THE SYCAMORE INSTITUTE

THE ECONOMIC IMPACT OF CHRONIC DISEASE IN TENNESSEE

The Excess Cost of Diabetes, Hypertension, and Cardiovascular Disease to Tennessee Taxpayers and Businesses

November 15, 2017

**This study was commissioned by
The Governor's Foundation for Health and Wellness
and conducted by The Sycamore Institute.**

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KEY TAKEAWAYS

- Tennesseans' health and well-being has a complex and mutually influential relationship with our economic prosperity. Each one affects the other.
- Diabetes, hypertension, and cardiovascular disease affected 460,000 additional Tennesseans in 2015 due to state prevalence rates exceeding the national rates.
- This excess burden of these 3 diseases alone cost Tennessee nearly $5.3 billion in 2015 in direct medical care, lost productivity, and premature death.

Higher rates of chronic disease in Tennessee have a cost — including higher health care expenditures, lost productivity, decreased quality of life, and premature death. Many of these chronic diseases are considered preventable. To better understand how preventable chronic disease affects Tennessee, this study estimates the economic impact that achieving aspirational-but-realistic reductions in the prevalence of 3 chronic conditions might have on our state.

OVERVIEW OF CHRONIC DISEASE IN THE U.S. AND TENNESSEE

Chronic disease is the leading cause of disability, morbidity, and mortality in the United States. (1) (2) In 2014, chronic conditions accounted for 7 of the top 10 causes of death. (3) Many of these conditions are preventable but have become increasingly prevalent. For example, the share of American adults with hypertension rose from 29% in 2000 to 34% in 2014. The proportion with diabetes grew from 9% to 13%.[i] (4) Half of adults in the U.S. had at least one chronic condition in 2012, and 25% had two or more, according to one estimate. (5)

The impact of chronic disease is far-reaching. Chronic health conditions affect individuals' quality of life and put a burden on families, businesses, communities, and our health care system. This report examines the prevalence of chronic disease in Tennessee and estimates the economic impact of the state's higher-than-average rates of 3 specific chronic conditions: diabetes, hypertension, and cardiovascular disease (CVD).

CHRONIC CONDITION:

"Lasts a year or more and requires ongoing medical attention and/or limits activities of daily living."

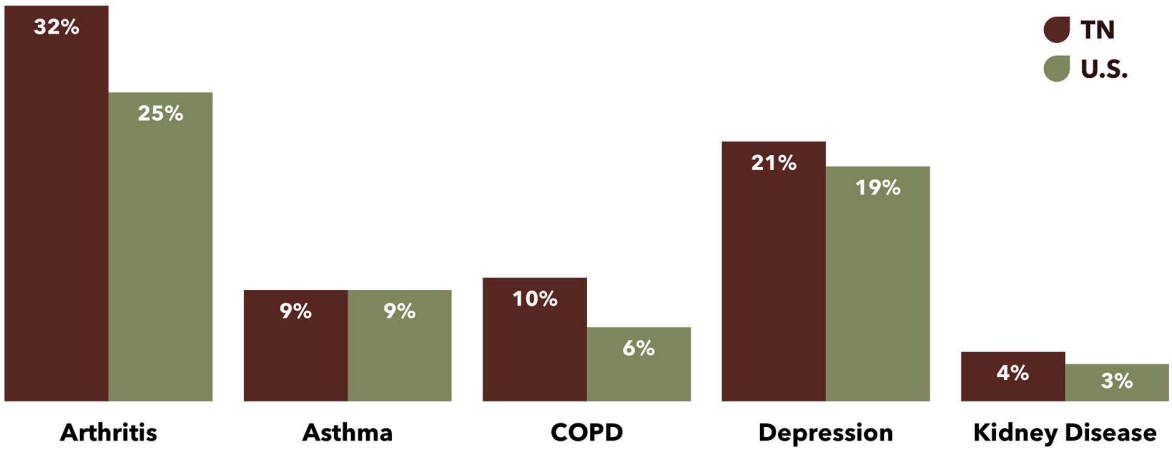
– U.S. Department of Health and Human Services. (50)

EXCESS DISEASE BURDEN

This study examines the costs of Tennessee's "excess disease burden," which is defined as the difference between the state's disease rate and the national rate.

Tennessee has higher rates of chronic disease and chronic disease-related mortality than the U.S. as a whole (**Figure 1** and **Table 1**). Compared to other parts of the country, southern states tend to have higher rates of chronic disease and poorer health outcomes. (6)

FIGURE 1. PREVALENCE OF SELECT CHRONIC HEALTH CONDITIONS TENNESSEE vs. U.S. (2015)



Note: Data are crude prevalence, not age-adjusted.
COPD = chronic obstructive pulmonary disease
Source: U.S. Centers for Disease Control and Prevention (7)

TABLE 1. LEADING CAUSES OF DEATH: TENNESSEE vs. U.S. (2015)

Cause of Death *(* indicates chronic condition)*	**Tennessee (per 100,000)**	**United States (per 100,000)**
*Heart diseases	207.3	168.5
*Cancers	180.5	158.5
*Chronic lower respiratory diseases	54.9	41.6
Accidents	56.4	43.2
*Stroke	46.0	37.6
*Alzheimer's disease	43.4	29.4
*Diabetes	23.4	21.3
Influenza and pneumonia	23.3	15.2
*Kidney diseases and conditions	14.4	13.4
Intentional self-harm (suicide)	15.7	13.3

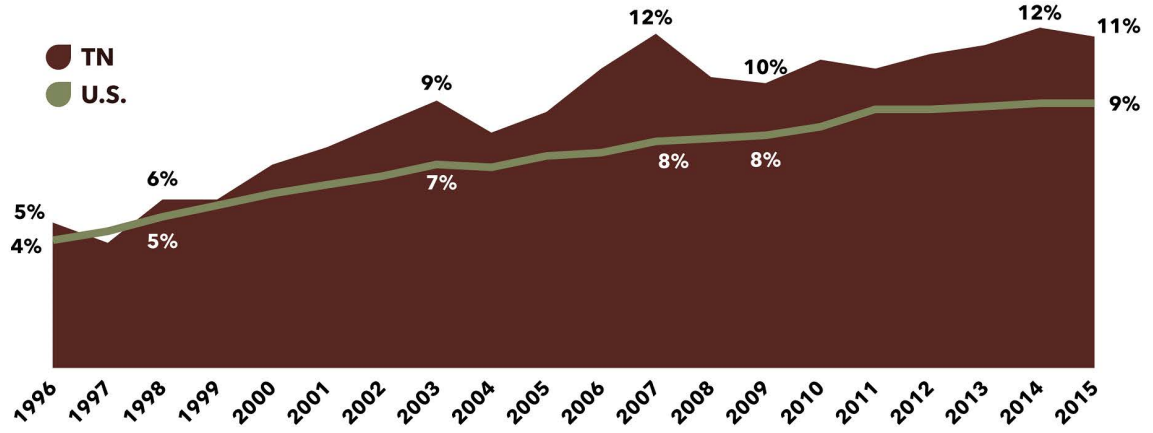
Note: Mortality rates are age-adjusted
Source: U.S. Centers for Disease Control and Prevention (8)

HISTORICAL CHRONIC DISEASE TRENDS IN TENNESSEE

Rates of key chronic diseases and obesity (a risk factor for many chronic conditions) have risen steadily for 3 decades. **Figure 2** and **Figure 3** show the increase in diabetes and obesity rates over the last 20 years — both in Tennessee and nationally.

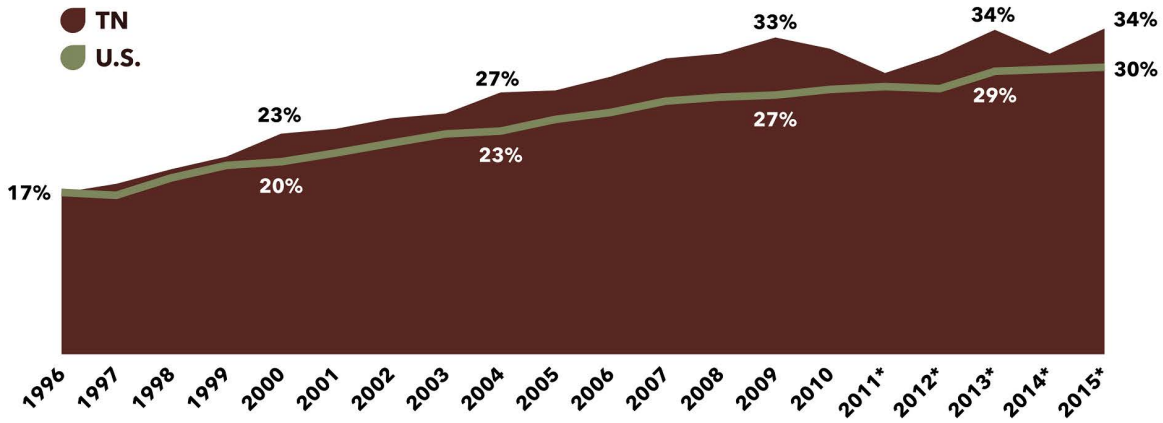
During this period, the rates of diabetes and obesity steadily increased, but those increases were more pronounced in Tennessee — exacerbating differences in the rates. Between 1996 and 2015, the U.S. rate of diabetes among adults increased by 104%. During the same period, Tennessee's rate increased by 128%. Similarly, the U.S. rate of obesity increased by 77%, while Tennessee's increased by just over 100%.

FIGURE 2. DIABETES PREVALENCE: TENNESSEE vs. U.S. (1996-2015)



Source: U.S. Centers for Disease Control and Prevention (55)

FIGURE 3. OBESITY PREVALENCE: TENNESSEE vs. U.S. (1996-2015)



*The survey methodology changed after 2010, which could affect comparisons of obesity rates reported before and after that year.
Source: U.S. Centers for Disease Control and Prevention (7)

RISK FACTORS FOR CHRONIC HEALTH CONDITIONS

Like all health outcomes, chronic diseases are influenced by the drivers of health (see Page 5). Three factors are primarily responsible for the elevated chronic disease burden in the United States (9):

1. **Health Behaviors** — Poor nutrition, a lack of physical activity, tobacco consumption, and excessive alcohol intake increase a person's risk of developing a chronic disease and related morbidity and mortality. (1)

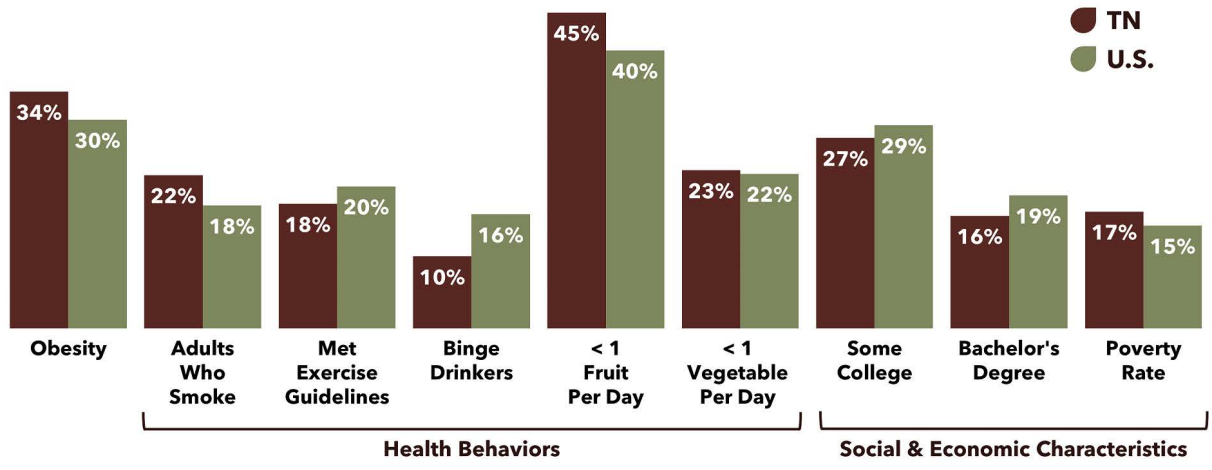
2. **Social and Economic Factors** — Populations and individuals with lower incomes, lower levels of education, and higher rates of poverty are at increased risk of developing a chronic disease and related morbidity and mortality. (10)

3. **Aging of the Population** — The number of Americans ages 65 years and over is expected to double by 2050. As people age, they are more likely to develop a chronic health condition. (11) (12) In 2015, 70% of Medicare beneficiaries ages 65 and over in Tennessee had two or more chronic health conditions. (13)

Many of the risk factors for chronic health conditions can be modified and influenced. As a result, many chronic conditions are considered preventable. (9)

In Tennessee, rates of key health behaviors and the social and economic characteristics that contribute to chronic health conditions are higher than the national rates (**Figure 4**). For example, Tennessee has higher rates of smoking, obesity, and poverty and lower rates of exercise and educational attainment than the nation as a whole. In some areas, however, Tennessee performs better — including higher rates of fruit and vegetable consumption and lower rates of binge drinking.

FIGURE 4. PREVALENCE OF RISK FACTORS FOR CHRONIC CONDITIONS TENNESSEE vs. U.S. (2015)

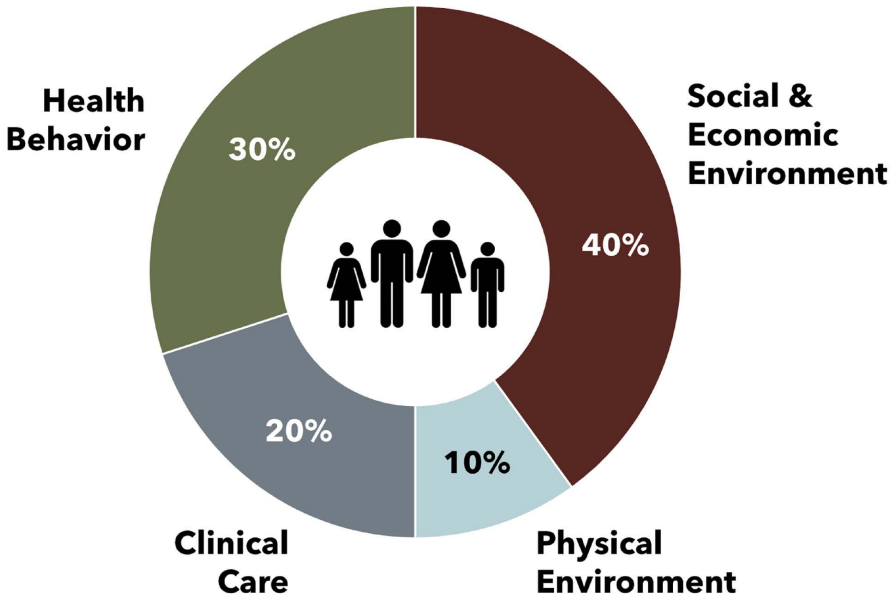


Source: U.S. Centers for Disease Control and Prevention (7)*, American Community Survey* (14)

WHAT INFLUENCES HEALTH?

Health means more than just health care. While access to clinical care is a contributing factor, health behaviors and the physical, social, and economic environments in which people live, work, and play are also major drivers of health (**Figure 5**). Relative to other drivers of health, the social and economic environment have the largest effect on individual and population health. (48)

FIGURE 5. THE DRIVERS OF HEALTH



Note: Excludes the role of genetics.

The factors that influence health are complex and interconnected. For example, individuals' health behaviors are a personal choice, but a person's environment can encourage or discourage certain behaviors. In the context of chronic conditions, healthy eating and exercise are two examples of how other drivers of health can influence health behaviors.

Unhealthy eating patterns and a lack of physical activity can both contribute to obesity. Environmental factors also influence risks for obesity – including access to healthy and affordable food, neighborhood exposure to fast food restaurants, access to recreational facilities and parks, and the relative costs of foods with greater nutritional value and fewer calories. (49) At the same time, transportation and infrastructure systems can impact the amount of time and the types of opportunities people have to engage in physical activity. (54)

See the Sycamore Institute's **Tennessee Health & Well-Being Index** for more information about the drivers of health in our state.

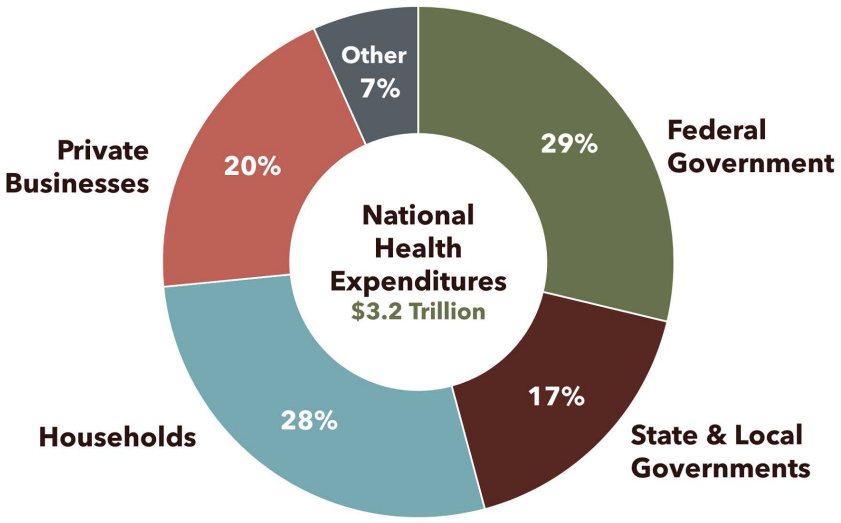
THE ECONOMIC BURDEN OF CHRONIC HEALTH CONDITIONS

Chronic health conditions affect our economy in a number of ways — ranging from increased medical spending by employers to harder-to-quantify impacts from premature death.

Health expenditures represent a growing share of the U.S. economy, and chronic health conditions account for the majority of this spending. In 2015, national health expenditures were $3.2 trillion, which was 18% of all U.S. spending. (15) Chronic diseases accounted for the majority of this spending. In 2010, for example, 86% of all health care spending was for individuals with one or more chronic health conditions. (16)

The health and well-being of individuals and populations has an economic and financial impact on governments, businesses, and individual households. The federal government, households, state and local governments, and private businesses all pay a portion of Americans' health care costs (**Figure 6)**. As a result, many stakeholders share the economic burden of chronic health conditions.

FIGURE 6. TOTAL NATIONAL HEALTH SPENDING BY PAYER (2015)



Note: Percentages do not equal 100 due to rounding. National Health Expenditures include Medicare, Medicaid, private health insurance, out-of-pocket spending, hospital services, physician and clinical services, and prescription drugs.
Source: U.S. Centers for Medicare & Medicaid Services (17)

The costs of chronic disease also include significant costs associated with lost productivity. Chronic conditions can cause people to miss work (i.e. absenteeism), be less productive while at work (i.e. presenteeism), or be unable to work entirely. (18) (19) (20) (21) (22)

In addition to medical costs and lost productivity, chronic conditions often cause premature death, which has harder-to-quantify impacts on society. People make a range of contributions to society —everything from spending time with their families to paying taxes. When individuals die prematurely, these contributions are cut short.

Figure 7 displays national estimates of the annual direct medical costs and costs associated with lost productivity for select chronic conditions in the United States.

THE HEALTH AND ECONOMIC IMPACT OF SMOKING

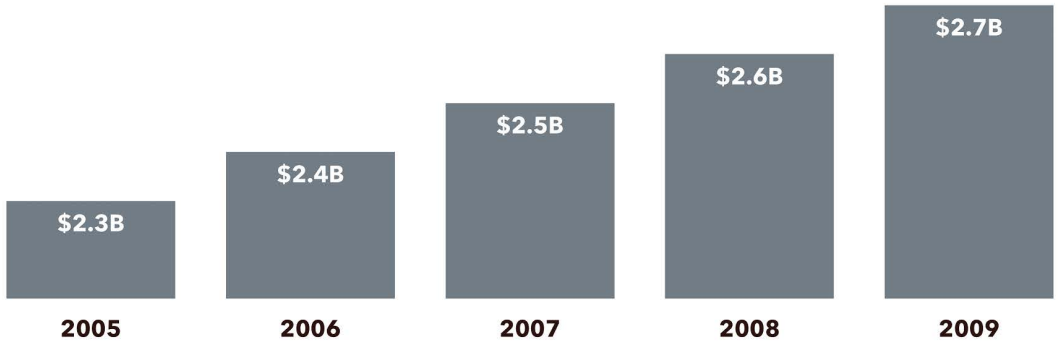
According to the most recent data available, smoking cost Tennessee an estimated $2.7 billion in health care spending in 2009 because of its link to a number of chronic conditions and premature death (**Figure 8**)**.** Nationally, smoking accounts for as much as 14% of all health care expenditures and costs more than $300 billion a year in direct medical costs ($170 billion) and lost productivity ($156 billion). (56) (58)

Smoking is the country's leading cause of preventable death. It is linked to poorer overall health and a number of chronic conditions — including cancer, stroke, cardiovascular disease (CVD), diabetes, and chronic obstructive pulmonary disease (COPD). (56)

Smoking is responsible for an estimated 480,000 deaths per year nationwide. (56) Smoking is linked to a 10-year shorter life expectancy. (57)

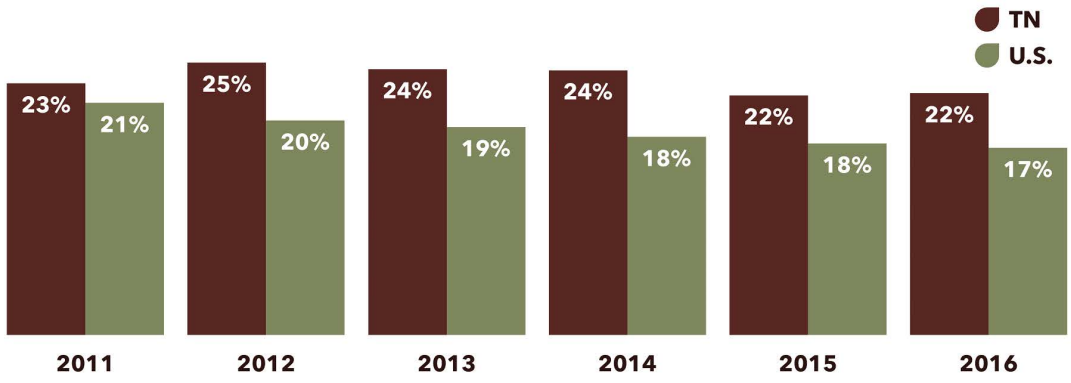
Tennessee has the 8th highest rate of smoking in the United States. In 2016, 22% of adult Tennesseans were current smokers compared to 17% of adults nationally (**Figure 9**).

FIGURE 8. ANNUAL SMOKING-RELATED HEALTH CARE COSTS IN TENNESSEE



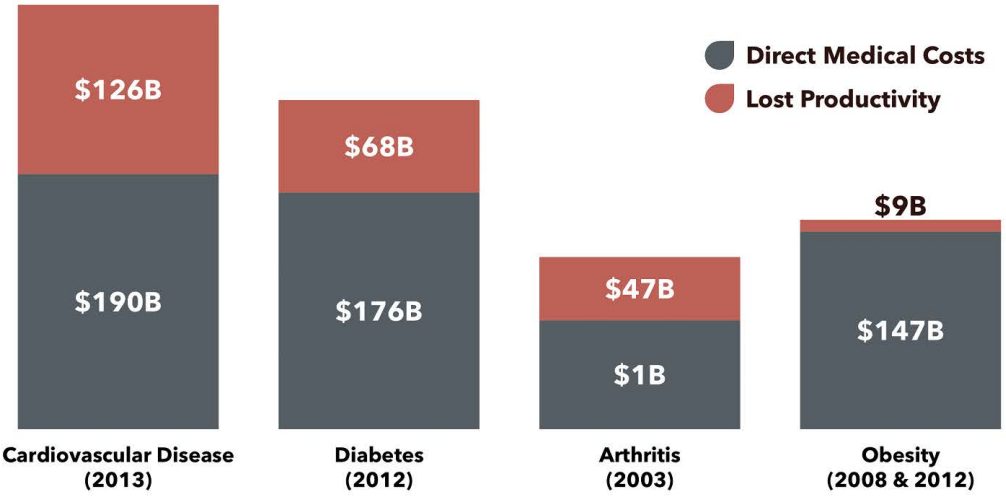
Source: U.S. Centers for Disease Control and Prevention (60)

FIGURE 9. SMOKING PREVALENCE: TENNESSEE vs. U.S. (2011-2016)



Source: U.S. Centers for Disease Control and Prevention (7)

FIGURE 7. ANNUAL AGGREGATE COSTS OF SELECT CHRONIC HEALTH CONDITIONS IN THE UNITED STATES



Source: Yelin et al. (23), American Diabetes Association (24), Andreyeva et al. (25), Finklestein et al. (26)

OUR FINDINGS

Tennessee's high rates of chronic disease have a significant economic impact on health care spending and worker productivity as well as the costs that come with premature death.

TENNESSEE'S EXCESS CHRONIC DISEASE BURDEN

In 2015, the difference between Tennessee's rates of diabetes, hypertension, and cardiovascular disease (CVD) and the U.S. rates meant these 3 chronic conditions alone affected 460,000 additional Tennesseans.

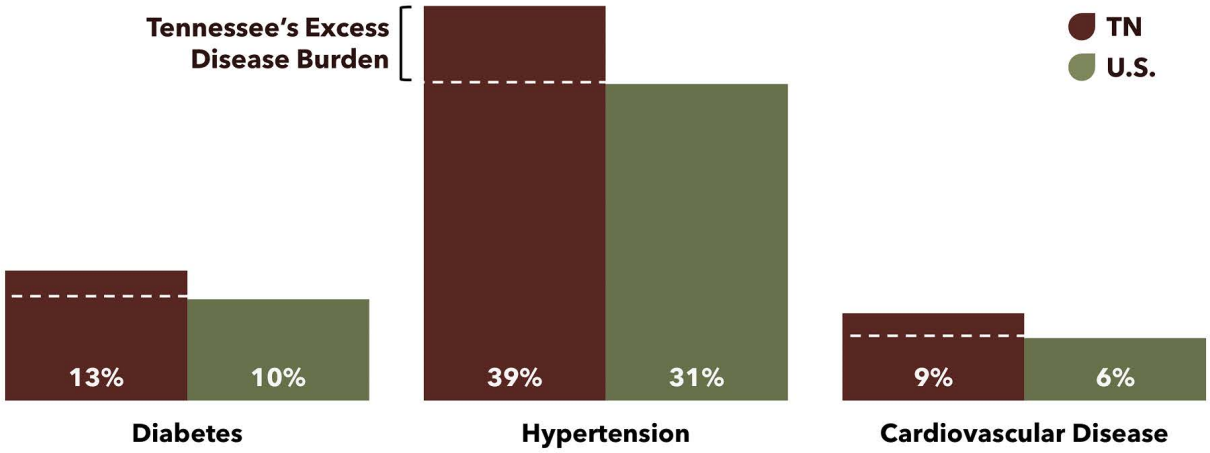
- The difference between Tennessee's 13% prevalence of diabetes and the national rate of 10% amounts to about 114,000 Tennesseans.
- The difference between Tennessee's 39% prevalence of hypertension and the national rate of 31% amounts to about 310,000 Tennesseans.
- The difference between Tennessee's 9% prevalence of CVD and the national rate of 6% amounts to about 37,000 Tennesseans with cardiovascular disease.

WHY "EXCESS" DISEASE BURDENS AND COSTS?

We opted to examine the costs associated with Tennessee's *excess* disease burden in order to produce estimates that are aspirational but realistic. Many of the existing studies in this area estimate the costs associated with a population's entire disease burden (e.g. **Figure 6)**. While these estimates are informative, eliminating any of the 3 conditions is not realistic — what *may* be, however, is bringing the state's chronic disease prevalence rates more in line with the national rate. Our estimates reflect the economic impact that accomplishing these aspirational-but-realistic reductions might have on our state.

Figure 10 shows Tennessee's prevalence of diabetes, hypertension, and CVD compared to the U.S. rates. The Appendix displays the results of our chronic disease-related deaths analysis used for the societal cost estimates.

FIGURE 10. CHRONIC DISEASE PREVALENCE TENNESSEE vs. U.S. (2015)



Source: U.S. Centers for Disease Control and Prevention (7)

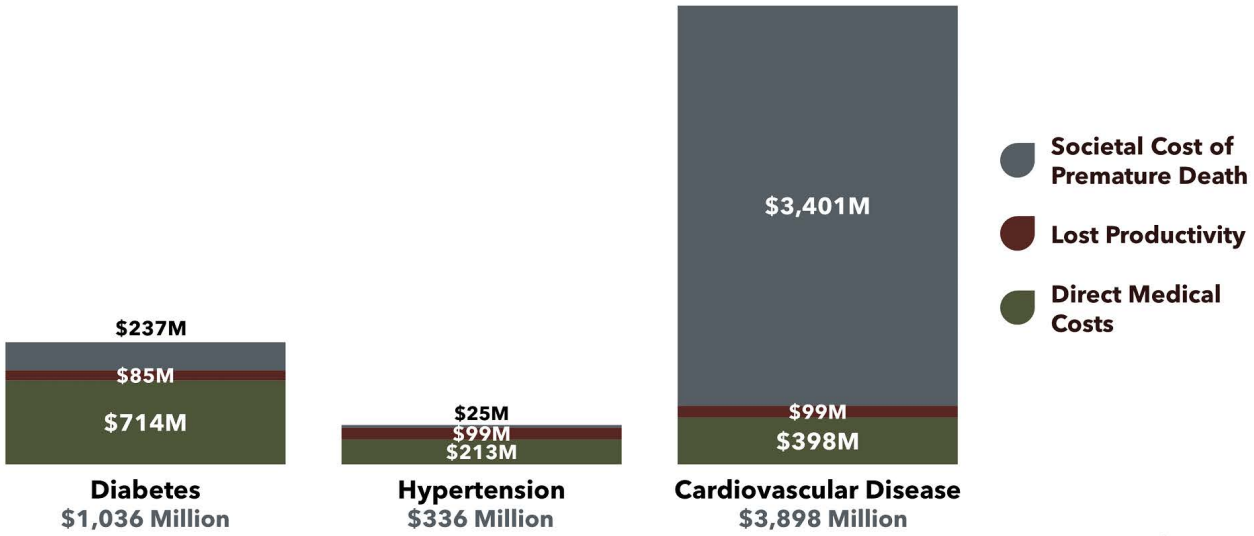
OUR APPROACH

Read more about the analytic approach used in this study — including limitations, assumptions, and technical definitions as well as additional high and low estimates — beginning on page 16.

OVERVIEW OF EXCESS COST ESTIMATES

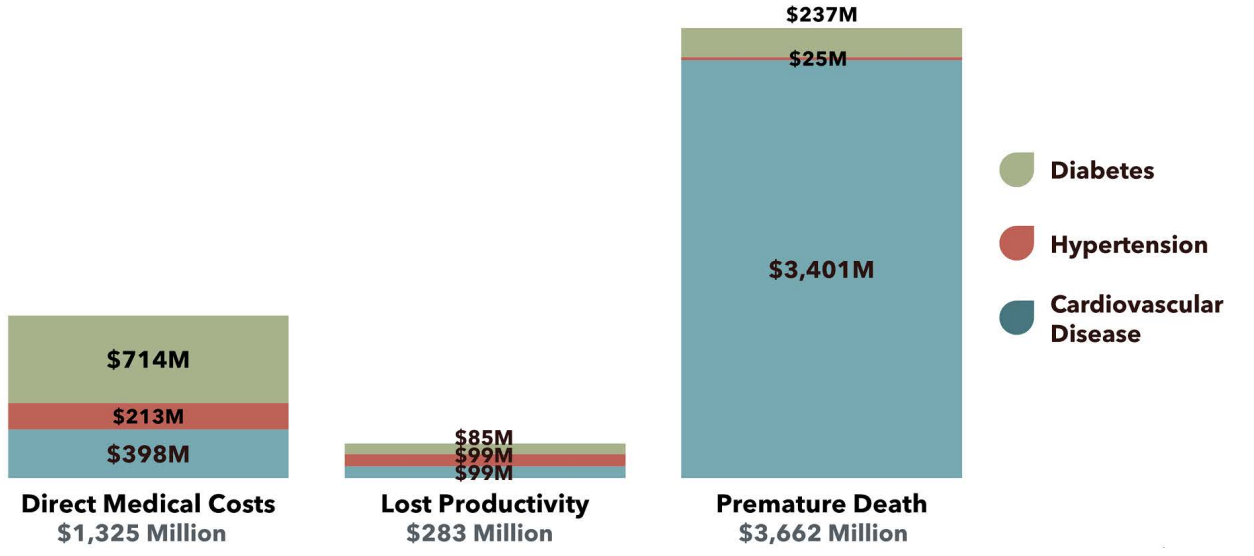
In 2015, the prevalence of diabetes, hypertension, and cardiovascular disease (CVD) in Tennessee in excess of the national rates cost Tennessee nearly $5.3 billion in excess costs. Broken down by chronic condition, excess rates of diabetes cost $1.0 billion, hypertension $336 million, and CVD $3.9 billion (**Figure 11**). By cost domain, direct medical costs were $1.3 billion, lost productivity $283 million, and premature death $3.7 billion **(Figure 12**). The full results of our analysis (including our high and low estimates) can be found in the Appendix.

FIGURE 11. ANNUAL ECONOMIC IMPACT OF EXCESS CHRONIC DISEASE IN TENNESSEE BY CONDITION (2015)



Numbers may not add up to totals due to rounding. Source: The Sycamore Institute's analysis

FIGURE 12. ANNUAL ECONOMIC IMPACT OF EXCESS CHRONIC DISEASE IN TENNESSEE BY COST DOMAIN (2015)



Numbers may not add up to totals due to rounding. Source: The Sycamore Institute's analysis

EXCESS DIRECT MEDICAL COSTS

In 2015, the estimated direct medical costs for Tennessee's excess prevalence of diabetes, hypertension, and cardiovascular disease (CVD) was roughly $1.3 billion (**Figure 13**).

Excess Direct Medical Costs by Chronic Condition

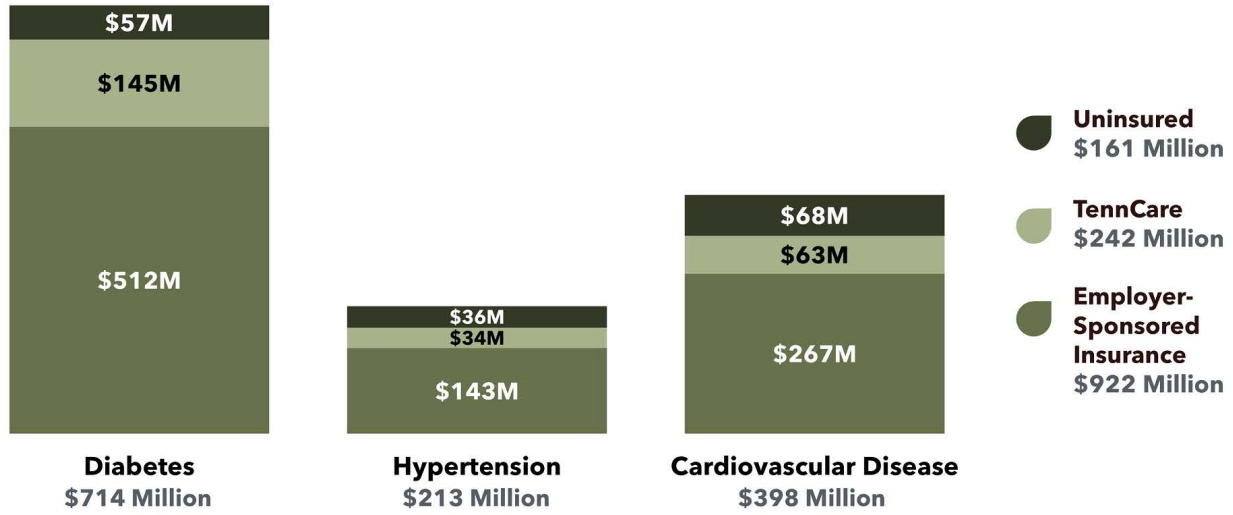
- Diabetes: $714 million, or 54% of the total
- Hypertension: $213 million, or 16% of the total
- CVD: $398 million, or 30% of the total

Excess Direct Medical Costs by Coverage Type

- Data for 2015 indicated that an estimated 2.4 million Tennesseans ages 18-64 received coverage through their employer, 558,000 were enrolled in TennCare, and 601,000 were uninsured. (14)
- Employer-Sponsored Insurance: $922 million, or 70% of the total
- TennCare: $242 million, or 18% of the total
- Uninsured: $161 million, or 12% of the total

The full results of our analysis, including the range of estimates by disease and type of health insurance coverage, can be found in the Appendix.

FIGURE 13. DIRECT MEDICAL COSTS DUE TO EXCESS CHRONIC DISEASE IN TENNESSEE (2015)



Numbers may not add up to totals due to rounding.
Source: The Sycamore Institute's analysis

EXCESS LOST PRODUCTIVITY COSTS

In 2015, the estimated lost productivity cost to Tennessee employers and workers for Tennessee's excess prevalence of diabetes, hypertension, and cardiovascular disease (CVD) was roughly $283 million (**Figure 14**). An estimated 2.5 million Tennesseans were employed full-time that year. (27)

Excess Lost Productivity Costs by Chronic Condition

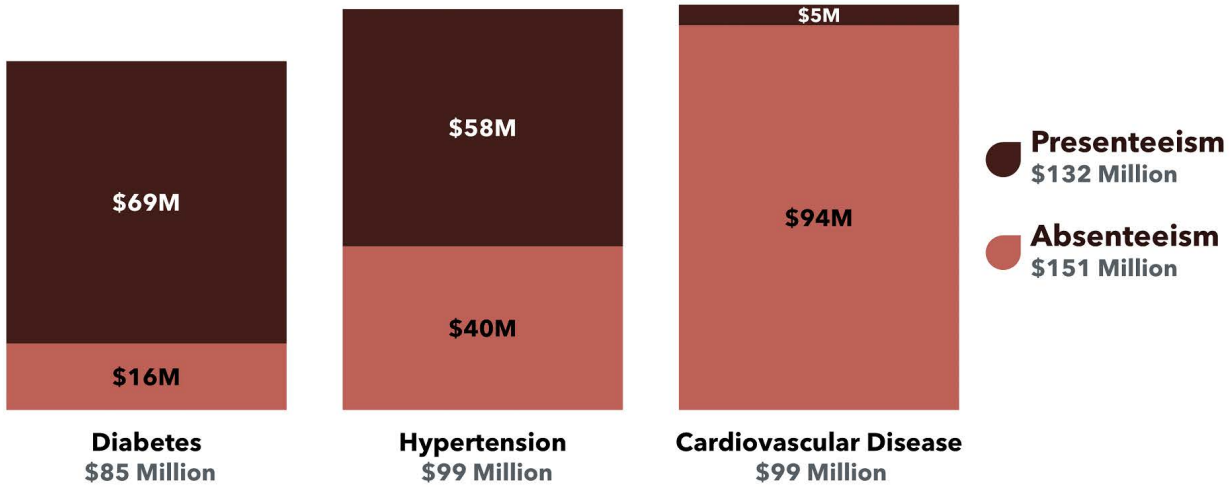
- Diabetes: $85 million, or 30% of the total
- Hypertension: $99 million, or 35% of the total
- CVD: $99 million, or 35% of the total

Excess Lost Productivity Costs by Component of Lost Productivity

- Absenteeism (i.e. missing work due to illness): $151 million, or 53% of the total
- Presenteeism (i.e. lower on-the-job productivity due to illness): $132 million, or 47% of the total
- For diabetes and hypertension, presenteeism was a more costly component of lost productivity. Absenteeism was a more costly component for cardiovascular disease.

The full results of our analysis, including the range of estimates by disease, can be found in the Appendix.

FIGURE 14. COSTS OF LOST PRODUCTIVITY DUE TO EXCESS CHRONIC DISEASE IN TENNESSEE (2015)



Numbers may not add up to totals due to rounding.
Source: The Sycamore Institute's analysis

EXCESS SOCIETAL COSTS FROM PREMATURE DEATH

In 2015, the estimated societal costs for Tennessee's excess premature mortality attributable to diabetes, hypertension, and cardiovascular disease (CVD) was roughly $3.7 billion (**Figure 15**).

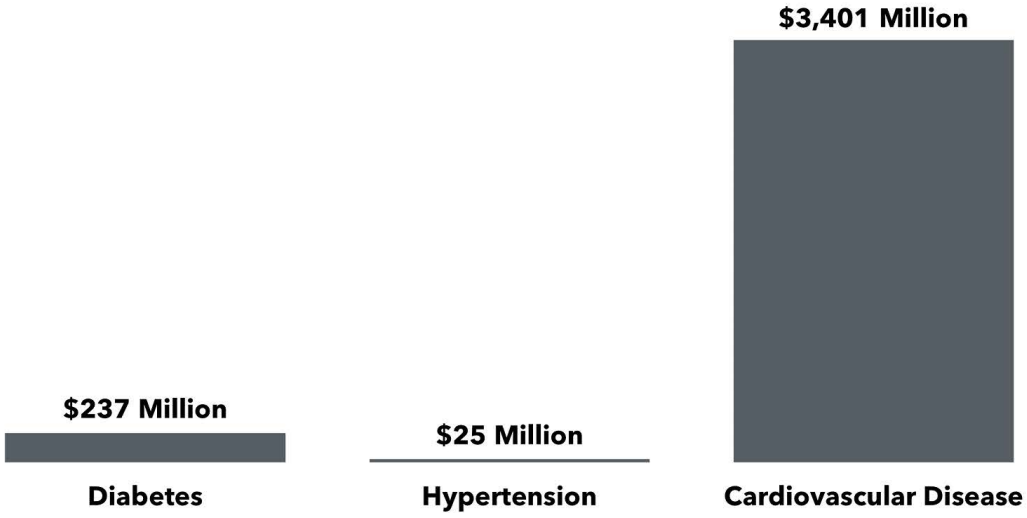
Excess Societal Costs by Chronic Condition

- Diabetes: $237 million, or 6% of the total
- Hypertension: $25 million, or 1% of the total
- CVD: $3.4 billion, or 93% of the total

Placing a monetary value on lost life is a difficult and inherently incomplete consideration of individual worth. These estimates, however limited, help quantify the loss society incurs due to premature death.

The full results of our analysis, including a display of mortality rates by age range in Tennessee and the U.S. and the range of estimates by disease, can be found in the Appendix.

FIGURE 15. SOCIETAL COSTS OF PREMATURE DEATH DUE TO EXCESS CHRONIC DISEASE IN TENNESSEE (2015)



Source: The Sycamore Institute's analysis

DISCUSSION

Tennesseans' health and our state's economy have a complex and mutually influential relationship. Economic growth and prosperity are among the many factors that influence Tennesseans' health and well-being. The estimates produced in this study begin to quantify and shed light on one important way that Tennesseans' health and well-being also affect our economy.

IMPLICATIONS FOR TAXPAYERS IN TENNESSEE

Tennessee's increased burden of chronic disease results in higher health care costs in taxpayer-funded programs like TennCare, our state's Medicaid program. Health care costs are rising faster than inflation and state revenues. As health care costs increase, states are spending an increasing share of their budgets on health care. (28) TennCare has constrained its per-enrollee cost growth better than most other states' Medicaid programs. (29) However, the state's higher rates of chronic disease necessarily mean that Tennessee is spending more on treating chronic conditions than it would if disease rates were lower.

Improving the health of Tennesseans could free up limited state taxpayer resources for other policy priorities like increased spending in other areas or state tax reductions. Based on this study's estimates, if Tennessee's rates of diabetes, hypertension, and CVD were more in line with the national rate, total state and federal funding for TennCare could be reduced by $240 million annually. (The estimated cost savings do not account for the cost of any state-funded programs and interventions aimed at reducing chronic disease rates.) For context, $240 million is roughly equivalent to the *combined* annual budgets for the Department of Economic and Community Development and the Legislature. In addition, the impact on the uninsured could potentially reduce taxpayer spending for uncompensated care.

IMPLICATIONS FOR TENNESSEE'S BUSINESSES AND WORKFORCE

Tennessee's higher-than-average burden of chronic disease raises employers' costs for health care and productivity loss. Based on this study's estimates, if Tennessee's rates of diabetes, hypertension, and CVD were more in line with the national rate, employers in the state could reduce their health care costs by $920 million annually and increase their full-time employees' productivity by over $280 million annually.

Improving Tennesseans' health could save employers money and increase their productivity, which could lead to higher wages and greater economic output for the state. The key components of these improvements are slowing the growth of health care costs and increasing worker productivity — both of which may have positive spillover effects for businesses and workers.

Evidence suggests that the rising cost of employer-sponsored health insurance has slowed wage growth and increased employees' out-of-pocket health spending. Increasing rates of chronic disease have contributed to the growth in health care costs over the last several decades. (1) As employers spend an increasing amount on health insurance for their employees, many look for strategies to help control these costs. For example, businesses may limit wage increases, offer less comprehensive health benefits, and increase premiums and/or cost-sharing requirements. (30) (31) Available data show that Tennessee workers' wages have increased at a much slower rate than deductibles and health care costs. (32)

The connection between peoples' health and their productivity is well established. Healthier people are more likely to work or actively seek work than people in poor health. (18) (19) (20) At the same time, healthier workers are more productive and miss fewer days of work for health reasons. (21) (22) This means that Tennessee's relatively higher rates of chronic disease may diminish our workforce's productivity compared to other states.

Research suggests that improving the health of Tennessee's workers could also increase the productivity of their fellow co-workers, generating even larger economic gains. The effects of lost productivity are not limited to the specific job that an employee performs. Absenteeism among employees with chronic health conditions can negatively impact their co-workers. When co-workers are absent, other employees may be more stressed or overwhelmed due to an increased workload. (33) Employers may also use time and resources to hire temporary workers or train another worker to complete new tasks. With many jobs, employees are not interchangeable. Employees often possess job-specific knowledge and other intangible qualities that have been developed over time and are not easily transferrable. (35) Our estimates of excess lost productivity costs do not include these spillover effects and may underestimate the costs of loss productivity.

PARTING WORDS

This study serves as a starting point for quantifying the economic impact of Tennessee's high rates of chronic disease — many of which are preventable. Because of the complex set of factors that influence health, our state's recent economic growth has the potential to improve the health of Tennesseans. At the same time, this study shows that the health and well-being of Tennesseans can impact our ability to make continued strides in growing our economy and increasing prosperity.

OUR APPROACH

Higher rates of chronic disease in Tennessee come at a cost — increased health care expenditures, lost productivity, decreased quality of life, and premature death. To better understand the economic impact of chronic disease in Tennessee, we estimated the excess costs associated with the state's rates of diabetes, hypertension, and cardiovascular disease being higher than the national rate.

METHODOLOGY

This study estimates the excess costs associated with the prevalence of 3 chronic diseases in Tennessee compared to 3 aspirational benchmarks. Costs were calculated across 3 domains.

Selecting the Chronic Conditions: The 3 chronic conditions studied in this report include:

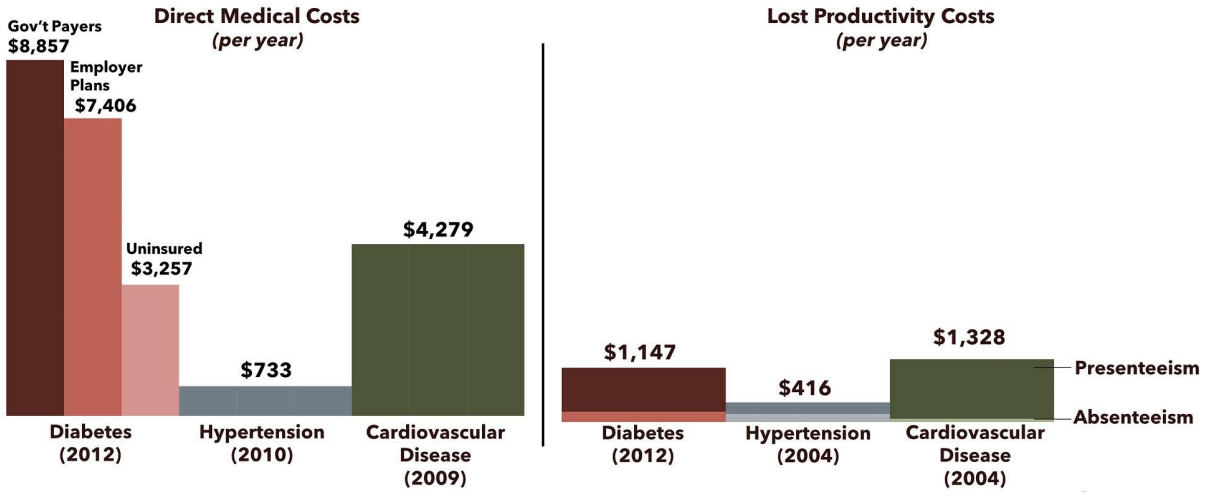
1. **Diabetes**: Tennessee has the 9th highest rate of diabetes in the country. (7)
2. **Hypertension**: Tennessee has the 7th highest rate of hypertension in the country. (7)
3. **Cardiovascular Disease**: Tennessee has the 10th highest rate of CVD in the country. (7)

These 3 chronic conditions were chosen because Tennessee's prevalence rate for each is among the 10 highest for all states, and the necessary data were available for all 3 conditions to produce estimates across all cost domains.

Defining Cost Domains: Our analysis included 3 types of costs:

1. **Direct Medical Costs** are associated with services provided by medical providers (i.e. hospitals, physicians, etc.). (34) These costs include inpatient and outpatient hospital care, doctor's office visits, prescribed medications, home health, and emergency room visits. In our analysis, the costs only include those paid for by the "payer," which is generally the health insurance company. The estimates do not include any out-of-pocket costs paid directly by patients (discussed further in the Limitations and Assumptions section). The direct medical cost estimates in this study are broken down into 3 insurance coverage categories:
    a. **TennCare Costs** estimate the excess medical costs borne by taxpayers.
    b. **Employer-Provided Insurance Costs** estimate the excess medical costs borne by employers.
    c. **Costs for the Uninsured** estimate the excess medical costs that, based on available information about uncompensated care, are at least partially covered by taxpayers and individuals on private health insurance. (35) (36) (37)
2. **Lost Productivity Costs** are borne by both employers and workers. These estimated costs are associated with both absenteeism and presenteeism. Absenteeism estimates the excess productivity costs associated with missed workdays — which includes both lost wages to employees and wages paid by employers with no work garnered. Presenteeism estimates the costs to employers from lower on-the-job productivity.
3. **Societal Costs** estimate the costs of premature death. These costs quantify individual contributions (e.g. taxes and economic contributions, time with children and family, involvement in communities, etc.) to society that may be lost due to premature death.

FIGURE 16. UNDERLYING PER PERSON COST ESTIMATES USED FOR TENNESSEE-SPECIFIC ESTIMATES



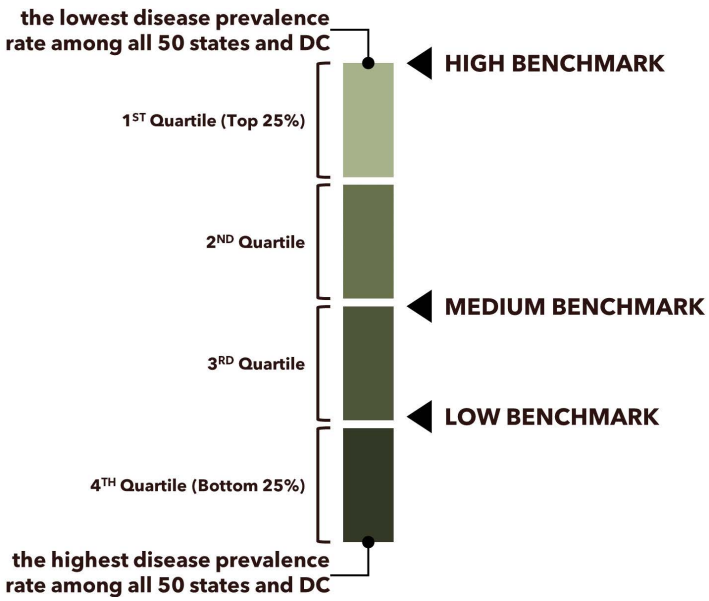
Sources: American Diabetes Association (24), Goetzel et al. (38), Uberoi and Cohen (39), Davis (40)

Excess direct medical and lost productivity cost estimates are based on disease-specific per-person estimates obtained from prior research studies (**Figure 16**). Direct medical cost estimates by payer type were available for diabetes but not for the other chronic conditions studied. The methodology for estimating excess societal costs is discussed below.

Identifying Benchmarks and Defining Excess Disease Burden: In this study, excess costs are defined as the estimated cost associated with the difference between Tennessee's disease prevalence rate and a benchmark prevalence rate. We identified statewide population-level differences in the prevalence of diabetes, hypertension, and cardiovascular disease between Tennessee and a **high, medium, and low benchmark** (**Figure 17**).

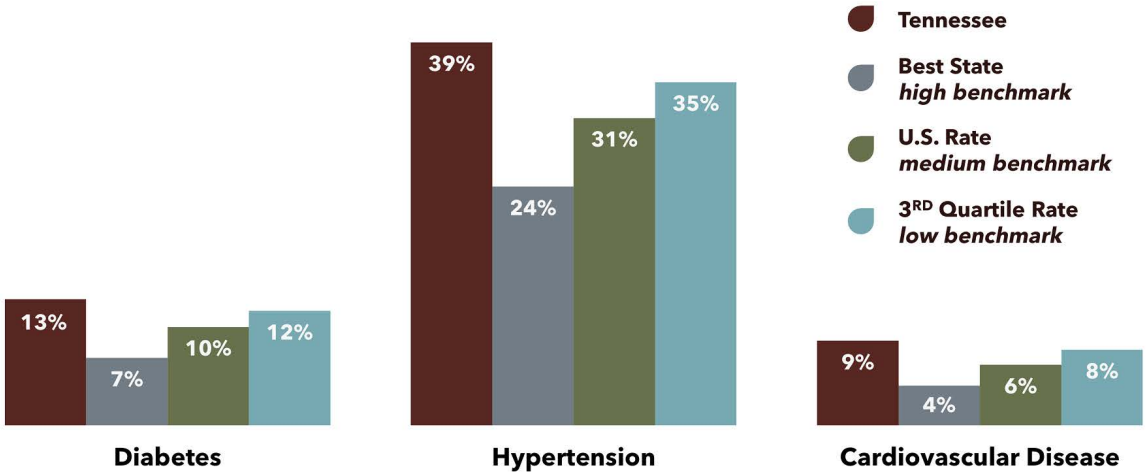
1. The **high benchmark** is the disease prevalence rate of the state with the lowest prevalence compared to all other states.
2. The **medium benchmark** is the national rate, which is the median state prevalence.
3. The **low benchmark** is the disease prevalence rate at the bottom of the 3rd quartile range (i.e. the bottom 25% of the range between the lowest and highest disease prevalence rates).

FIGURE 17. DISEASE PREVALENCE BENCHMARKS FOR COST ESTIMATES



The state's "excess disease burden" is defined as the difference between Tennessee's prevalence and each benchmark prevalence rate. **Figure 18** shows Tennessee's prevalence of diabetes, hypertension, and CVD compared to 3 benchmarks.

FIGURE 18. CHRONIC DISEASE PREVALENCE TENNESSEE vs. BENCHMARKS (2015)



Source: U.S. Centers for Disease Control and Prevention (7)

The discussion of our findings focuses on the excess disease burden associated with the medium benchmark. The study's findings for all the benchmarks are included in the Appendix.

The low benchmark reflects lifting Tennessee's chronic disease prevalence rates out of the bottom 25% of states. The medium benchmark represents bringing the state's rates more in line with the national rate, and the high benchmark reflects improving Tennessee's rates to that of the states with the lowest rates.

For the excess societal cost estimates, we used a different methodology (discussed below) for producing high, medium, and low estimates.

Defining and Estimating Excess Costs: "Excess costs" are defined as the costs associated with the state's excess disease burden across the 3 cost domains for each of the 3 chronic diseases studied. These estimates are based on the per-person cost estimates summarized in **Figure 16**.

Estimating Excess Direct Medical Costs: To calculate excess direct medical costs, we applied per-person treatment cost estimates to an estimate of the excess number of Tennesseans with each of the 3 conditions within each insurance coverage category. To do this, we first applied Tennessee's excess disease burden for diabetes, hypertension, and cardiovascular disease to estimates of the number of Tennesseans that have employer-sponsored coverage, TennCare, and who are uninsured. This produced an estimate of the excess number of individuals with each of the 3 conditions within each insurance coverage category. We then applied estimates of the total direct medical costs for treating an individual with diabetes, hypertension, or CVD to the estimate of the excess number of individuals with each of the conditions within each of the insurance coverage categories. For the direct medical costs associated with diabetes, the cost estimates were adjusted based on insurance category.

This level of detail was not available for the medical cost estimates for hypertension and cardiovascular disease, so the same cost estimate was used across all 3 insurance coverage categories.

***Estimating Excess Lost Productivity Costs*:** To calculate excess lost productivity costs, we applied per-person estimates of absenteeism and presenteeism to an estimate of the excess number of employed Tennesseans with each of the 3 conditions. We applied the state's excess disease burdens for diabetes, hypertension, and CVD prevalence rates to population estimates of the number of Tennesseans ages 18-64 that work more than 35 hours per week. This provided us with the excess number of Tennesseans with diabetes, hypertension, and CVD among the full-time working population in Tennessee. We then applied this estimate to the disease-specific costs of presenteeism and absenteeism from the literature to determine the cost of lost productivity among Tennesseans working full-time.

***Estimating Excess Societal Costs Due to Premature Death*:** To calculate excess societal costs, we first compared Tennessee's rates to national rates of premature death attributable to diabetes, hypertension, and CVD. We used these comparisons along with state population estimates for 2015 to calculate the number of excess deaths in Tennessee for each of the 3 chronic conditions within nine age groups. Then, we estimated the number of years of potential life lost (YPLL) associated with the excess deaths in each age group. The societal costs were estimated using a commonly-used economic measure known as a quality-adjusted life year (QALY — see below) and a high, medium, and low economic estimate ($50,000, $100,000, and $200,000) of the societal value of each QALY. We then applied the QALYs and QALY economic estimates to the number of YPLL associated with the excess deaths in each age group. This produced an aggregate estimate of the societal costs associated with Tennessee's higher-than-average premature mortality rates attributable to the 3 chronic conditions. See the Appendix for more technical methodological details about the societal cost estimates.

WHAT *IS* A QALY?

A quality adjusted life-year (or QALY — pronounced kwa-LEE) is a tool used in health economics to evaluate the cost-effectiveness of treatments and interventions that influence health. The QALY concept essentially creates an index that accounts for both life expectancy *and* the quality of life. One QALY is equal to one year of perfect health; while death is equal to zero QALYs. The index is then assigned a corresponding economic estimate for the value of one QALY. (52) (53)

One source aptly summarizes the underlying concept: "The basic construct is that individuals move through health states over time and that each health state has a value attached to it." (52)

Internationally, QALYs are commonly used as a tool to help determine individuals' and society's willingness to pay for improvements in health and, ultimately, to allocate health care resources. (53) When used in this way, QALYs can be controversial and raise ethical questions. To be sure, the measurement is not perfect (52). However, **QALYs provide an opportunity to estimate an economic value for the individual and societal impact of improving health — value that is not easily captured in measures of direct health costs or even productivity.**

***Indexing the Excess Cost Estimates*:** We adjusted all costs obtained from the literature to 2015 nominal dollars to account for inflation.

Data Sources: We obtained data about health insurance coverage in 2015 from the American Community Survey (14) ; the number of adults (18-64 years old) that worked full-time in 2015 from the Current Population Survey Annual Social and Economic Supplement (27); 2015 mortality rates from the Centers for Disease Control and Prevention's (CDC) National Center for Health Statistics (8); 2015 diabetes, hypertension, and cardiovascular disease prevalence rates from CDC's Behavioral Risk Factor Surveillance System (BRFSS) (25); absenteeism and presenteeism costs from previously-published literature (24) (38); direct medical costs from the previously-published literature (24) (39) (40); quality adjusted life years from the peer-reviewed literature (41); and price indexes from the U.S. Bureau of Economic Analysis. (42)

LIMITATIONS AND ASSUMPTIONS

Our analysis has several limitations and assumptions. First, our analysis relies on population-wide disease prevalence estimates. It does not adjust for differences in disease prevalence rates based on age, gender, race, ethnicity, geography, or socioeconomic characteristics. For example, older adults, people of color, and low-income populations have higher rates of chronic disease. (43) This level of detail was beyond the scope of the current analysis.

TennCare and Tennessee employer-sponsored insurance claims data were not available. This presents several limitations:

- The analysis does not reflect the actual costs of treating diabetes, hypertension, and CVD in Tennessee or for specific payers in the state. Our analysis instead relies on available disease-specific per person medical cost estimates from national literature.
- With one exception, the analysis does not adjust national cost estimates for any differences in medical costs across payers. National estimates allowed for a payer adjustment for diabetes, but the analysis assumes that payers are spending similar amounts of money to treat hypertension and CVD.
- The analysis does not adjust national cost estimates for any differences based on patient characteristics in Tennessee. For example, older adults have higher medical costs compared to younger adults. (44)

Our analysis only accounts for "direct" medical costs (which are those generally paid for by insurance companies and other "payers") due to limitations in the data sources used by the studies we relied on for disease-specific per-person medical cost estimates (**Figure 13**). The underlying per-person cost estimates and our analysis, therefore, do not include out-of-pocket costs the patient pays for deductibles, copayments, coinsurance, or premiums. Because of this exclusion, our analysis of direct medical costs likely understates total excess medical costs — particularly for individuals covered by employer-sponsored insurance, where enrollees must often pay for a portion of their medical costs out-of-pocket to meet deductibles and other cost-sharing requirements.

The underlying health-related productivity loss estimates used in this study were based on wages for full-time workers. As a result, the study only estimates lost productivity costs for adults who worked full-time and does not include estimates of health-related productivity losses for part-time workers. Our study also does not attempt to quantify any spillover effects that each individual's productivity may have on the productivity of their colleagues (discussed further in the Discussion section).

Finally, the study does not adjust for differences in employment patterns and behaviors across populations and employment sectors. For example, research suggests that women, low-income workers, and people aged 25-34 are more likely to have presenteeism behavior compared to other groups of people. (45) To our knowledge, there is not detailed data available at the state or national level for each of these demographic groups that would have allowed us to subset or adjust our analysis by these demographic groups.

It may be possible to get at some of these important population- and payer-level differences in future analyses — depending on the availability of data. In the meantime, this study provides an important first step for beginning to understand the costs associated with Tennessee's high rates of chronic disease and chronic disease-related mortality.

DATA NOTE

[i] Prevalence rates reported throughout the document may be slightly inconsistent as a result of their underlying data sources. We primarily used 2015 data from the U.S. Centers for Disease Control and Prevention's (CDC) Behavioral Risk Factor Surveillance System (BRFSS) for the core analysis. However, in order to provide additional contextual information about trends nationally and in Tennessee, we had to rely on data obtained from other sources like the National Health and Nutrition Examination Survey (NHANES) and the National Health Interview Survey (NHIS), which have additional years of historical data that were not available from the BRFSS. Because different surveys use slightly different methods, they sometimes produce slightly different state and national prevalence rates.

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APPENDIX

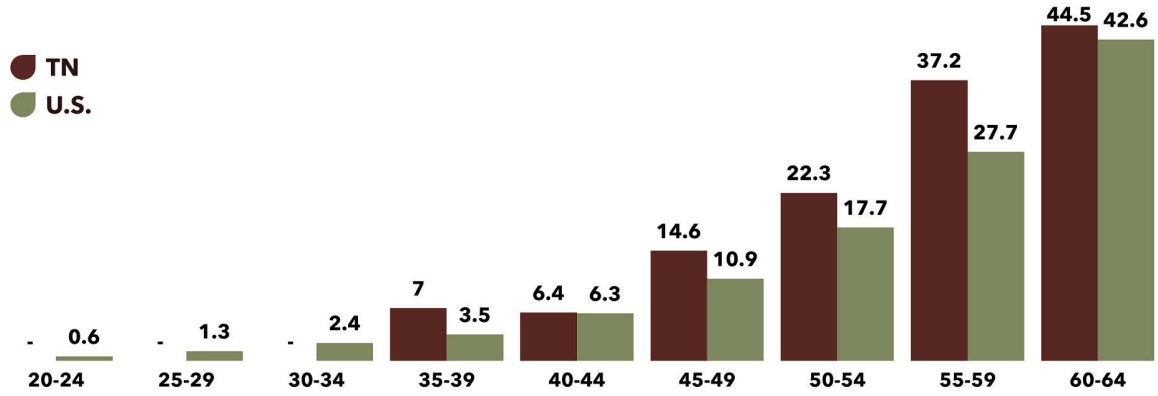
ADDITIONAL INFORMATION ABOUT THE EXCESS SOCIETAL COST ESTIMATES

Our methodology for estimating excess societal costs were based on the methodology used in the following study:

> **Turner, Ani, LaVeist, Thomas, Gaskin, Darrell, and Munoz-Rumsey, Erica.** Economic Impacts of Health Disparities in Texas. *Espiscopal Health Foundation and Methodist Healthcare Ministries of South Texas*. [Online] December 7, 2016. http://www.episcopalhealth.org/files/7314/8106/4634/Economic_Impact_Report_EHF_and_MHM_Logos_FINAL.pdf

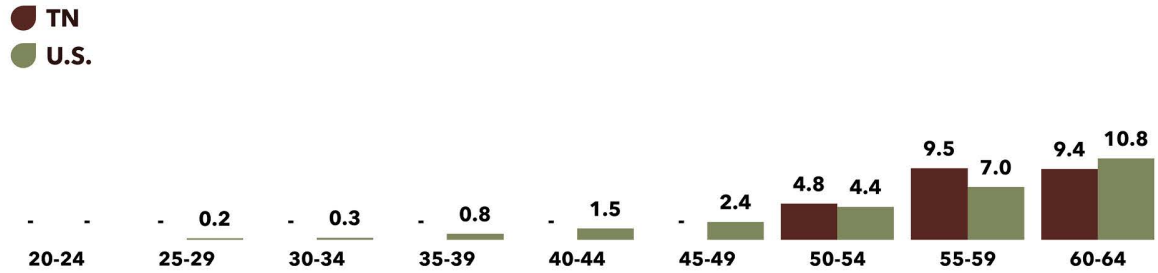
ICD-10 codes for diabetes (E10-E14), hypertension (I10,I12, I15), and cardiovascular disease (I00-I09,I11,I13,I20-I51,I60-I69) were used to identify the mortality rates for Tennessee and the United States by age group (20-24, 25-29,30-34, 35-39, 40-44, 45-49, 50-54, 55-59, 60-64). These rates are displayed in Appendix Figures 1, 2, and 3. Excess deaths were calculated by subtracting the U.S. mortality rate from Tennessee's mortality rate for each age group and applying the rate to population estimates of the number of Tennesseans in each of the age groups. To calculate the years of potential life lost (YPLL), we subtracted 75 (i.e. life expectancy) from the midpoint of each age group. The societal value of a year of life was estimated using a quality-adjusted life year (QALY). QALYs are a measure used in economic evaluations to quantify the length of life and the quality of life. (46) A low, medium, and high estimate of quality-adjusted life years was used for this analysis — $50,000, $100,000, and $200,000, respectively. QALYs were then applied to the YPLL for each age group. Lastly, the number of excess deaths for each age group was multiplied by the QALYs and YPLL for the corresponding age group to quantify the societal costs of premature death.

APPENDIX FIGURE 1.
DIABETES MORTALITY RATES BY AGE: TENNESSEE vs. U.S. (2015)
deaths per 100,000



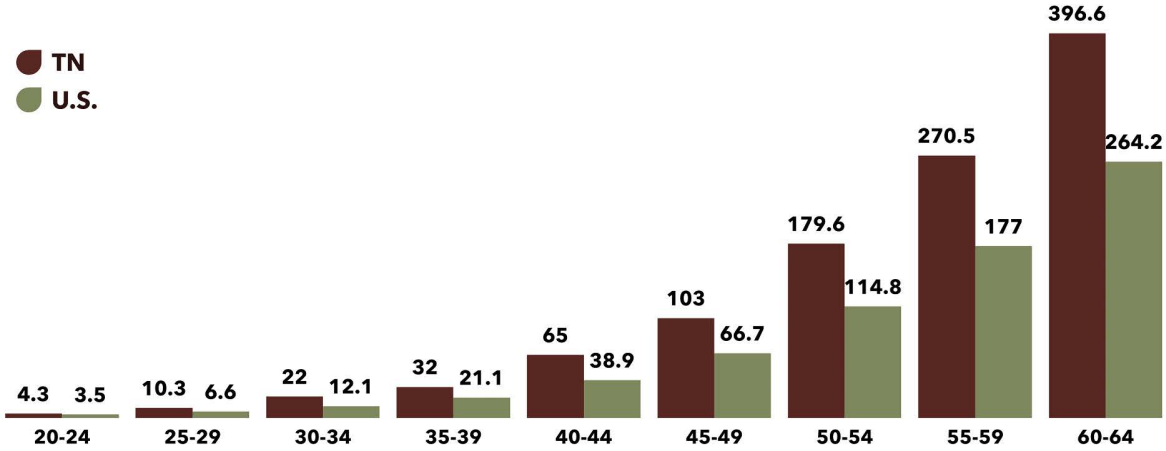
Source: The Sycamore Institute's analysis of 2015 mortality data from the U.S. Centers for Disease Control and Prevention

APPENDIX FIGURE 2.
HYPERTENSION MORTALITY RATES BY AGE: TENNESSEE vs. U.S. (2015)
deaths per 100,000



Source: The Sycamore Institute's analysis of 2015 mortality data from the U.S. Centers for Disease Control and Prevention

APPENDIX FIGURE 3.
CARDIOVASCULAR DISEASE MORTALITY RATES BY AGE: TENNESSEE vs. U.S. (2015)
deaths per 100,000



Source: The Sycamore Institute's analysis of 2015 mortality data from the U.S. Centers for Disease Control and Prevention

APPENDIX TABLE 1. SUMMARY OF ESTIMATED ANNUAL COSTS OF TENNESSEE'S EXCESS CHRONIC DISEASE BURDEN (2015)

in millions

		Excess Direct Medical Costs	Excess Lost Productivity Costs	Excess Societal Costs from Premature Death	TOTAL, Excess Costs
Low Estimate	**TOTAL, Excess Costs**	**$567**	**$126**	**$1,831**	**$2,524**
	Diabetes	$306	$36	$119	**$461**
	Hypertension	$112	$52	$12	**$176**
	Cardiovascular Disease	$149	$37	$1,700	**$1,887**
Medium Estimate	**TOTAL, Excess Costs**	**$1,325**	**$283**	**$3,662**	**$5,270**
	Diabetes	$714	$85	$237	**$1,036**
	Hypertension	$213	$99	$25	**$336**
	Cardiovascular Disease	$398	$99	$3,401	**$3,898**
High Estimate	**TOTAL, Excess Costs**	**$2,669**	**$559**	**$7,324**	**$10,552**
	Diabetes	$1,505	$179	$474	**$2,158**
	Hypertension	$418	$193	$49	**$660**
	Cardiovascular Disease	$746	$186	$6,801	**$7,733**

Note: For Direct Medical Costs and Lost Productivity, low, medium, and high estimates correspond to the estimates using the low, medium, and high benchmarks respectively. For the Societal Costs, the low, medium, and high estimates correspond to the estimates using the low, medium, and high QALY thresholds respectively.
Numbers may not add up to totals due to rounding.
Source: The Sycamore Institute's analysis

APPENDIX TABLE 2. ESTIMATED ANNUAL DIRECT MEDICAL COSTS FOR TENNESSEE'S EXCESS CHRONIC DISEASE BURDEN (2015)

in millions

		Employer-Sponsored Insurance	TennCare	Uninsured	TOTAL, Excess Direct Medical Costs
Diabetes	**Low (TN vs. 3rd Quartile)**	$220	$62	$25	**$306**
	Medium (TN vs. U.S.)	$512	$145	$57	**$714**
	High (TN vs Best State)	$1,079	$305	$121	**$1,505**
Hypertension	**Low (TN vs. 3rd Quartile)**	$75	$18	$19	**$112**
	Medium (TN vs. U.S.)	$143	$34	$36	**$213**
	High (TN vs Best State)	$280	$66	$71	**$418**
Cardiovascular Disease	**Low (TN vs. 3rd Quartile)**	$100	$24	$25	**$149**
	Medium (TN vs. U.S.)	$267	$63	$68	**$398**
	High (TN vs Best State)	$500	$118	$127	**$746**
TOTAL	**Low (TN vs. 3rd Quartile)**	**$395**	**$103**	**$69**	**$567**
	Medium (TN vs. U.S.)	**$922**	**$242**	**$161**	**$1,325**
	High (TN vs Best State)	**$1,860**	**$489**	**$319**	**$2,669**

Numbers may not add up to totals due to rounding.
Source: The Sycamore Institute's analysis

APPENDIX TABLE 3. ESTIMATED ANNUAL LOST PRODUCTIVITY COSTS FOR TENNESSEE'S EXCESS CHRONIC DISEASE BURDEN (2015)

in millions

		Absenteeism	Presenteeism	TOTAL, Excess Lost Productivity Costs
Diabetes	Low (TN vs. 3rd Quartile)	$7	$29	$36
	Medium (TN vs. U.S.)	$16	$69	$85
	High (TN vs Best State)	$34	$145	$179
Hypertension	Low (TN vs. 3rd Quartile)	$21	$31	$52
	Medium (TN vs. U.S.)	$40	$58	$99
	High (TN vs Best State)	$79	$114	$193
Cardiovascular Disease	Low (TN vs. 3rd Quartile)	$35	$2	$37
	Medium (TN vs. U.S.)	$94	$5	$99
	High (TN vs Best State)	$177	$10	$186
TOTAL	Low (TN vs. 3rd Quartile)	$63	$62	$126
	Medium (TN vs. U.S.)	$151	$132	$283
	High (TN vs Best State)	$289	$269	$559

Numbers may not add up to totals due to rounding.
Source: The Sycamore Institute's analysis

APPENDIX TABLE 4. ESTIMATED ANNUAL SOCIETAL COSTS FOR TENNESSEE'S EXCESS PREMATURE DEATHS RELATED TO CHRONIC DISEASE (2015)

in millions

Diabetes	Low ($50,000 QALY)	$119
	Medium ($100,000 QALY)	$237
	High ($200,000 QALY)	$474
Hypertension	Low ($50,000 QALY)	$12
	Medium ($100,000 QALY)	$25
	High ($200,000 QALY)	$49
Cardiovascular Disease	Low ($50,000 QALY)	$1,700
	Medium ($100,000 QALY)	$3,401
	High ($200,000 QALY)	$6,801
TOTAL	Low ($50,000 QALY)	$1,831
	Medium ($100,000 QALY)	$3,662
	High ($200,000 QALY)	$7,324

Numbers may not add up to totals due to rounding.
Source: The Sycamore Institute's analysis