Data Release

The Commonwealth of Massachusetts Executive Office of Health and Human Services
Department of Public Health

Smoking-Attributable Mortality, Morbidity, and Economic Costs Massachusetts 2000

Division of Research and Epidemiology,
Bureau of Health Statistics, Research and Evaluation
Jayne West, Ph.D. and Bruce Cohen, Ph.D.

Background

In order to examine the effect of smoking upon Massachusetts residents, the Division of Research and Epidemiology in the Bureau of Health Statistics, Research and Evaluation in the Department of Public Health analyzed smoking-attributable mortality, morbidity, and economic costs using the SAMMEC program, developed by the Centers for Disease Control and Prevention. SAMMEC (Smoking-Attributable Mortality, Morbidity, and Economic Costs) was designed to enable state officials to calculate the costs of smoking for residents age 35 and over according to four outcome variables: deaths, years of productive life lost, lost productivity costs, and health-care expenditures. The latest version of SAMMEC released in April 2002 also calculates an estimate of the number of infant deaths per year and excess neonatal health costs that are associated with maternal smoking during pregnancy.

Major Findings

Even though smoking rates have recently declined in Massachusetts, the analysis of SAMMEC data reveals significant loss of life and economic costs due to smoking tobacco in the Commonwealth. Much of the smoking-related mortality and economic costs seen in 2000 are the result of higher smoking rates in the past. The findings for 2000 may, in fact, *underestimate* the true impact of cigarette smoking because the SAMMEC software program uses the current lower smoking prevalence in its calculations.

Analysis of SAMMEC data for 2000 indicate that there were 9,277 deaths attributable to smoking: on average, 25 Massachusetts residents die each day from smoking-related causes. Smoking costs are estimated at $4.4 billion: $2.8 billion in personal health care expenditures and $1.6 billion in lost productivity due to premature deaths of smokers. Smoking costs almost $12 million per day in lost productivity and health care expenditures. Additionally, almost $20,000 per day was spent on neonatal health care expenditures related to smoking by women who gave birth in 1999.

The 9,277 smoking-attributable deaths among residents age 35 and over can be assigned to four major categories: cancer, heart disease, respiratory diseases, and fire fatalities (Figure 1). These data do not include any deaths from environmental exposure to tobacco smoke; the SAMMEC program does not calculate deaths or disease from second-hand smoke. Also, these data do not include deaths attributable to pipe, cigar, or smokeless tobacco use. The 9,277 deaths represent 17% of all deaths of residents age 35 and over: 20% of male deaths and 14% of female deaths. A list of the smoking-attributable deaths associated with each disease is presented in Table 1.

Analysis of SAMMEC data also indicates that 12 infants die each year in Massachusetts from causes associated with maternal smoking. These causes of death include short gestation/low birthweight, Sudden Infant Death Syndrome, and newborn respiratory conditions. (Figure 2)

In 2000, Massachusetts residents lost a total of 118,389 years of potential life due to smoking-related illnesses (Figure 3). This figure represents, on average, a loss of 13 years of life for every smoker in the Commonwealth of Massachusetts. A list of the smoking-attributable years of potential life lost associated with each disease is found in Table 2. These figures do not include the 968 years of potential life lost due to infant mortality related to maternal smoking (Figure 4).

Smoking-attributable lost productivity costs were calculated to be over $1.6 billion dollars for the year 2000. (Figure 5). A total of $853 million dollars is lost each year to premature death from smoking-related cancers. An additional $556 million dollars were lost due to premature deaths from smoking-attributable heart disease, and $202 million dollars per year were lost due to premature deaths from smoking-related respiratory diseases. Again, these figures do not include any lost productivity costs from deaths related to exposure to second-hand smoke.

Smoking-attributable health care expenditures are the excess personal health care costs of smokers and former smokers. For those residents over 18 years of age, $2.765 billion dollars were spent on smoking-related illnesses in 1998 in Massachusetts (Figure 6). This figure represents 10% of all health care expenditures in the Commonwealth. There were an additional $7.3 million dollars of smoking-attributable neonatal expenditures in Massachusetts in 1999 as estimated by the SAMMEC program. This figure represents 2% of all neonatal expenditures in Massachusetts.

Technical Notes

Data on smoking prevalence are from the Massachusetts Behavioral Risk Factor Surveillance System (BRFSS). For each year since 1986, the Commonwealth of Massachusetts has collected data on smoking through the BRFSS. The BRFSS is a random-digit-dialed telephone survey of non-institutionalized adults age 18 years or older. It is a cooperative effort between the Centers for Disease Control and Prevention (CDC) and state health departments. In 2000, 8,149 adults completed interviews in the Massachusetts BRFSS. Data on maternal smoking prevalence were obtained from certificates of live birth from the Massachusetts Registry of Vital Records and Statistics for mothers who gave birth in Massachusetts in 1999.

Data on outcomes were provided from several data sources. The American Cancer Society's Cancer Prevention Study provided estimates of the relative risks of mortality for smoking related diseases. Massachusetts mortality data were obtained from death certificates from the Registry of Vital Records and Statistics for the year 2000. Smoking prevalence data and relative risk information were used to calculate the smoking-attributable fraction (SAF) for each smoking related cause of death. The SAFs were then combined with Massachusetts mortality data to estimate the number of deaths attributable to smoking.

Smoking-attributable years of potential life lost (YPLL) is defined as the sum of the years of life lost from premature deaths caused by smoking. This figure was obtained by multiplying the midpoint estimate of remaining life expectancy (RLE), which was obtained from 1999 National Centers for Health Statistics life tables, for each smoking-related cause of death, sex, and five-year age by the number of smoking attributable deaths.

Smoking-attributable productivity costs are calculated as the estimated costs of lost future earnings from paid market and unpaid household labor resulting from premature death due to smoking-related disease. This measure is considered to be an economic parallel to YPLL and is based on the present value of future earnings with an annual 1% increase in labor productivity. SAMMEC uses updated age-specific present value of lifetime future earnings estimates from "Prevention Effectiveness: A Guide to Decision Analysis and Economic Evaluation" by A.C. Haddix et al., 1996. These cost data were combined with smoking attributable mortality estimates for the year 2000 in Massachusetts to calculate total smoking attributable productivity costs.

Smoking-attributable health care expenditures are defined as the excess personal health care costs of smokers and former smokers compared to those residents who have never smoked. Figures are obtained by applying the smoking-attributable fraction (SAF) to total health care expenditures for the state of Massachusetts. The SAF of medical expenditures reflects the proportion of annual personal health care expenditures that could be avoided if smoking were eliminated from the population. SAMMEC uses expenditure SAFs from B. P. Miller et al. "Smoking Attributable Medical Care Costs in the United States" Social Science and Medicine, 1999. The health care expenditure data are for 1998 for the state of Massachusetts as published on CDC's SAMMEC website: http://apps.nccd.cdc.gov/sammec/show_same_data.asp.

The smoking-attributable fraction (SAF) is a critical calculation for the SAMMEC application. The SAF is used to calculate Smoking-Attributable Mortality (SAM) for 18 smoking-related diseases. The SAF is calculated using sex-specific smoking prevalence and relative risk (RR) of death data for adult current and former smokers age 35 and over. Infant mortality SAFs are calculated using maternal smoking prevalence and RR of death estimates for four perinatal conditions caused by smoking. The SAFs for each disease and sex are derived using the following formula:

$$SAF= [(p0 + p1(RR1) + p2 (RR2))-1] / [p0 + p1(RR1) + p2(RR2)]$$

Where p0 is the percentage of adult never smokers in the study group(in this case, Massachusetts residents), or with the maternal and child health calculations, the percentage of maternal nonsmokers in the study group.

p1 is the percentage of adult current smokers in the study group, or with the maternal child health calculations, the percentage of maternal smokers in the study group.

p2 is the percentage of adult former smokers in the study group. This figure does not apply to maternal child health calculations.

RR1 is the relative risk of death for adult current smokers relative to adult never smokers, or with the maternal and child health calculations, the relative risk of death for infants of maternal smokers relative to infants of maternal nonsmokers

RR2 is the relative risk of death for adult former smokers relative to adult never smokers. This figure does not apply to maternal child health calculations.

Relative Risk estimates for persons 35 years and older were obtained from the second wave of the American Cancer Society's Cancer Prevention Study (CPS-II), and six year follow-up (Thun et al., 1997. ACS unpublished.) Relative risk estimates for short-gestation/low birth weight, Sudden Infant Death Syndrome (SIDS), Respiratory Distress Syndrome (RDS) and other infant conditions of the newborn were obtained from a meta-analysis of the epidemiological literature conducted by Gavin et al (2001).

All relative risk data are pre-set by the SAMMEC computer software package; death data and smoking prevalence data are Massachusetts-specific data and are input in to the computer software programs to generate the data for the above analyses.

References

Centers for Disease Control and Prevention. Smoking-Attributable Mortality, Morbidity, and Economic Costs (SAMMEC): Adult SAMMEC and Maternal and Child Health (MCH) SAMMEC software. Available at:
http://www.cdc.gov/tobacco/sammec. Accessed April 2002.

Gavin NI, Wiesen C, Layton C. Review and meta-analysis of the evidence on the impact of smoking on perinatal conditions built into SAMMEC II. Final Report to the National Centers for Chronic Disease Prevention and Health Promotion (NCCDPHP) Research Triangle Institute (RTI), RTI Project NO. 7171-010, September 2001.

Haddix AC, Teutsch SM, Shaffer PA, Dunet DO. Prevention Effectiveness: A Guide to Decision Analysis and Economic Evaluation. New York, NY: Oxford University Press, 1996.

Miller VP, Ernst C, Collin F. Smoking-attributable medical care costs in the USA. Social Science & Medicine 1999;48:375–391.

Thun MJ, Day-Lally C, Myers DG, et al. Trends in tobacco smoking and mortality from cigarette use in Cancer Prevention Studies I (1959 through 1965) and II (1982 through 1988). In: Changes in Cigarette-Related Disease Risks and Their Implication for Prevention and Control. Smoking and Tobacco Control Monograph 8. Bethesda, MD: US Department of Health and Human Services, Public Health Service, National Institutes of Health, Nation Cancer Institute, 1997:305-382. NIH Publication no. 97-1213.

Table 1: Smoking-Attributable Deaths by Disease, Massachusetts 2000

Cause of Death	Males	Females	Total
Malignant Neoplasms			
Lip, Oral Cavity, Pharynx	77	37	114
Esophagus	190	47	237
Pancreas	66	113	179
Larynx	61	17	78
Trachea, Lung, Bronchus	1,747	1,266	3,013
Cervix Uteri	0	10	10
Urinary Bladder	91	37	128
Kidney and Renal Pelvis	64	5	69
Total Malignant Neoplasms	**2,296**	**1,532**	**3,828**
Cardiovascular Diseases			
Hypertension	33	41	74
Ischemic Heart Disease	925	697	1,622
Other Heart Disease	308	267	575
Cerebrovascular Disease	110	189	299
Atherosclerosis	28	15	43
Aortic Aneurysm	126	86	212
Other Arterial Disease	9	22	31
Total Cardiovascular Diseases	**1,539**	**1,317**	**2,856**
Respiratory Diseases			
Pneumonia, Influenza	181	170	351
Bronchitis, Emphysema	166	202	368
Chronic Airways Obstruction	843	1,031	1,856
Total Respiratory Diseases	**1,190**	**1,403**	**2,575**
Fire Deaths	8	10	18
All Cause Total	**5,033**	**4,262**	**9,277**

Source: Bureau of Health Statistics, Research and Evaluation
Massachusetts Department of Public Health.
Adult SAMMEC and Maternal and Child Health (MCH) SAMMEC software.
Available at: http://www.cdc.gov/tobacco/sammec.

Table 2: Smoking-Attributable Years of Potential Life Lost (YPLL) by Disease, Massachusetts 2000

Cause of Death	Males	Females	Total*
Malignant Neoplasms			
Lip, Oral Cavity, Pharynx	1,273	541	1,814
Esophagus	2,796	713	3,509
Pancreas	1,045	1,589	2,634
Larynx	856	288	1,145
Trachea, Lung, Bronchus	23,968	19,712	43,679
Cervix Uteri	0	208	208
Urinary Bladder	1,015	425	1,440
Kidney and Renal Pelvis	904	57	961
Total Malignant Neoplasms	**31,857**	**23,533**	**55,390**
Cardiovascular Diseases			
Hypertension	528	377	906
Ischemic Heart Disease	13,931	7,983	21,914
Other Heart Disease	3,634	2,739	6,372
Cerebrovascular Disease	1,544	2,630	4,174
Atherosclerosis	291	114	404
Aortic Aneurysm	1,390	997	2,387
Other Arterial Disease	102	227	329
Total Cardiovascular Diseases	**21,420**	**15,067**	**36,486**
Respiratory Diseases			
Pneumonia, Influenza	1,586	1,451	3,037
Bronchitis, Emphysema	1,703	2,458	4,161
Chronic Airways Obstruction	8,153	11,161	19,315
Total Respiratory Diseases	**11,442**	**15,070**	**26,513**
All Cause Total	**64,719**	**53,670**	**118,389**

* The sum of the values for males and females do not always equal the total because of rounding.

Source: Bureau of Health Statistics, Research and Evaluation Massachusetts Department of Public Health. Adult SAMMEC and Maternal and Child Health (MCH) SAMMEC software.

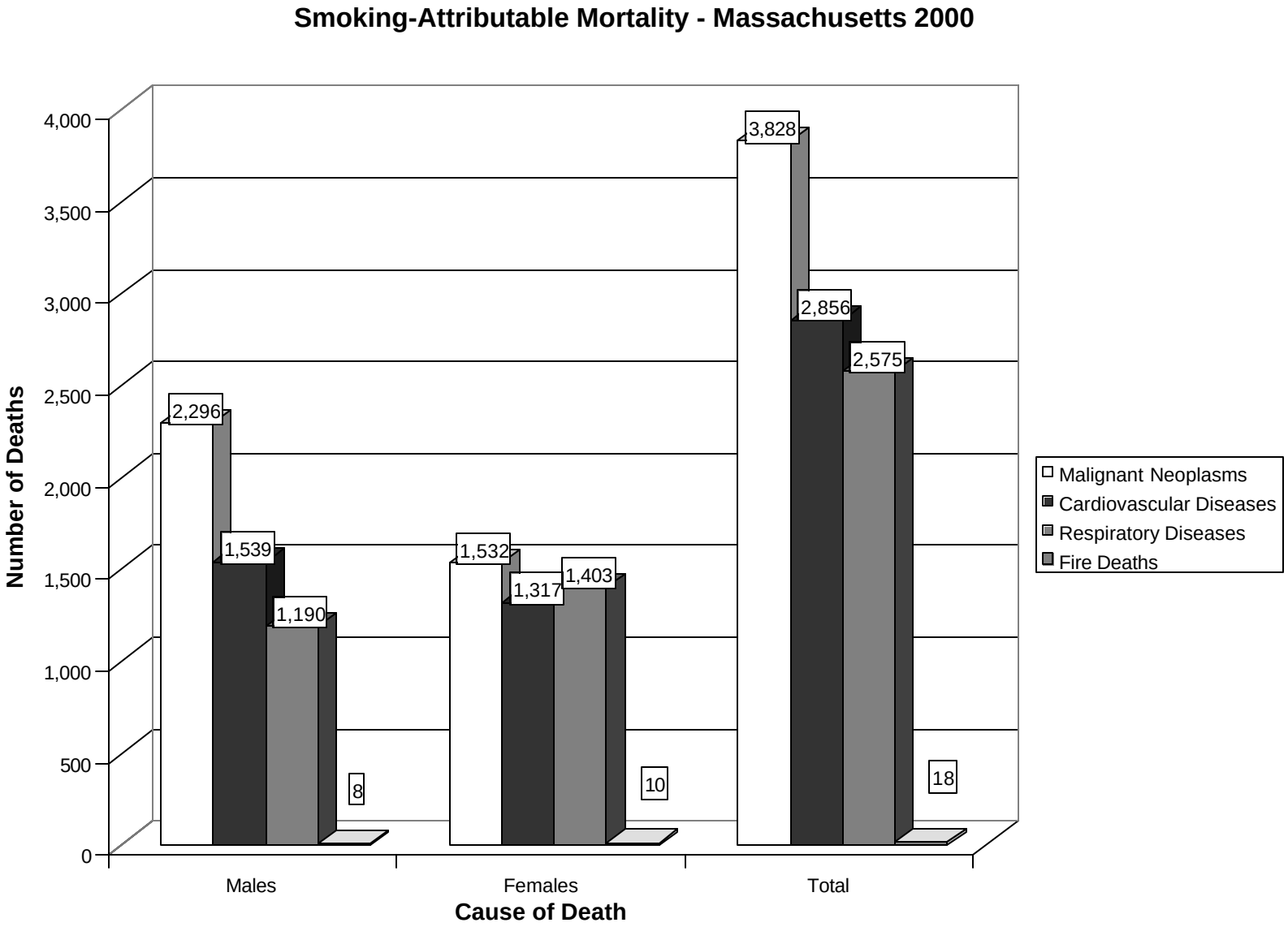

Figure 1

Source: Bureau of Health Statistics, Research and Evaluation, Massachusetts Department of Public Health. Adult SAMMEC and Maternal and Child Health (MCH) SAMMEC software. Online: http://www.cdc.gov/tobacco/sammec.

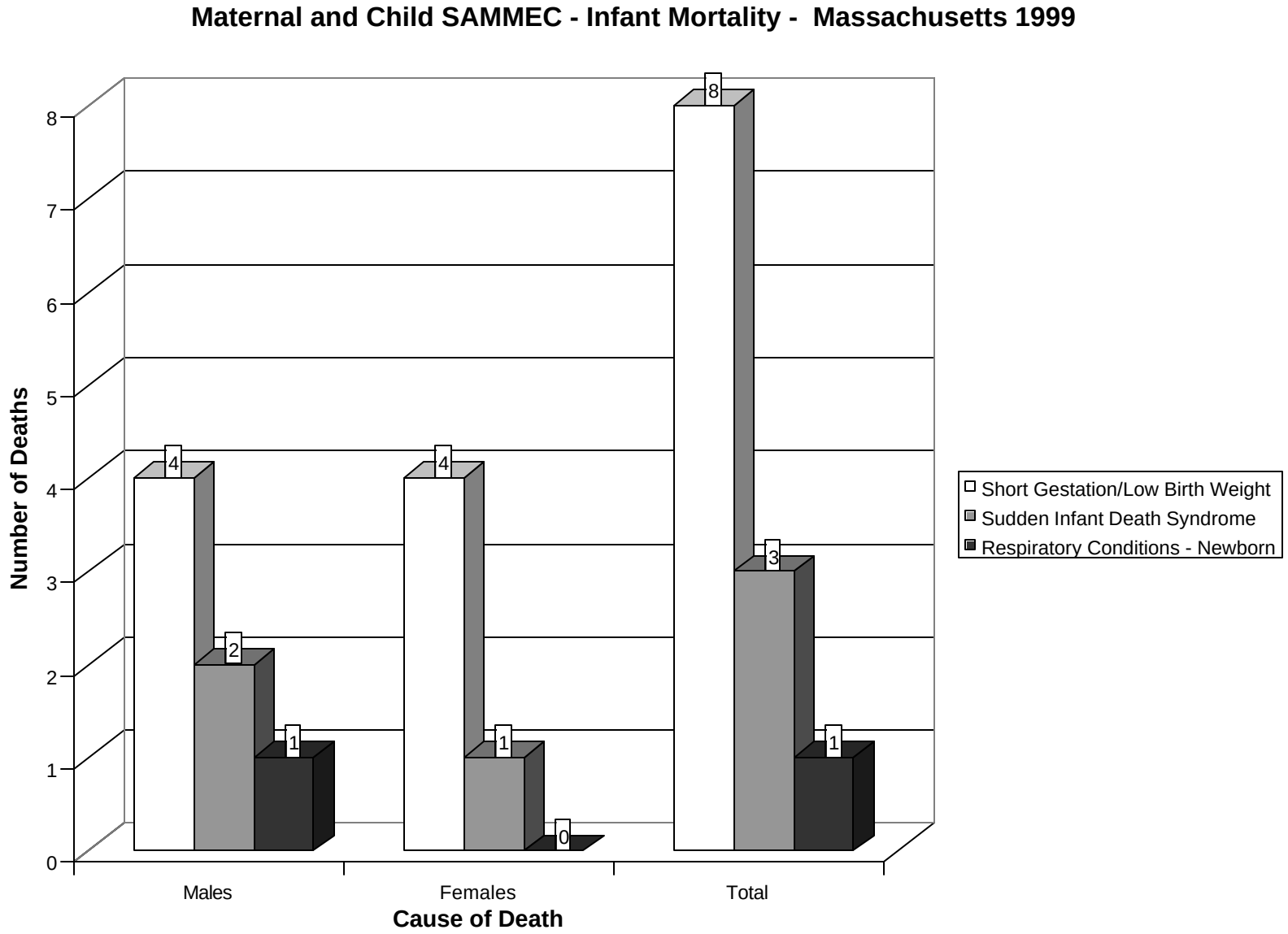

Figure 2

Source: Bureau of Health Statistics, Research and Evaluation, Massachusetts Department of Public Health. Adult SAMMEC and Maternal and Child Health (MCH) SAMMEC software. Online: http://www.cdc.gov/tobacco/sammec.

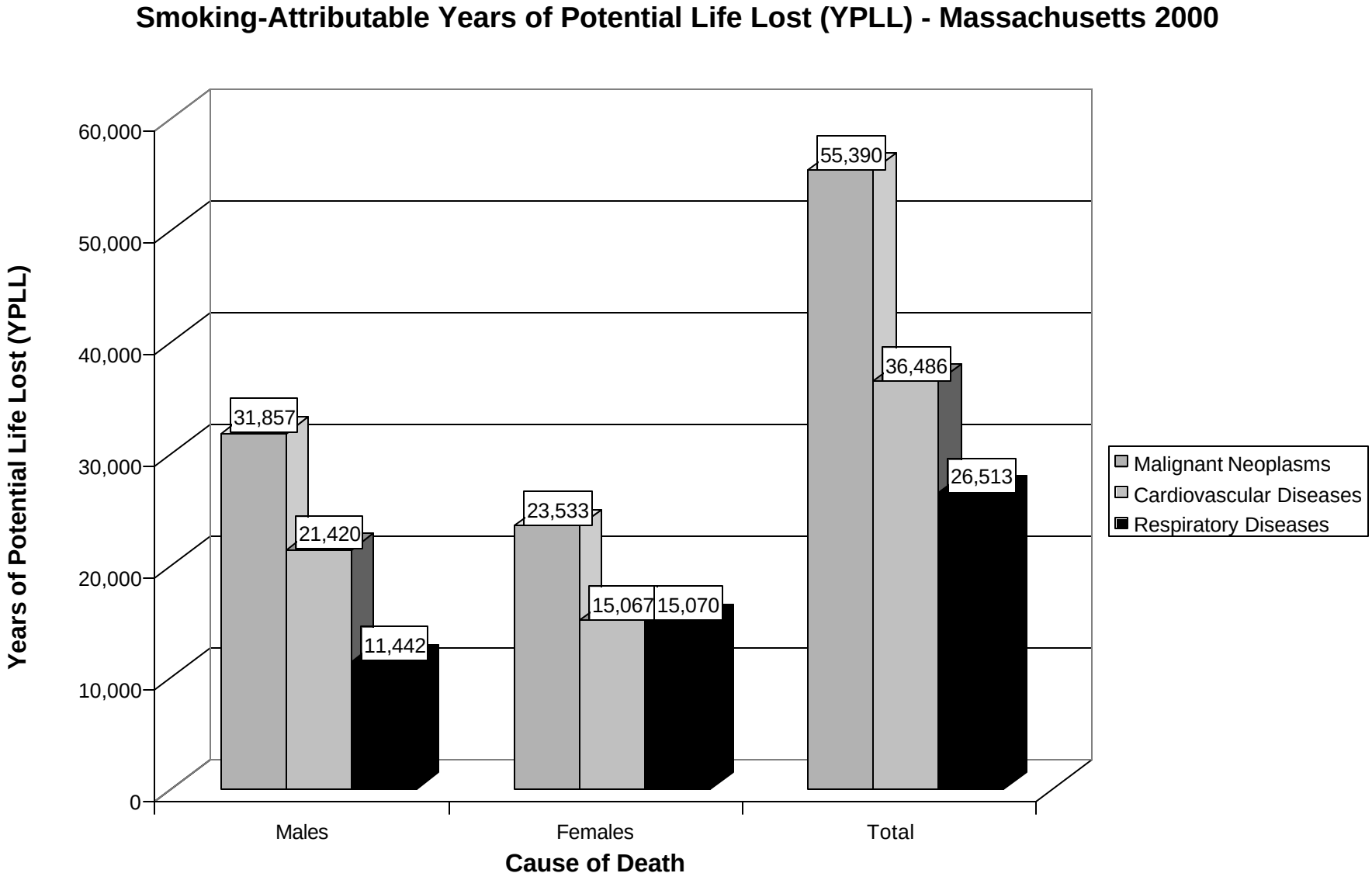

Figure 3

Source: Bureau of Health Statistics, Research and Evaluation, Massachusetts Department of Public Health. Adult SAMMEC and Maternal and Child Health (MCH) SAMMEC software. Online: http://www.cdc.gov/tobacco/sammec.

Maternal and Child SAMMEC
Smoking-Attributable Years of Potential Life Lost (YPLL) for Infants Born in Massachusetts
1999

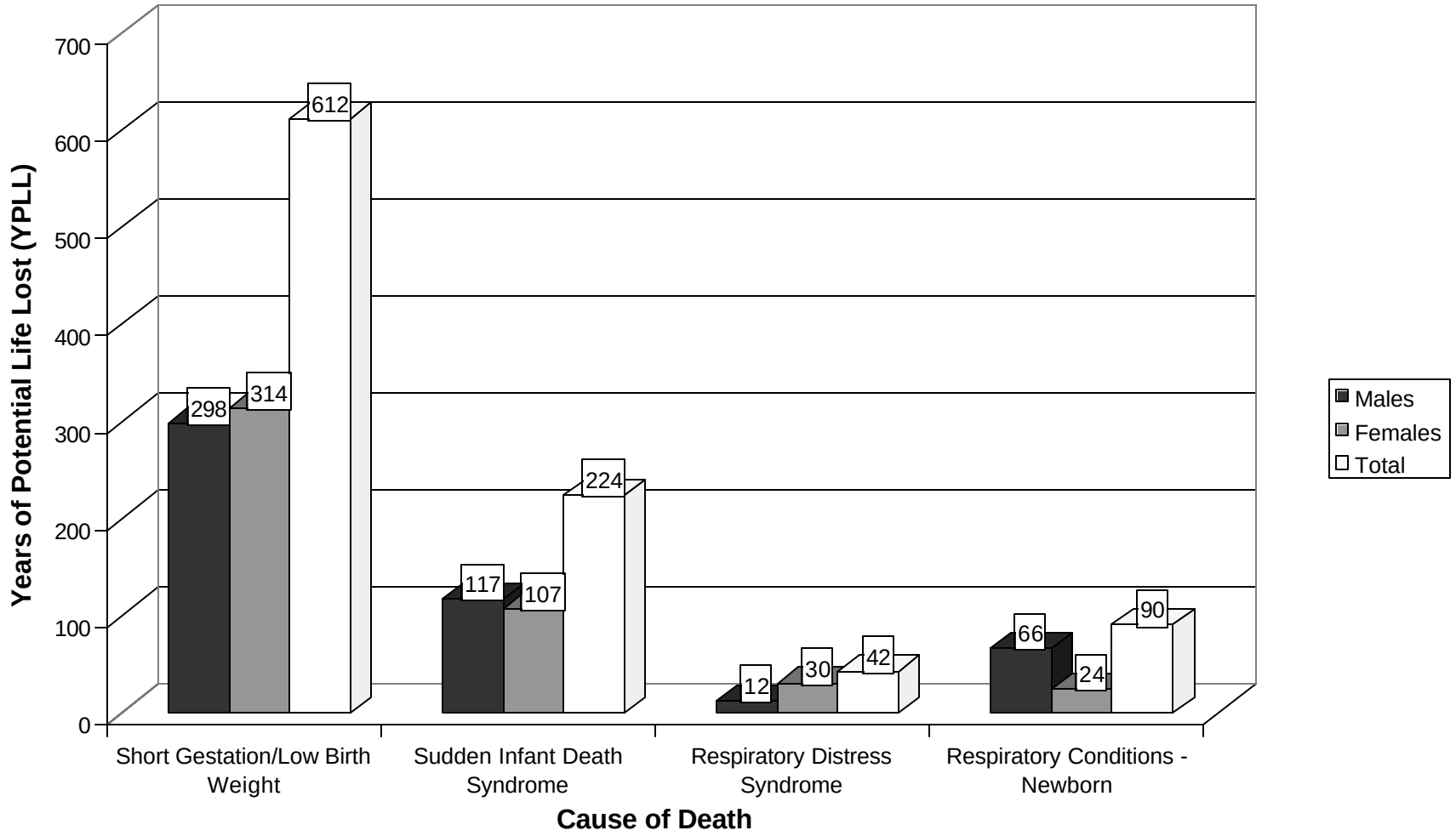

Figure 4

Source: Bureau of Health Statistics, Research and Evaluation, Massachusetts Department of Public Health. Adult SAMMEC and Maternal and Child Health (MCH) SAMMEC software. Online: http://www.cdc.gov/tobacco/sammec.

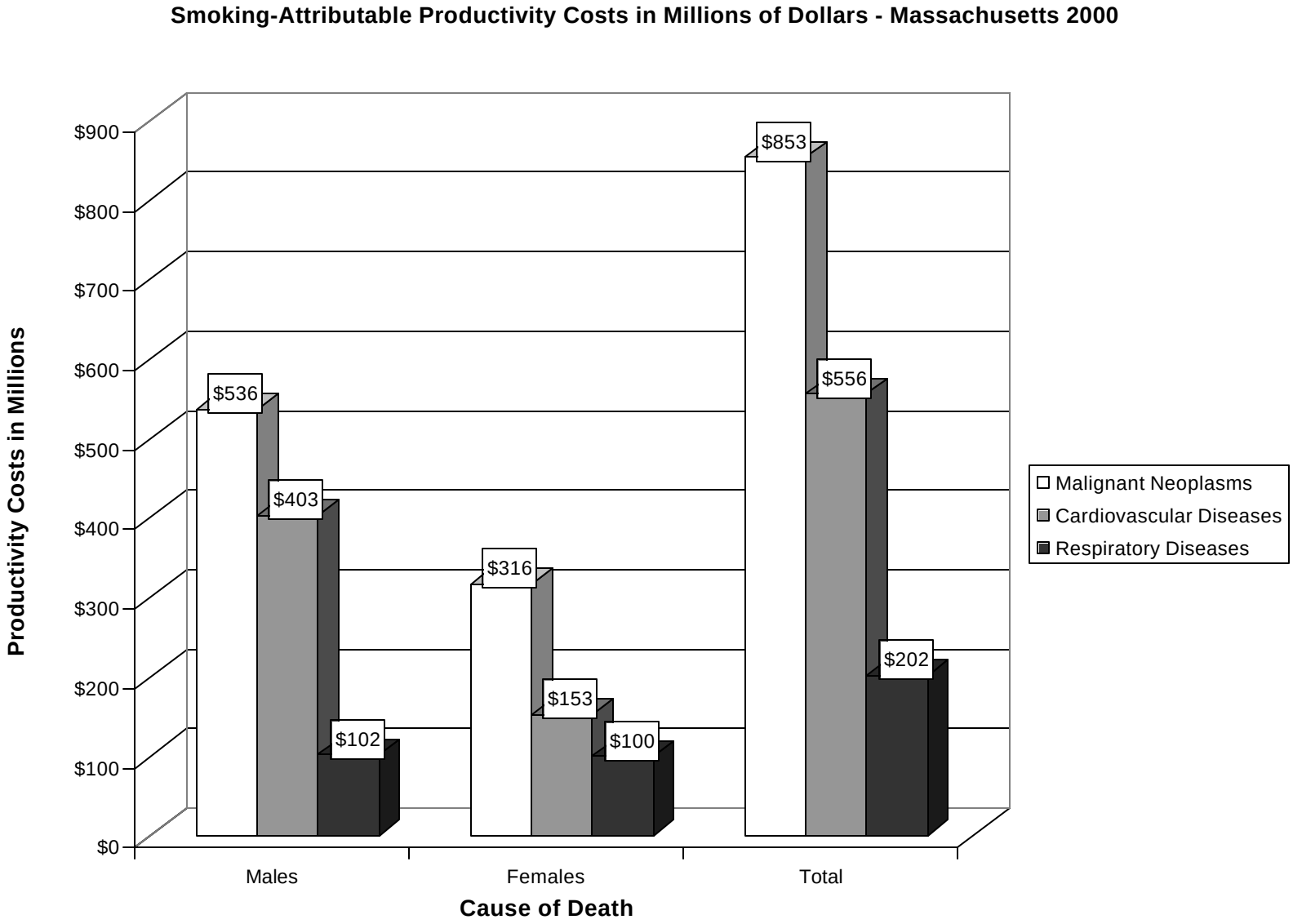

Figure 5

Source: Bureau of Health Statistics, Research and Evaluation, Massachusetts Department of Public Health. Adult SAMMEC and Maternal and Child Health (MCH) SAMMEC software. Online: http://www.cdc.gov/tobacco/sammec.

Smoking-Attributable Health Care Expenditures in Millions of Dollars - Massachusetts 1998 (age 18+)

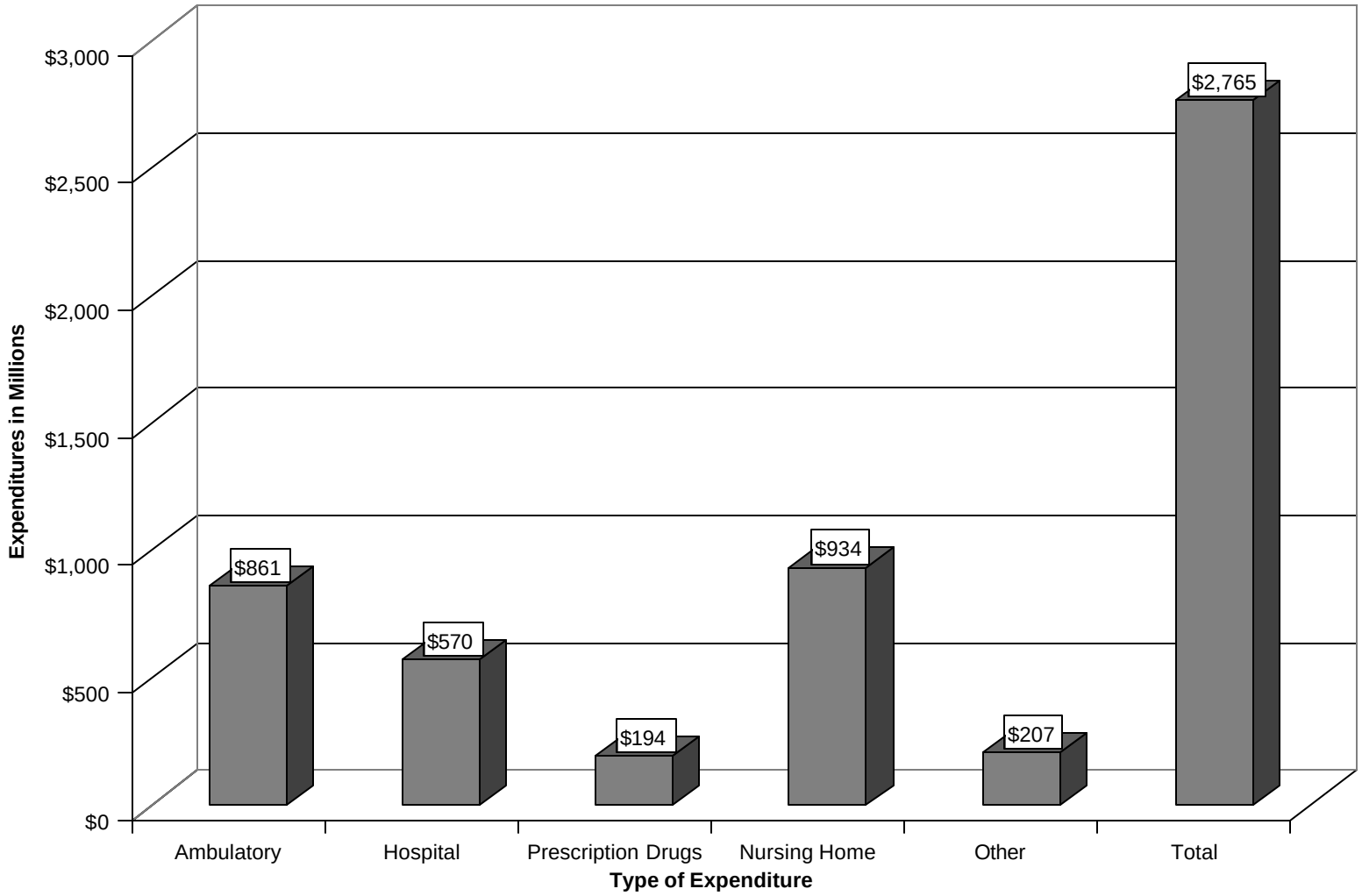

Figure 6

Source: Bureau of Health Statistics, Research and Evaluation, Massachusetts Department of Public Health. Adult SAMMEC and Maternal and Child Health (MCH) SAMMEC software. Online: http://www.cdc.gov/tobacco/sammec.