality rate for females. This series of maps reveals that even when rates of death are low, as in the case of diabetes, disparities by race and gender still exist in the Tennessee population.

CONCLUSIONS

- Fighting heart disease, cancer, stroke, and diabetes is critical for improving health status in community public health practice and plays a very important role in disease prevention and control in the new century. Characterizing these chronic diseases by Tennessee State Senate Districts not only provides a more clear description of the spatial distribution of mortality data, but also can minimize the problem of population size that poses such disadvantages for mapping mortality by county.

- The results of this series of maps confirm that there are striking disparities according to race and gender in mortality rates attributed to heart disease, cancer, stroke, and diabetes. Developing preventive measures and establishing public health priorities for those chronic diseases are critical for improving the health status of Tennessee's population and to achieve the 2010 health objectives of the State.
- Since it is critical to get support from State legislators for public health practice, characterizing these chronic diseases by Tennessee State Senate Districts may be useful in communicating with legislators, policy makers and the public about the burden of these diseases and serve as a guide in the development of health policy.

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TENNESSEE DEPARTMENT OF HEALTH

Epidemiology

- “Epi” = upon
- “Demos” = people
- “Logos” = study

“The study of what is upon the people”

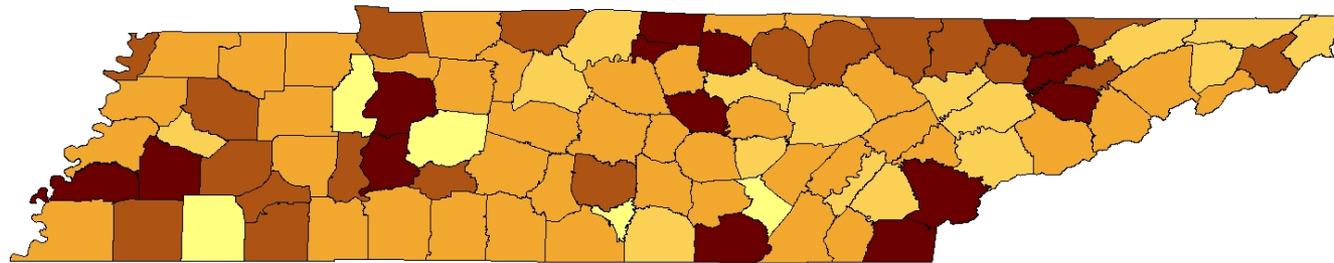
GIS and Epidemiology

Maps help us to:

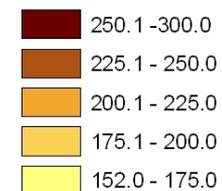
- Understand the spatial distribution of diseases
- Track diseases
- Plan for treatment and/or prevention
- Plan the allocation of resources
- Communicate with the public, law-makers, etc.

Choropleth Mapping by County

**Cancer, 2005
Age-Adjusted Mortality Rate**



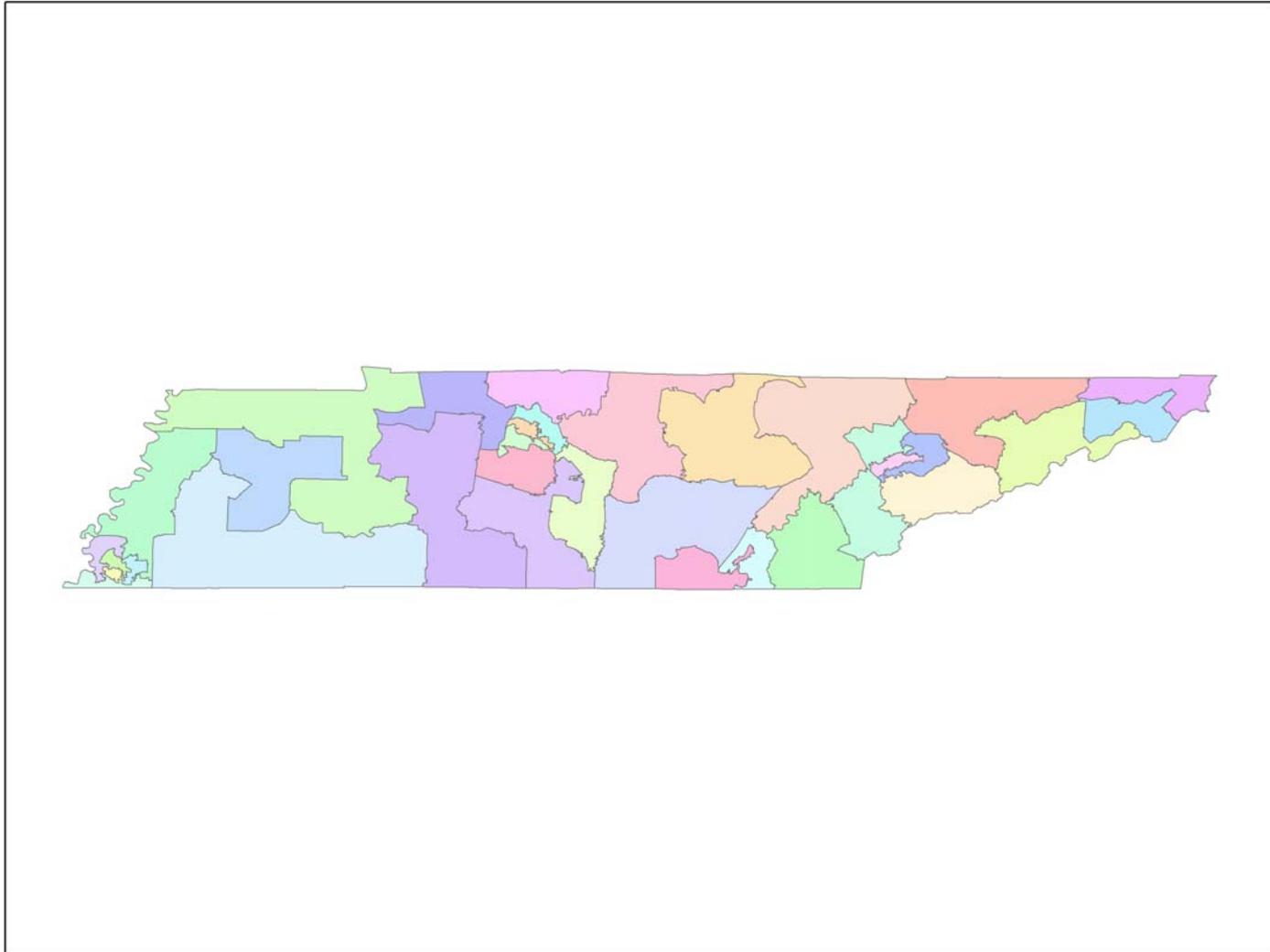
**Age-adjusted Rate
Per 100,000**



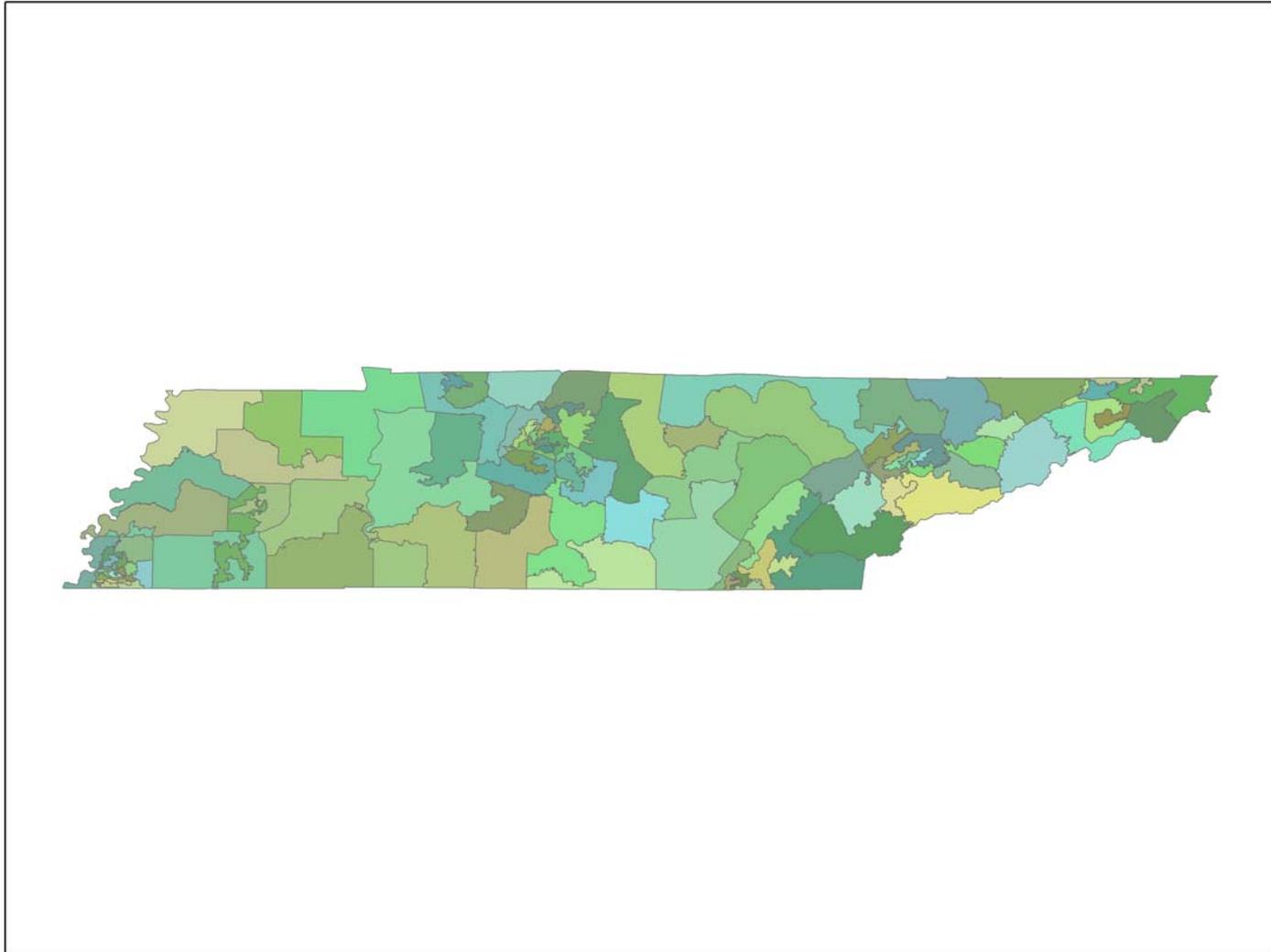
The Search for a New Set of Boundaries

- State “Upper House” Legislative Districts
- VS
- “Lower House” Districts

State Legislative Senate Districts



Lower House Districts



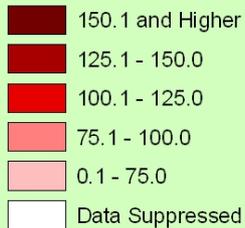
Criteria for New Boundaries

- Minimize the need for suppression
- Units with similar population size
- Units small enough to show regional variations
- Units for which we can obtain population data, disease data
- Boundaries that hold meaning for lawmakers and the general public

Data Suppression

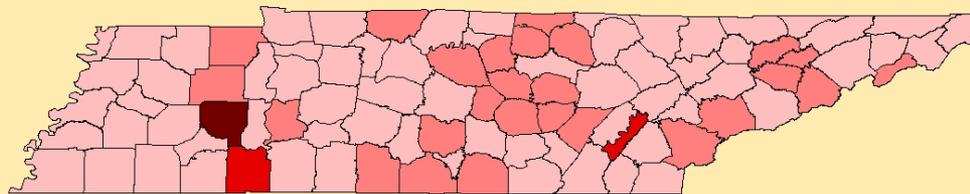
Stroke 1999-2004 Age-Adjusted Mortality Rates By Race For Females

Age-Adjusted Rate
Per 100,000 Population

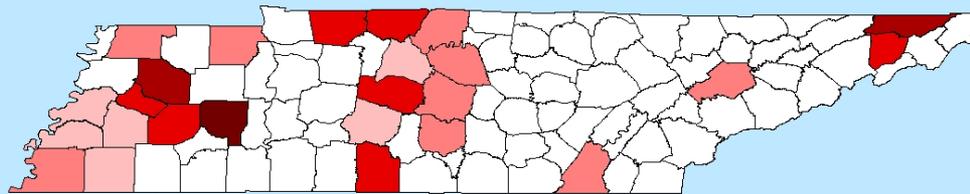


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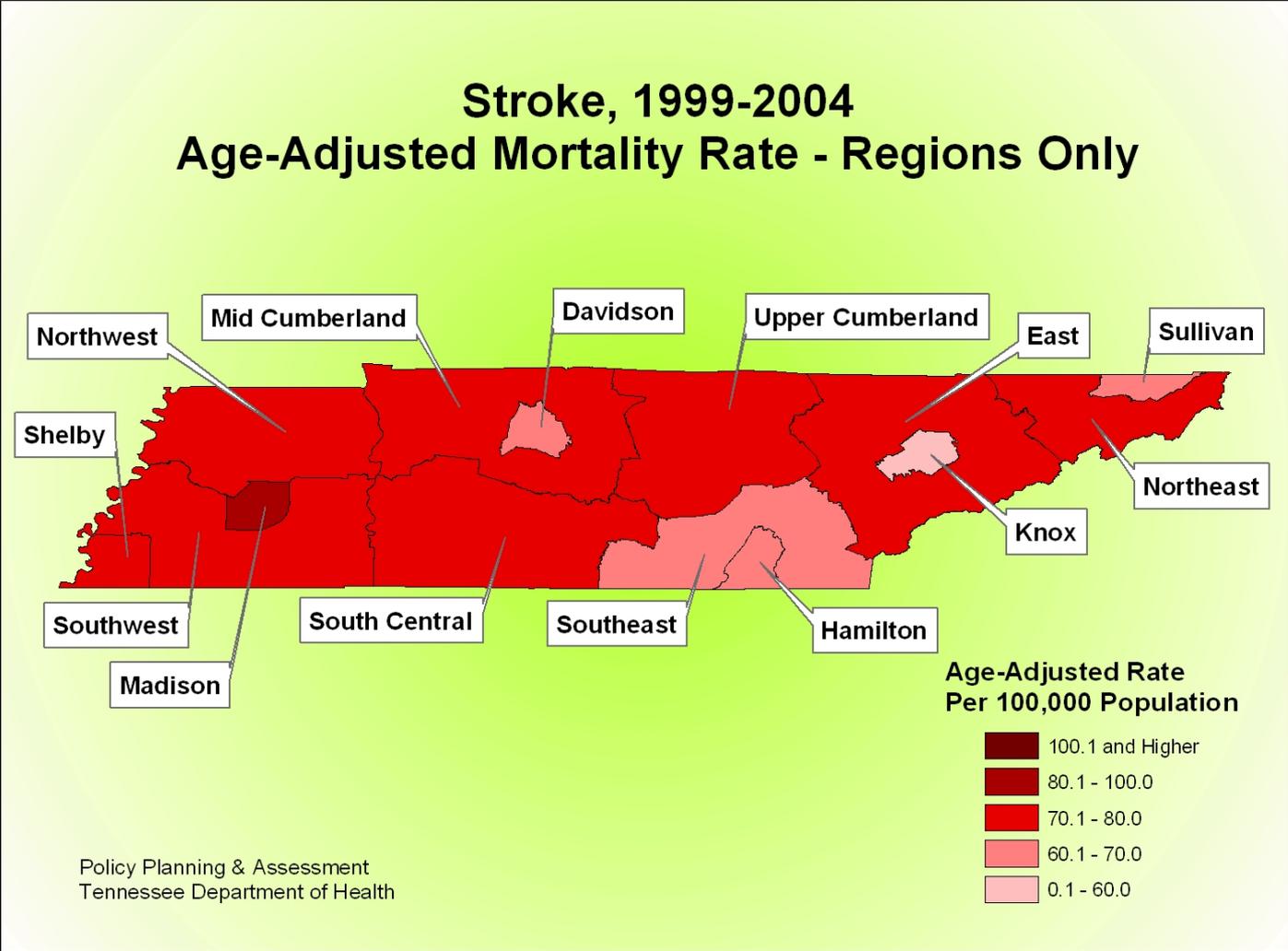
White Females



Black Females



Choropleth Mapping by Region



What to Map First?

- Previous series of maps for the HIT site showing mortality rates for top leading causes of death due to chronic diseases
 - Heart Disease
 - Cancer
 - Stroke
 - Diabetes

Chronic Disease Mortality

- An ongoing battle for public health professionals
- Four diseases contributed to 60% of total deaths for Tennesseans from 2000 – 2006
- Disparities exist between populations and regions, which need to be targeted
- Implications for lawmakers, planners

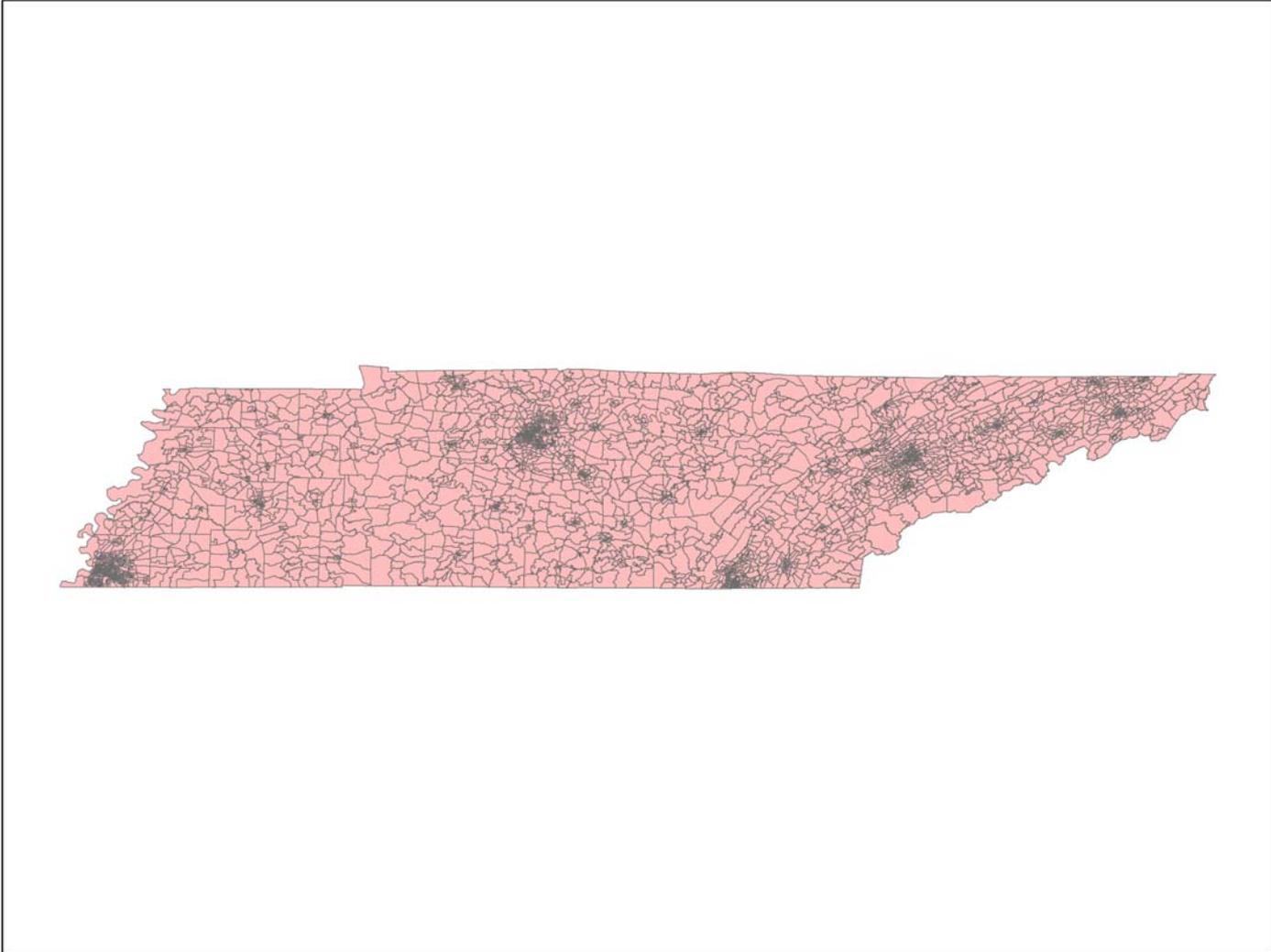
Technical Problems

- No census population data
- Voting district data not on death certificate

Base Population

- Estimates based on Census Block Groups
- 2000 Census Data
- Includes data on age, sex, and race
- Rural areas match boundaries
- Urban areas approximate

TN Census Block Groups



Calculate Numerator, Age-Adjusted Rates

- Geocoded patient addresses using composite address locator
- 95% address match rate
- Counted death events using Spatial Join function
- Age-adjusted rates based on 2000 standard population data

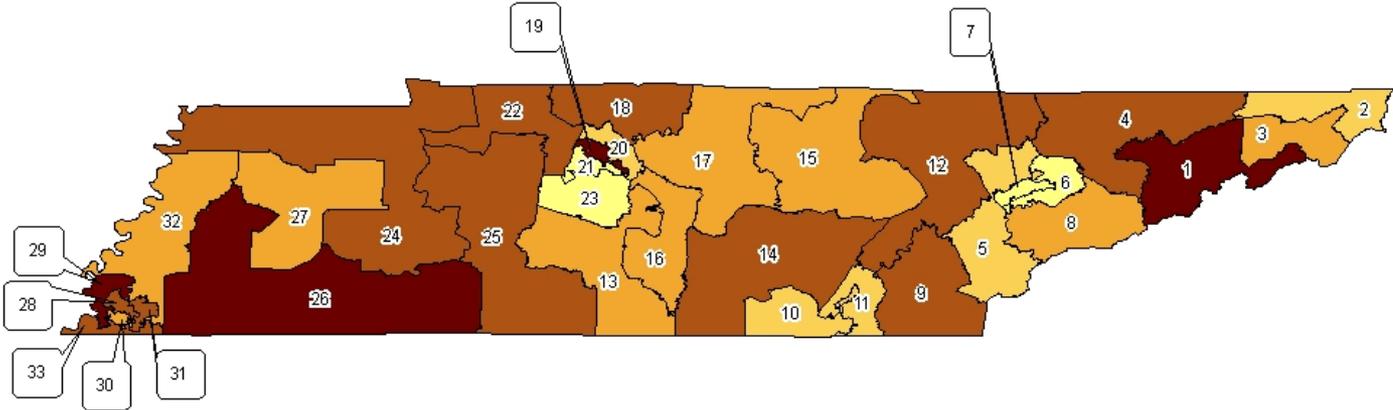
Mapping

- Maps for total population as well as broken down by race and gender
- Standard scale for mapping by race/sex to see absolute differences
- Color Schema
- Labeling
- Note on estimation methods

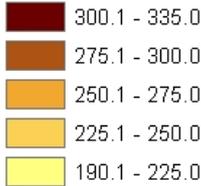
Heart Disease

What Do We See?

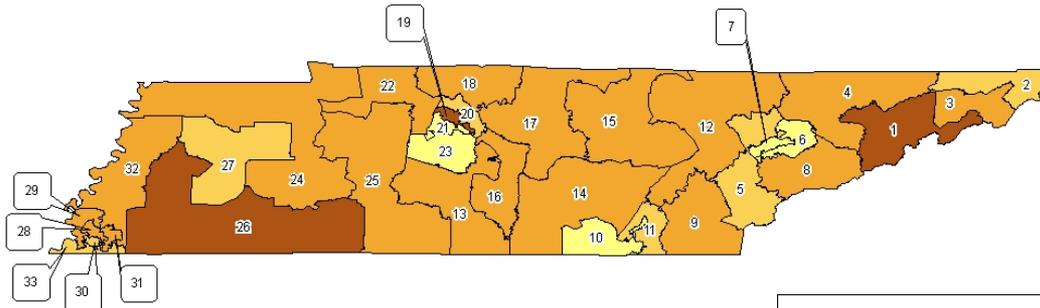
Diseases of the Heart Mortality Rate, 2004 By Tennessee State Senate Districts



**Age-adjusted Rate
Per 100,000 Population**



Diseases of the Heart Mortality Rate for Whites, 2004 By Tennessee State Senate Districts

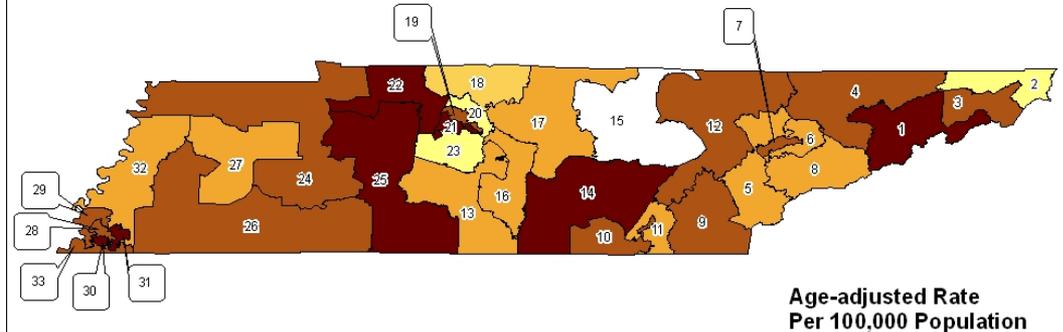


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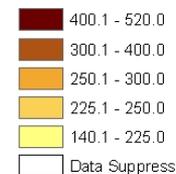
Rates were

White vs. African- American

Diseases of the Heart Mortality Rate for African-Americans, 2004 By Tennessee State Senate Districts



Age-adjusted Rate
Per 100,000 Population

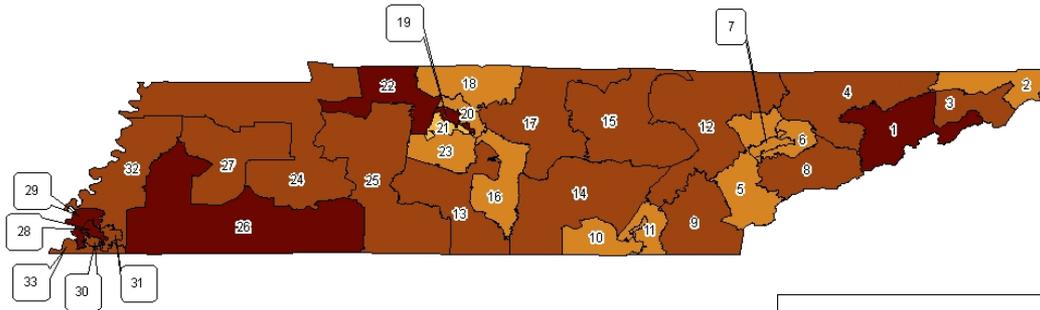


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Tennessee Department of Health

Rates were calculated using 2000 population data.

Heart Disease

Diseases of the Heart Mortality Rate for Males, 2004 By Tennessee State Senate Districts

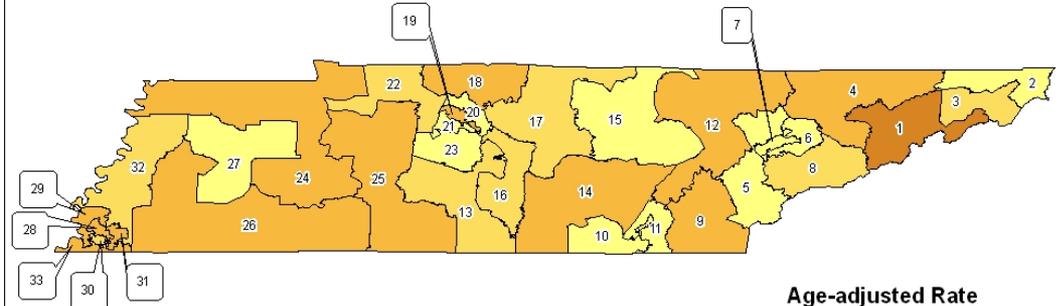


Office of Policy Planning & Assessment
Tennessee Department of Health

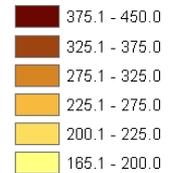
Rates were

Male vs. Female

Diseases of the Heart Mortality Rate for Females, 2004 By Tennessee State Senate Districts



Age-adjusted Rate
Per 100,000 Population



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Tennessee Department of Health

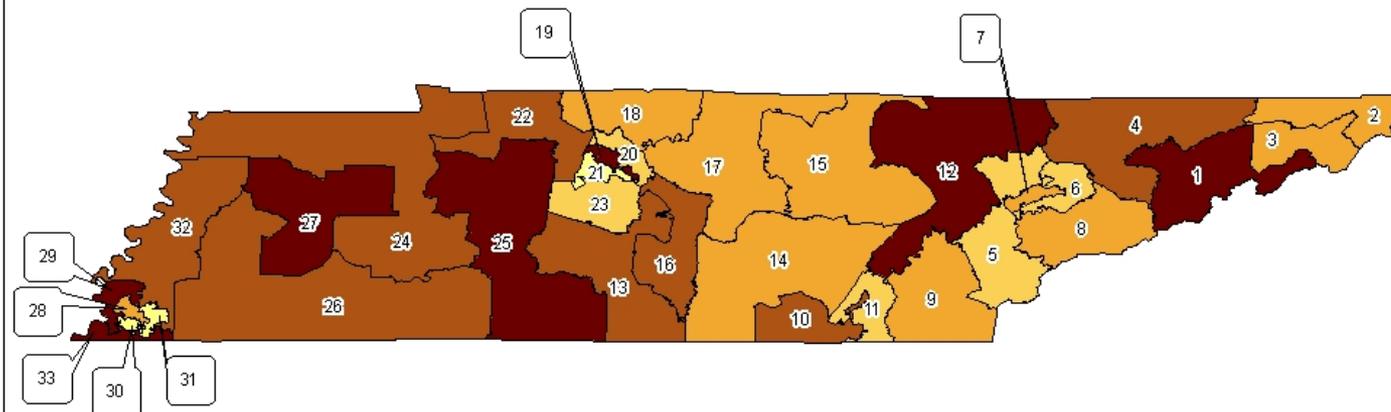
Rates were calculated using 2000 population data.

Heart Disease

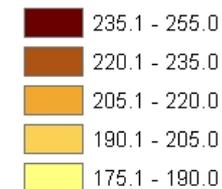
Cancer

Cancer Mortality

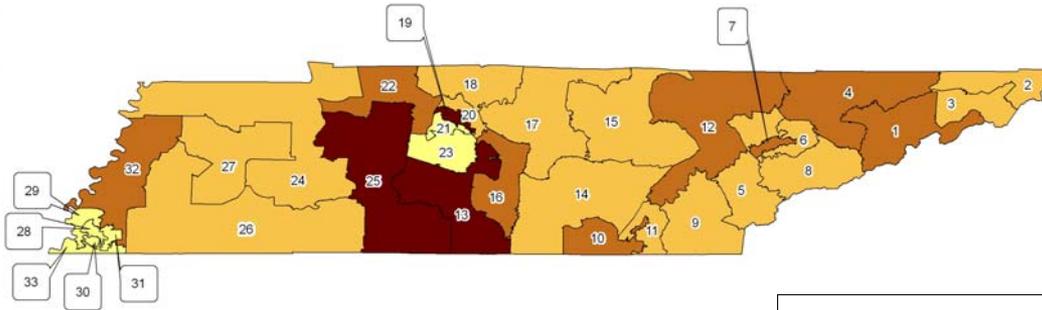
**Cancer Mortality Rate, 2004
By Tennessee State Senate Districts**



**Age-adjusted Rate
Per 100,000 Population**



Cancer Mortality Rate for Whites, 2004 By Tennessee State Senate Districts

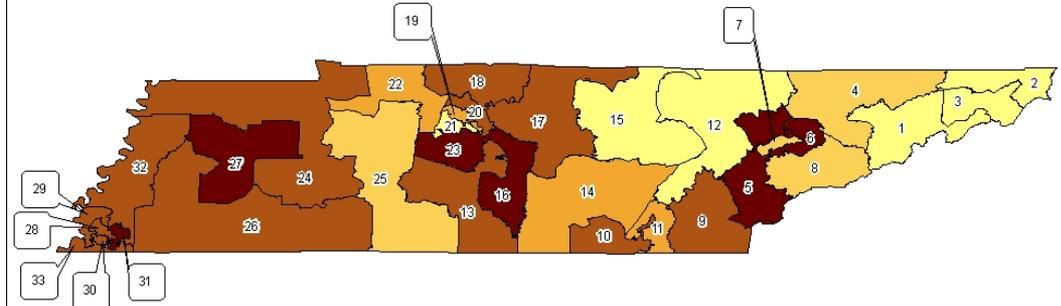


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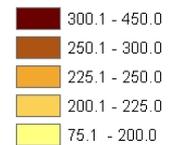
Rates w/

White vs. African- American

Cancer Mortality Rate for African-Americans, 2004 By Tennessee State Senate Districts



Age-adjusted Rate
Per 100,000 Population

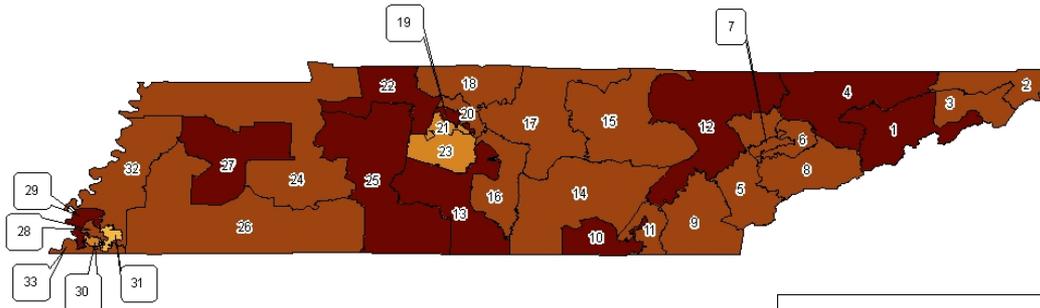


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Rates were calculated using 2000 population data.

Cancer

Cancer Mortality Rate for Males, 2004 By Tennessee State Senate Districts

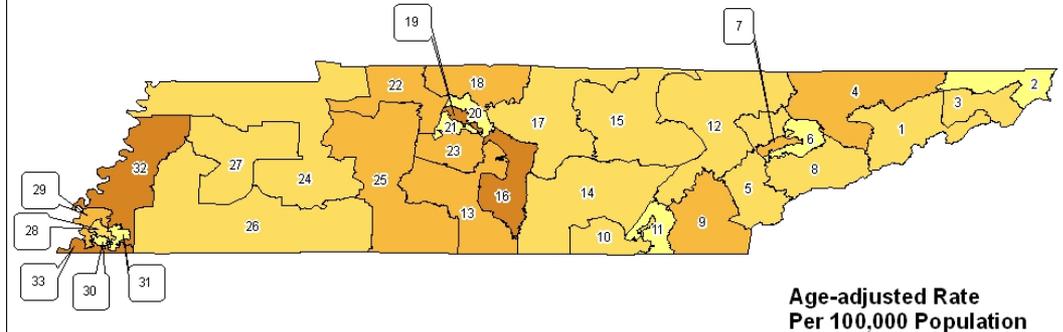


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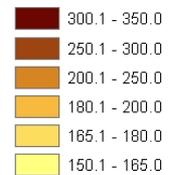
Rates were

Male vs. Female

Cancer Mortality Rate for Females, 2004 By Tennessee State Senate Districts



Age-adjusted Rate
Per 100,000 Population



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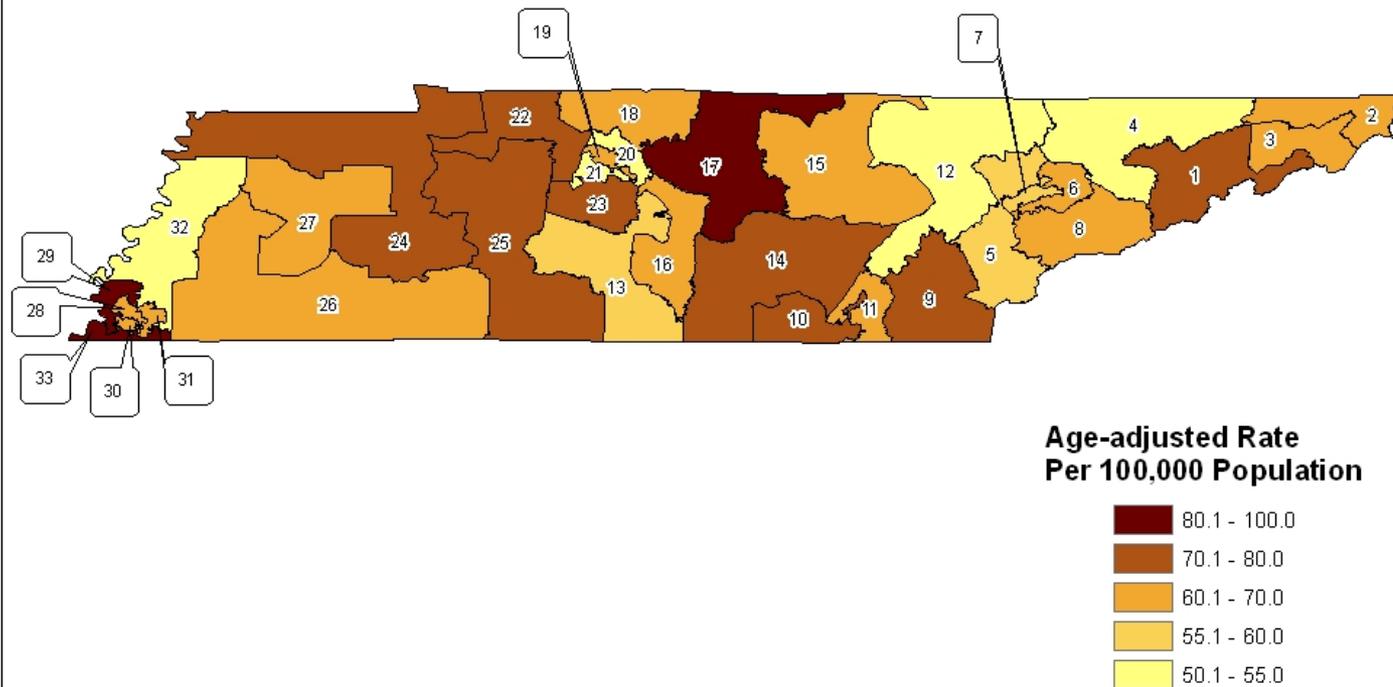
Rates were calculated using 2000 population data.

Cancer

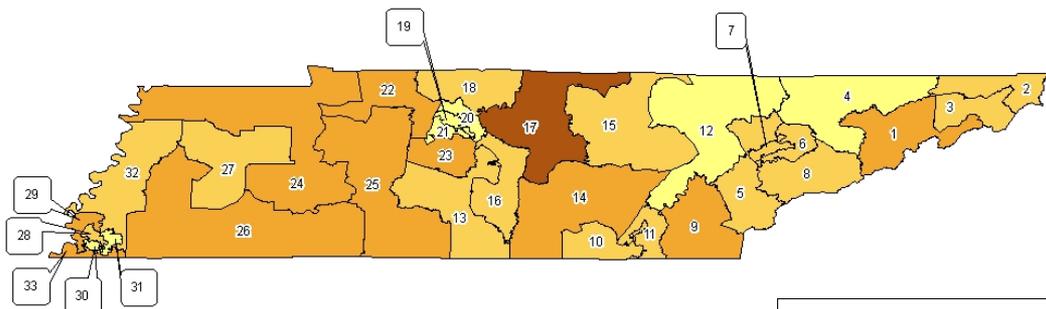
Stroke

Stroke Mortality

**Stroke Mortality Rate, 2004
By Tennessee State Senate Districts**



**Stroke Mortality Rate for Whites, 2004
By Tennessee State Senate Districts**

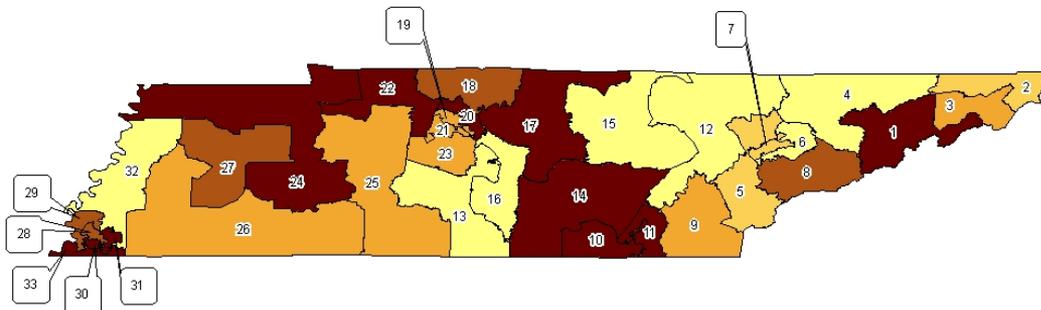


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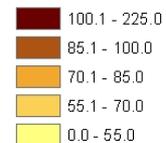
Rates were

White vs. African- American

**Stroke Mortality Rate for African-Americans, 2004
By Tennessee State Senate Districts**



**Age-adjusted Rate
Per 100,000 Population**

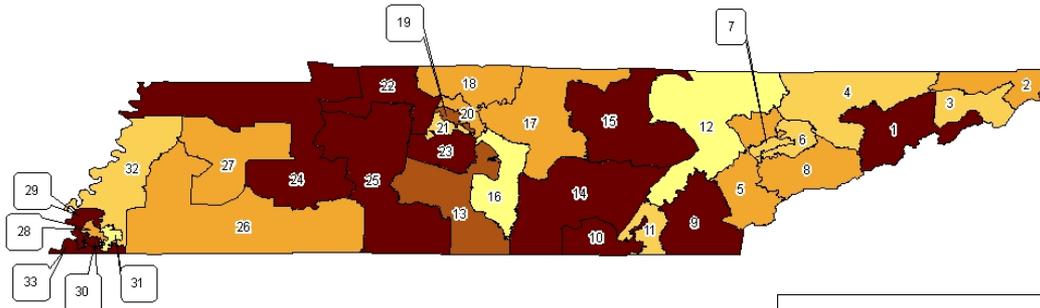


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Rates were calculated using 2000 population data.

Stroke

Stroke Mortality Rate for Males, 2004 By Tennessee State Senate Districts

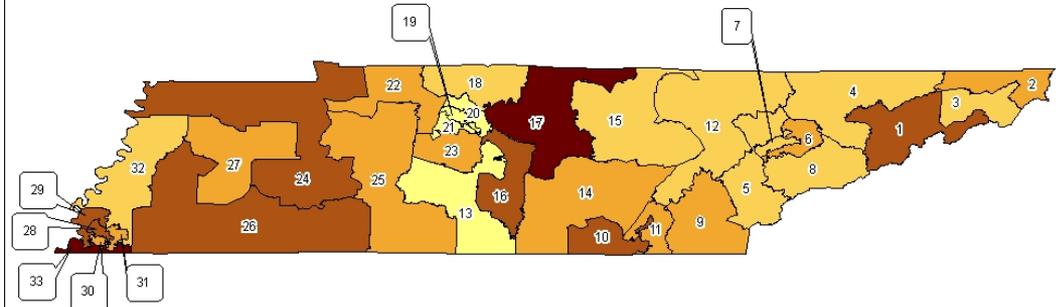


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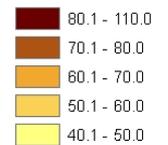
Rates were

Male vs. Female

Stroke Mortality Rate for Females, 2004 By Tennessee State Senate Districts



Age-adjusted Rate
Per 100,000 Population



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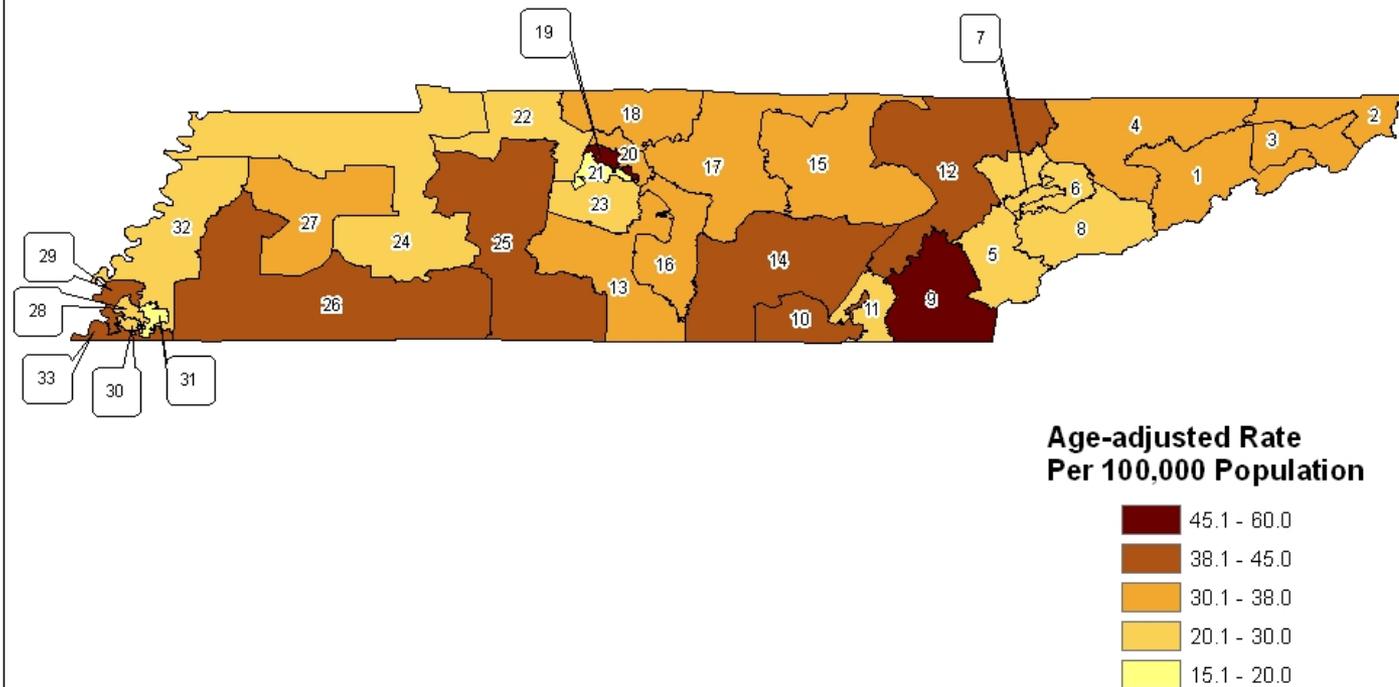
Rates were calculated using 2000 population data.

Stroke

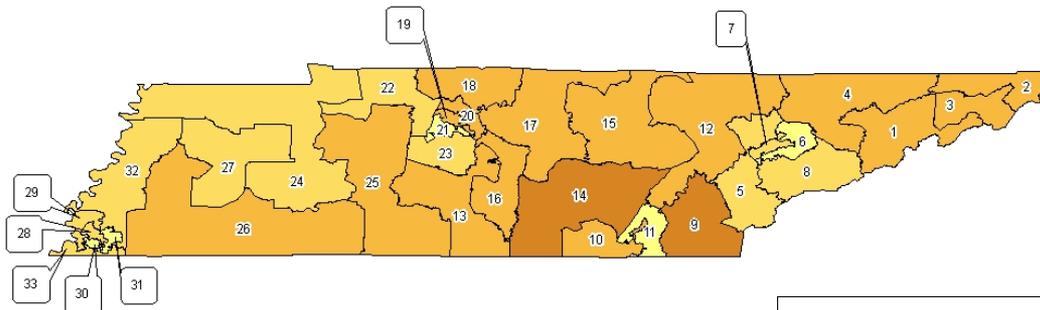
Diabetes

Diabetes Mortality

**Diabetes Mortality Rate, 2004
By Tennessee State Senate Districts**



Diabetes Mortality Rate for Whites, 2004 By Tennessee State Senate Districts

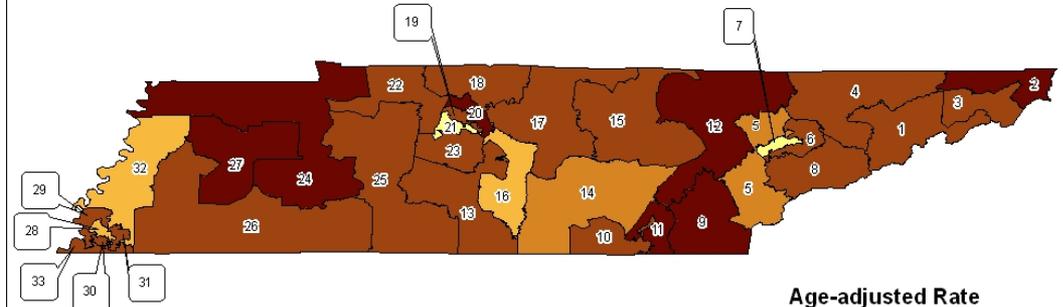


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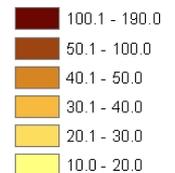
Rates were

White vs. African- American

Diabetes Mortality Rate for African-Americans, 2004 By Tennessee State Senate Districts



Age-adjusted Rate
Per 100,000 Population

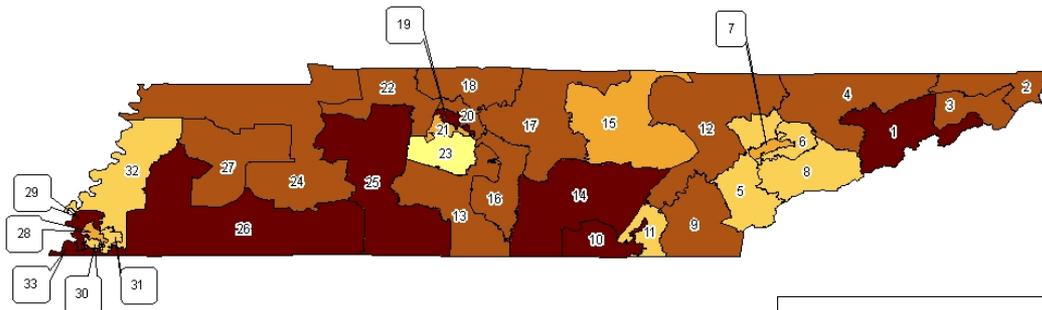


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Rates were calculated using 2000 population data.

Diabetes

Diabetes Mortality Rate for Males, 2004 By Tennessee State Senate Districts

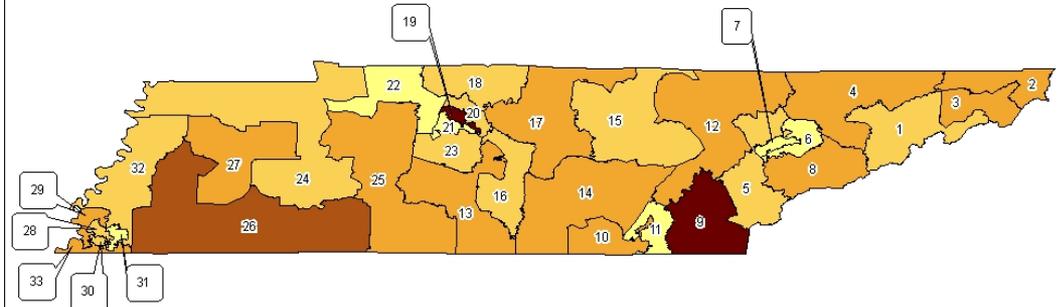


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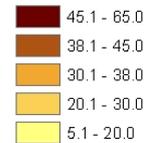
Rates were

Male vs Female

Diabetes Mortality Rate for Females, 2004 By Tennessee State Senate Districts



**Age-adjusted Rate
Per 100,000 Population**



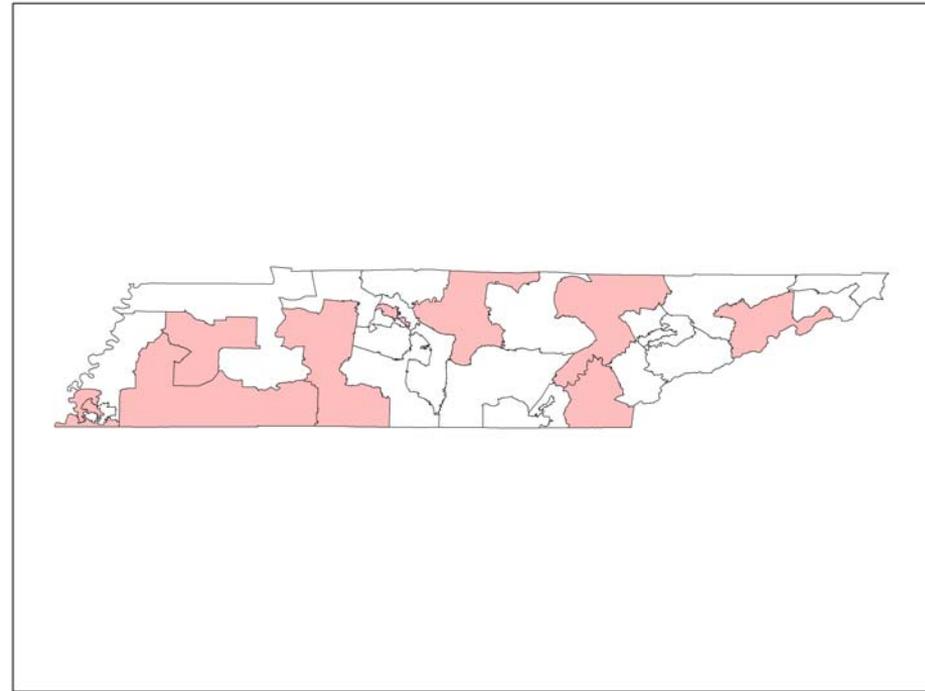
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Rates were calculated using 2000 population data.

Diabetes

Disparities by Geography

- Isolated districts in the highest rate brackets
- 11 out of 33 districts consistently in the highest bracket
- No evident pattern to geographic disparity



Conclusions

- State Senate Districts are an effective tool for mapping chronic disease mortality
- They decreased our need to suppress data and provided good regional contrast
- They represent an effective means for communicating our findings to lawmakers, and thus could impact health policy

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