



*The Burden of*  
**Heart Disease  
and Stroke**  
*in Tennessee*

Tennessee Department of Health  
in collaboration with  
Tennessee State University and  
University of Tennessee Health Science Center

**2006**

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### CONTRIBUTING AGENCIES

**Tennessee Department of Health**  
Office of Policy Planning and Assessment  
Community Services Section  
Division of Health Promotion  
Heart Disease and Stroke Prevention Program

**Tennessee State University**  
Center for Health Research

Chapter on the Impact on Health Care Costs  
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Department of Health Science Administration

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# EXECUTIVE SUMMARY

## PURPOSE

The purpose of this report is to document Tennessee's burden of heart disease and stroke from 1996 to 2002. Heart disease and stroke are the two most common forms of cardiovascular disease, and they are also the first and third leading causes of death both in the United States and Tennessee. This report includes trends in risk factors that increase risk for heart disease and stroke; trends in the occurrence of diseases of the heart, stroke, and hypertension; and trends in health service utilization and costs associated with these conditions.

## KEY FINDINGS

### Modifiable Risk Factors

- In 2002, nine out of ten adult Tennesseans reported at least one modifiable risk factor for heart disease and stroke, and 63% reported two or more risk factors, the most common of which were poor diet and sedentary lifestyle.
- The prevalence of some risk factors have remained fairly stable (current smoking and high cholesterol), some decreased only slightly (sedentary lifestyle and poor diet), and others increased at a disturbing rate (obesity and diabetes mellitus). Black females, especially, had high prevalence for multiple risk factors.

### Diseases of the Heart (DOH)

- Nearly 70,000 (40,000 elderly) Tennesseans were hospitalized for DOH in 2002.
- Age-adjusted rates of DOH among inpatients increased by 4% from 1,140.7 to 1,189.5 per 100,000 population from 1997-2002, and were higher for males than females.
- Among the elderly, rates of physician-diagnosed DOH were highest for white males and lowest for black males.
- About 2/3 of people with DOH had hypertension (HTN), 1/4 to 1/3 had diabetes mellitus, and 30-40% had high cholesterol.
- Compared to other states in 2002, Tennessee ranked 6th highest in DOH mortality. DOH caused around 16,000 deaths each year in Tennessee, but the age-adjusted mortality rate for DOH decreased by 9%, from 313.6 per 100,000 in 1996 to 284.7 per 100,000 in 2002. DOH mortality was highest for black males.

### Myocardial Infarction (MI)

- Six percent of Tennessee adults reported ever having a physician-diagnosed heart attack, with a higher prevalence for white males, and over 14,000 Tennesseans were hospitalized for MI in 2002.
- Age-adjusted rates of MI among inpatients increased by 3% from 1997-2002, but the age-adjusted mortality rate from MI decreased by 17% from 1996-2002. Both rates were highest for White males.

### Congestive Heart Failure (CHF)

- Nearly 18,000 Tennesseans were hospitalized for CHF in 2002. Age-adjusted rates of CHF among inpatients increased by 7% from 1997-2002, and rates were much higher for blacks than for whites
- The age-adjusted mortality rate for CHF increased by 10% from 1996-2002, and was higher for blacks than for whites in most years.

### Stroke

- Among Tennessee adults, 3.6% reported ever having a physician-diagnosed stroke, including 9% of black males in 2002. Nearly 20,000 Tennesseans were hospitalized for stroke in 2002.
- Age-adjusted rates of stroke among inpatients decreased by 2% from 352.5 to 346.7 per 100,000 during 1997-2002, and were higher for blacks compared to whites. Among the elderly, though, rates of physician-diagnosed stroke were higher for whites.
- Compared to other states in 2002, Tennessee ranked 3rd highest in stroke mortality. Stroke caused around 4,000 deaths per year in Tennessee, but the age-adjusted mortality rate for stroke decreased by 11% from 79.7 to 70.8 during 1996-2002.
- Stroke mortality rates were higher for blacks compared to whites, particularly for black males.

### High Blood Pressure, or Hypertension (HTN)

- Among Tennessee adults in 1996-2002, 27-30% report ever having physician-diagnosed HTN, with higher prevalence for black females in most years.
- Age-adjusted rates of HTN among inpatients decreased by 3% from 1997-2002, and were highest for blacks.

- Nearly 300,000 elderly had physician-diagnosed HTN in 2002, and the age-adjusted rate increased by 25% from 1996-2002, with the highest rates for black females.

### Impact on Health Service Utilization

- For DOH, the annual number of inpatient hospitalizations (about 70,000 in 2002) increased by 11% from 1997-2002 (with a slower increase for blacks), accounting for around 12% of all inpatient visits.
- About three-fourths of DOH hospitalizations among blacks were admitted through the emergency room, compared to just over half for whites. The average length of stay (LOS) decreased by 3% from 5.3 to 5.1 days, and was slightly longer for females and a day longer for blacks than whites (highest for black females).
- The annual number of outpatient visits for DOH (nearly 52,000 in 2002) increased by 80% from 1997-2002, with a two times greater increase for whites compared to blacks. Elderly individuals had on average 6.1 physician visits for DOH in 2002 (higher for males, especially black males).
- For stroke, the annual number of inpatient hospitalizations (nearly 23,000 in 2002) increased by 8% from 1997-2002 (with a greater increase for whites), accounting for around 3% of all inpatient visits.
- About three-fourths of stroke hospitalizations among blacks were admitted through the emergency room (ER), compared to about 60% for whites. The average LOS increased by 7% from 5.7 to 6.0 days, and was 2-3 days longer for blacks than whites.
- The annual number of outpatient visits for stroke (about 6,500 in 2002) increased by 92% from 1997-2002, with a four-times greater increase for whites compared to blacks. Elderly individuals had on average 4.2 physician visits for DOH in 2002 (higher for blacks, especially black males).
- For HTN, there were about 7,000 inpatient hospitalizations in 2002. Nearly three-fourths of HTN hospitalizations among blacks were admitted through the emergency room, compared to over half for whites. Elderly individuals had on average 3.4 physician visits for HTN in 2002 (higher for Blacks).
- The total number of cardiac and vascular procedures performed each year in an inpatient setting (about 40,000 in 2002) increased by 21% from 1997-2002.
- The procedures with the greatest increase in frequency were inpatient open heart surgery and heart valve surgery

(especially for whites) as well as outpatient angioplasty/stenting and outpatient cardiac catheterization (especially for blacks).

### Impact on Health Care Costs

- The total cost for inpatient services for all diseases increased 61% from \$6.9 billion in 1997 (in 2002 dollars) to \$11.1 billion in 2002. DOH, stroke and HTN inpatient costs also increased from 1997 to 2002 similarly to the total cost (\$2.1 billion for DOH, \$395 million for stroke, and \$115 million for HTN in 2002).
- The total cost for physician services among the elderly increased approximately 33% from \$1.05 billion in 1996 to \$1.4 billion in 2002. The cost of physician services for DOH and stroke increased to a smaller extent than the cost for all diseases (11% for DOH, 2% for stroke) but physician services cost for HTN increased to a higher extent than all diseases (31%). In 2002, the physician services cost was \$143 million for DOH, \$42 million for stroke and \$46 million for HTN.
- For DOH, the age-adjusted per capita charges (AAPCC) for inpatient services increased 43% from \$253 in 1997 to \$362 in 2002, which is much higher than the increase in age-adjusted DOH inpatient hospitalization rate (4%). This suggests that the increase in DOH inpatient costs were not due to the increase of inpatients alone.
- Males had higher age-adjusted per capita charges than females with white females being the lowest from 1997-2002.
- Among the elderly, the age-adjusted per capita cost for DOH physician services increased by 4.8% from 1996-2002, which is much higher than the increase in physician-diagnosed DOH rates (2%). white males had the highest age-adjusted per capita charges while the other three gender-race groups were similar.
- For stroke, the age-adjusted per capita charges for inpatient services increased 45% from \$47 in 1997 to \$68 in 2002, despite the decreases in stroke hospitalization and mortality rates. The age-adjusted per capita charges for blacks were more than twice as high as in whites and the gap increased over time.
- Among the elderly, the age-adjusted per capita cost for stroke physician services decreased by 5% from 1996-2002, with white females being slightly higher than the other three gender-race groups.
- For HTN, the age-adjusted per capita charges for inpatient services increased 54% from \$13 in 1997 to

\$20 in 2002, despite the 3% decrease in HTN hospitalization rate. In 2002, the age-adjusted per capita charges for blacks (\$75) were more than 5 times higher than that for whites (\$12) and the gap was also increasing over time.

- Among the elderly, the age-adjusted per capita cost for HTN physician services increased by 37% from 1996-2002, with black females being the highest and white males the lowest.
- Medicare was the largest payer for all types of services and population age ranges, paying for 62-65% of DOH,

stroke, and HTN costs in 2002 while TennCare paid for 9-12% and other insurance coverage paid for 17-25%. Tax payers (combination of Medicare and TennCare) paid for about three-fourths of the cost.

- Medicare paid for a higher proportion of the cost for females than males and a higher proportion for whites than blacks. TennCare paid for a higher percentage of the cost for blacks than whites, and other insurance coverage paid for a higher percentage of the cost for males than females.

## CONCLUSION

- Patterns in disease rates, health service utilization and mortality suggest that blacks may be more likely to delay seeking care for DOH and stroke and present with more severe conditions compared to whites.
- Increased utilization of effective inpatient and outpatient procedures, particularly when used as secondary preventive treatments, likely contributed to the decrease in DOH and stroke mortality rates as well as the constant

increase in health care cost. However, these mortality rates are still much higher than the national average and disproportionately affect blacks compared to whites.

- The growing prevalence of modifiable risk factors, especially for black females, needs to be targeted by public health programs. Future research should focus on identifying the causes of geographic disparities in heart disease and stroke, as well.





# INTRODUCTION

## PURPOSE

The purpose of this report is to document the burden of heart disease and stroke in Tennessee based on several available data sources. The report addresses various aspects of the burden of heart disease and stroke in Tennessee during the period of 1996-2002, including trends in risk factors that increase risk for heart disease and stroke; trends in the occurrence of diseases of the heart, stroke, and hypertension; and trends in health service utilization and costs associated with these conditions.

## BACKGROUND

### Definitions

- In general, *cardiovascular disease (CVD)* refers to any of the diseases that affect the circulatory system, including heart disease, stroke, and other conditions.<sup>1</sup>
- *Diseases of the heart (DOH)* represent the most common type of CVD, which includes coronary heart disease, myocardial infarction, congestive heart failure, and other conditions.
  - *Coronary heart disease (CHD)* is caused by impaired circulation in one or more coronary arteries, and includes acute *myocardial infarction (MI or heart attack)* and *angina pectoris* (or chest pain).
  - *Congestive heart failure (CHF)* is impairment in the pumping function of the heart from heart disease.
- *Stroke*, or cerebrovascular disease, generally refers to the interruption of blood supply to the brain due to either an obstruction or rupture of a blood vessel, and it includes conditions such as hemorrhage, infarction, occlusion, or stenosis in the brain and cerebral blood vessels.

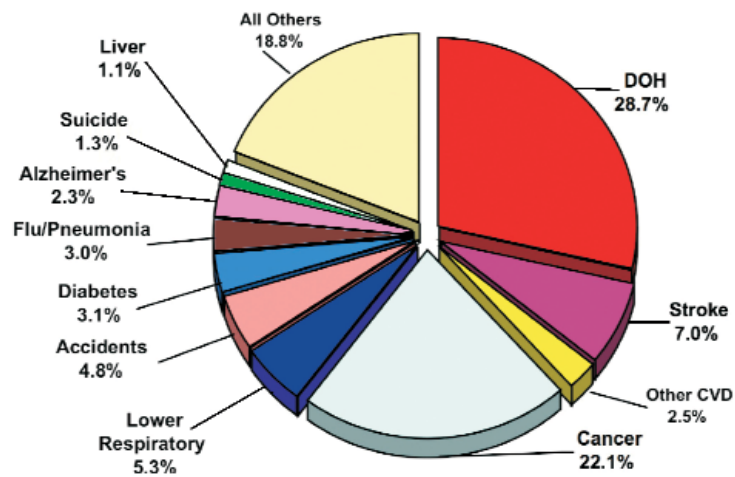


Figure 1.1 Causes of Death in Tennessee in 2002

Source: Report of Tennessee Deaths 2002, TN Dept. of Health, Div. Health Statistics

- *Hypertension (HTN)*, or *high blood pressure*, is a form of CVD in which the pressure in the arteries is elevated. High blood pressure greatly increases the risk of developing heart disease and stroke.

### Diseases of the Heart (DOH)

- Over 23 million Americans, or 11.1% of adults, have some form of heart disease.<sup>2</sup>
- Prevalence of DOH is greater among males compared to females, and is greater among whites compared to blacks.<sup>2</sup>
- DOH is the leading cause of death in the United States, with nearly 700,000 Americans dying of DOH in 2002.<sup>3</sup>
- **DOH** is also the leading cause of death in Tennessee, accounting for 28.7% of deaths, which ranks Tennessee as the 6<sup>th</sup> highest state in DOH mortality.
- Coronary heart disease affects around 13 million Americans, or 6.9% of the total adult population.<sup>1</sup>
- Around 7.1 million Americans, or 3.5% of adults, have suffered from

myocardial infarction, with around 565,000 new attacks and 300,000 recurrent attacks each year.<sup>1</sup>

- In general, new heart attacks are more common among males compared to females and among blacks compared to whites.
- black females tend to have new heart attacks at younger ages than White females.<sup>4</sup>
- Congestive heart failure affects 4.9 million Americans, or 2.3% of adults, and prevalence is higher for blacks compared to Whites.<sup>1</sup>
- One in five adults with CHF die within one year of diagnosis, and around three-fourths of adults under age 65 diagnosed with CHF die within eight years.<sup>5</sup>

### Stroke

- Around 5.4 million Americans, or 2.6% of the total adult population, have had a stroke, with an estimated 500,000 new attacks and 200,000 recurrent attacks annually.<sup>1</sup>
- Incidence rates for strokes are higher among males (1.25 times greater than for females), and blacks have almost twice the risk of stroke compared to whites.<sup>1</sup>

- Stroke is the third leading cause of death in the United States and in Tennessee.<sup>1</sup>
  - In 2002, over 162,000 Americans died from stroke, which accounted for 1 in 15 deaths.<sup>1</sup>
  - In 2002, stroke accounted for approximately 7.0% of deaths in Tennessee.
- High Blood Pressure, or Hypertension (HTN)**
- HTN is the most prevalent form of cardiovascular disease, afflicting an estimated 65 million Americans, or nearly 1 in 3 adults.<sup>6</sup>
  - The prevalence of HTN is higher among males compared to females under age 55, while females have higher prevalence after age 55.<sup>1</sup>
- Prevalence of HTN is higher among Black Americans compared to White Americans.<sup>1</sup>

## MODIFIABLE RISK FACTORS

### Poor diet

- Annually \$33 billion in medical costs and \$9 billion in lost productivity due to heart disease, stroke, diabetes, and cancer are attributed to diet.<sup>1</sup>
- Less than one in four American adults consumes at least five servings of fruits and vegetables per day, as recommended.

### Sedentary lifestyle

- Physical inactivity is associated with increased risk of heart disease and stroke.<sup>8,9</sup>
- Only 31% of U.S. adults engage in regular physical activity, with prevalence being higher for males and Whites.<sup>7</sup>

### High cholesterol

- Self-reported prevalence of high blood cholesterol among persons screened increased from 25.7% in 1991 to 28.6% in 1999 in the U.S.<sup>10</sup>
- A 10% decrease in total cholesterol levels in the U.S. population could result in a 30% lower rate of new coronary heart disease cases.<sup>11</sup>

### Cigarette smoking

- It is a major risk factor for developing and dying from heart disease or stroke.<sup>13-15</sup>
- Although smoking among American adults has declined by 47% since 1965, an estimated 22.5% are current smokers.<sup>12</sup>

### Obesity

- Obesity, particularly abdominal obesity, is strongly associated with heart disease and stroke, and the obese have considerably shortened life expectancies.<sup>16-18</sup>
- Prevalence of obesity increased in the U.S. by 75% from 1991 to 2002, affecting nearly a third of the population.<sup>1</sup>

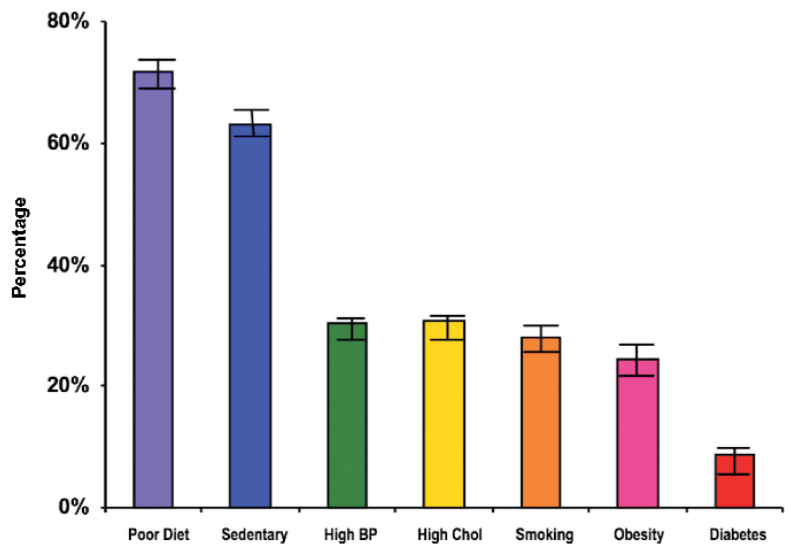
### Diabetes mellitus

- Heart disease death rates among adults with diabetes are 2 to 4 times higher than for those without diabetes.<sup>1</sup>
- Age-adjusted prevalence of diabetes for U.S. adults increased by 54% between 1994 and 2002 (from 4.8% to 7.3%).<sup>19</sup>

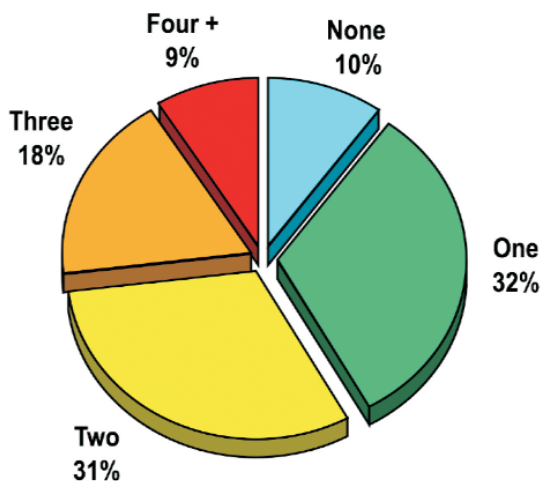
# MODIFIABLE RISK FACTORS

- This chapter discusses several major risk factors for heart disease and stroke that can be modified through behavior change and/or treatment.
- High blood pressure (hypertension) is both a cardiovascular disease and also a modifiable risk factor for other forms of heart disease and stroke (see chapter on hypertension).
- Among the modifiable risk factors examined here, poor dietary habits had the highest prevalence (71.6%) in 2002 among Tennessee adults, followed by sedentary lifestyle (63.0%).
- The others were: high blood pressure (30.3%), high cholesterol (30.7%), cigarette smoking (27.8%), obesity (24.6%), and diabetes (8.5%).

*Note: 2001 data used for Sedentary Lifestyle due to change in question wording in 2002.*



**Figure 2.1 Prevalence of Modifiable Risk Factors in 2002, Tennessee, BRFSS**



**Figure 2.2 Distribution of Multiple Modifiable Risk Factors in 2002, Tennessee, BRFSS**

- Tennessee was ranked the 4<sup>th</sup> highest among states in the nation for prevalence of smoking, 8<sup>th</sup> for prevalence of obesity, and 3<sup>rd</sup> highest for prevalence of diabetes in 2002 (BRFSS).
- Among Tennessee adults, nine out of ten reported at least one risk factor for heart disease and stroke.
- Almost two-thirds reported two or more risk factors, including 9% who reported four or more risk factors.

### POOR DIETARY HABITS

- Consumption of less than five servings of fruits and vegetables per day among Tennessee adults declined from 74.2% (1996) to 62.9% (2001), but rose again to 71.6% in 2002. (Fig. 2.3)
- The prevalence for Tennessee in 2002 was slightly better than that of the nation (75.6%).
- During this time period, the prevalence of poor dietary habits was highest for black males, followed by black females, white males, and lowest for white females. (Fig. 2.3)

Note: Questions regarding fruit and vegetable consumption were not asked in 1997 and 1999.

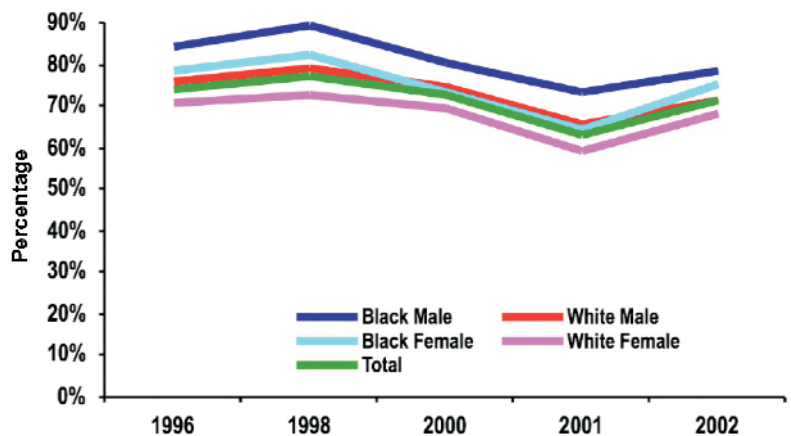


Figure 2.3 Trends in Prevalence of Consuming Less Than Five Servings of Fruits and Vegetables per Day, Tennessee, BRFSS

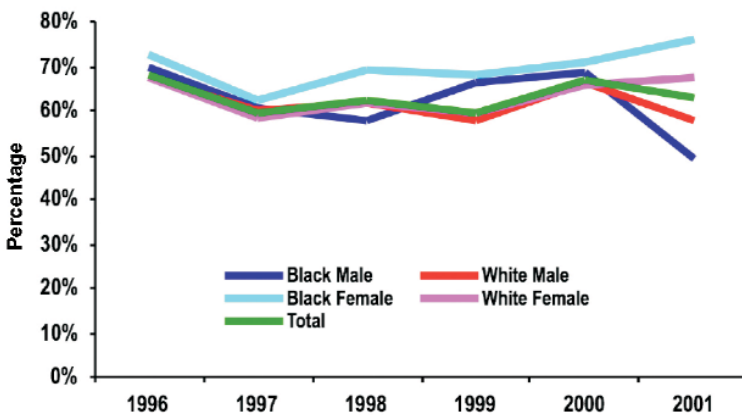


Figure 2.4 Trends in Prevalence of Sedentary Lifestyle, 1996-2001, Tennessee, BRFSS

### SEDENTARY LIFESTYLE

- The overall prevalence of adult Tennesseans with a sedentary lifestyle decreased slightly from 68.0% in 1996 to 63.0% in 2001 (which compares to 54.7% for the U.S. in 2002). (Fig. 2.4)
- From 1996 to 2001, black males showed the greatest improvement in sedentary lifestyle with a decrease of about 20 percentage points.
- Black females were always highest and even increased slightly, while white females and males were about average.

Note: 2002 not reported due to change in question wording

### HIGH CHOLESTEROL

- Overall, the percentage of Tennessee adults who had been told by a doctor that they had high cholesterol (HCL) stayed fairly stable in recent years, with 31.1% in 1996 and 30.7% in 2002. (Fig. 2.5)
- The prevalence for Tennessee in 2002 was slightly better than that of the nation (32.9%).
- During this time period, the prevalence of high cholesterol among white males showed an overall increase, while the prevalence for black females decreased.

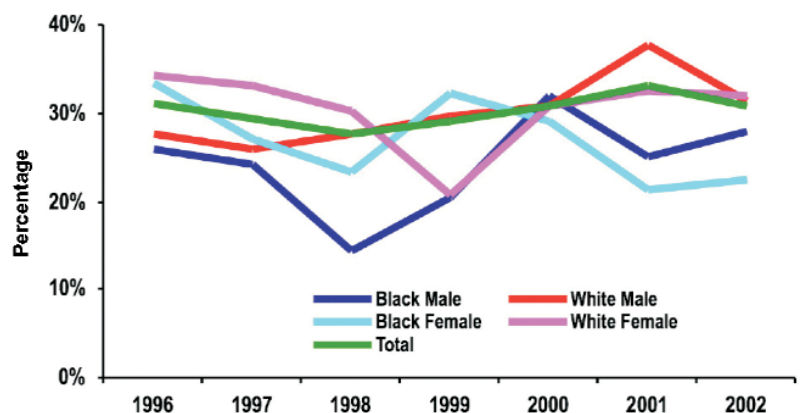


Figure 2.5 Trends in Prevalence of High Blood Cholesterol, 1996-2002, Tennessee, BRFSS

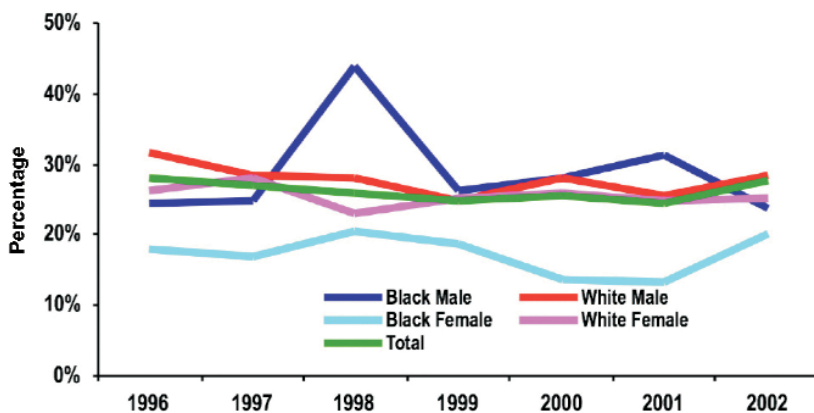


Figure 2.6 Trends in Prevalence of Current Cigarette Smoking, 1996-2002, Tennessee, BRFSS

### CIGARETTE SMOKING

- The prevalence of current smokers among Tennessee adults remained fairly stable, ranging between 24.4% and 28.0% from 1996 to 2002. (Fig. 2.6)
- The percentage of current cigarette smokers was relatively stable among Whites, percentages for blacks varied across time.
- The prevalence of smoking was lowest among black females.

### OBESITY

- The percentage of the total adult population considered obese (Body Mass Index of 30 or higher) increased steadily from 17.4% in 1996 to 24.6% in 2002, compared to 21.9% in 2002 for the nation. (Fig. 2.7)
- Obesity was highest among black females in all years but 2002.
- Adult black males had the largest increase in the percentage considered obese, increasing from 21.1% in 1996 to 35.9% in 2002, catching up to black females in 2002.

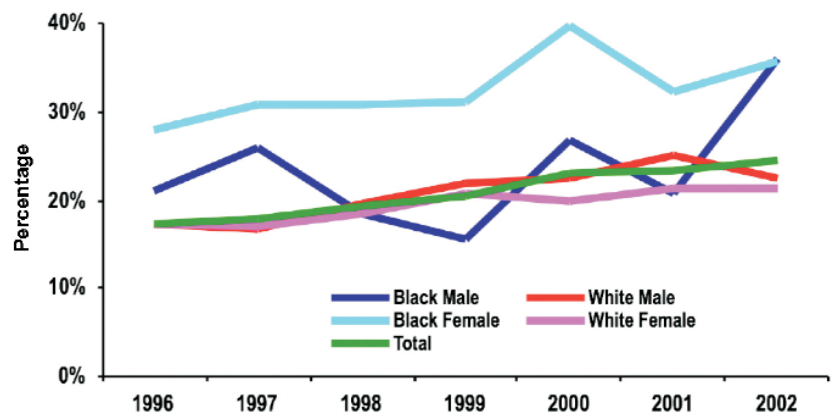


Figure 2.7 Trends in Prevalence of Obesity, 1996-2002, Tennessee, BRFSS

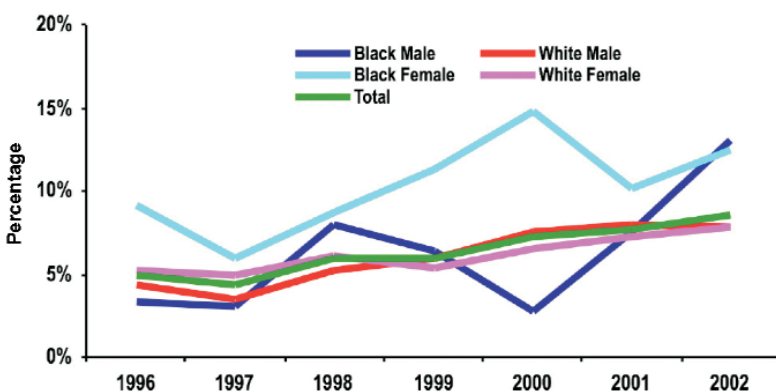


Figure 2.8 Trends in Prevalence of Diabetes Mellitus, 1996-2002, Tennessee, BRFSS

### DIABETES MELLITUS

- Trends in prevalence of diabetes mellitus among Tennessee adults showed a steady increase from a low of 4.4% in 1997 to a high of 8.5% in 2002. (Fig. 2.8)
- The prevalence for Tennessee in 2002 was slightly higher than that of the nation (7.1%).
- Black females had the highest prevalence in all years except 2002, increasing from 9% in 1996 to 12% in 2002. Black males had the largest overall increase from 3% in 1996 to 13% in 2002.

# DISEASES OF THE HEART (ICD-9: 390 – 398, 402, 404-429) (ICD-10: I00 – I09, I11, I13, I20-I51)

## DISEASES OF THE HEART (Overall)

- According to hospital discharge data system (HDDS) data, the number of inpatients in Tennessee with a primary diagnosis of DOH increased by 13% from 61,803 in 1997 to 69,628 in 2002.
- However, the age-adjusted rates among inpatients only increased by 4% from 1,140.7 to 1,189.5 per 100,000 population during this time period. (Fig. 3.1)
- Black male inpatients had the highest rate of DOH in 2002 even though it decreased by 11%, while white female inpatients consistently had the lowest rate even though it increased by 7%.
- Rates of DOH among elderly inpatients were nearly 5 times higher, with highest rates among white males, followed by black females, black males, and lowest among white females. (Graph not shown)

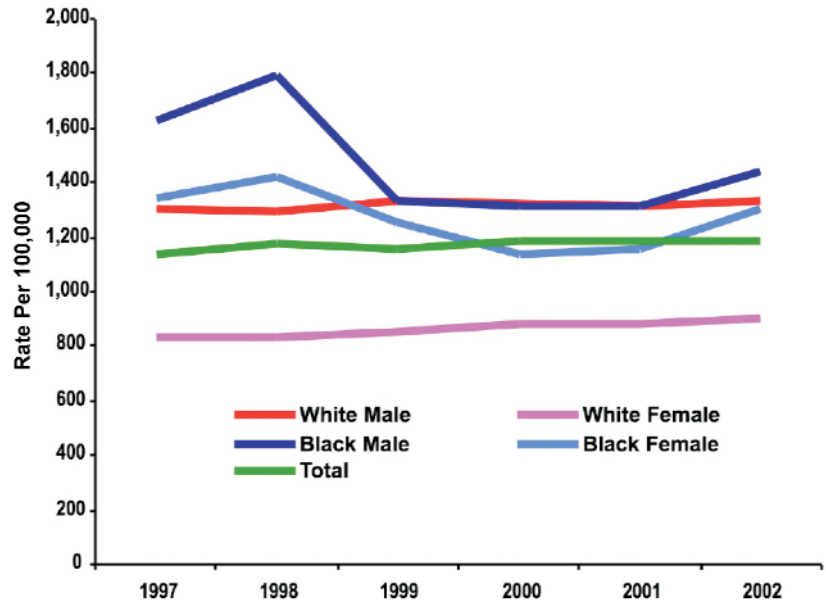


Figure 3.1 Trends in Age-Adjusted Rate of Diseases of the Heart, 1997-2002, Tennessee, HDDS Inpatient File

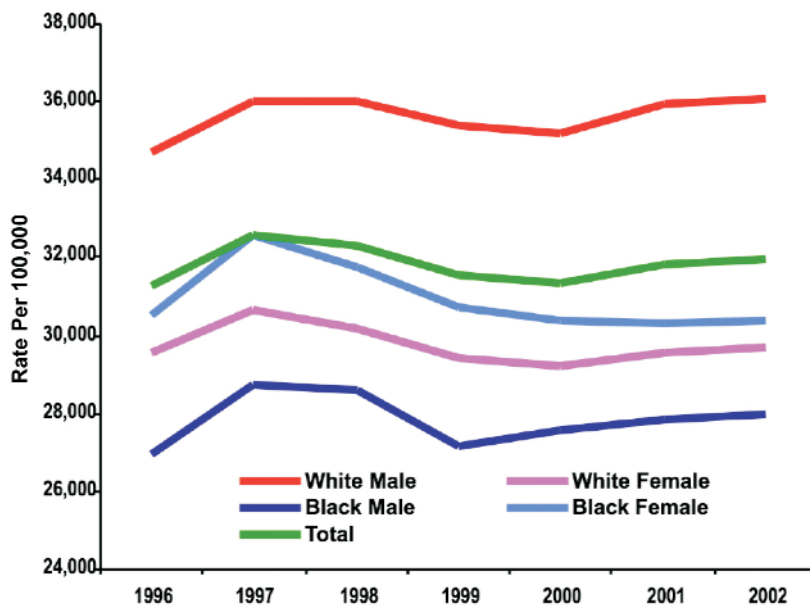
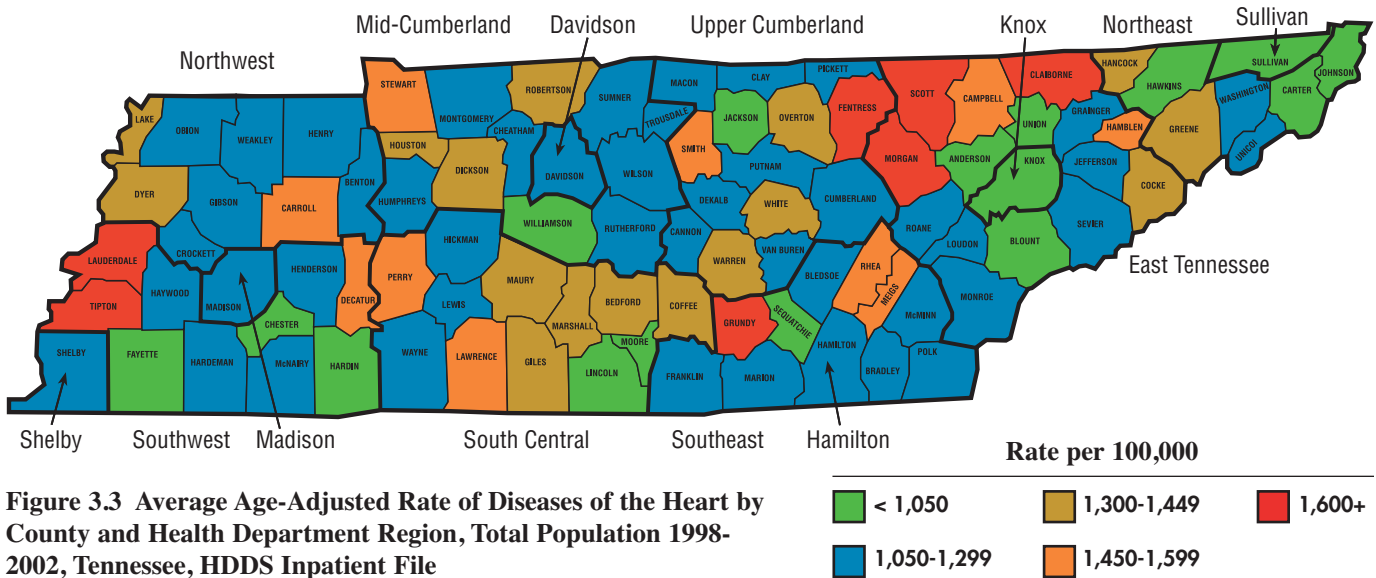


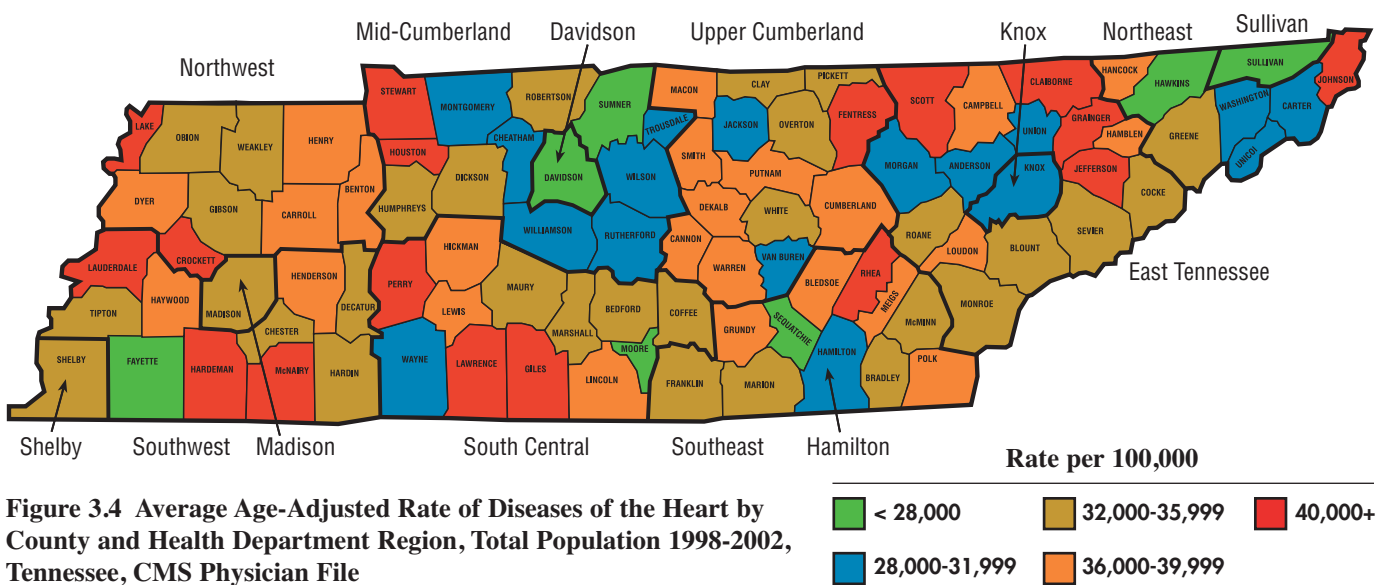
Figure 3.2 Trends in Age-Adjusted Rate of Diseases of the Heart, 1996-2002, Tennessee, CMS Physician File

- Medicare (CMS) physician data offer a good estimate of 12-month prevalence among the age 65 and over population, who saw a physician in any setting (such as a physician office, inpatient hospital, nursing home, outpatient, etc.).
- According to CMS physician data, the number of elderly patients who were seen by a physician with a primary diagnosis of DOH increased by 8% from 221,384 in 1996 to 239,169 in 2002.
- However, the age-adjusted rates of physician-diagnosed DOH among elderly patients increased by 2% from 31,296.3 to 31,978.1 per 100,000 population during this time period. (Fig. 3.2)
- Elderly white males had by far the highest age-adjusted rate of physician-diagnosed DOH, followed by black females then white females, and the lowest for elderly black males.

- Average age-adjusted rates of DOH among inpatients in Tennessee (HDDS, 1998-2002) ranged from 496.4 in Moore County to 2,162.3 per 100,000 in Fentress County. (Table 3.1)



- Average age-adjusted rates of DOH diagnoses by physicians among Medicare (65+) beneficiaries in Tennessee (CMS, 1998-2002) ranged from 25,326 in Sullivan County to 64,691 per 100,000 in Crockett County. (Table 3.2)



- The patterns of which counties had the highest and lowest rates of DOH among inpatients (Table 3.1) or among elderly patients in general (Table 3.2) varied across race and gender groups.



**Table 3.1 Average Age-Adjusted Rate (per 100,000) of Diseases of the Heart by Race and Gender, 1998-2002, Lowest and Highest Counties, Tennessee, HDDS Inpatient File**

Total (n=95)	White Male (n=95)	White Female (n=95)	Black Male (n=54)*	Black Female (n=55)*
<b>Highest Counties</b>	<b>Highest Counties</b>	<b>Highest Counties</b>	<b>Highest Counties</b>	<b>Highest Counties</b>
Fentress 2,162	Fentress 2,139	Fentress 2,009	Montgomery 5,166	Montgomery 3,955
Lauderdale 1,752	Lawrence 1,840	Scott 1,557	Dickson 3,308	Houston 3,929
Scott 1,739	Meigs 1,831	Claiborne 1,440	Sevier 3,279	Smith 2,634
Morgan 1,656	Claiborne 1,824	Campbell 1,364	Lawrence 2,706	Dickson 2,131
Claiborne 1,647	Hamblen 1,818	Smith 1,296	White 2,601	Robertson 1,826
<b>Lowest Counties</b>	<b>Lowest Counties</b>	<b>Lowest Counties</b>	<b>Lowest Counties</b>	<b>Lowest Counties</b>
Moore 496	Moore 583	Montgomery 350	Lake 688	Anderson 771
Lincoln 752	Montgomery 745	Moore 375	Obion 773	Meigs 793
Anderson 889	Lincoln 854	Stewart 579	Lincoln 866	Obion 835
Sequatchie 897	Stewart 933	Lincoln 595	Marion 871	Weakley 841
Union 964	Sequatchie 938	Obion 602	Hardin 1,002	Hamilton 849

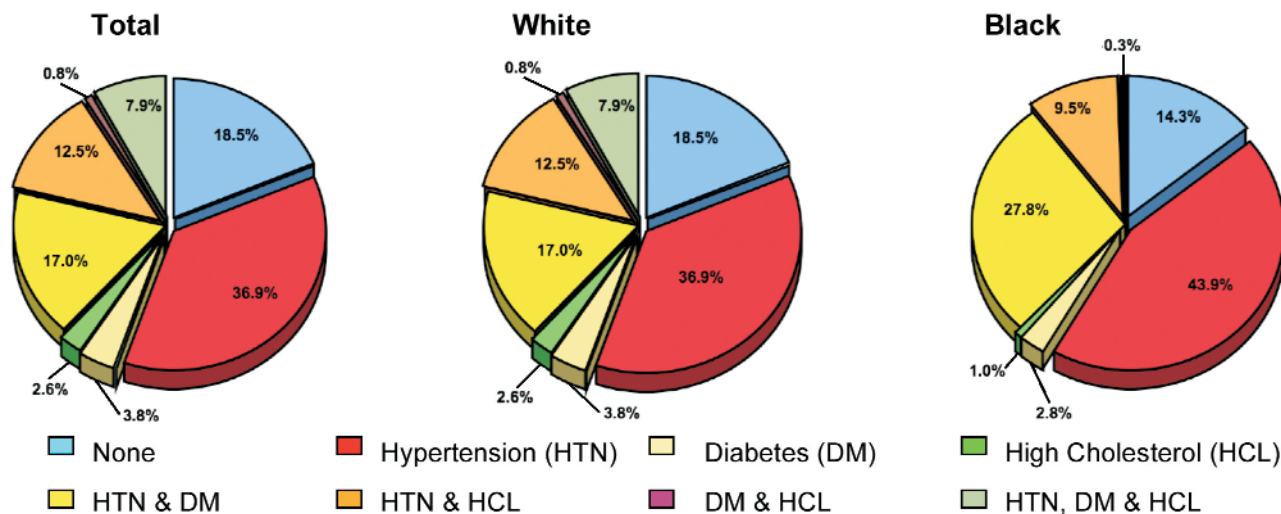
\*Some county rates suppressed due to data reliability

Total (n=95)	White Male (n=95)	White Female (n=95)	Black Male (n=55)*	Black Female (n=55)*
<b>Highest Counties</b>	<b>Highest Counties</b>	<b>Highest Counties</b>	<b>Highest Counties</b>	<b>Highest Counties</b>
Crockett 64,691	Crockett 69,115	Crockett 63,273	Rhea 57,730	Lauderdale 51,537
Lake 59,575	Lake 65,202	Lake 62,543	McNairy 54,441	Smith 51,427
Lauderdale 57,187	Lauderdale 60,618	Lauderdale 58,558	Warren 47,076	McNairy 48,280
Perry 53,431	Fentress 47,397	Fentress 48,336	Greene 46,263	Humphreys 47,416
Fentress 49,162	Perry 47,134	Perry 47,397	Lauderdale 44,846	Hardin 47,015
<b>Lowest Counties</b>	<b>Lowest Counties</b>	<b>Lowest Counties</b>	<b>Lowest Counties</b>	<b>Lowest Counties</b>
Sullivan 25,326	Carter 25,475	Sullivan 22,877	Washington 18,805	Fayette 23,595
Sequatchie 26,066	Van Buren 26,609	Sequatchie 24,150	Davidson 21,366	Sumner 24,603
Hawkins 26,724	Moore 26,755	Hawkins 24,581	Fayette 22,317	Davidson 24,861
Davidson 26,997	Sequatchie 26,904	Davidson 24,901	Trousdale 22,407	Trousdale 25,859
Moore 27,249	Sullivan 27,761	Sumner 25,364	Obion 22,914	Hamilton 25,909

\*Some county rates suppressed due to current CMS privacy guidelines and data reliability

**Table 3.2 Average Age-Adjusted Rate (per 100,000) of Diseases of the Heart by Race and Gender, 1998-2002, Lowest and Highest Counties, Tennessee, CMS Physician File**

- In 2002, over 80% (four out of five) of Tennessee inpatients with DOH also had health conditions that tend to co-occur with DOH (i.e., high blood pressure (HTN), high cholesterol (HCL), or diabetes mellitus (DM)).
- More than two-thirds of inpatients with DOH also had a diagnosis of HTN, one-third also had a diagnosis of DM, and almost one-third also had a diagnosis of HCL. About one-third of inpatients with DOH had two of these co-morbid conditions, and one-tenth had all three of these co-morbid conditions.
- Black inpatients with DOH are more likely than white inpatients to have co-morbid HTN only and HTN/DM, and they are less likely to have co-morbid HCL only and HTN/HCL. These patterns are also consistent among elderly inpatients and elderly patients seen by a physician.



**Figure 3.5 Co-morbidity of Diseases of the Heart with Hypertension, Diabetes and High Cholesterol, 2002, Tennessee, HDDS Inpatient File**

- According to the Death Statistical Summary System (DSSS), approximately 16,000 people (13,000 elderly) died from DOH in Tennessee annually from 1996 to 2002, with only a 0.2% decrease in the annual number of DOH deaths.
- However, the age-adjusted mortality rate from DOH decreased by 9% from 313.6 to 284.7 per 100,000 population during this time period. (Fig. 3.6)
- Black males had the highest DOH mortality rates by far, followed by white males, then black females, and white females with the lowest.
- Average age-adjusted mortality rates from DOH from 1998-2002 varied across counties, ranging from 200.2 in Moore County to 423.0 per 100,000 in Lauderdale County. (Fig. 3.7 & Table 3.3)

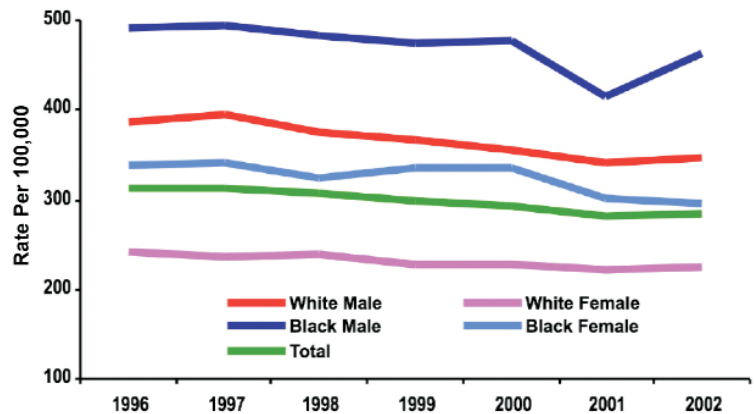


Figure 3.6 Trends in Age-Adjusted Mortality Rate From Diseases of the Heart, 1996-2002, Tennessee, DSSS

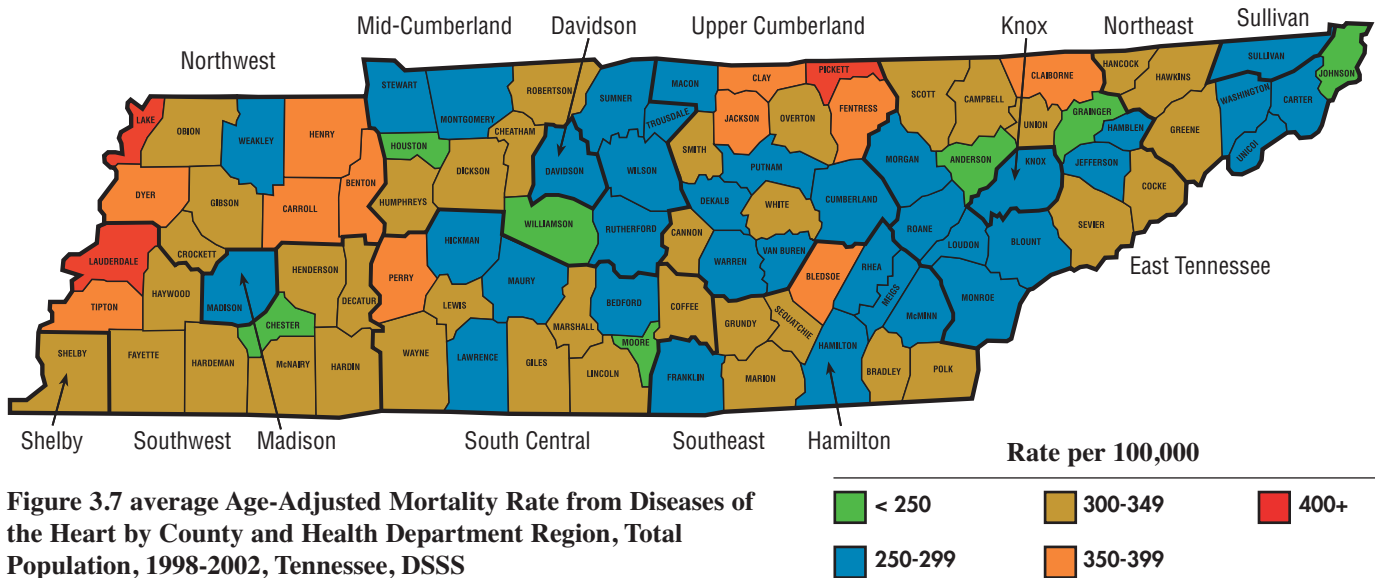


Figure 3.7 average Age-Adjusted Mortality Rate from Diseases of the Heart by County and Health Department Region, Total Population, 1998-2002, Tennessee, DSSS

- The patterns of which counties had the highest and lowest rates of DOH mortality varied across race and gender groups. (Table 3.3)

Total (n=95)	White Male (n=95)	White Female (n=95)	Black Male (n=28)*	Black Female (n=32)*
<b>Highest Counties</b>	<b>Highest Counties</b>	<b>Highest Counties</b>	<b>Highest Counties</b>	<b>Highest Counties</b>
Lauderdale 423	Lake 530	Pickett 353	Henry 729	Lake 530
Lake 417	Lauderdale 510	Lake 334	Obion 687	Dickson 484
Pickett 406	Claiborne 492	Carroll 321	Henderson 640	Lauderdale 477
Carroll 398	Pickett 491	Benton 318	Lauderdale 614	Obion 473
Benton 386	Carroll 489	Polk 313	Carroll 608	Lincoln 471
<b>Lowest Counties</b>	<b>Lowest Counties</b>	<b>Lowest Counties</b>	<b>Lowest Counties</b>	<b>Lowest Counties</b>
Moore 200	Chester 254	Moore 154	Giles 338	Bedford 216
Chester 216	Moore 264	Chester 170	Hardeman 355	Montgomery 242
Anderson 227	Houston 280	Marshall 261	Montgomery 358	Maury 250
Johnson 229	Williamson 281	Anderson 191	Williamson 367	Blount 261
Houston 234	Anderson 284	Grainger 192	Robertson 381	Madison 268

\*Some county rates suppressed due to reliability

Table 3.3 Average Age-Adjusted Mortality Rate (Per 100,000) From Diseases of the Heart by Race and Gender, 1998-2002, Lowest and Highest Counties, Tennessee, DSSS

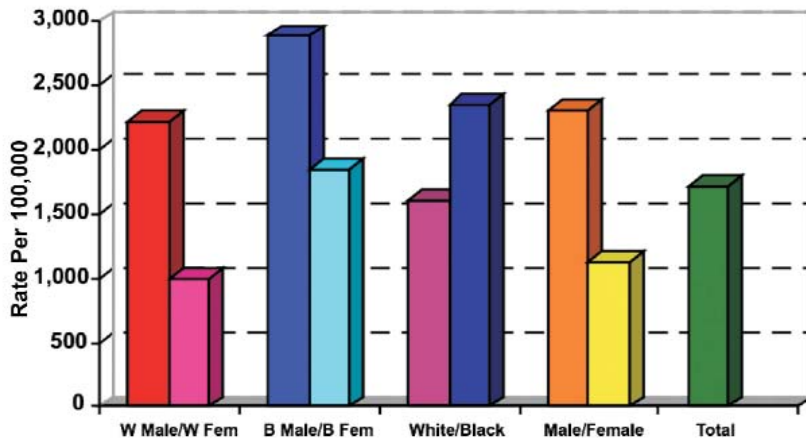


Figure 3.7 average Years of Potential Life Lost (YPLL) Rate From Diseases of the Heart, 1996-2002, Tennessee, DSSS

- Years of potential life lost (YPLL) measures the impact of premature mortality, and is the sum of the number of years that people died before age 75 (which is average life expectancy).
- The annual YPLL due to mortality from DOH increased by 8.5% from 86,218 in 1996 to 93,529 in 2002. (Graph not shown)
- But the YPLL rate (per 100,000 population under age 75) stayed very stable during this time period.
- The YPLL rate due to DOH was highest for black males (2,861.8) and lowest for white females (938.1). (Fig. 3.7)

### MYOCARDIAL INFARCTION AND CONGESTIVE HEART FAILURE

(ICD-9: 410) (ICD-10: I21 – I22)  
(ICD-9: 428.0) (ICD-10: I50.0)

- In 2002, according to HDDS data, just under half of all inpatient visits for DOH had coronary heart disease (CHD) as the primary diagnosis, which includes 18% of inpatient visits with heart attack (MI) as the primary diagnosis. (Fig. 3.8)
- The percentages of both CHD and MI were higher among white male inpatients and lowest among black female inpatients.
- About a quarter of inpatient visits for DOH had congestive heart failure (CHF) as the primary diagnosis, but was highest among black females and black males.

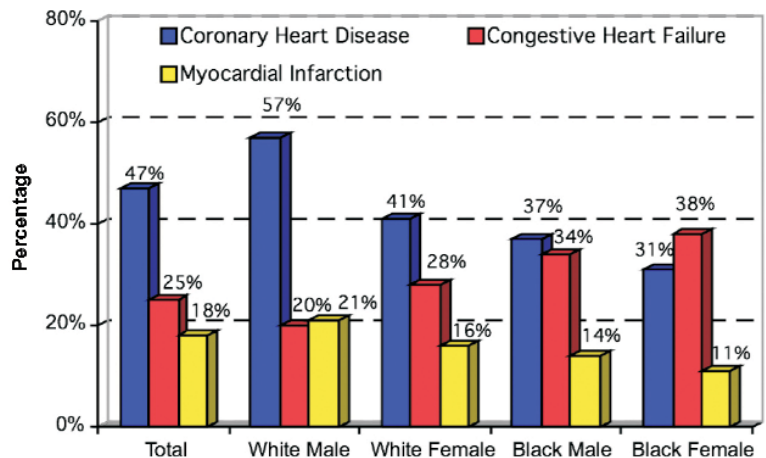


Figure 3.8 Major Subtypes of Diseases of the Heart, 2002, Tennessee, HDDS Inpatient File

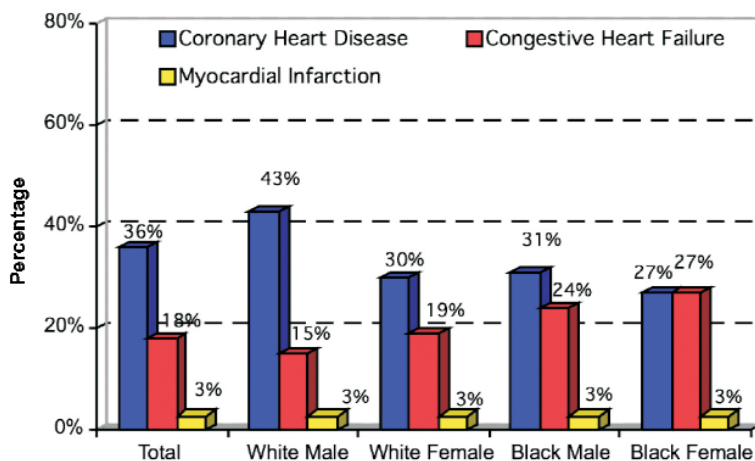
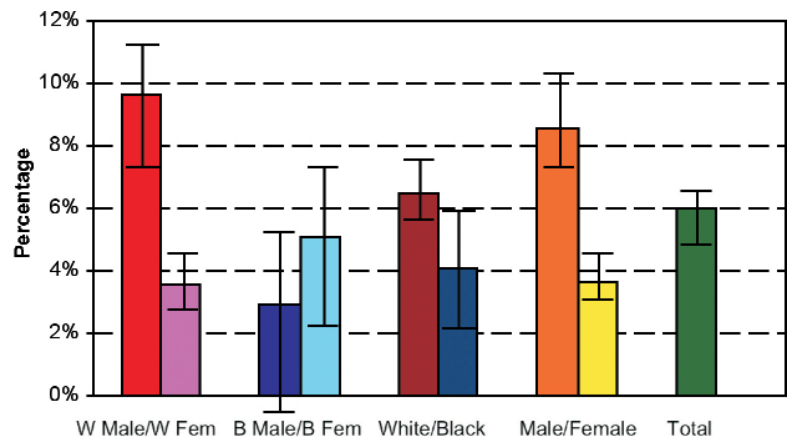


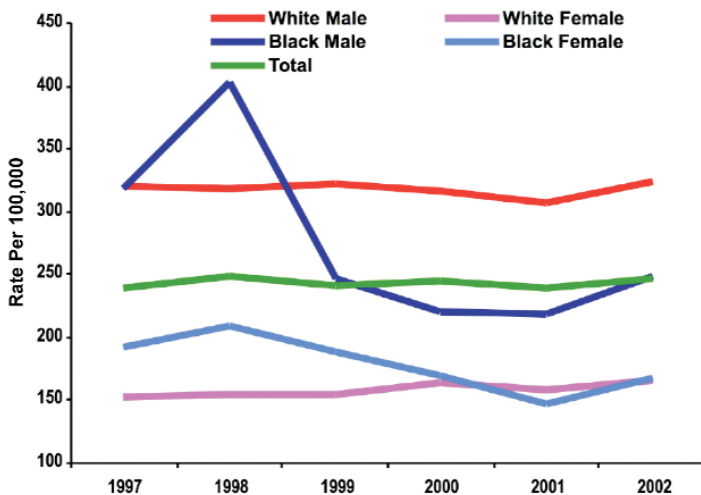
Figure 3.9 Major Subtypes of Diseases of the Heart, 2002, Tennessee, CMS Physician File

- In 2002, just over one-third of all physician visits for DOH among the 65 and over population had CHD as the primary diagnosis, which includes 3% of physician visits with MI as the primary diagnosis. (Fig. 3.9)
- The percentage of CHD was highest among white male inpatients while the percentage of MI did not vary.
- About 18% of physician visits for DOH had CHF as the primary diagnosis, but was higher among black females and black males.

- In 2001, 6% of the adult population in Tennessee reported that they had a physician-diagnosed heart attack [MI] (BRFSS, 2001). (Fig. 3.10)
- Overall, the prevalence of heart attack was higher for males compared to females, and higher for whites compared to blacks.
- White males had the highest self-reported prevalence of heart attack; however, black females had the second highest prevalence. White females had the next highest prevalence, and black males had the lowest.
- According to HDDS data, the number of inpatients in Tennessee with a primary diagnosis of MI increased by 11% from 13,011 in 1997 to

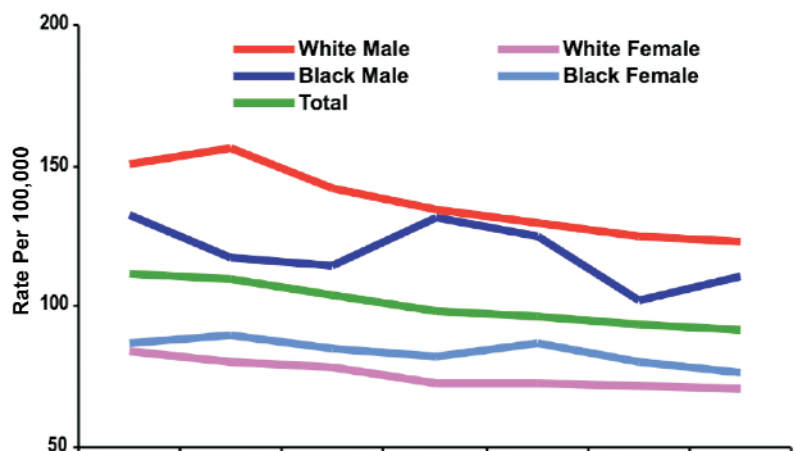


**Figure 3.10 Prevalence of Heart Attack in 2001, Tennessee, BRFSS**



**Figure 3.11 Trends in Age-Adjusted Rate of Myocardial Infarction, 1997-2002, Tennessee, HDDS Inpatient File**

- With an average of about 5,500 deaths per year, MI accounted for over one-third of all DOH deaths.
- The age-adjusted mortality rate from MI decreased by 17% from 111.3 to 92.1 per 100,000 population from 1996 to 2002. (Fig. 3.12)
- Although white males had a 30% higher rate of MI diagnoses in the HDDS inpatient data compared to black males, the mortality rate from MI for white males was only 11% higher than the mortality rate for black males. Black females had the third highest MI mortality rate, and white females had the lowest.
- Patterns of MI mortality by race and gender were very similar among the age 65 and over population. (Graph not shown)



**Figure 3.12 Trends in Age-Adjusted Mortality Rate From Myocardial Infarction, 1996-2002, Tennessee, DSSS**

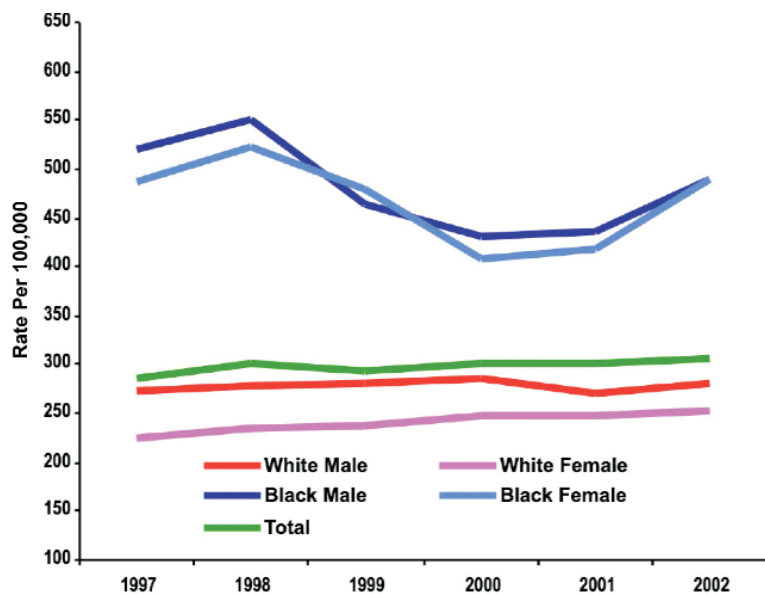


Figure 3.13 Trends in Age-Adjusted Rate of Congestive Heart Failure, 1997-2002, Tennessee, HDDS Inpatient File

- According to HDDS data, the number of inpatients in Tennessee with a primary diagnosis of CHF increased by 15% from 15,526 in 1997 to 17,601 in 2002.
- However, the age-adjusted rates for CHF only increased by 7% from 285.6 to 305.1 per 100,000 population during this period.
- Black males had the highest age-adjusted rate of CHF in most years, although their rate decreased by 6% from 1997 to 2002 and converged with the rate of black females, which were both nearly twice as high as the rate for whites.
- White males had slightly higher age-adjusted rates of CHF than white females, although the rates for white females increased by 13% during this period.
- Among elderly patients seen by a physician, the racial gap in CHF rates was smaller, and the rate

was highest for elderly black females. (Graph not shown)

- With an average of about 500 deaths per year, CHF accounted for about 3% of all DOH deaths in Tennessee.
- The age-adjusted mortality rate from CHF fluctuated from 1996 to 2002, but overall showed a slight increase of 10%, from 8.1 to 8.9 per 100,000 deaths.
- Males consistently had higher age-adjusted mortality rates from CHF compared to females in most years.
- The mortality rates from CHF were higher for blacks compared to whites in most years, until 2002 when mortality rate for black females showed a noticeable drop.

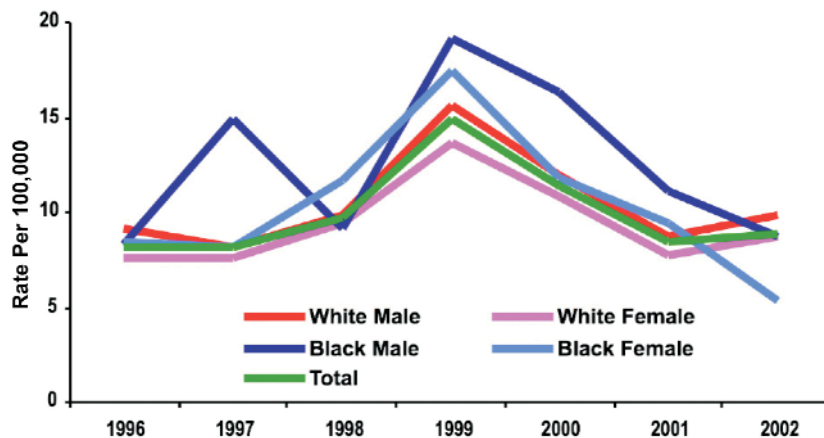
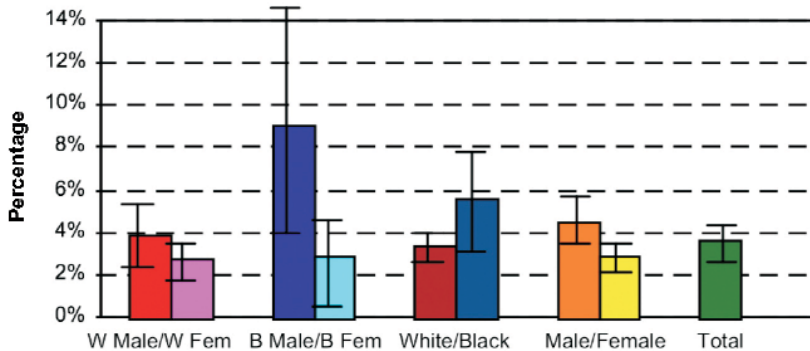


Figure 3.14 Trends in Age-Adjusted Mortality Rate from Congestive Heart Failure, 1996-2002, Tennessee, DSSS

# STROKE (ICD-9: 430-438) (ICD-10: I60 – I69)

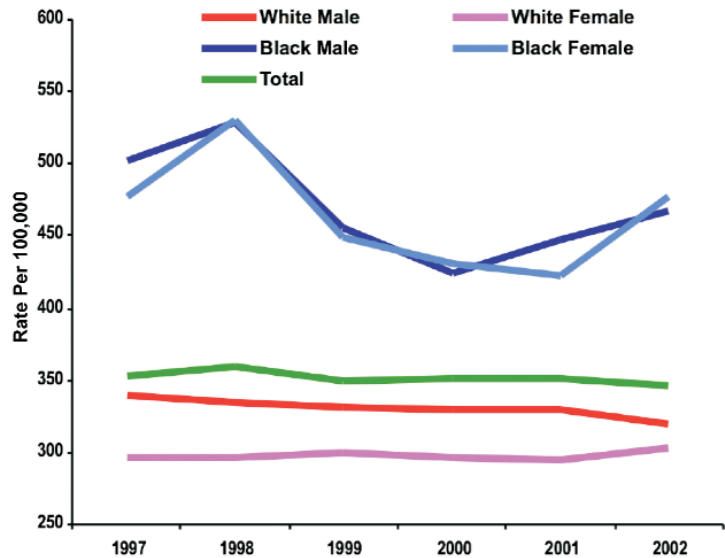


**Figure 4.1 Prevalence of Ever Having a Stroke in 2001, Tennessee, BRFSS**

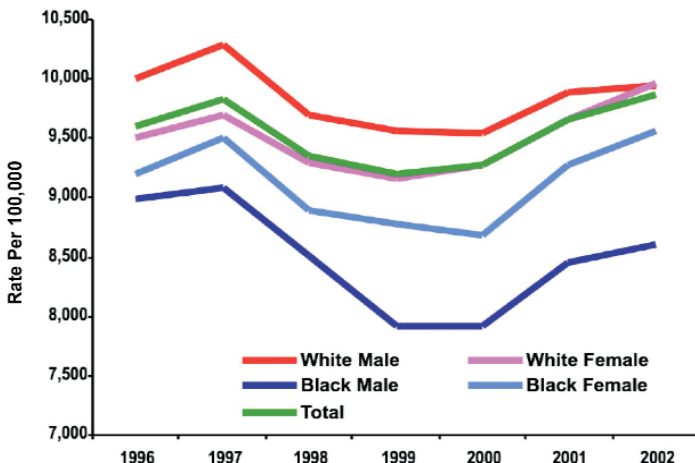
- In 2001, 3.6% of the adult population in Tennessee reported that they had ever been told by a doctor that they had a stroke (BRFSS, 2001).
- Black males had the highest self-reported prevalence of stroke, and white males had the second highest, followed by black females and white females with the lowest prevalence.
- According to HDDS data, the number of inpatients in Tennessee with a primary

diagnosis of stroke increased by 6% from 18,943 in 1997 to 20,067 in 2002.

- However, the age-adjusted rates actually decreased slightly (2%) from 352.5 to 346.7 per 100,000 population during this period. (Fig. 4.2)
- Black males and females had the highest age-adjusted rates of stroke among inpatients (53% higher than whites), varying across the years in whether males or females were higher.
- White males had slightly higher rates of stroke than white females as inpatients.
- Patterns were similar among elderly inpatients but the racial gap in stroke rates was not quite as wide (20% higher for blacks).
- According to CMS physician data, the number of elderly patients who were seen by a physician



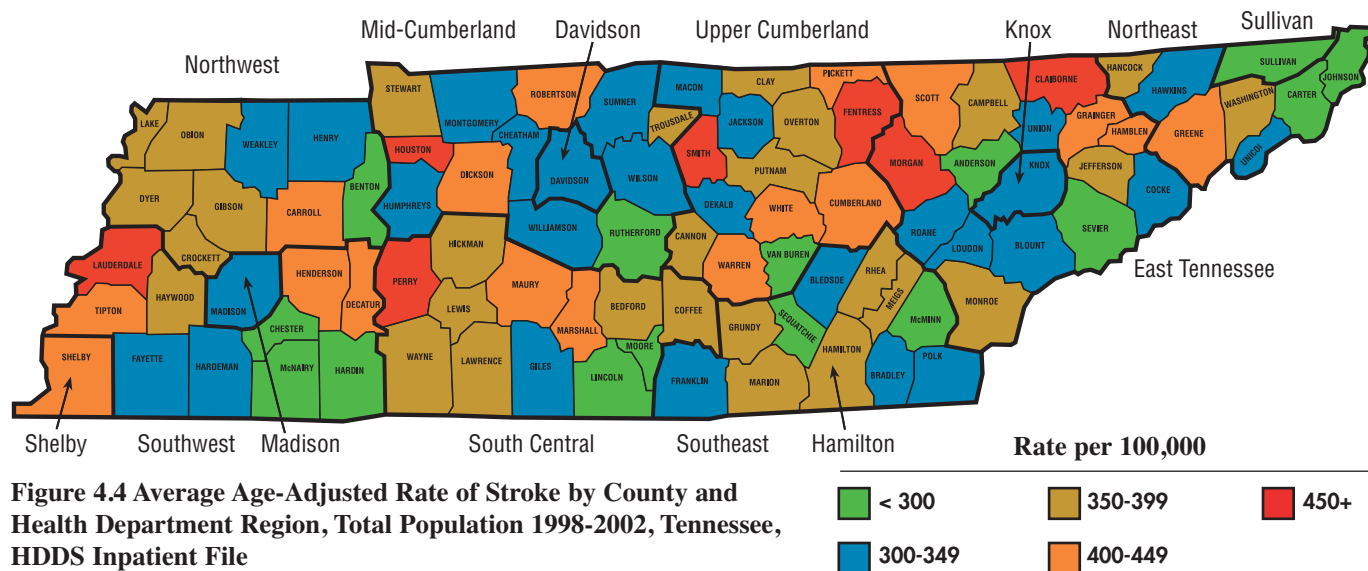
**Figure 4.2 Trends in Age-Adjusted Rate of Stroke, 1997-2002, Tennessee, HDDS Inpatient File**



**Figure 4.3 Trends in Age-Adjusted Rate of Stroke, 1996-2002, Tennessee, CMS Physician File**

- with a primary diagnosis of stroke increased by 9% from 67,149 in 1996 to 73,305 in 2002.
- However, the age-adjusted rates of physician-diagnosed stroke among elderly patients only increased by 3% from 9,603.4 to 9,872.0 per 100,000 population during this time period. (Fig. 4.3)
- Elderly white males had the highest age-adjusted rate of physician-diagnosed stroke in most years, next were elderly white females (although they were about the same in 2002), followed by elderly black females, and the lowest was for elderly black males.

- Average age-adjusted rates of stroke among inpatients from 1998-2002 varied across counties, ranging from 186.5 per 100,000 in Moore County to 599.9 per 100,000 in Fentress County. (Fig. 4.4 & Table 4.1)
- The patterns of which counties had the highest and lowest rates of stroke among inpatients (Table 4.1) or among elderly patients in general (Table 4.2) varied across race and gender groups.



**Figure 4.4 Average Age-Adjusted Rate of Stroke by County and Health Department Region, Total Population 1998-2002, Tennessee, HDDS Inpatient File**

**Table 4.1 Average Age-Adjusted Rate (per 100,000) of Stroke by Race and Gender, 1998-2002, Lowest and Highest Counties, Tennessee, HDDS Inpatient File**

Total (n=95)	White Male (n=95)	White Female (n=95)	Black Male (n=29)*	Black Female (n=35)*
<b>Highest Counties</b>	<b>Highest Counties</b>	<b>Highest Counties</b>	<b>Highest Counties</b>	<b>Highest Counties</b>
Fentress 600	Claiborne 480	Fentress 647	Montgomery 1,570	Montgomery 1,289
Houston 514	Decatur 476	Houston 465	Dickson 818	Bradley 674
Morgan 484	Fentress 472	Smith 456	Mauzy 612	Dickson 668
Perry 477	Hamblen 463	Perry 423	Robertson 572	Trousdale 659
Smith 477	Marshall 458	Scott 416	Henderson 538	Hamblen 622
<b>Lowest Counties</b>	<b>Lowest Counties</b>	<b>Lowest Counties</b>	<b>Lowest Counties</b>	<b>Lowest Counties</b>
Moore 187	Montgomery 103	Montgomery 86	Williamson 329	Lauderdale 307
Lincoln 222	Stewart 182	Moore 176	Giles 331	Lincoln 321
Johnson 231	Sequatchie 210	Johnson 176	Lauderdale 336	Carroll 323
Sequatchie 247	Moore 214	Stewart 196	Carroll 346	McMinn 333
Van Buren 252	Johnson 214	Lincoln 197	Sumner 354	Dyer 334

\*Some county rates suppressed due to data reliability

Total (n=95)	White Male (n=95)	White Female (n=95)	Black Male (n=43)*	Black Female (n=43)*
<b>Highest Counties</b>	<b>Highest Counties</b>	<b>Highest Counties</b>	<b>Highest Counties</b>	<b>Highest Counties</b>
Lake 18,115	Lake 17,368	Lake 19,224	Greene 18,831	Roane 16,272
Crockett 16,295	Crockett 15,743	Crockett 16,854	Warren 16,032	Greene 15,029
Houston 15,656	Scott 15,119	Houston 16,015	McNairy 15,554	Henry 14,594
Fentress 15,621	Lawrence 14,643	Fentress 15,724	Anderson 14,945	Dickson 14,361
Scott 15,432	Houston 14,595	Scott 15,409	Roane 14,641	McNairy 13,957
<b>Lowest Counties</b>	<b>Lowest Counties</b>	<b>Lowest Counties</b>	<b>Lowest Counties</b>	<b>Lowest Counties</b>
Sequatchie 7,007	Sequatchie 6,071	Sequatchie 7,128	Fayette 6,268	Madison 7,063
Van Buren 7,229	Rutherford 7,612	Van Buren 7,601	Davidson 7,068	Obion 7,225
Fayette 7,686	Van Buren 7,650	Madison 7,709	Montgomery 7,147	Fayette 7,231
Madison 7,780	Sumner 7,660	Davidson 7,752	Dyer 7,228	Hamilton 7,655
Davidson 7,897	Fayette 7,761	Montgomery 7,810	Shelby 7,407	Hardeman 7,805

\*Some county rates suppressed due to current CMS privacy guidelines and data reliability

**Table 4.2 Average Age-Adjusted Rate (per 100,000) of Stroke by Race and Gender, 1998-2002, Lowest and Highest Counties, Tennessee, CMS Physician File**

- In 2002, almost 80% (four out of five) of Tennessee inpatients with stroke also had major co-morbid conditions that tend to co-occur with stroke (i.e., high blood pressure (HTN), high cholesterol (HCL), or diabetes mellitus (DM)). (Fig. 4.5)
- More than three-fourths of inpatients with stroke also had a diagnosis of

HTN, almost one-third also had a diagnosis of DM, and almost one-quarter also had a diagnosis of high cholesterol.

- Almost one-third of inpatients with stroke had two of these co-morbid conditions, and 8% had all three of these co-morbid conditions.

- Black inpatients with stroke were more likely than white inpatients to have co-morbid HTN only and HTN/DM, and they are less likely to have co-morbid HCL only and HTN/HCL. These patterns were also consistent among elderly inpatients and elderly patients seen by a physician. (Graph not shown)

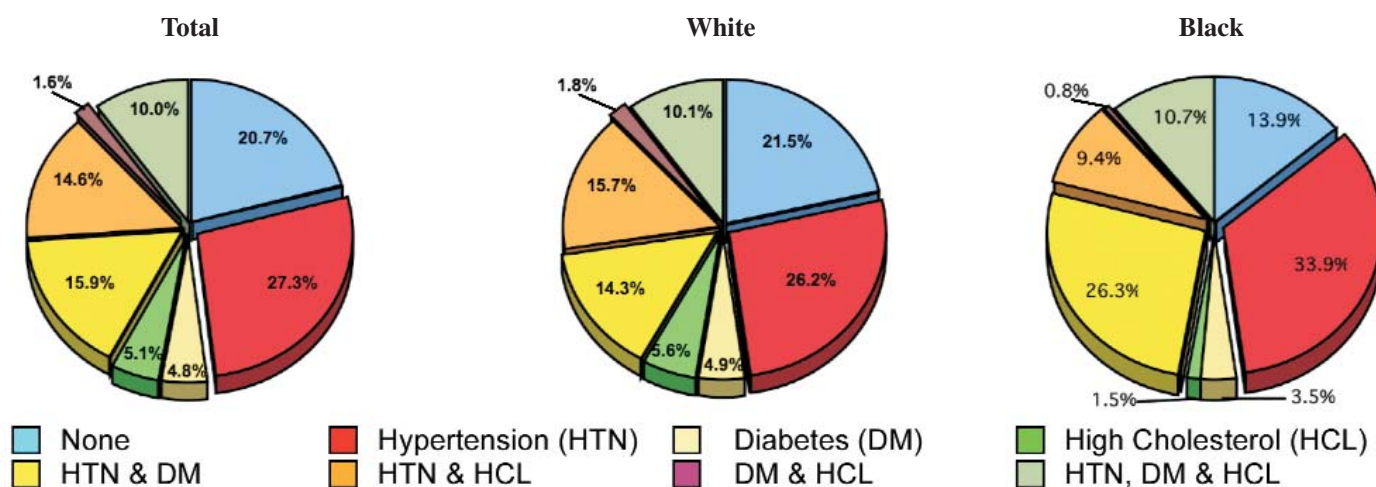


Figure 4.5 Co-morbidity of Stroke with Hypertension, Diabetes and High Cholesterol, 2002, Tennessee, HDDS Inpatient File

- Around 4,000 people (3,500 elderly) died from stroke in Tennessee annually, with a 2% decrease in the number of stroke deaths during 1996-2002.
- The age-adjusted mortality rate from stroke decreased by 11% from 79.7 to 70.8 per 100,000 population. (Fig. 4.6)
- Blacks (black males then black females) had higher mortality rates from stroke compared to whites, although black males had a greater decline.
- White males and white females had similar stroke mortality rates.
- Patterns of stroke mortality were very similar among the age 65 and over population. (Graph not shown)

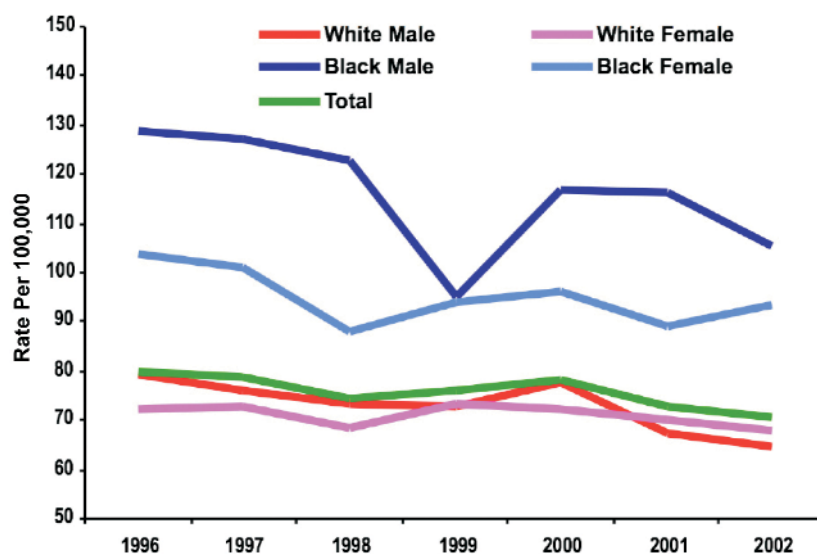
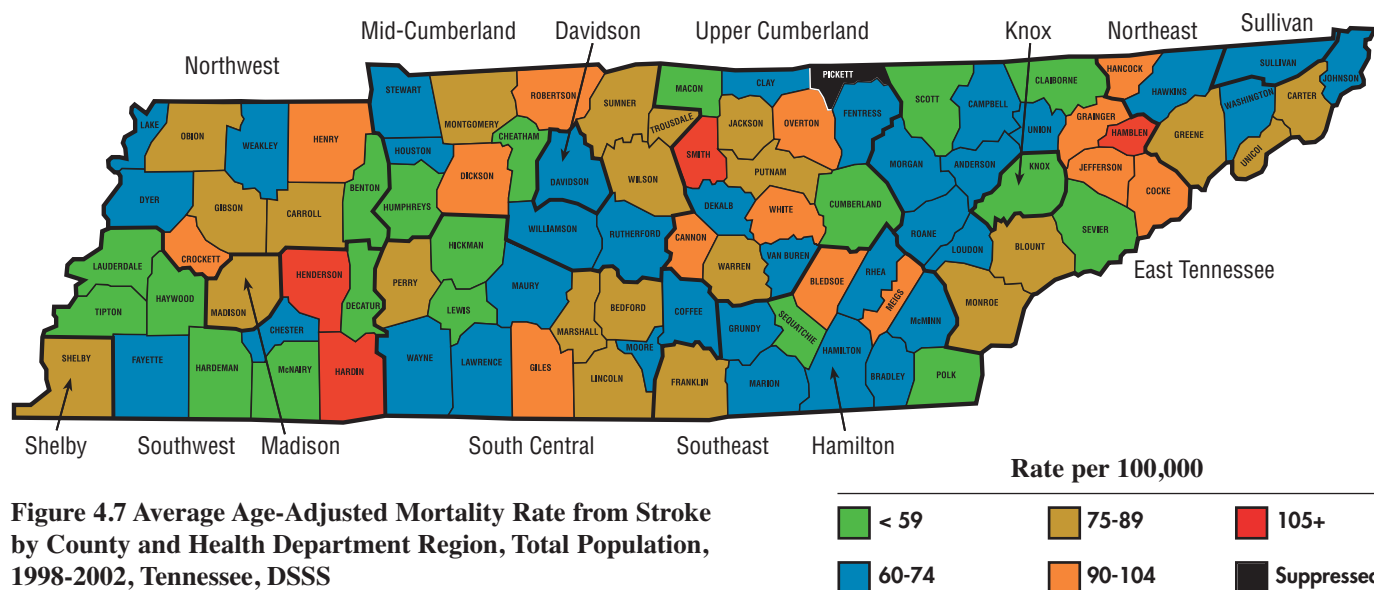


Figure 4.6 Trends in Age-Adjusted Mortality Rate From Stroke, 1996-2002, Tennessee, DSSS



- Average age-adjusted mortality rates from stroke from 1998-2002 varied across counties, ranging from 37.3 in Lewis County to 184.7 per 100,000 in Henderson County. (Fig. 4.7 & Table 4.3)
- The patterns of which counties had the highest and lowest rates of stroke mortality varied across race and gender groups. (Table 4.3)



**Figure 4.7 Average Age-Adjusted Mortality Rate from Stroke by County and Health Department Region, Total Population, 1998-2002, Tennessee, DSSS**

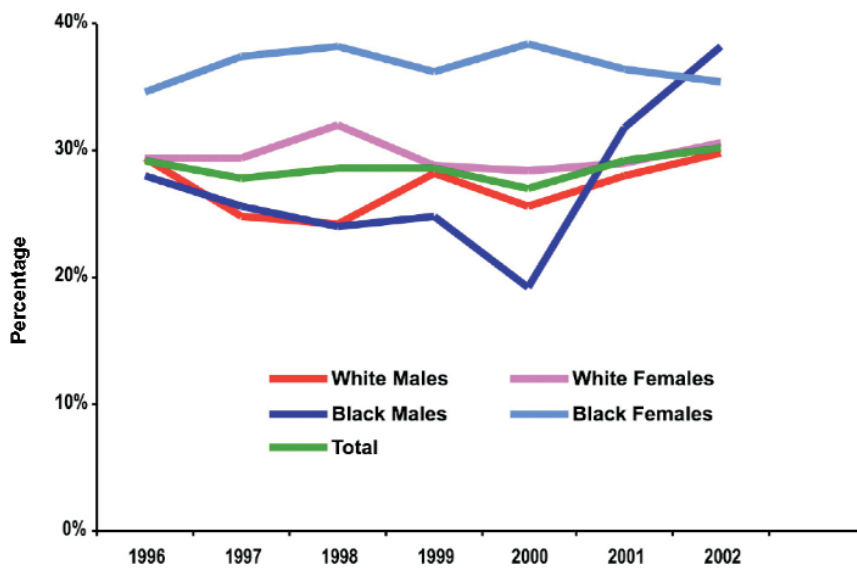
**Table 4.3 Average Age-Adjusted Mortality Rate (per 100,000) from Stroke by Race and Gender, 1998-2002, Lowest and Highest Counties, Tennessee, DSSS**

Total (n=94)*	White Male (n=77)*	White Female (n=87)*	Black Male (n=10)*	Black Female (n=11)*
<b>Highest Counties</b>	<b>Highest Counties</b>	<b>Highest Counties</b>	<b>Highest Counties</b>	<b>Highest Counties</b>
Henderson 185	Henderson 169	Henderson 178	Madison 156	Wilson 129
Hardin 130	Smith 152	Hardin 134	Mauy 146	Madison 113
Hamblen 117	White 131	Hamblen 112	Hardeman 142	Gibson 110
Smith 114	Cannon 124	Robertson 107	Rutherford 140	Shelby 101
Cannon 104	Hamblen 121	Cocke 103	Gibson 139	Montgomery 97
<b>Lowest Counties</b>	<b>Lowest Counties</b>	<b>Lowest Counties</b>	<b>Lowest Counties</b>	<b>Lowest Counties</b>
Lewis 37	McNairy 43	Hardeman 44	Knox 82	Davidson 78
Cheatham 48	Cumberland 45	Lauderdale 45	Davidson 87	Rutherford 79
Humphreys 51	Claiborne 45	Union 46	Hamilton 94	Knox 79
Lauderdale 54	Knox 50	Decatur 50	Fayette 123	Mauy 82
Claiborne 54	Benton 50	Macon 51	Shelby 127	Fayette 88

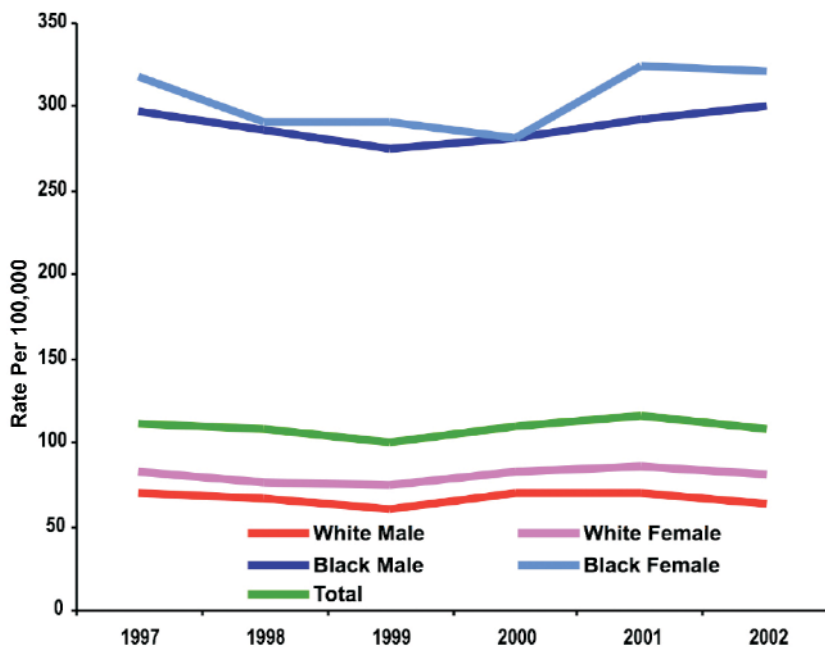
\*Some county rates suppressed due to data reliability

# HYPERTENSION (ICD-9: 401 – 404) (ICD-10: I10 – I13)

- The total prevalence of physician-diagnosed high blood pressure reported among Tennessee adults stayed fairly constant from 1996 to 2002 around 27-30%. (Fig. 5.1)
- Tennessee was above the national prevalence (25.8%) for HTN in 2002.
- Black females consistently had the highest prevalence of HTN for all years (up to 38.5%) except for 2002, when they were surpassed by black males, who showed a notable increase in HTN during this period.
- The prevalence for white males and white females fluctuated somewhat but stayed fairly stable around the prevalence for the total sample.



**Figure 5.1 Trends in Prevalence of Physician-Diagnosed Hypertension, 1996-2002, Tennessee, BRFSS**



**Figure 5.2 Trends in Age-Adjusted Rate of Hypertension, 1997-2002, Tennessee, HDDS Inpatient File**

- According to the HDDS data, the number of inpatients in Tennessee with a primary diagnosis of HTN increased by 5% from 6,009 in 1997 to 6,320 in 2002. (Fig. 5.2)
- However, the age-adjusted rates decreased by 3% from 111.0 to 108.5 per 100,000 population during this time period.
- The rate of HTN among black inpatients was about 4 times higher than the rate for white inpatients.
- Black females had the highest rate of HTN in most years, followed by black males. White females had higher age-adjusted rates of HTN than white males.
- The pattern was similar among elderly inpatients (CMS), but there was a bigger gap between black females and black males. (Graph not shown)

- The number of elderly patients who were seen by a physician with a primary diagnosis of HTN increased by 31% from 228,599 in 1996 to 298,394 in 2002.
- The age-adjusted rates of physician-diagnosed HTN among elderly patients increased by 25% from 31,617.7 to 39,410.7 per 100,000 population during this time period. (Fig. 5.3)
- Elderly black females consistently had the highest age-adjusted rate of physician-diagnosed HTN, followed by elderly white females, elderly black males, and the lowest was elderly white males.

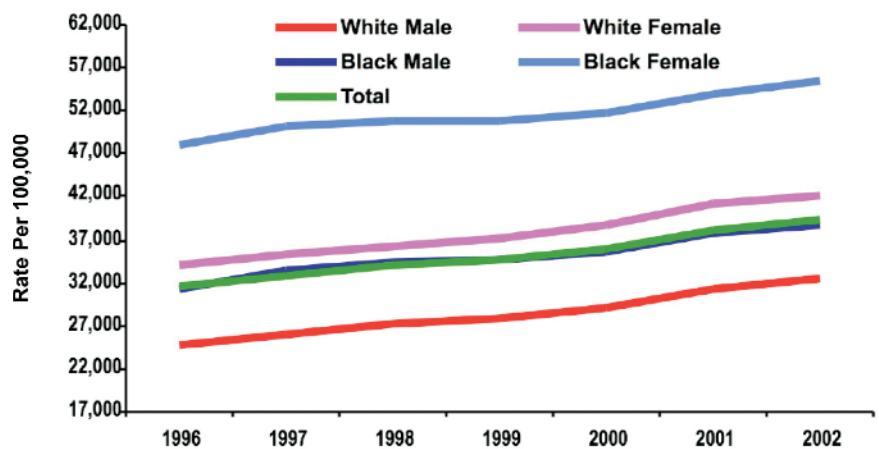


Figure 5.3 Trends in Age-Adjusted Rate of Hypertension, 1996-2002, Tennessee, CMS Physician File

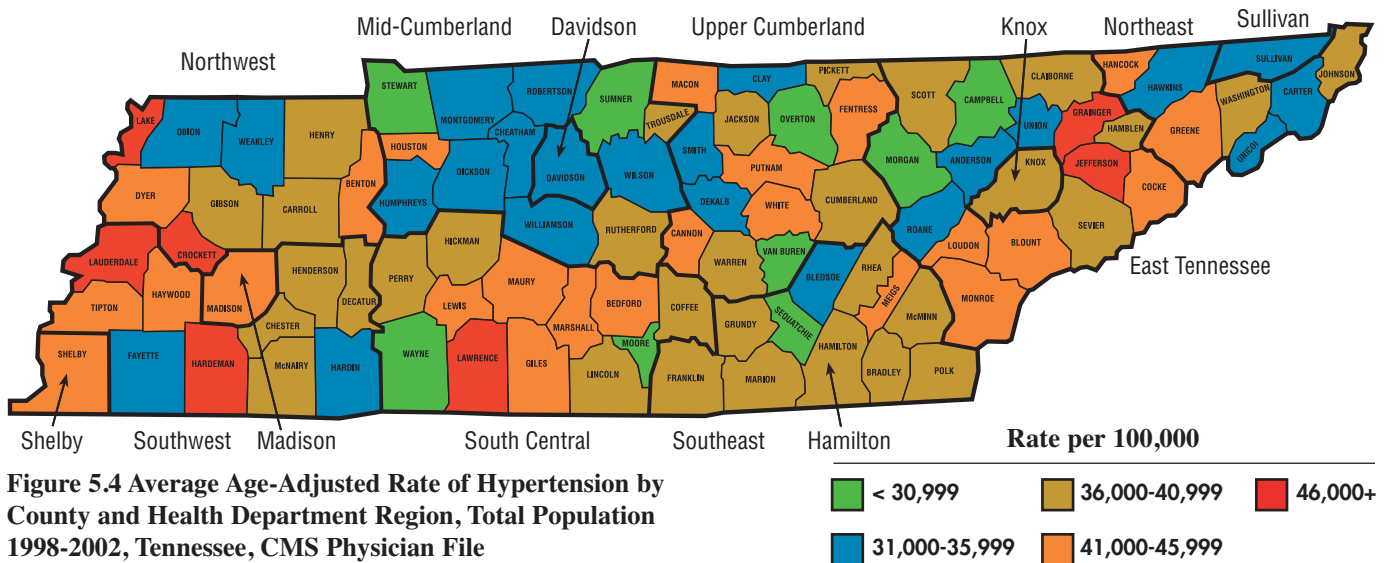


Figure 5.4 Average Age-Adjusted Rate of Hypertension by County and Health Department Region, Total Population 1998-2002, Tennessee, CMS Physician File

- Average age-adjusted rates of physician-diagnosed HTN among elderly patients from 1998-2002 varied across counties, ranging from 27,769 in Morgan County to 67,116 per 100,000 in Crockett County. (Fig. 5.4 & Table 5.1)
- The patterns of which counties had the highest and lowest rates of HTN among elderly patients in general (Table 5.1) varied across race and gender groups.

Total (n=95)	White Male (n=95)	White Female (n=95)	Black Male (n=55)*	Black Female (n=55)*
<b>Highest Counties</b>	<b>Highest Counties</b>	<b>Highest Counties</b>	<b>Highest Counties</b>	<b>Highest Counties</b>
Crockett 67,116	Crockett 55,212	Crockett 74,349	Rhea 63,574	Monroe 78,682
Lake 64,200	Lake 49,244	Lake 73,956	Monroe 56,811	Smith 68,814
Lauderdale 57,064	Lauderdale 43,715	Lauderdale 63,622	Humphreys 50,007	Rhea 67,819
Jefferson 51,674	Jefferson 42,310	Jefferson 56,782	McMinn 49,369	Putnam 67,634
Hardeman 48,954	Lawrence 40,980	Grainger 52,743	Lauderdale 49,305	Greene 67,311
<b>Lowest Counties</b>	<b>Lowest Counties</b>	<b>Lowest Counties</b>	<b>Lowest Counties</b>	<b>Lowest Counties</b>
Morgan 27,769	Carter 20,549	Morgan 31,009	Hawkins 21,179	Fayette 41,868
Van Buren 27,957	Van Buren 20,701	Fayette 32,338	Washington 23,593	Davidson 44,601
Overton 29,583	Morgan 22,940	Campbell 32,573	Obion 28,485	Sumner 44,681
Wayne 30,363	Overton 23,965	Overton 32,941	Montgomery 28,879	Henderson 45,095
Sequatchie 30,382	Stewart 24,042	Anderson 33,113	Fayette 28,900	Montgomery 46,071

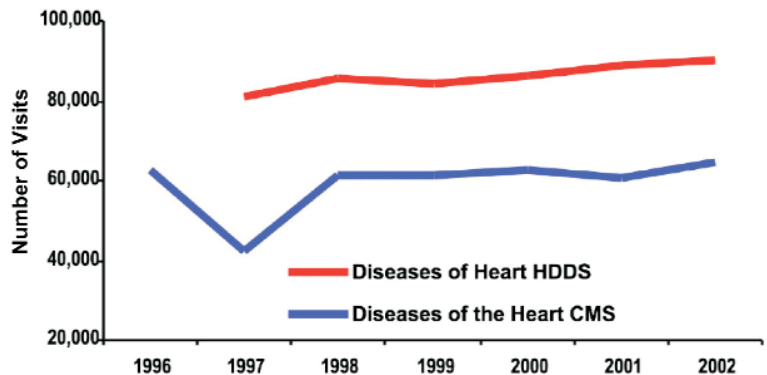
Table 5.1 Average Age-Adjusted Rate (per 100,000) of Hypertension by Race and Gender, 1998-2002, Lowest and Highest Counties, Tennessee, CMS Physician File

\*Some county rates suppressed due to current CMS privacy guidelines and data reliability

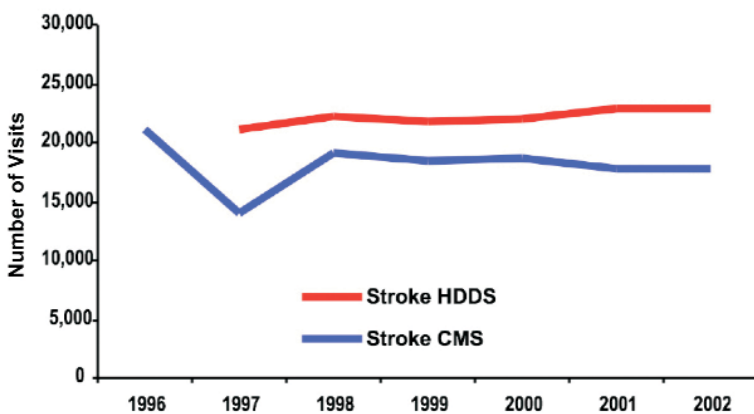
# IMPACT ON HEALTH SERVICE UTILIZATION

## SERVICE UTILIZATION PATTERNS

- According to HDDS data, the annual number of inpatient visits for DOH increased by 11% from 81,220 to 90,458 from 1997 to 2002. (Fig. 6.1)
- Among the elderly (CMS data), the number of inpatient visits for DOH increased by 5% from 62,459 to 64,474 from 1996 to 2002. (Fig. 6.1)
- Overall, the number increased by 11% for whites compared to 3% for blacks, but among elderly it increased by 25% for blacks and 3% for whites.
- DOH accounted for around 12% of all inpatient visits (18-19% among the elderly).



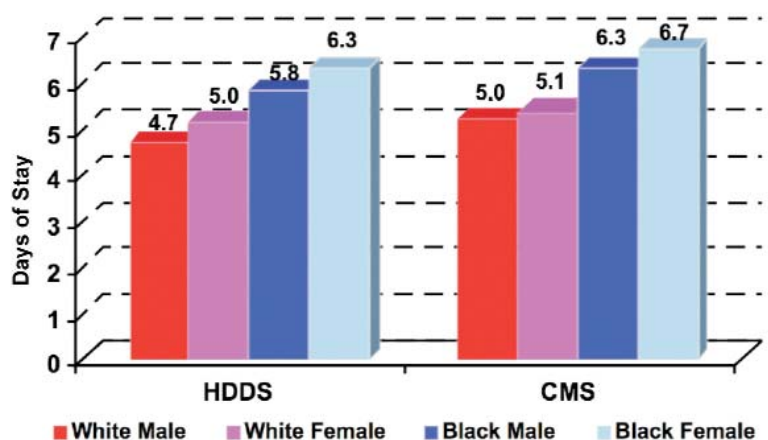
**Figure 6.1 Trends in Inpatient Hospitalization for Diseases of the Heart, 1996/7-2002, Tennessee, HDDS & CMS Inpatient Files**



**Figure 6.2 Trends in Inpatient Hospitalization for Stroke, 1996/7-2002, Tennessee, HDDS & CMS Inpatient Files**

- According to HDDS data, the annual number of inpatient visits for stroke increased by 8% from 21,120 to 22,844 from 1997 to 2002.
- Among the elderly (CMS data), the number of inpatient visits for stroke decreased by 23% from 21,047 to 17,789 from 1996 to 2002.
- Overall, the number increased by 12% for whites compared to 7% for blacks, but among elderly it decreased by 24% for whites compared to 12% for blacks.
- Stroke accounted for around 3% of all inpatient visits (5-6% among the elderly).

- According to HDDS data, the average length of stay (LOS) for DOH hospitalizations decreased by 3%, from 5.3 to 5.1 days during 1997-2002.
- LOS for DOH was slightly longer for the elderly and for females compared to males, and about a day longer for blacks compared to whites.
- In 2002, LOS for DOH was longest for black females, second highest for black males, followed by white females, and lowest for white males.



**Figure 6.3 Average Inpatient Length of Stay for Diseases of the Heart, 2002, Tennessee, HDDS & CMS Inpatient Files**

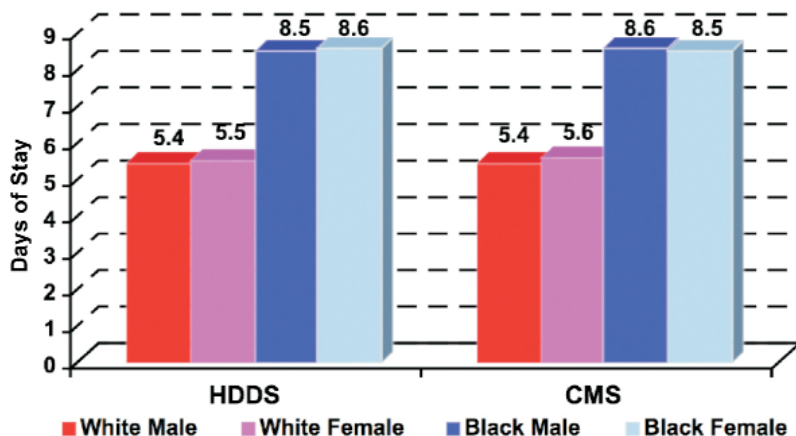


Figure 6.4 Average Inpatient Length of Stay for Stroke, 2002, Tennessee, HDDS & CMS Inpatient Files

- According to HDDS data, the average LOS for stroke hospitalizations only increased by 7%, from 5.7 to 6.0 days during 1997-2002.
- LOS for stroke was slightly longer for the elderly and for females compared to males, and 2-3 days longer for blacks compared to whites.
- Notably, the average LOS for stroke for blacks increased by 20% compared to 5% for whites during 1997-2002.

- According to HDDS data, the total annual number of outpatient visits for DOH increased by 80% from 28,718 to 51,765 during 1997-2002. (Fig. 6.5)
- The above number increased by twice as much for whites compared to blacks.
- The number of outpatient visits for stroke increased by 92% from 3,377 to 6,487 from 1997 to 2002.
- The increase was four times greater for whites compared to blacks.

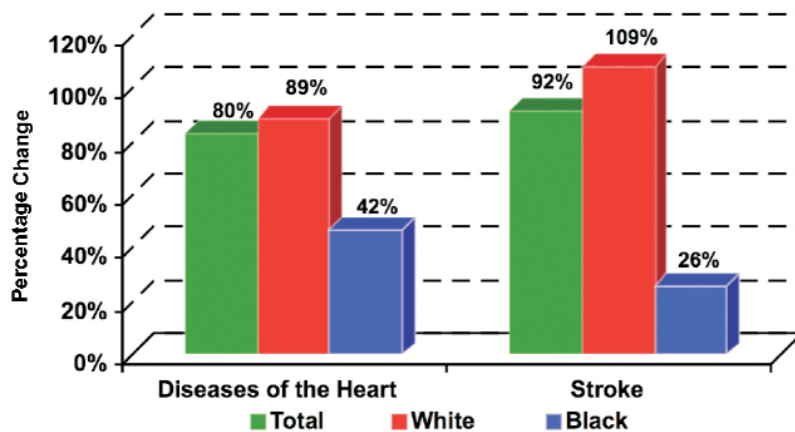


Figure 6.5 Percentage Change in Number of Outpatient Visits for Diseases of the Heart, Stroke & Hypertension 1997-2002, Tennessee, HDDS Outpatient File

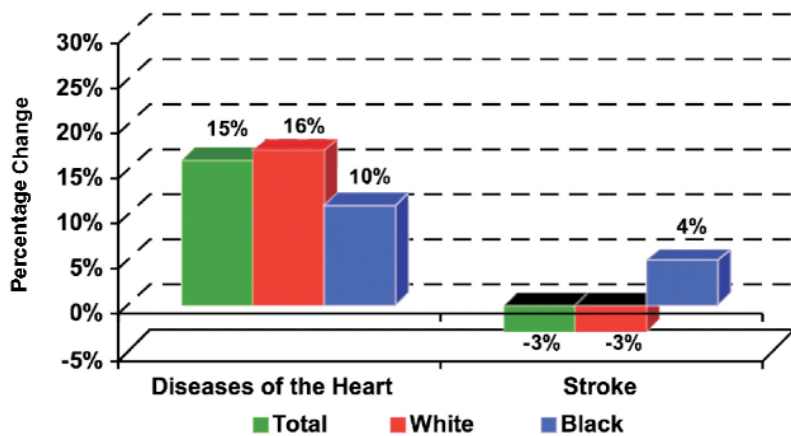


Figure 6.6 Percentage Change in Number of Outpatient Visits for Diseases of the Heart, Stroke & Hypertension, 1996-2002, Tennessee, CMS Outpatient File

- According to CMS data, the total annual number of outpatient visits for DOH among age 65 and over population increased by 15% from 169,622 to 202,572 from 1996 to 2002. (Fig. 6.6)
- The above number increased slightly more for elderly whites compared to blacks.
- The number of outpatient visits for stroke among the elderly decreased by 3% from 54,801 to 52,838 from 1996 to 2002.
- However, the number of outpatient visits actually increased by 4% for elderly blacks.

- According to 2002 HDDS data, 57.2% of inpatient hospitalizations for DOH were admitted through the ER, which was slightly lower in the CMS data for the 65 and over population (51.4%). (Graph not shown)
- The percentage of ER admissions for DOH was higher for blacks compared to whites, and slightly higher for females compared to males.
- In 2002, ER visits comprised 48.5% of outpatient visits for DOH. (Fig. 6.7)
- The percentage of ER outpatient visits for DOH was highest for black females and lowest for white males. (Fig. 6.7)

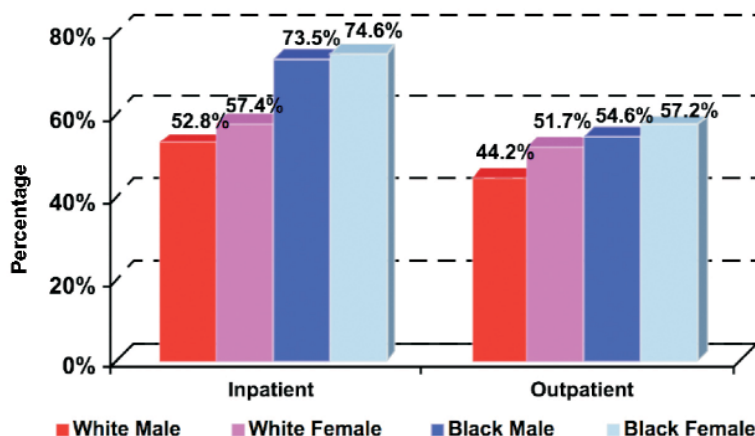


Figure 6.7 Percentage of Inpatient Admissions and Outpatient Visits for Diseases of the Heart Through the Emergency Room, 2002, Tennessee, HDDS Files

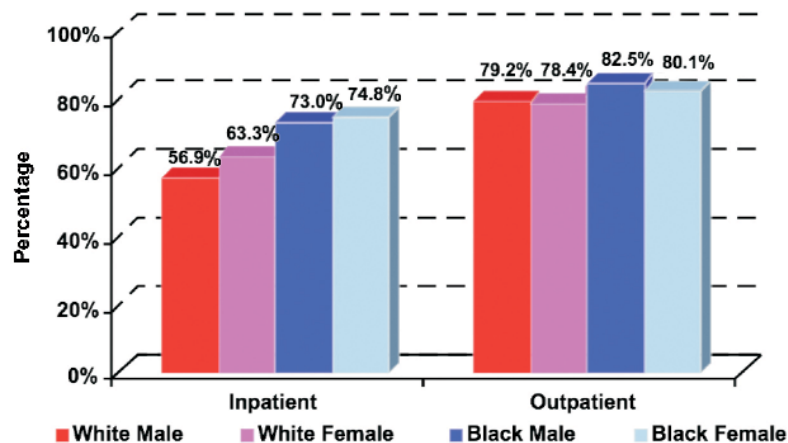


Figure 6.8 Percentage of Inpatient Admissions and Outpatient Visits for Stroke Through Emergency Room, 2002, Tennessee, HDDS Files

- According to 2002 HDDS data, 62.6% of inpatient hospitalizations for stroke were admitted through the ER, which was slightly lower in the CMS data for the 65 and over population (56.1%). (Graph not shown)
- The percentage of ER admissions for stroke was highest for black females and lowest for white males. (Fig. 6.8)
- The percentage of ER admissions for stroke declined slightly for blacks from 1997 to 2002. (Graph not shown)

- In 2002, ER visits comprised 79.4% of outpatient visits for stroke, with little difference by race or gender. (Fig. 6.9)
- According to 2002 HDDS data, 63.2% of inpatient hospitalizations for HTN were admitted through the ER, which was slightly lower in the CMS data for the 65 and over population (57.1%). (Fig. 6.9)
- The percentage of ER admissions for HTN was higher for blacks compared to whites.
- In 2002, ER visits comprised 76.7% of outpatient visits for HTN, being slightly higher for whites (78.5%) than for blacks (72.8%).

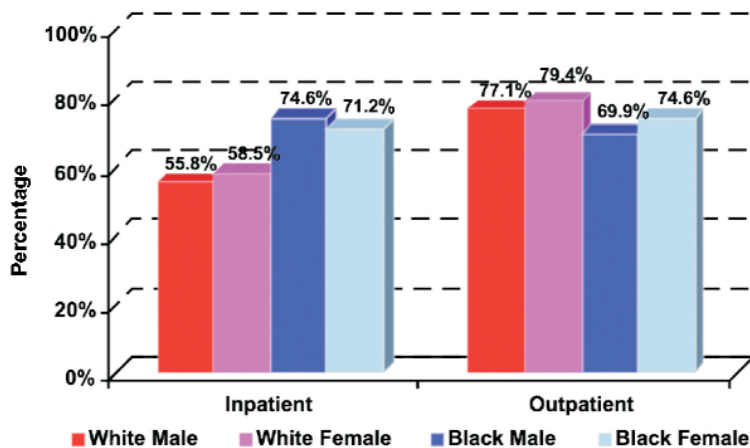


Figure 6.9 Percentage of Inpatient Admissions and Outpatient Visits for Hypertension Through the Emergency Room, 2002, Tennessee, HDDS Files

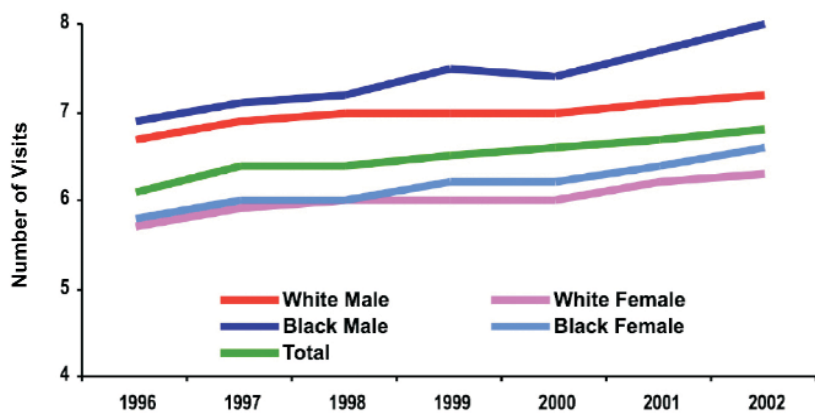


Figure 6.10 Average Number of Physician Visits for Diseases of the Heart among Age 65 and Over, 1996-2002, Tennessee, CMS Physician File

- The average number of physician visits for DOH among the elderly increased by 11% from 6.1 visits in 1996 to 6.8 visits in 2002, according to CMS physician data.
- Elderly males had about one more physician visit for DOH than females, with the most for black males and least for white females.
- The total number of physician visits for DOH among the elderly increased by 20% from 1,356,860 in 1996 to 1,627,981 in 2002. (Graph not shown)
- DOH as a primary diagnosis accounted for around 9% of all physician visits for the elderly, which was higher for males compared to females, and higher for whites compared to blacks. (Graph not shown)

- The average number of physician visits for stroke among the elderly decreased by 7% from 4.5 visits in 1996 to 4.2 visits in 2002, according to CMS physician data. (Fig. 6.11)
- Elderly blacks had about one more physician visit for stroke than whites, with the most for black males and least for white females.
- The total number of physician visits for stroke among the elderly increased by 2.9% from 301,338 in 1996 to 310,171 in 2002. (Graph not shown)
- Stroke as a primary diagnosis accounted for roughly 2% of all physician visits for the elderly.

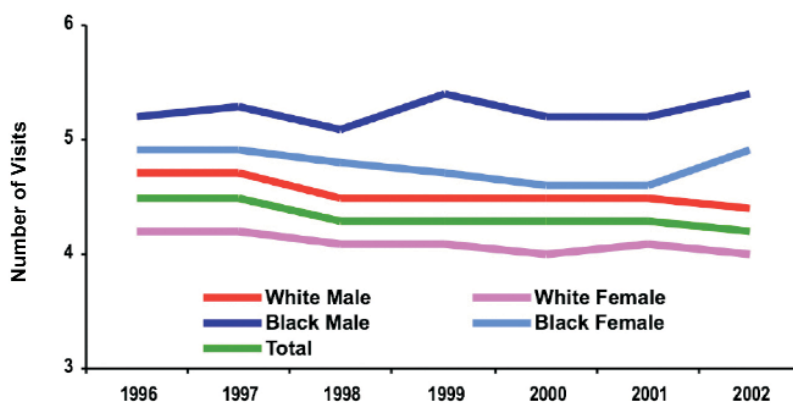


Figure 6.11 Average Number of Physician Visits for Stroke Among Age 65 and Over, 1996-2002, Tennessee, CMS Physician File

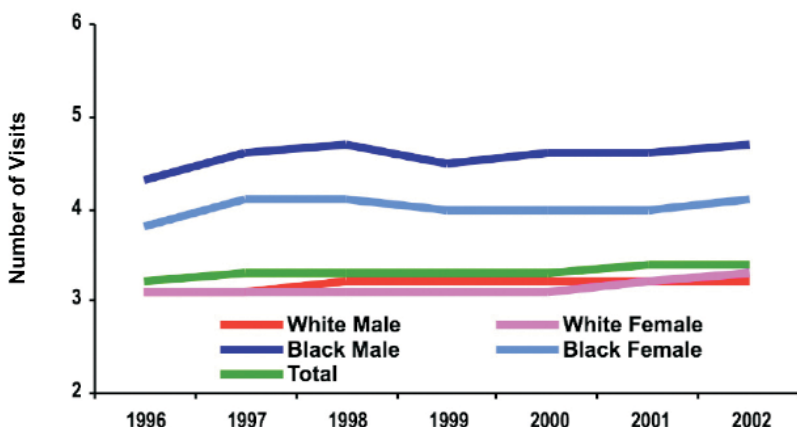


Figure 6.12 Average Number of Physician Visits for Hypertension Among Age 65 and Over, 1996-2002, Tennessee, CMS Physician File

- The average number of physician visits for HTN for the elderly increased by 6% from 3.2 visits in 1996 to 3.4 visits in 2002, according to CMS physician data. (Fig. 6.12)
- Compared to elderly whites, elderly black males had about 1 more physician visit for HTN, and elderly black females had about 1 more visit.
- The total number of physician visits for HTN among the elderly increased by 38% from 740,047 in 1996 to 1,017,405 in 2002. (Graph not shown)
- HTN as a primary diagnosis accounted for roughly 2% of all physician visits for the elderly, with little variation by race or gender. (Graph not shown)

### UTILIZATION OF PROCEDURES

- In the overall population, the total number of cardiac and vascular procedures performed for DOH each year in an inpatient setting increased by 21% from 33,236 in 1997 to 40,187 in 2002. (Fig. 6.13)
- The increase was lower for blacks than the increase for whites.
- Among the elderly, the increase for elderly blacks was twice as high as the increase for elderly whites from 1996 to 2002.
- Overall, cardiac and vascular procedures comprised over half of all inpatient hospital visits in 2002.

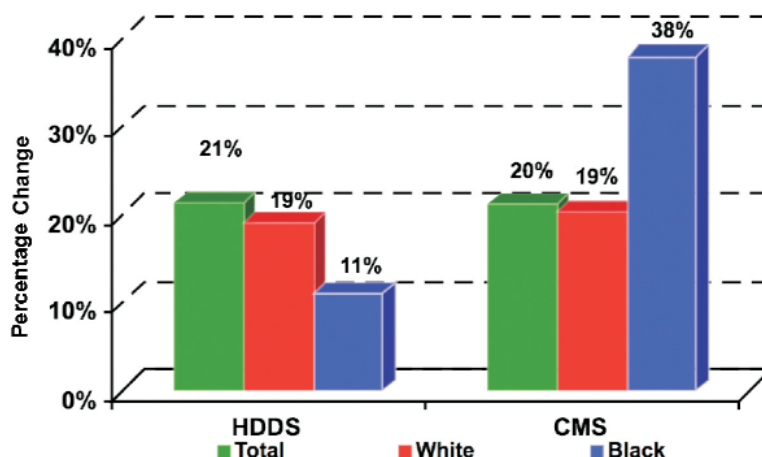


Figure 6.13 Percentage Change in Cardiac and Vascular Procedures of Patients Diagnosed with Diseases of the Heart 1996/7-2002, Tennessee, HDDS & CMS Inpatient Files

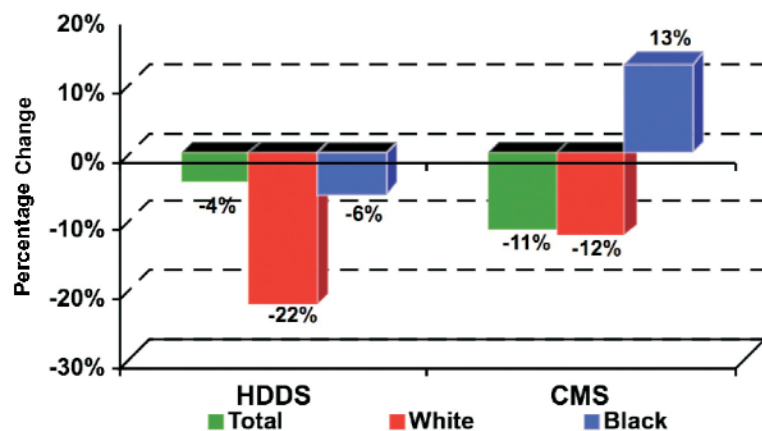


Figure 6.14 Percentage Change in Coronary Artery Bypass Graft Procedures of Patients Diagnosed with Diseases of the Heart, 1996/7-2002, Tennessee, HDDS & CMS Inpatient Files

- In the overall population, the number of coronary artery bypass graft procedures performed each year in an inpatient setting decreased by 4% from 8,895 in 1997 to 8,550 in 2002. (Fig. 6.14)
- The decrease in number of inpatient coronary artery bypass graft procedures for blacks (22%) was greater than the decrease for whites (6%).
- However, among the elderly, the increase in total number of inpatient procedures decreased for elderly whites (12%) while it increased for elderly blacks (13%) from 1996 to 2002.
- Overall, coronary artery bypass graft procedures comprised around 12% of all inpatient hospital visits in 2002 .

- In the overall population, the number of open heart surgeries performed for DOH each year in an inpatient setting increased by 136% from 362 in 1997 to 854 in 2002. (Fig. 6.15)
- In the overall population, the increase in open heart surgeries for whites (142%) was twice the increase for blacks (70%).
- Among the elderly, the increase in open heart surgeries for elderly whites (118%) was also greater than the increase for elderly blacks (82%) from 1996 to 2002.
- Open heart surgeries comprised only 1.2% of all inpatient hospital visits (1.8% among the elderly) in 2002.

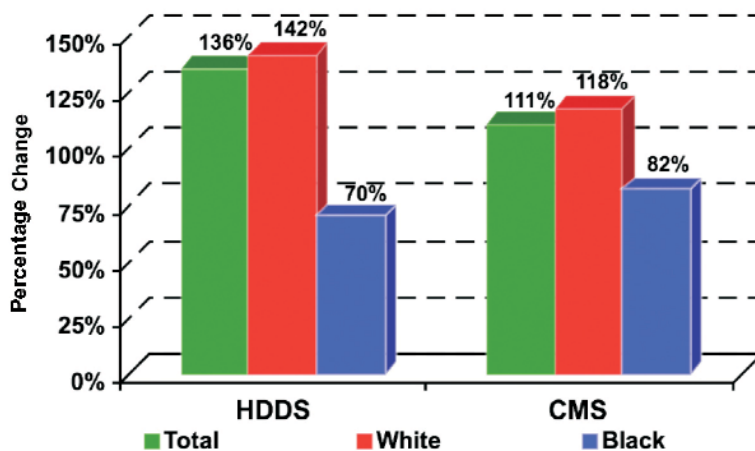


Figure 6.15 Percentage Change in Open Heart Surgical Procedures of Patients Diagnosed with Diseases of the Heart 1996/7-2002, Tennessee, HDDS & CMS Inpatient Files



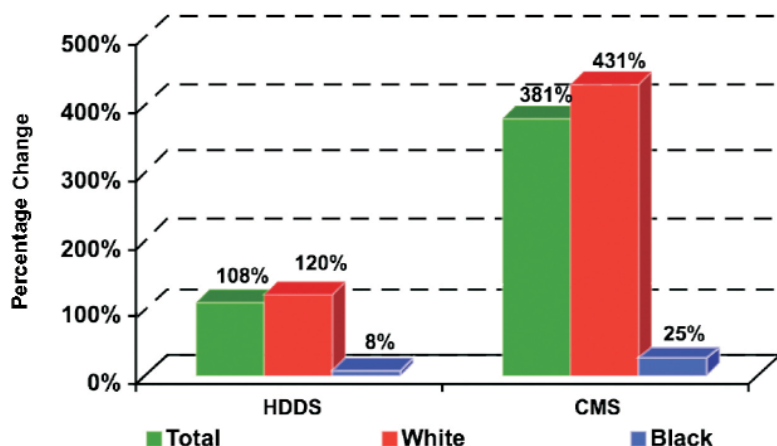


Figure 6.16 Percentage Change in Heart Valve Surgical Procedures of Patients Diagnosed with Diseases of the Heart 1996/7-2002, Tennessee, HDDS & CMS Inpatient Files

- In the overall population, the number of heart valve surgeries performed for DOH each year in an inpatient setting increased by 108% from 89 in 1997 to 185 in 2002. (Fig. 6.16)
- In the overall population, the increase in heart valve surgeries for whites (120%) was far greater than the negligible increase for blacks (8%).
- Among the elderly, the number of heart valve surgeries increased by 431% for elderly whites, compared to only a 25% increase for elderly blacks from 1996 to 2002.
- Heart valve surgeries comprised only 0.3% of all inpatient hospital visits in 2002.

- In the overall population, the number of cardiac catheterization procedures performed each year in an inpatient setting increased by 4% (not shown). However, outpatient cardiac catheterizations increased by 120% from 7,622 in 1997 to 16,727 in 2002. (Fig. 6.17)
- The increase was slightly lower for black males (98%) and slightly higher for black females (159%). (Graph not shown)
- Among the elderly, the increase in cardiac catheterization procedures for whites was higher than the increase for blacks from 1996 to 2002.

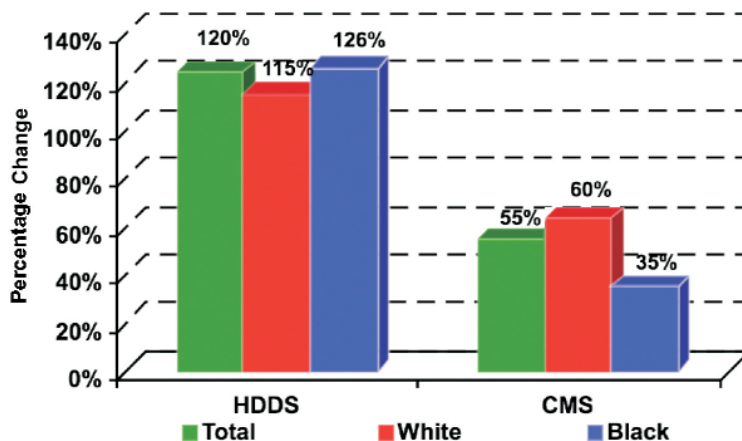


Figure 6.17 Percentage Change in Cardiac Catheterization Procedures of Patients Diagnosed with Diseases of the Heart 1996/7-2002, Tennessee, HDDS & CMS Outpatient Files

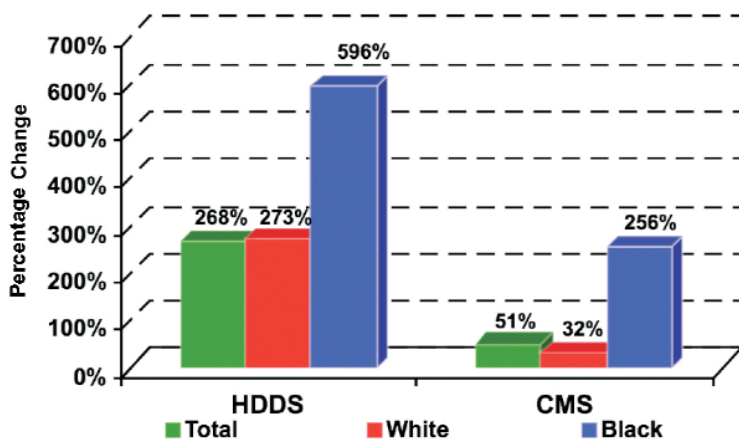


Figure 6.18 Percentage Change in Angioplasty and Stenting Procedures of Patients Diagnosed with Diseases of the Heart 1996/7-2002, Tennessee, HDDS & CMS Outpatient Files

- According to HDDS data, the number of angioplasty/stenting procedures in an inpatient setting increased by 43% (not shown). However, outpatient procedures increased by 268% from 639 in 1997 to 2,350 in 2002. (Fig. 6.18)
- The increase in angioplasty/stenting procedures was more than twice as high for blacks compared to whites.
- Among the elderly, the increase for blacks was higher than the increase for whites from 1996 to 2002.

# IMPACT ON HEALTH CARE COSTS

## TOTAL COST

- Based on HDDS data, the total cost of inpatient hospitalizations for Tennessee's general population (all ages) increased 61% from \$6.9 billion in 1997 (in 2002 dollars) to \$11.1 billion in 2002. The costs for physician visits among the elderly (65+) based on CMS physician data, increased 33% from \$1.05 billion in 1996 (in 2002 dollars) to \$1.4 billion in 2002.

## DISEASES OF THE HEART

- Inpatient costs associated with DOH (primary diagnosis) among the general population increased from 1.4 billion in 1997 (in 2002 dollars) to 2.1 billion in 2002, a 50% increase. Despite the increase in the dollar amount of costs, inpatient DOH costs accounted for about 20% of total inpatient costs for all years from 1997 to 2002, i.e. the increase in DOH costs was similar to that of the total cost for all diseases.
- The costs for physician services associated with DOH among the elderly increased from \$130 million in 1996 (in 2002 dollars) to \$143 million in 2002, a 10% increase. DOH costs accounted for 12% of physician services in 1996 and 10% in 2002, indicating that the costs associated with DOH physician services increased to a smaller extent than the physician services costs for all diseases.

### Age-Adjusted Per Capita Charges

- Age-adjusted per capita charges reflect the average cost per person in the population accounting for differences in the distribution of the population by age (age-adjusted to 2000 U.S. standard population).
- Among the general population, age-adjusted per capita charges for inpatient services resulting from DOH in constant 2002 dollars increased by 43% from \$253 in 1997 to \$362 in 2002. Compared to the 4% increase in

the age-adjusted inpatient hospitalization rate in the same time period (Fig. 3.1), DOH costs increased to a greater extent than the increase in the number of DOH patients receiving inpatient services. This suggests that the increase in DOH inpatient costs was not just due to the increase in services received.

- For inpatient services, white males and black males had the highest age-adjusted per capita charges for all years from 1997 to 2002, followed by black females, with white females having the lowest. (Fig. 7.1)

- Age-adjusted per capita charges for DOH physician services among the elderly increased by 4.8% from \$186 in 1996 (in 2002 dollars) to \$195 in 2002. (Fig. 7.2) Although this increase was not as dramatic as for DOH inpatient costs, it was 2.4 times the increase in the age-adjusted physician visit rate of 2%. (Fig. 3.2)
- For DOH physician services among the elderly, white males had the highest age-adjusted per capita charges in all years and black males, white females, and black females were similar to each other.

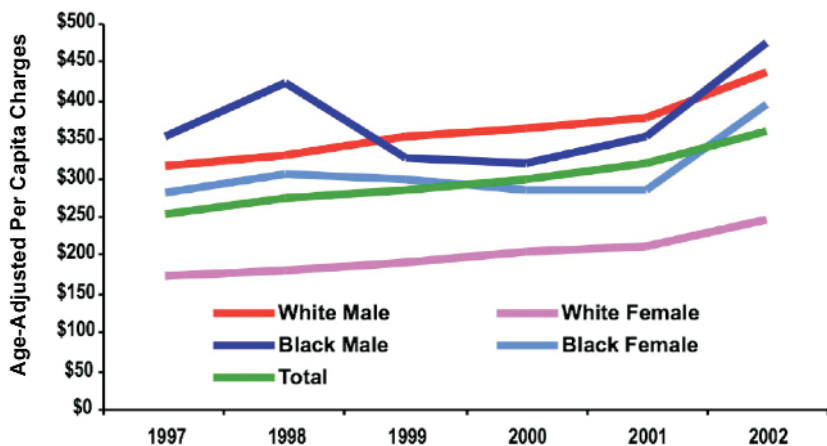


Figure 7.1 Trends in Age-Adjusted Per Capita Charges for Diseases of the Heart, 1997-2002, Tennessee, HDDS Inpatient File (2002 Dollars)

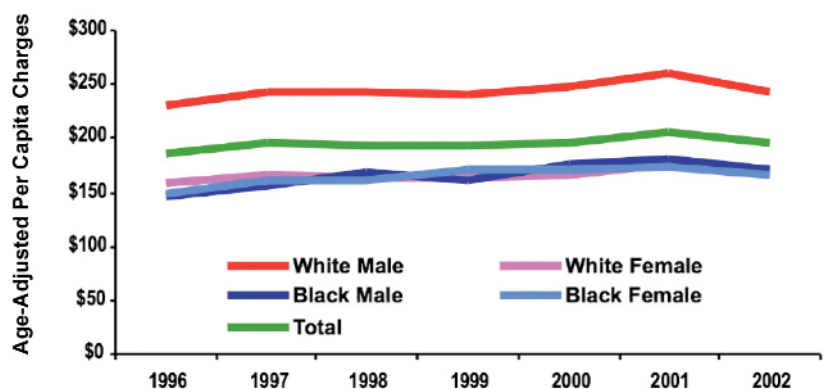


Figure 7.2 Trends in Age-Adjusted Per Capita Charges for Diseases of the Heart, 1996-2002, Tennessee, CMS Physician File (2002 Dollars)

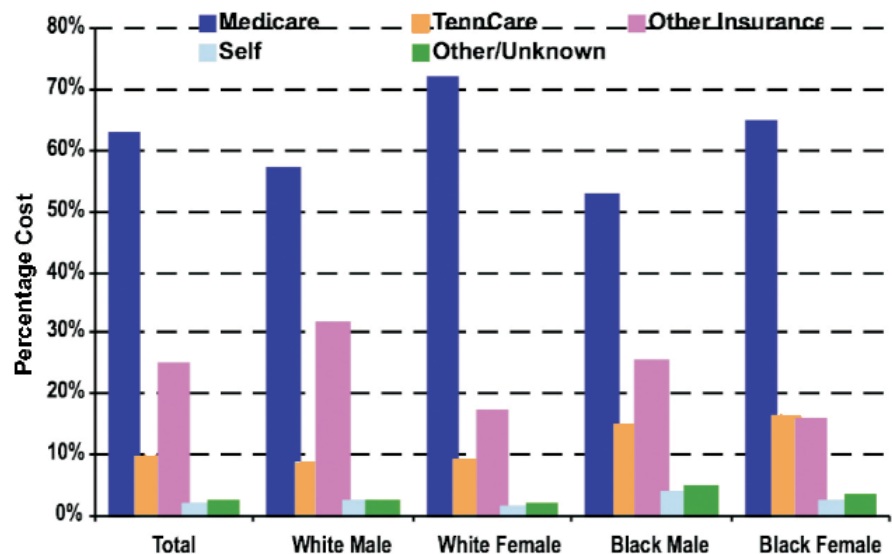
**Costs by Payer**

- Medicare payments for inpatient costs associated with DOH for the general population increased 57% from \$845 million in 1997 (in 2002 dollars) to \$1,324 million in 2002. The costs paid by other insurers increased by 44% from \$362 million in 1997 (in 2002 dollars) to \$523 million in 2002. The costs paid by TennCare increased 62% from \$129 million in 1997 (in 2002 dollars) to \$209 million in 2002. These three major payers paid for about 96% of DOH inpatient costs in 2002.
- For inpatient services, regardless of the race-gender group, Medicare was the largest payer for DOH from 1997 to 2002, followed by other insurance coverage, and then TennCare (Figure 7.3). Self-pay and other/unknown payers paid for less than 4% of the DOH costs in 2002.
- Medicare paid a greater proportion of the inpatient costs for females (72% for white females, 64% for black females in 2002) than for males (57% for white males, 52% for black males in 2002). TennCare paid a higher percentage of the inpatient costs for blacks (15% for black males, 16% for black females in 2002) than for whites (10% for both white males and white females in 2002). In contrast to Medicare, other insurance coverage paid a smaller proportion of the inpatient costs for females (17% for white females, 15% for black females in 2002) than for males (31% for white males, 25% for black males in 2002). (Fig. 7.3)

**Relative Costs for Major Types**

The three major types of Diseases of the Heart (DOH) considered here are Coronary Heart Disease (CHD), Myocardial Infarction (MI) and Congestive Heart Failure (CHF). Note that these subtypes of DOH are not mutually exclusive from each other.

- In 2002, CHD accounted for 57% of DOH costs for the general population and 50% of the DOH physician services costs among the elderly.
- White males consistently had the highest relative CHD costs and black females had the lowest, regardless of the types of services and population age ranges.
- In 2002, MI accounted for 23% of the DOH inpatient costs among the general population and 5% of DOH physician services costs among the elderly.
- Black females had the highest relative CHF costs, followed by black males, then white females and white males. White males had the lowest relative CHF costs from 1996/1997 to 2002 regardless of the type of services and population age ranges.
- For all three types of DOH, the inflation-adjusted costs increased over time regardless of types of services and the population age ranges. However, their relative costs to DOH costs remained relatively unchanged from 1996/1997 to 2002.



**Figure 7.3 Diseases of the Heart Costs by Payer, 2002, Tennessee, HDDS Inpatient File**

- The relative costs of MI to diseases of the heart were the highest among white males and lowest among black females for the general population. Such a pattern was also observed for physician services among the elderly.
- In 2002, CHF accounted for 17% of DOH inpatient costs for the general population and 14% of the DOH physician services costs among the elderly.

**Costs for Procedures**

In this section, we examine the inpatient costs associated with six major DOH procedures: coronary artery bypass graft, angioplasty and stenting, cardiac catheterization, heart valve surgery, open heart surgery, and heart transplant.

- Coronary artery bypass graft was the most costly inpatient procedure for the general population, accounting for 22% of DOH inpatient costs. Costs for this procedure increased the least (22% increase after adjusting for inflation) from 1997 to 2002 when compared with other inpatient procedures examined. The second most costly procedure for the general population was angioplasty & stenting (19% of DOH costs in 2002), whose costs almost doubled (86% increase after adjusting for inflation) from 1997 to 2002. Heart valve surgery costs increased the most (by 150% after adjusting for inflation) from 1997 to 2002, but it only accounted for less than 1% of DOH costs. (Fig. 7.4)

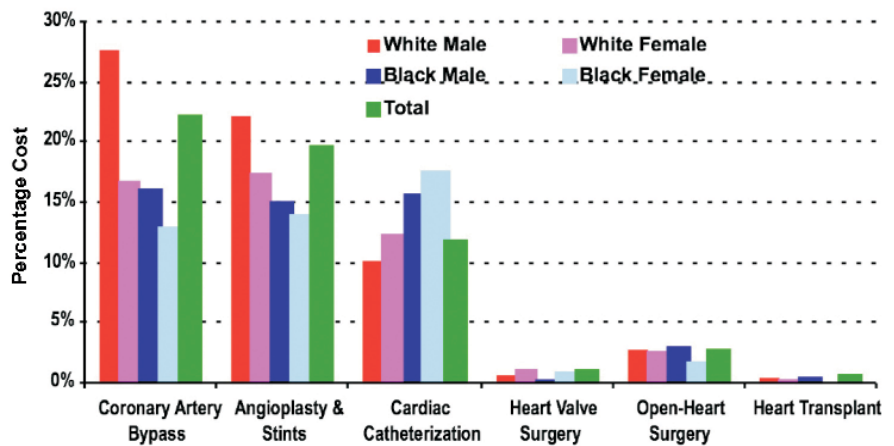


Figure 7.4 Relative Costs for Major Diseases of the Heart Procedures, 2002, Tennessee, HDDS Inpatient File

- Cardiac catheterization was the most costly inpatient procedure among the elderly, which accounted for 42% of the DOH inpatient costs. The second most costly inpatient procedure among the elderly was coronary artery bypass graft. (Fig. 7.5)
- For both the general population and the elderly in 2002, the relative costs for coronary artery bypass graft and angioplasty and stenting was higher for males than females and higher for whites than blacks. For cardiac catheterization, the relative costs

were higher for females than males, and higher for blacks than whites in the general population. Among the elderly, the relative costs for cardiac catheterization was higher for males than females and similar for whites and blacks. (Fig. 7.4, Fig. 7.5)

million in 2002. Physician services costs for stroke among the elderly increased 2%, from \$41 million in 1996 (in 2002 dollars) to \$42 million in 2002.

### STROKE

#### Total Costs

- Stroke inpatient costs among the general population (HDDS data) increased by 56% from \$255 million in 1997 (in 2002 dollars) to \$395

- Despite the dollar increases in costs, stroke consistently accounted for about 4% of inpatient costs for all diseases among the general population and 3-4% of physician services costs among the elderly for all years from 1996/1997 to 2002.

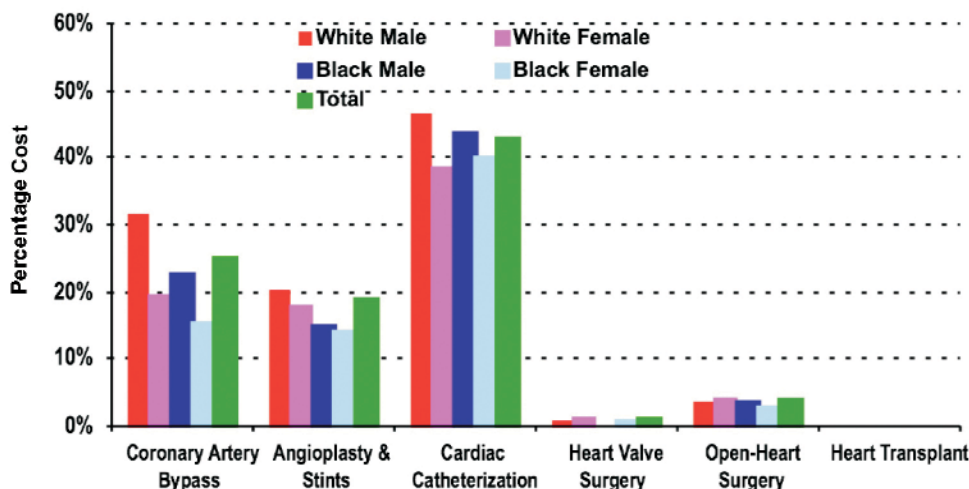


Figure 7.5 Relative Costs for Major Diseases of the Heart Procedures, 2002, Tennessee, CMS Inpatient File

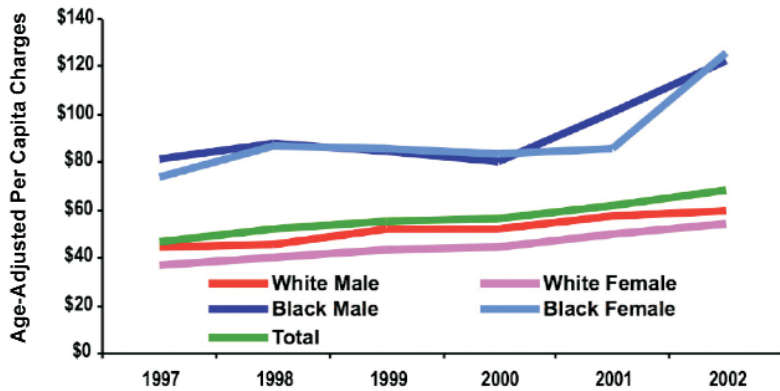


Figure 7.6 Trends in Age-Adjusted Per Capita Charges for Stroke, 1997-2002, Tennessee, HDDS Inpatient File (2002 Dollars)

Age-adjusted Per Capita Charges

- Age-adjusted per capita inpatient charges for stroke services among the general population increased by 45% from \$47 in 1997 (in 2002 dollars) to \$68 in 2002. Age-adjusted per capita charges for blacks were more than twice as high as those for whites in all years from 1997 to 2002, and such gaps widened over time. (Fig. 7.6)
- Age-adjusted per capita physician charges for stroke services among the elderly decreased slightly (5%) from \$60 in 1996 (in 2002 dollars) to \$57 in 2002, with white females being slightly lower than other race-gender groups. (Fig. 7.7)

Costs by Payer

- Medicare paid \$253 million of inpatient stroke costs in 2002, which was a 46% increase from \$173 million in 1997 (in 2002 dollars). Other insurance coverage paid \$80 million in 2002, which was a 54% increase from \$52 million in 1997 (in 2002 dollars). TennCare paid \$37 million in 2002, which was a 68% increase from \$22 million in 1997 (in 2002 dollars). These three major payers paid about 94% of stroke inpatient costs.

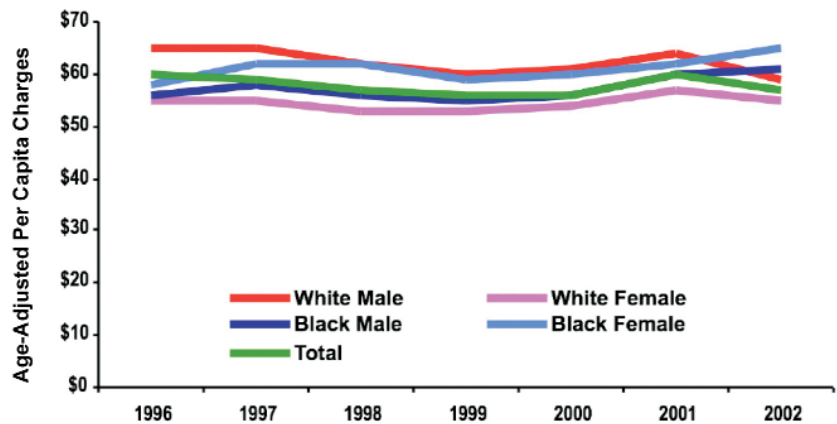


Figure 7.7 Trends in Age-Adjusted Per Capita Charges for Stroke, 1996-2002, Tennessee, CMS Physician File (2002 Dollars)

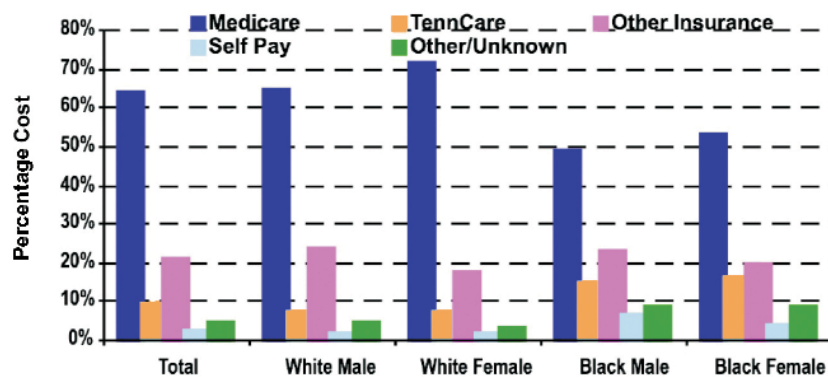


Figure 7.8 Stroke Costs by Payer, 2002, Tennessee, HDDS Inpatient File

- For inpatient services among all race-gender groups, Medicare bore the largest cost burden, paying 64% of stroke costs for the general population in all years from 1997 to 2002. Other insurance coverage was the second largest payer for all groups with the exception of black females, whose second highest payer was either other insurance coverage or TennCare. (Fig. 7.8)
- Medicare paid a greater proportion of the inpatient stroke costs for females than for males. In contrast, other insurance coverage paid a smaller proportion of the inpatient stroke costs for females than for males.

## HYPERTENSION

### Total Costs

- Inpatient costs for hypertension among the general population was \$115 million in 2002, which was a 53% increase from 1997 (\$75 million in 2002 dollars). Despite the increase in actual costs, the relative costs of hypertension compared to the costs of all diseases was about 1% for inpatient services for all years from 1997 to 2002. The relative costs for hypertension were consistently higher among blacks than whites and the gap increased over time. (Fig. 7.9)
- The costs of physician services for hypertension among the elderly also increased by 31% from \$35 million in 1996 (in 2002 dollars) to \$46 million in 2002. Hypertension costs accounted for about 5-6% of DOH physician services costs in all years from 1996 to 2002.

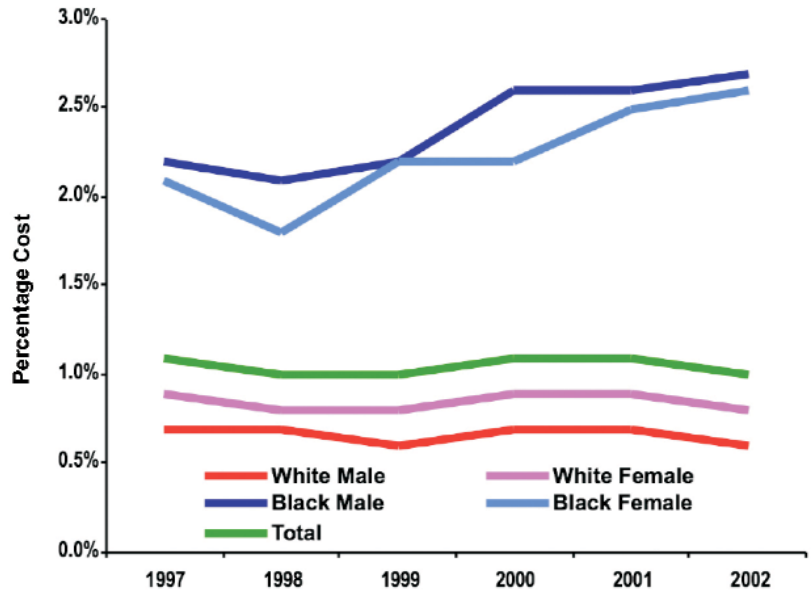


Figure 7.9 Trends in Relative Costs for Hypertension, 1997-2002, Tennessee, HDDS Inpatient File

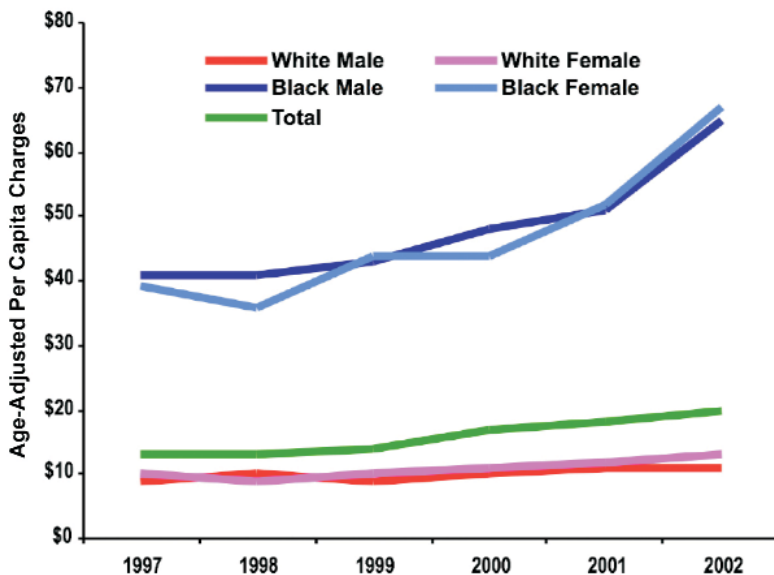


Figure 7.10 Trends in Age-Adjusted Per Capita Charges for Hypertension, 1997-2002, Tennessee, HDDS Inpatient File (2002 Dollars)

### Age-Adjusted Per Capita Charges

- Age-adjusted per capita charges for inpatient services due to hypertension for the general population increased from \$13 per capita in 1997 (in 2002 dollars) to \$20 per capita in 2002, which was a 54% increase. (Fig. 7.10)
- Blacks had much higher age-adjusted per capita charges for hypertension than whites and the gaps widened over time. In 2002, the age-adjusted per capita charges for hypertension were more than 5 times higher among blacks (\$75) compared to whites (\$12). (Fig. 7.10)

- Age-adjusted per capita charges for physician services due to hypertension among the elderly also increased 37% from \$46 in 1996 (in 2002 dollars) to \$63 in 2002. Black females had the highest age-adjusted per capita charges, white males had the lowest, and black males and white females were in the middle from 1996 to 2002. (Fig. 7.11)

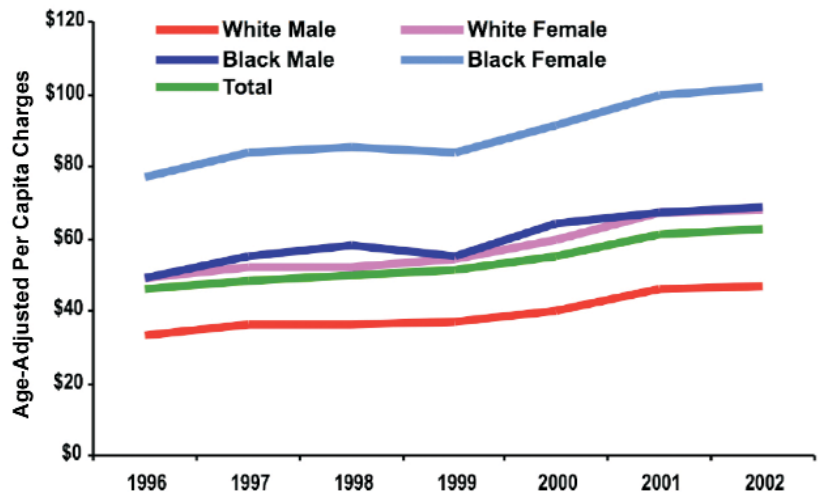


Figure 7.11 Trends in Age-Adjusted Per Capita Charges for Hypertension, 1996-2002, Tennessee, CMS Physician File (2002 Dollars)

**Costs by Payer**

- In 2002, Medicare paid \$75 million for hypertension inpatient services for the general population, which was a 44% increase from \$52 million in 1997 (in 2002 dollars). Hypertension costs paid by other insurance coverage increased by 65% from \$11.9 million in 1997 (in 2002 dollars) to \$19.6 million in 2002. Hypertension costs paid by TennCare increased by 74% from \$8.2 million in 1997 (in 2002 dollars) to \$14.3 million in 2002. These three major payers paid about 94% of the total hypertension costs in 2002.
- Despite the increase in the dollar amount paid by Medicare, the percentage of costs paid by Medicare

stayed around 65-69% of inpatient hypertension costs. (Fig. 7.12)

- Medicare was the largest payer for inpatient hypertension costs for all race-gender groups, followed by other insurance coverage, with the exception of black females whose second largest payer was TennCare. (Fig. 7.12)
- For inpatient services, other insurance coverage paid a higher

proportion of the hypertension costs for males (23%) than for females (12.9%) in 2002. In contrast, Medicare paid a higher proportion of the hypertension costs for females (70%) than for males (59%) in 2002. TennCare tended to pay for a higher proportion of hypertension costs for blacks (17.3%) than for whites (8.5%) in 2002. (Fig. 7.12)



Figure 7.12 Hypertension Costs by Payer, 2002, Tennessee, HDDS Inpatient File

# CONCLUSION

## DISCUSSION

- DOH, stroke, and other CVD combined are the most common cause of death for Tennesseans, accounting for 38% of deaths in Tennessee.
- To put that in perspective, Tennesseans were 73% more likely to die from DOH, stroke or other CVD than to die from cancer in 2002.
- Among all states Tennessee ranked 6th highest for DOH mortality and 3rd highest for stroke mortality in 2002.

### Risk Factors

- Altering modifiable risk factors can help prevent many people from developing DOH and stroke. Alarming, 9 out of 10 adult Tennesseans reported at least one risk factor in 2002, and nearly two-thirds reported two or more risk factors.
- Of major concern are the rapidly increasing trends in obesity and diabetes, combined with high levels of sedentary lifestyle and poor dietary habits (i.e., low fruit and vegetable consumption) among adult Tennesseans.
- Prevalence of obesity, diabetes and sedentary lifestyle in Tennessee were all higher than the national average, while poor diet was slightly better than the national average.
- Physical activity and diet both impact weight gain and risk of developing diabetes, and sedentary lifestyle also has a direct adverse impact on overall heart function.
- The prevalence of cigarette smoking (above national average) and self-reported diagnosed high blood cholesterol (near national average) both remained fairly stable over time.
- Black Tennesseans consistently reported lower prevalence of high cholesterol than whites, possibly due to fewer physician visits with opportunities for cholesterol screening.

### Diseases of the Heart (DOH)

- Rates of DOH and MI (heart attack) slowly increased by 3-8% from 1996/7-2002. At the same time, DOH mortality decreased by 9% and MI mortality decreased by 17%.
- Despite this decline, Tennessee remained far above the national mortality rate for DOH (ranking 6th highest in 2002), and DOH accounted for 28.7% of all deaths in 2002.

- The rate of CHF among inpatients and CHF mortality both increased (by 7% and 10%, respectively) from 1996/7 to 2002.

### Stroke

- Rates of stroke among inpatients slowly decreased by 2% from 1997-2002 (with a greater decline among elderly inpatients).
- Stroke accounted for 7% of all Tennessee deaths in 2002. At the same time, stroke mortality decreased by 11%, although Tennessee was still 3rd highest in the nation for stroke mortality.
- Stroke rates were highest for black males followed by black females.

### High Blood Pressure, or Hypertension (HTN)

- HTN affects close to one-third of all adult Tennesseans, and self-reported HTN did not change from 1996-2002.
- However, rates of HTN among inpatients decreased slightly by 3%, while rates of physician-diagnosed HTN among the elderly increased by 25% from 1996-2002.
- Co-occurrence of DOH and stroke with HTN is very high, given that more than two-thirds of those with DOH also have HTN, and more than three-fourths of those with stroke also have HTN.

### Utilization & Procedures

- The frequency of inpatient hospitalizations for DOH and stroke increased modestly, while the number of outpatient visits for DOH and stroke increased dramatically (except among the elderly).
- Over half of inpatient hospitalizations for DOH, stroke and HTN were admitted through the ER. About half of outpatient visits for DOH were in the ER, compared to more than three-fourths for stroke and HTN.
- Among the elderly, the average number of physician visits for DOH and HTN increased modestly, but decreased modestly for stroke.
- The total number of cardiac and vascular inpatient procedures for DOH increased by 21% from 1997-2002, and accounted for over half of all inpatient hospitalizations in 2002.
- There was dramatic growth in the frequency of open heart surgery and heart valve surgery, as well as outpatient angioplasty/stenting and cardiac catheterization.



## Costs

- Inpatient and outpatient hospital costs for DOH, stroke and HTN totaled \$3 billion in 2002, and accounted for 20% of total hospitalization costs for all causes. In addition, the costs for physician services for these three conditions among the elderly was \$231 million in 2002.
- Medicare and TennCare paid for the majority of hospitalization costs from DOH, stroke and HTN; together these federal and state sponsored providers paid the bill for 70% of inpatient and outpatient hospital costs for these conditions totaling \$2.1 billion in 2002.
- Medicare paid for a higher proportion of the costs for females than males and a higher proportion for whites than blacks while TennCare paid for a higher proportion of the costs for blacks than whites. Private insurance companies paid a higher proportion of costs for males than females.
- The age-adjusted per capita costs for inpatient hospitalization increased 43% for DOH, 45% for stroke and 54% for HTN from 1997 to 2002, consistently outpacing inflation in each year.
- Similar to the race-gender pattern observed for mortality and inpatients, the age-adjusted per capita costs for inpatient services were much higher for blacks than whites for stroke and HTN and higher for males than females for DOH.

## Racial and Gender Differences

- Blacks had a greater disease burden of DOH, CHF, stroke, and HTN in the general population. The DOH rate among inpatients increased most rapidly for black males. However, among the elderly, rates of physician-diagnosed DOH and stroke were higher for whites, particularly white males.
- MI affected white males more frequently than other groups, while HTN affected females more frequently than males, especially black females.
- Blacks (especially black males) were more likely to die from DOH and stroke than whites. MI and CHF mortality rates were both higher for males compared to females, but MI mortality was higher for whites (particularly white males) while CHF mortality was higher for blacks.
- Black females would appear to be most at risk for heart disease and stroke since they have the highest prevalence of obesity, sedentary lifestyle, diabetes and high blood pressure, and were only slightly lower than black males in poor diet.
- However, black females actually have lower DOH and MI mortality than white and black males and lower stroke

mortality than black males. In addition, the relative protective advantage that females in general have compared to males for developing heart disease and the considerably lower prevalence of smoking among black females may partially counteract their other risk factors.

- Black Tennesseans were more likely to seek emergency treatment for DOH or stroke compared to whites, which demonstrates a greater use of acute care.
- Black Tennesseans hospitalized for DOH or stroke stayed more days than whites, which is an indication of greater severity. Elderly blacks (especially black males) had more physician visits for DOH or stroke than whites.
- However, the frequency of outpatient visits for DOH and stroke grew more rapidly for whites compared to blacks, which may reflect greater use of therapeutic treatments to prevent first or recurring cardiovascular events and complications (i.e., secondary prevention).
- In terms of specific procedures, the frequency of open heart surgery and heart valve surgery increased more rapidly for Whites, while the frequency of outpatient angioplasty/stenting and cardiac catheterization grew more rapidly for Blacks.

## Geographic Variation

- Age-adjusted rates of DOH, stroke, and HTN, and age-adjusted mortality rates from these causes varied substantially across Tennessee counties.
- For example, in terms of the rate of DOH among inpatients, the highest county rate was more than 4 times greater than the lowest county rate (and 3 times greater for stroke).
- The rate of physician-diagnosed DOH and HTN among the elderly were about 2 times greater, the DOH mortality rate was 2 times greater, and the stroke mortality rate was nearly 5 times greater in the highest versus lowest counties.
- However, there were no clear patterns in the distribution of higher and lower disease or mortality rates across geographic regions of the state. In addition, counties with high (or low) rates of disease did not necessarily have high (or low) mortality rates from that disease.
- Therefore, general statements of geographic trends are not possible, and the findings for each county must be interpreted in its respective context.
- Interestingly, there were clearly different patterns by race in terms of which counties were highest and lowest in disease burden and mortality.

## PROGRAM AND POLICY IMPLICATIONS

- Regions of the state with high disease burden and/or high mortality from DOH, stroke or HTN should be targeted for educational and health care delivery programs to promote changes in modifiable risk factors like poor diet, sedentary lifestyle, and smoking and to help citizens manage chronic morbidity.
- The county-level rates for disease burden and mortality for black females and especially black males must be interpreted carefully, though, since many non-urban Tennessee counties have small black populations. Thus, age-adjusted rates must be interpreted in conjunction with the size of the black female and black male population in the respective county when making program decisions.
- Racial disparities in disease burden are influenced by differences in modifiable risk factors, as well as by differences in the prevalence of co-occurring conditions. In particular, diabetes mellitus and hypertension disproportionately affect black Tennesseans, both of which increase risk for developing heart disease and stroke and accompanying complications.
- Previous research also suggests that racial disparities in health outcomes may be partially eliminated through increasing regular physician visits for elderly black Tennesseans.<sup>20,21,22</sup>
- Racial disparities in heart disease and stroke outcomes are not only costly in terms of lives, but also the costs paid by families, businesses, and the state and federal governments. In particular, hospitalization costs for stroke and HTN are higher for blacks, regardless of gender. black females have higher hospitalization costs than white females for DOH.
- Part of the racial differences in inpatient costs, as well as mortality, may be due to the fact that blacks are more likely to be admitted to the hospital through the ER, when conditions have already become acute and more severe (as opposed to receiving elective procedures before conditions become severe). Another contributing factor is the fact that blacks tend to have longer stays when they are hospitalized, which is also an indicator of severity and complications.
- Overall, the increased use of expensive procedures to treat DOH and prevent first or recurring attacks has likely contributed to the rise in inflation-adjusted costs for DOH and stroke. However, most importantly, the increased use of treatment innovations has likely contributed to the declines in DOH and stroke mortality.
- Further improvements in DOH and stroke mortality may be achieved by promoting adherence to evidence-based disease management and treatment guidelines across the state.

## RESOURCE AND RESEARCH NEEDS

- Areas of Tennessee with low disease burden and/or mortality from DOH, stroke or HTN should be studied for “best practices” to help determine what policies, programs or infrastructure might effectively lower rates in other comparable areas.
- Research should investigate whether other factors help to explain racial disparities in disease burden and mortality, such as socioeconomic status, access to health care, and health literacy. Also, ER utilization and length of stay data suggest that blacks may be sicker when they arrive at hospitals, which would contribute to higher mortality rates. Research should also investigate possible cultural competence issues and racial biases in the health care system.
- Research should focus on the transfer of effective health education and behavior modification programs that target modifiable risk factors into community-based settings. In order for such programs to be culturally competent and successful, it is important for community members to participate actively as partners.
- More data resources need to be developed for surveillance of the disease burden of DOH and stroke and adherence to treatment guidelines. For example, the establishment of a stroke registry would be an invaluable public health surveillance tool. Furthermore, heart disease and stroke data are not currently available for the growing Hispanic population in Tennessee, which could be another disparity population.

# TECHNICAL NOTES

## DATA SOURCES

**Behavioral Risk Factor Surveillance System (BRFSS):** The BRFSS is an annual state-based, random-digit-dialed telephone survey of the U.S. non-institutionalized population, 18 years of age and older, which gathers self-reported data on prevalence of certain conditions and behavioral risk factors. The annual sample sizes range from approximately n=2,900 to n=3,300 for Tennessee.

**Hospital Discharge Data System (HDDS):** The HDDS (1997-2002) is an annual state-based compilation of data on patients discharged from all hospitals licensed by the Tennessee Department of Health. The HDDS does not include federal facilities (i.e., VA hospitals, etc.) and facilities licensed by the Tennessee Department of Mental Health and Developmental Disabilities. The database comes in two parts, the inpatient and outpatient files. The number of patients in the inpatient service files ranges yearly from N=453,958 to 521,032, while outpatient service files range from N=1,048,887 to 1,669,347 (note: these figures refer to the individual-level files).

**Medicare Billing Data (CMS):** Medicare billing data (1996-2002) were obtained from the Centers for Medicare and Medicaid Services (CMS). The CMS data contain all Medicare beneficiaries in Tennessee who utilized services under Part A or Part B coverage. Almost all Tennessee residents age 65 and older are enrolled in Part A; and Part B (optional coverage) enrollees comprise 97.5% of the age 65 and over population in Tennessee. The Enrollment Data Base (EDB) file contains date of birth, date of death, gender, and race for all enrolled beneficiaries. The number of beneficiaries aged 65 and over in each year ranges from N=688,369 to N=728,560 (note: these figures refer to the individual-level files).

**Death Statistical Summary System (DSSS):** The DSSS (1996-2002) is an annual state-based compilation of mortality data. The data set contains basic demographic data (i.e., sex, race, county of residence, zip code of residence, etc.). For 1996 through 1998, the data set has the cause of death coded in ICD-9 format. From 1999 to 2002, the cause of death is coded in ICD-10 format, which lists secondary causes of death. However, in this report only the underlying cause of death is analyzed. The analyses are limited to the records of Tennessee resident decedents. The number of deaths range from 51,367 in 1996 to 56,513 in 2002.

## MEASURES

**BRFSS:** The Tennessee BRFSS surveys for 1996 through 2002 were used to obtain annual data on overall prevalence of

heart disease and three modifiable risk factors for heart disease (obesity, inactive lifestyle, and current cigarette smoking) in the state. Data were not available on physical inactivity in 2002 because the BRFSS question on physical activity was changed to include all physical activity, including occupational, which is not comparable to previous years. Respondents who answered “don’t know/not sure” or refused to answer a question were excluded from the analyses for that question. The BRFSS variables were defined as follows:

**Heart Attack** (1996-2002): Participants who answered ‘yes’ to “Have you been told by a doctor that you have had a heart attack?”

**Stroke** (1996-2002): Participants who answered ‘yes’ to “Have you been told by a doctor that you have had a stroke?”

**High Blood Pressure** (1996-2002): Participants who answered ‘yes’ to “Have you been told by a doctor that you have high blood pressure?”

**Poor Dietary Habits** (1996, 1998, 2000-2002): Participants who consumed less than five servings of fruits and vegetables per day.

**High Blood Cholesterol** (1996-2002): Participants who answered ‘yes’ to “Have you been told by a doctor that you have high blood cholesterol?”

**Obesity** (1996-2002): Body Mass Index (BMI) greater than or equal to 30.

**Inactive lifestyle** (1996-2001): Individuals who are “physically inactive” (no leisure time activity reported during the last month).

**Current cigarette smoking** (1996-2002): Smoked at least 100 cigarettes in one’s lifetime and currently smoke every day or some days a week.

**Diabetes Mellitus** (1996-2002): Participants who answered ‘yes’ to “Have you been told by a doctor that you have diabetes mellitus?”

**Diagnosis & Procedure Codes:** The diagnosis and procedure codes used in this report are in accordance with the ICD-9-CM (HDDS diagnoses and procedures, CMS diagnoses), ICD-10 (DSSS), and Current Procedural Terminology (CPT; CMS procedures) coding systems. The diagnosis codes used in this report are as follows:

**Diseases of the Heart:** 390 - 398, 402, 404 - 429 (ICD-9-CM); I00 - I09, I11, I13, I20 - I51 (ICD-10)

**Coronary Heart Disease:** 410 - 414, 429.2 (ICD-9-CM); I20 - 125 (ICD-10)

**Myocardial Infarction:** 410 (ICD-9-CM); I21 - I22 (ICD-10)

**Congestive Heart Failure:** 428.0 (ICD-9-CM); I50.0 (ICD-10)

**Stroke:** 430 - 438 (ICD-9-CM); I60 - I69 (ICD-10)

**Transient Ischemic Attack:** 435 (ICD-9-CM); I65 (ICD-10)

**Hypertension:** 401 - 404 (ICD-9-CM); I10 - I13 (ICD-10)

**Diabetes Mellitus:** 250 (ICD-9-CM)

**High Cholesterol:** 272.0 (ICD-9-CM)

The procedure codes used in this report are as follows:

**Total Vascular & Cardiac Procedures:** 35 - 39 (ICD-9-CM); 33010 - 37606 (CPT)

**Total Open-Heart Surgery:** 35 [less 35.1-35.2, 35.4, 35.96, 35.99]; 36 [less 36.0 - 36.1]; 37.1, 37.3 - 37.5 (ICD-9-CM); 33300 - 33999 (CPT)

**Angioplasty & Stents:** 36.0 - 36.09 (ICD-9-CM); 35450 - 35476, 75968, 92982, 92984, 92997 - 92998 (CPT)

**Heart Valve Surgery:** 35.1 - 35.2, 35.99 (ICD-9-CM); 33400 - 33478 (CPT)

**Coronary Artery Bypass Graft (CABG):** 36.1 - 36.39 (ICD-9-CM); 33510 - 33545 (CPT)

**Heart Transplant:** 37.5 - 37.52 (ICD-9-CM); 33940 - 33945 (CPT)

**Cardiac Catheterization:** 37.2 - 37.23 (ICD-9-CM); 93526 - 93529, 93531, 93532 - 93533 (CPT)

**Race Classification:** “White” and “Black” refer to persons of both Hispanic and Non-Hispanic origin.

## ANALYTIC METHODS

**Age-Adjustment:** Age-adjusted rates per 100,000 population and age-adjusted per capita charges (AAPCC) were calculated for the HDDS, CMS, & DSSS data files, and they are adjusted to the 2000 U.S. standard population with a 10-year age interval (i.e., 11 age groups) using the direct method of standardization.

**Years of Potential Life Lost (YPLL):** YPLL is a measure of premature mortality (i.e., deaths before average life expectancy, age 75). YPLL rates (per 100,000 Tennessee population) were calculated using the DSSS files. YPLL was calculated by summing the difference between age at death (if

before age 75) and 75 for decedents whose underlying cause of death was DOH or stroke. These numbers were then divided by the respective population estimate in a given year and multiplied by 100,000 to obtain a rate.

**Cost Analyses:** With the exception of age-adjusted per capita charges (AAPCC), all cost analyses were performed at the discharge/billing level across all available years and are not age-adjusted. The total charges listed on a particular discharge/billing are considered attributable to DOH, stroke or HTN or a DOH-related procedure if the condition of interest was listed as primary diagnosis on the record. Cost trends are adjusted for inflation and the results are presented in 2002 dollars.

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