

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

**Smoking-Attributable Mortality, Morbidity, and Economic Costs (SAMMEC)
Massachusetts 2001**

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Background

The Division of Research and Epidemiology in the Bureau of Health Statistics, Research and Evaluation in the Department of Public Health used Centers for Disease Control and Prevention's Smoking-Attributable Mortality, Morbidity, and Economic Costs (SAMMEC) software application to examine the impact of smoking on Massachusetts residents in 2001. SAMMEC includes an Adult and a Maternal and Child Health (MCH) program that provide the ability to estimate the health and health-related economic consequences of smoking (CDC, SAMMEC, 2003).

SAMMEC calculates annual state and national-level smoking-attributable deaths and years of potential life lost for adults and infants in the United States. The Adult application also calculates medical expenditures and productivity costs among adults. Likewise, MCH SAMMEC estimates annual state and national-level smoking-attributable deaths and years of potential life lost for infants (CDC, SAMMEC, 2003).

Major Findings

The 2001 Massachusetts SAMMEC data indicate significant smoking-related loss of life and economic costs despite the recent decline in smoking rates. Much of the smoking-related mortality and economic costs occurring in 2001 are the result of higher smoking prevalence in the past. The 2001 BRFSS data indicate that an average of 19.6% of Massachusetts adults are current smokers. The findings for 2001 may, in fact, underestimate the true impact of cigarette smoking because the SAMMEC application uses the current smoking rates (2001) in its calculations, rather than using the smoking rates from previous years when smoking was more prevalent in the population.

Total Deaths Due to Smoking and Economic Costs

Analyses of SAMMEC data for 2001 indicate that there were 9,076 total deaths in Massachusetts among residents 35 and older that were attributable to smoking. The 9,076 deaths represent 16.5% of all deaths of residents age 35 and over; 19.9% of male deaths, and 13.7% of female deaths. Overall, approximately 25 Massachusetts residents die each day from smoking-related causes. In terms of economic impact, smoking costs for Massachusetts are approximately \$1.5 billion in lost productivity due to premature deaths of smokers. Additionally, in 1998 Massachusetts smoking costs were estimated at \$2.8 billion in personal health care expenditures, and almost \$20,000 per day was spent on neonatal health care expenditures related to smoking by women who gave birth in 1999.

Total Deaths Due to Smoking for by Category

The 9,076 smoking-attributable deaths among residents age 35 and over can be classified by four major categories: cancer, heart disease, respiratory disease, and fire fatalities. Table 1 presents the smoking-attributable deaths associated with each disease. 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.

**Table 1. Smoking-Attributable Mortality– Massachusetts 2001
Residents age 35 and older**

Cause of Death	Males	Females	Total
Malignant Neoplasms (Cancer)			
Lip, Oral Cavity, Pharynx	82	32	114
Esophagus	183	41	224
Pancreas	65	107	172
Larynx	65	15	80
Trachea, Lung, Bronchus	1,663	1,282	2,945
Cervix Uteri	0	6	6
Urinary Bladder	118	38	156
Kidney and Renal Pelvis	61	6	67
Total Malignant Neoplasms	2,237	1,527	3,764
Cardiovascular Diseases (Heart Disease)			
Hypertension	34	38	72
Ischemic Heart Disease	930	668	1,598
Other Heart Disease	321	266	587
Cerebrovascular Disease	128	162	290
Atherosclerosis	25	17	42
Aortic Aneurysm	138	88	226
Other Arterial Disease	8	24	32
Total Cardiovascular Diseases	1,584	1,263	2,847
Respiratory Diseases			
Pneumonia, Influenza	158	136	294
Bronchitis, Emphysema	139	195	334
Chronic Airways Obstruction	815	1,006	1,821
Total Respiratory Diseases	1,112	1,337	2,449
Fire Deaths (Fire Fatalities)			
Smoking-caused fire deaths	6	10	16
All Cause Total	4,939	4,137	9,076

Smoking Prevalence Source: MDPH 2001 MA BRFSS
Relative Risk Source: Cancer Prevention Study (CPS)-II (82-88);
Mortality Source: MDPH 2001 MA Mortality

Total Deaths Due to Maternal Smoking

According to SAMMEC data, nine Massachusetts infants died in 2001 from causes associated with maternal smoking. For 2001, these causes of death include short gestation/low birth weight and Sudden Infant Death Syndrome (Figure 1). In past years, infants have also died from smoking-attributable respiratory conditions.

Years of Potential Life Lost Due to Smoking

In 2001, Massachusetts' residents lost a total of 115,251 years of potential life due to smoking-related diseases (Table 2). This figure represents, on average, a loss of almost 13 years of life for

every smoker in the state. Table 2 shows a list of the smoking-attributable years of potential life lost associated with each disease. These figures do not include the 772 years of potential life lost due to infant mortality related to maternal smoking presented in Figure 2.

Table 2. Smoking-Attributable Years of Potential Life Lost (YPLL) by Disease, Massachusetts 2001			
Cause of Death	Males	Females	Total
Malignant Neoplasms (Cancer)			
Lip, Oral Cavity, Pharynx	1,336	517	1,853
Esophagus	2,594	592	3,186
Pancreas	1,016	1,456	2,472
Larynx	899	254	1,153
Trachea, Lung, Bronchus	22,361	19,915	42,276
Cervix Uteri	0	132	132
Urinary Bladder	1,311	426	1,737
Kidney and Renal Pelvis	884	79	963
Total Malignant Neoplasms	30,401	23,371	53,772
Cardiovascular Diseases (Heart Disease)			
Hypertension	527	401	928
Ischemic Heart Disease	13,725	7,753	21,478
Other Heart Disease	3,695	2,716	6,411
Cerebrovascular Disease	1,847	2,321	4,168
Atherosclerosis	228	125	353
Aortic Aneurysm	1,636	877	2,513
Other Arterial Disease	60	252	312
Total Cardiovascular Diseases	21,718	14,445	36,163
Respiratory Diseases			
Pneumonia, Influenza	1,417	1,272	2,689
Bronchitis, Emphysema	1,375	2,210	3,585
Chronic Airways Obstruction	7,992	11,050	19,042
Total Respiratory Diseases	10,784	14,532	25,316
All Cause Total	62,903	52,348	115,251

Smoking Prevalence Source: MDPH 2001 MA BRFSS

Relative Risk Source: Cancer Prevention Study (CPS)-II (82-88);

Mortality Source: MDPH 2001 MA Mortality

Life Expectancy* Source: US 1999 Life Expectancy

* Note that, since US life tables are used to calculate YPLL, the MA YPLL may be UNDERESTIMATED because MA, in general, had a longer life expectancy than the US for 5-year age groups.

Costs of smoking: Lost Productivity and Health Care Expenditures

Smoking-attributable lost productivity costs were calculated to be over \$1.5 billion dollars in 2001 (Figure 3). A total of \$814 million dollars was lost to premature death from smoking-related cancers. An additional \$550 million dollars were due to premature deaths from smoking-attributable heart disease, and \$200 million dollars per year were lost due to premature deaths from smoking-related respiratory diseases. However, 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, \$2.766 billion dollars were spent on smoking-related illnesses in Massachusetts in 1998, the latest year for which data are available (Figure 4). 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 the Commonwealth.

Data Collection and Analyses

Data on smoking prevalence are from the 2001 Massachusetts Behavioral Risk Factor Surveillance System (BRFSS). For each year since 1986, the Commonwealth of Massachusetts has collected data on smoking through the BRFSS. This system includes a random-digit-dialed telephone survey of non-institutionalized adults years 18 or older. BRFSS is a cooperative effort between the Centers for Disease Control and Prevention (CDC) and state health departments. In 2001, 8,628 adults completed interviews conducted through the Massachusetts BRFSS. Data on maternal smoking prevalence were obtained from certificates of live birth from Massachusetts Registry of Vital Records and Statistics for mothers who gave birth in Massachusetts in 1999. Fire deaths are from the fact sheet, "Massachusetts Fires in 2001," Department of Fire Services Office of the State Fire Marshal.

Data on outcomes were provided from several 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 2001. Smoking prevalence data and relative risk estimates were used to calculate the smoking-attributable fraction (SAF) for each smoking related disease for adult current and former smokers aged 35 years and older. 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 disease, sex, and five-year age group by the number of smoking-attributable deaths. Since Massachusetts, in general, had a longer life expectancy than US estimates, the life expectancy data from the 1999 US Life Expectancy tables may underestimate YPLL for Massachusetts residents.

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 of the year 2001 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 expenditures 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/sammecc/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:

$$\text{SAF} = [(p_0 + p_1(\text{RR}_1) + p_2(\text{RR}_2)) - 1] / [p_0 + p_1(\text{RR}_1) + p_2(\text{RR}_2)]$$

Where p_0 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.

p_1 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

p_2 is the percentage of adult former smokers in the study group. This figure does not apply to maternal child health calculations.

RR_1 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.

RR_2 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 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 published). Relative risk estimates for short-gestation/low birth weight, Sudden Infant Death Syndrome (SIDS), Respiratory Distress Syndrome (RDS) and other infant conditions 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 into the computer software programs to generate data for the above analyses.

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**Figure 1. Number of Deaths Associated with Maternal Smoking
Maternal and Child SAMMEC- Massachusetts 2001**

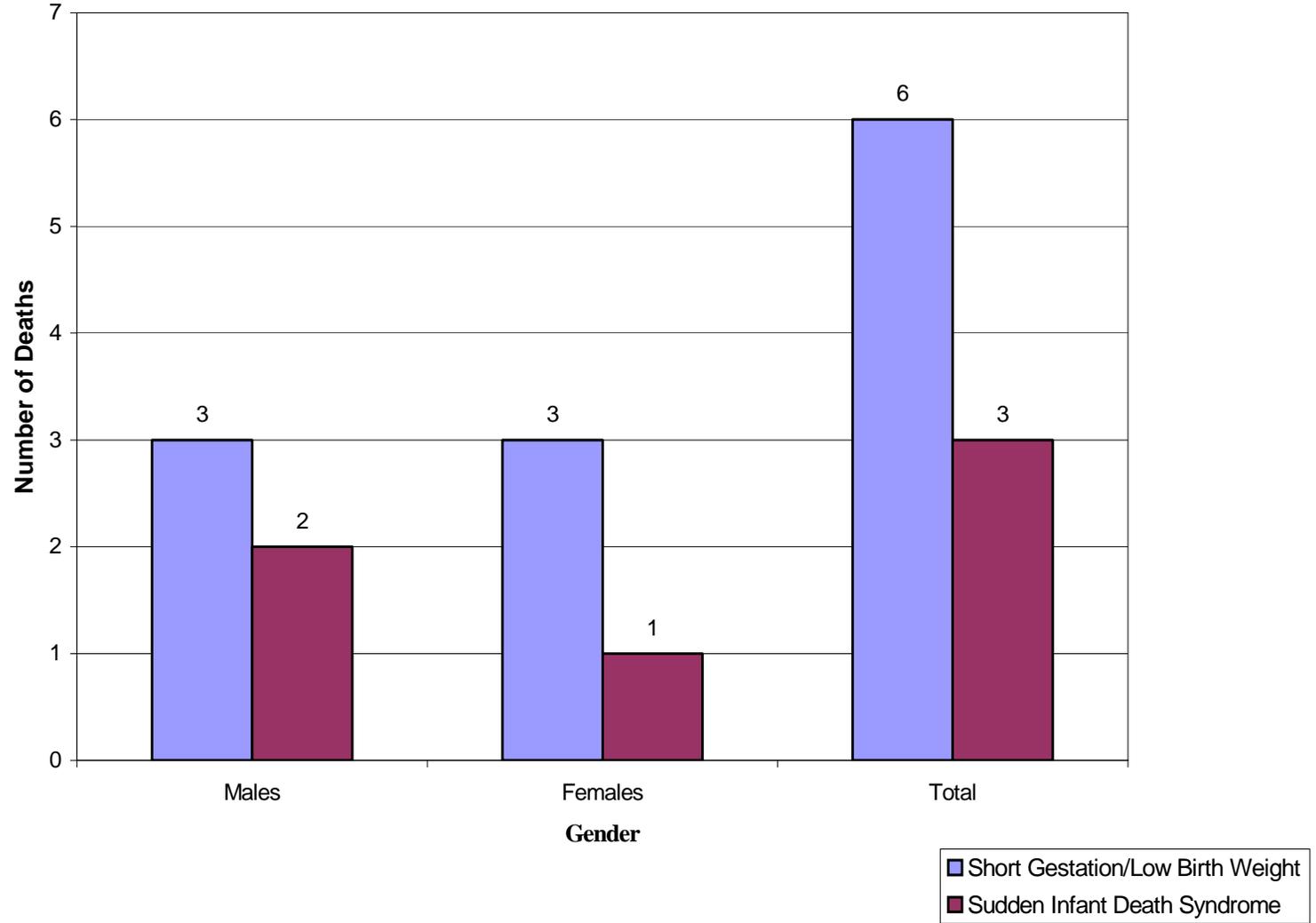


Figure 2. Smoking Attributable Years of Potential Life Lost (YPLL) for Infants Born in Massachusetts 2001

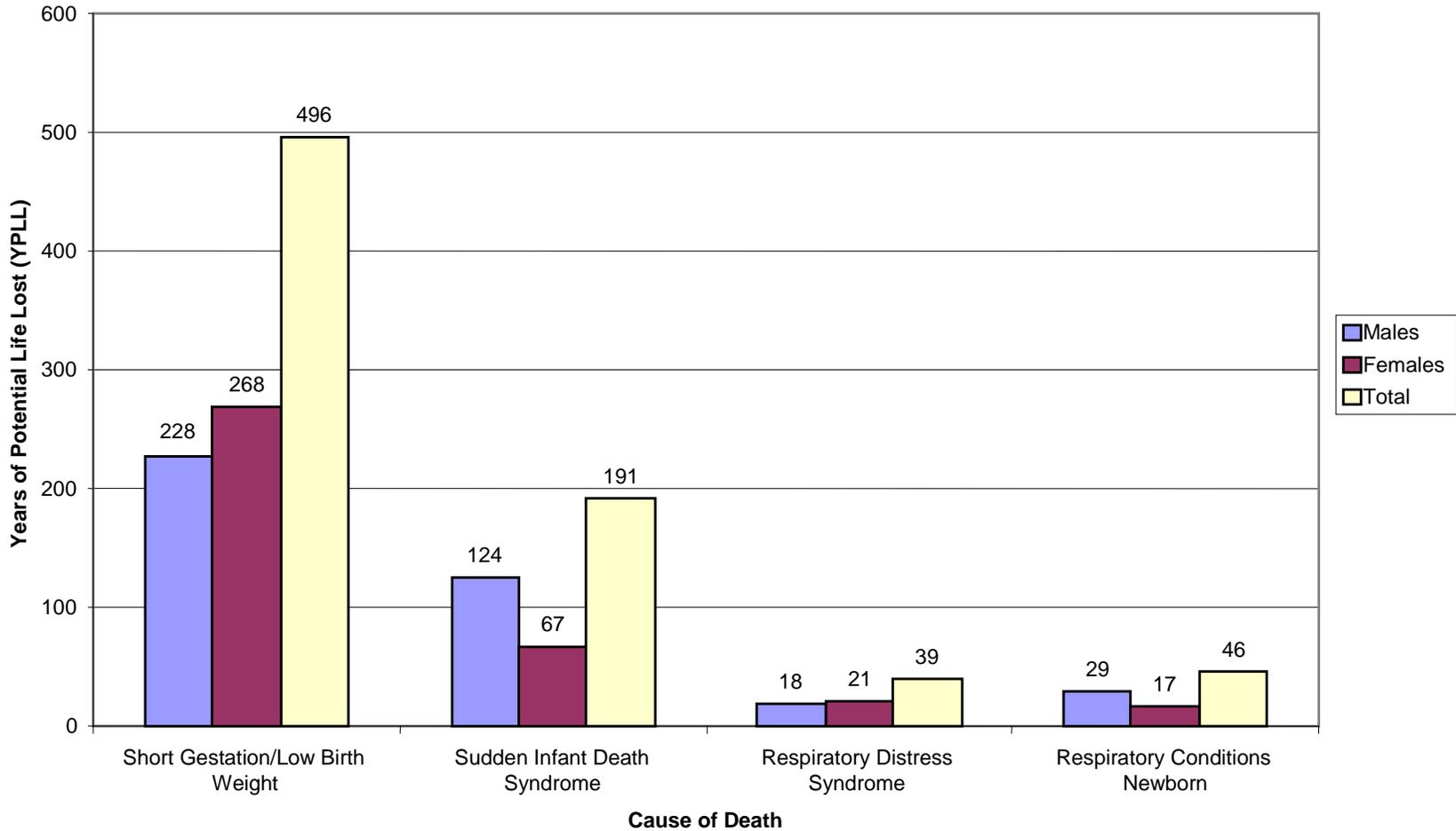


Figure 3. Smoking Attributable Productivity Costs in Millions of Dollars - Massachusetts 2001

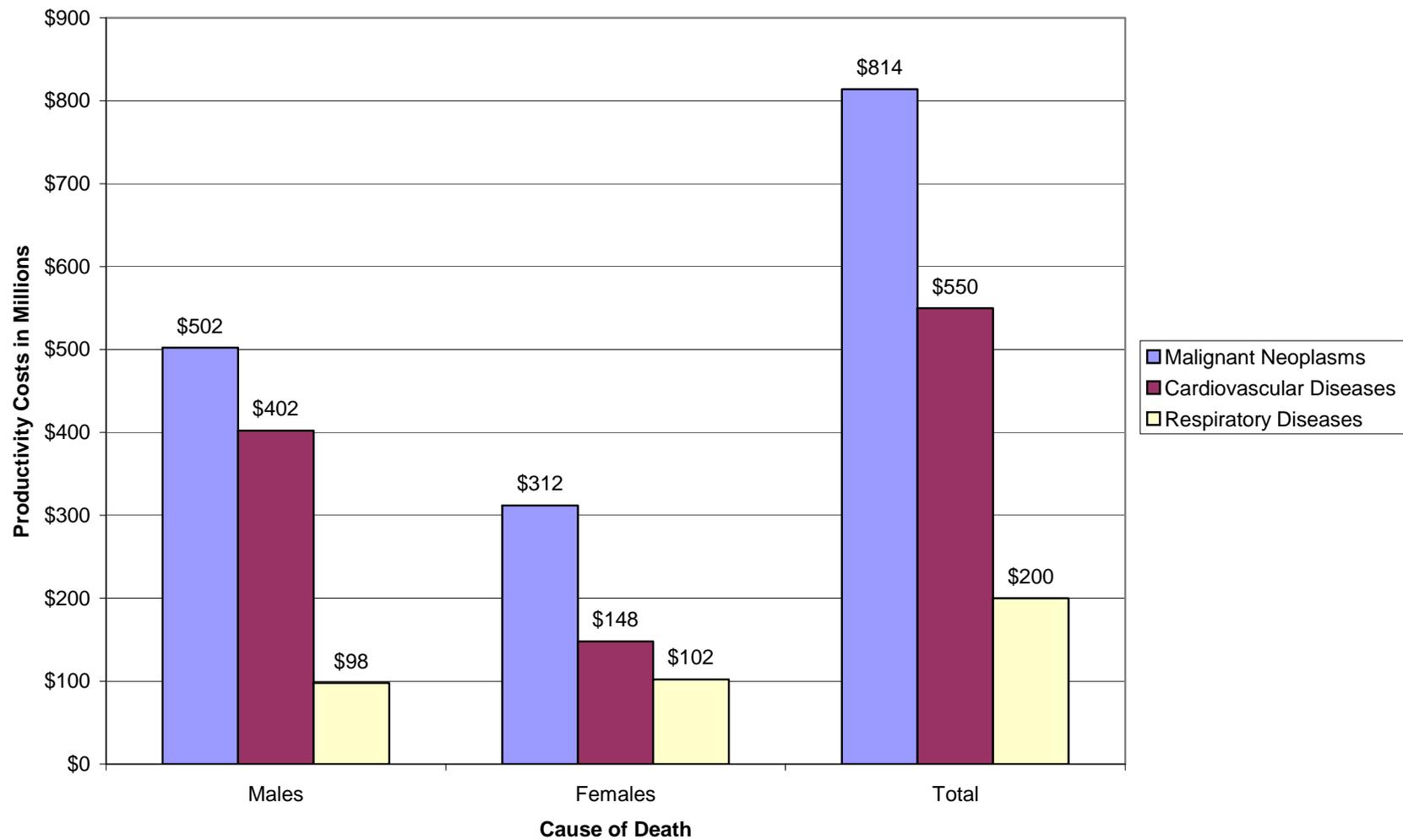


Figure 4. Smoking-Attributable Health Care Expenditures in Millions of Dollars - Massachusetts 1998 (age 18+)

