Costs of Illness for Environmentally Related Health Effects in Older Americans

Final Report

Prepared for

Kathy Sykes
Senior Advisor, Aging Initiative
Office of Children's Health Protection
EPA (Mail Code 1107A)
1200 Pennsylvania Ave. NW
Room 2512N (Ariel Rios North)
Washington, DC 20460
(202) 564-3651
FAX (202) 564-2733

Prepared by

George Van Houtven
Amanda Honeycutt
Boyd Gilman
Nancy McCall
Wanda Throneburg
RTI International
Health, Social, and Economics Research
Research Triangle Park, NC 27709

RTI Project Number 08687.029.001

April 2005

RTI INTERNATIONAL

RTI Project Number
08687.029.001

Costs of Illness for Environmentally Related Health Effects in Older Americans

Final Report

April 2005

Prepared for

Kathy Sykes
Senior Advisor, Aging Initiative
Office of Children's Health Protection
EPA (Mail Code 1107A)
1200 Pennsylvania Ave. NW
Room 2512N (Ariel Rios North)
Washington, DC 20460
(202) 564-3651
FAX (202) 564-2733

Prepared by

George Van Houtven
Amanda Honeycutt
Boyd Gilman
Nancy McCall
Wanda Throneburg
RTI International*
Health, Social, and Economics Research
Research Triangle Park, NC 27709

*RTI International is a trade name of Research Triangle Institute.

Table of Contents

Section **Page**

List of Tables

Number **Page**

1. Introduction

With the U.S. population expected to age rapidly over the next half century, environmental health effects among older Americans are becoming an increasingly important public health concern. Forecasts suggest that the elderly population is likely to grow to 70 million people by 2030, and the number of individuals over 85 years is expected to increase to 19 million by 2050—an almost fivefold increase between 2000 and 2050.

For several reasons, a rapidly growing elderly population presents unique challenges in the area of environmental health. First, because of diminished immunity associated with aging, older adults are often more susceptible than younger adults to environmental hazards. Second, the prevalence of diseases that can further compromise immunity, such as Alzheimer's and diabetes, tend to be highest among the elderly. Finally, older persons have accumulated a lifetime of exposures that persist in the body and may manifest as health problems long after the time period of exposure.

The U.S. Environmental Protection Agency's (EPA's) Aging Initiative has been established precisely to address these challenges. EPA launched the Aging Initiative in 2002 to "prioritize and study environmental health hazards to older persons and examine the effect that a rapidly growing aging population will have on our environment" (EPA, 2003). Through this initiative, the Agency is developing a national agenda on the environment and aging, with efforts focused on research that could lead to developing and implementing policies to better protect older Americans from the health effects of environmental exposures. One such research effort is to develop a better understanding of the burden of disease associated with environmental exposures among the elderly.

The purpose of this report is to contribute to this research effort by assessing the economic burden of specific illnesses among the elderly. The analysis focuses on health conditions for which environmental exposure are known or suspected to be an important contributing factor. In particular, we analyzed costs for specific health conditions within the following six illness categories:

- chronic respiratory disease
- heart disease
- stroke
- lung cancer
- pneumonia
- gastrointestinal illness

In Section 2, we provide a more detailed description of the specifically selected health conditions, and we also discuss the main reasons for selecting these conditions. The discussion in Section 2 includes a summary of the evidence linking these conditions with environmental exposures.

To assess the economic burden of the selected illnesses among the elderly, we applied a cost-of illness (COI) approach. This approach is well established in the field of health valuation and has been widely applied to assess losses for a variety of illnesses. In Section 2 we describe the conceptual framework underlying COI and the primary issues associated with conducting this type of analysis. We also summarize the evidence from previous COI research related to these conditions. Although we identified over 20 articles published since 1990 that have estimated costs for these (or related) conditions, the methods and results of these studies varied widely and few of them specifically focused on health effects in older Americans. Our analysis was designed to address the limitations and gaps in this literature.

By applying a consistent set of COI methods, data sources, and disease classifications and by limiting our attention to older Americans, our analysis provides estimates of the burden of illness that are directly comparable across conditions and are targeted to the population of interest for EPA's Aging Initiative. Based on available data, we estimated the main health care costs (direct costs) and productivity losses (indirect costs) associated with the prevalence of the six conditions among adults 65 years and older in 2000. In Section 3, we describe the data and the methods we used to construct our cost estimates. To estimate direct costs associated with each condition, we primarily relied on Medicare claims data from a nationally representative sample of Medicare fee-for-service beneficiaries. We supplemented these direct cost estimates using national survey data to estimate incremental prescription drug (self-

administered) and nursing home costs. To estimate indirect costs, we combined national health and earnings data to estimate both morbidity and mortality related productivity losses for the 65 and older population. Section 3 also describes the main limitations and caveats associated with these data and methods, which must be kept in mind when interpreting the results.

It is important to emphasize that the cost estimates developed with these approaches should not be interpreted as those specifically attributable to environmental exposures. Unfortunately, the science and empirical evidence regarding the epidemiological links between environmental exposures and these health outcomes are not sufficiently advanced to reliably estimate this attributable fraction. Consequently, the results are more appropriately interpreted as upper-bound estimates of environmentally related costs of illness for these conditions.

Section 4 describes the results separately for each of the six health categories. We break down medical costs by type of medical service (e.g., inpatient, physician visits, hospital outpatient) and by age and gender category. Estimates of prescription drug and nursing home costs are separately reported by age and gender category. The indirect costs are divided into losses associated with morbidity and those due to mortality, and they are also subdivided according to age and gender category.

Table 1-1 summarizes our results by reporting estimated aggregate direct and indirect costs for each of the six illness categories. Comparisons of these aggregate cost estimates across illness categories must be made with caution. Due to data limitations, certain components of direct and indirect costs could not be reliably estimated for different illnesses (see footnotes to Table 1-1). Nevertheless, the results clearly suggest that chronic lung disease and ischemic heart disease are the two categories of illness with the largest aggregate costs in 2000. The point estimate for chronic lung disease exceeds $35 billion and, even without nursing home costs included, the point estimate for ischemic heart disease is close to $52 billion. Gastrointestinal illness is estimated to impose the lowest aggregate cost of the six conditions, but even without estimates of nursing home or morbidity related productivity losses, its aggregate costs are estimated to exceed $1 billion. For each of the six conditions, direct medical costs comprise the largest component of estimated aggregate costs.

Table 1-1. Estimated Aggregate Annual Costs of Illness Among Older Americans for Selected Health Conditions in 2000 (in millions of 2000$)

	Chronic Lung Disease	Ischemic Heart Disease	Stroke
Direct Costs	27,294	42,239	11,840[a]
Indirect Costs	6,605	7,913	6,292
Total Costs	33,898	50,152	18,133
	Lung Cancer	**Pneumonia**	**Gastrointestinal Illness**
Direct Costs	4,277[b]	10,936	1,006[a]
Indirect Costs	173[c]	4.7[d]	0.039[d]
Total Costs	4,450	10,941	1,006

[a]Does not include nursing home costs.

[b]Does not include self administered prescription drug or nursing home costs.

[c]Does not include lost household productivity for morbidity.

[d]Does not include any morbidity related productivity losses.

The numbers reported in Table 1-1 represent our best point estimates of aggregate costs for the selected illnesses; however, these estimates are best interpreted as midpoints within a range of uncertainty. This uncertainty arises from several different sources and for several different reasons which are discussed throughout the report and summarized in the concluding section (Section 6). To partially quantify this uncertainty, the results described in Section 4 also include confidence intervals for several of the key values that went into constructing the aggregate cost estimates.

2. Background

Several of the most prevalent and costly adverse health conditions among older Americans—including chronic respiratory disease, heart disease, cerebrovascular disease, cancer, pneumonia/influenza, and gastrointestinal illness—are known to be associated, at least in part, with environmental exposures. To improve understanding of the magnitude of the cost burden imposed by these types of environmentally related health effects among older Americans, we selected specific health conditions for economic analysis. In this section, we define the selected conditions and discuss why they were chosen for this analysis. We also provide a general description of the COI method, and we review the existing evidence from the COI literature regarding the direct and indirect costs associated with the selected conditions. We then discuss the limitations of using results from the existing literature for assessing the direct and indirect costs of conditions related to environmental exposures in older adults.

2.1 Selection of Health Effects

Some of the key considerations in selecting conditions for analysis were:

- prevalence among the older population,
- expected average costs associated with illness,
- evidence of linkages to environmental exposures, and
- data availability.

We targeted conditions that were expected to impose a relatively high burden (through high prevalence and/or high cost) among the elderly and conditions for which environmental exposures are expected to be important risk factors. Using the commonly applied International Classification of Disease (ICD-9) system for coding illnesses, we also defined conditions in a way that could be easily identified and matched from multiple data sources.

Table 2-1 lists the selected health conditions according to their ICD-9 codes and groups the conditions into six general categories of illness. The first category—chronic respiratory illness—is common among older Americans and strongly associated with indoor and outdoor air-quality conditions. Based on data for the Centers for Disease Control and Prevention (Lucas et al., 2004), in 2001, 6.7 percent of the 65 and older population suffered from chronic bronchitis and 5.1 percent suffered from emphysema, compared to 5.3 and 0.8 percent respectively for those under 65. Prevalence of asthma among the elderly (8.7 percent) is lower than in children and young adults; however, the illness is typically more severe in older age groups. Exposures to common air pollutants, such as particulate matter (PM) and ozone, have been found in several studies to cause and/or exacerbate these conditions.[1]

Coronary heart disease, including heart attacks and angina pectoris, is among the most common conditions among the 65 and older population in the U.S., affecting roughly 21 percent of this population in 2001. Several studies have also shown that exposures to common pollutants such as PM can increase risks associated with heart disease, and exposures to less common toxic pollutants such as lead have also been found to increase these risks. Because of the chronic nature of both heart disease and chronic respiratory disease, both diseases are expected to be associated with frequent and costly health-care utilization.

The prevalence of stroke is also very high among seniors, affecting 9 percent of the 65 and older population in 2001. In that same year, more than 404,000 Medicare fee-for-service beneficiaries were admitted to the hospital with a primary diagnosis of stroke (Trisolini et al., 2002). The Medicare hospital payments associated with those admissions were quite high—approximately $2 billion in 2001. Because

[1] For a summary of the epidemiological evidence regarding links between common air pollutants and respiratory and cardiovascular illness, see for example EPA (1999).

stroke victims often require a great deal of therapy and care beyond the initial hospital admission, the full cost of stroke among older Americans is likely to be much higher than $2 billion. Regarding the environmental etiology of stroke, studies have shown that exposures to pollutants such as PM, ozone, and lead may increase risks of stroke-related deaths (ATSDR, 1999).

Lung cancers, which according to CDC estimates (Lucas et al., 2004) affect less than one percent of the 65 and older population, are less prevalent in the elderly population than other conditions and certain other cancers. Nevertheless, lung cancers have the 2nd highest prevalence of cancers among those 65 and older, and it is known to impose significant costs on a per case basis. Furthermore, links between environmental exposures and lung cancers are well established. Known or suspected environmental causes of lung cancer include, among others, exposures to PM (Pope et al., 2002), asbestos (ATSDR, 2001), and radon (ATSDR, 1990).

Table 2-1. Selected Health Conditions (by ICD-9 Code)

ICD-9 Code	Health Condition
	Chronic Lung Disease
491	Chronic bronchitis
492	Emphysema
493	Asthma
494	Bronchiectasis
496	Chronic airway obstruction, not elsewhere classified
	Ischemic Heart Disease
410	Acute myocardial infarction
411	Other acute and subacute forms of ischemic heart disease
412	Old myocardial infarction
413	Angina pectoris
414	Other forms of chronic ischemic heart disease
	Stroke
430	Subarachnoid hemorrhage
431	Intracerebral hemorrhage
432	Other and unspecified intracranial hemorrhage
433	Occlusion and stenosis of precerebral arteries
434	Occlusion of cerebral arteries
436	Acute, but ill-defined, cerebrovascular disease
	Lung Cancer
162.2–162.9	Malignant neoplasm of bronchus and lung
197	Secondary malignant neoplasm of respiratory and digestive systems
231	Carcinoma in situ of respiratory system
	Pneumonia
480	Viral pneumonia
481	Pneumococcal pneumonia
482	Other bacterial pneumonia
483	Pneumonia due to other specified organism
485	Bronchopneumonia, organism unspecified
486	Pneumonia, organism unspecified
487	Influenza with pneumonia
	Gastrointestinal Illness
001–009*	Intestinal Infectious Diseases
558.9	Other and unspecified noninfectious gastroenteritis and colitis

*Excluding 008.45 (Clostridium difficile colitis)

Pneumonia is a relatively high-prevalence condition among older individuals, but more importantly, when older individuals are afflicted with this condition, they generally require more costly medical care than younger individuals. Among Medicare fee-for-service beneficiaries, the rate of hospital admission for pneumonia (and/or influenza) was 20 per 1,000 in 2001.[2] The annual cost of hospitalizations related to pneumonia is also typically very high, and pneumonia infections are also more likely to result in death when elderly persons become infected. As with chronic lung disease, exposures to common air pollutants, such as PM and ozone, have been found in several studies to cause and/or exacerbate pneumonia.

[2] Age- and gender-adjusted; based on RTI analysis of the Medicare Quality Monitoring System special analytical files (Trisolini et al., 2002).

Gastrointestinal illness (GI) is common in all age groups in the U.S.; however, the elderly face particularly high risks of hospitalization and death due to GI. According to discharge statistics for 1979–1995, hospitalization rates for GI were more than twice as high for those older than 65, and over 75 percent of hospital deaths from diarrheal disease were among this age group (Mounts et al., 1999). Exposures to waterborne pathogens are suspected to be significant contributors to overall rates of GI (Morris and Levin, 1995; Payment et al., 1991; and Bennett et al., 1987), although the attributable fraction is highly uncertain.

2.2 Overview of the COI Approach

The COI approach may be used to assess both direct and indirect costs of illness. Direct costs represent the dollar value of goods and services consumed as a result of illness and for which payment is made. They include payments for treatment, diagnosis, continuing care, rehabilitation, and terminal care and are typically measured as costs related to hospital stays, physician services, nursing homes, prescription drugs, and in-home health care services. Indirect costs represent costs for which no payment changes hands but for which an economic effect is still observed. They include primarily productivity losses associated with illness and premature death, and are typically measured as the value of lost productivity (labor and household) due to illness.

Most COI studies use a prevalence-based approach for estimating costs. Prevalence-based cost estimates include all costs related to a condition for the prevalent population over a given time period, usually a year. This approach includes costs for newly diagnosed cases as well as for those in the advanced stage of disease. Prevalence-based COI estimates are useful primarily for quantifying and highlighting the burden of a particular disease or condition. Incidence-based COI estimates represent the lifetime cost of disease, from onset to death. Incidence-based estimates require a great deal of data on disease progression in addition to costs at each stage of disease, and provide a useful measure of the cost savings of preventing or delaying onset of a disease for use in economic evaluations of preventive interventions. Because EPA is currently interested in understanding and quantifying the burden of diseases associated with environmental exposures in older Americans, a prevalence-based approach is most appropriate.

In this study, we used a prevalence-based approach to develop COI estimates that focus on the direct costs and labor, as well as household productivity losses, associated with each of the six conditions of interest. Our methods and data sources for the COI analysis are described in Section 3, and results are shown and described in Section 4.

2.3 COI Literature Review

Prior to generating our own estimates of the costs associated with heart disease, stroke, chronic lung disease, lung cancer, pneumonia, and gastrointestinal illness in individuals older than 65 years, we reviewed the literature on the costs of these conditions. We initially searched MEDLINE and PubMED to identify articles on the cost, cost-of-illness, expenditure, or economic impact or burden of each of the health conditions in a U.S. population 65 years and older. We limited our review to articles that were published in peer-reviewed journals from 1990 to the present. Following the decision to focus on the specific conditions and associated ICD-9 codes listed in Table 2-1 for COI analysis, we refined our literature search to include only those conditions. However, we also eliminated the requirement that studies provide cost estimates specifically for the 65 and older population. Our final review of articles on the six conditions consisted of 24 articles on the direct or indirect costs of chronic lung disease, 7 on heart disease, 9 on stroke, 7 on lung cancer, 9 on pneumonia, and 6 on GI illness. Brief summaries of methods, data sources, and findings from each study reviewed are provided in Tables A-1 to A-6 in Appendix A.

The methods, data sources, disease classifications, age groups considered, and specific cost categories estimated in each study varied widely. For chronic lung disease, specific studies focused on a

range of different cost outcomes, including hospitalization costs only, expenditures for all health care services, work-loss costs only, employer costs for absenteeism and employees' health care services, and informal caregiving costs. Data sources for estimating chronic lung disease costs also varied, and included survey data sources, such as the National Hospital Discharge Survey and Medical Expenditure Panel Survey, Medicare or private insurance claims data, and hospital-specific data on costs. Consequently, cost estimates also varied widely. In 2000 dollars, estimated annual costs for all health care services associated with chronic lung disease were approximately $1,000 to $7,800 per person (See Table A-1).

Estimated costs for heart disease also varied widely. Estimated direct medical costs associated with heart disease varied from about $5,900 to $7,400 per person. Total estimated medical costs associated with heart disease ranged from $67 billion for females over 45 years of age to $90.3 billion for all circulatory diseases in those 65 years and older. Large differences in estimated costs arise primarily because of differences in the cost categories analyzed or in the age groups considered.

For stroke, many of the studies reviewed focused on hospital charges, but one of these estimated costs only for those with diagnoses of both stroke and myocardial infarction. One study estimated hospital charges of approximately $13,000 per person for stroke alone. The estimated total direct and indirect cost of stroke was approximately $46 billion per year.

The estimated costs of lung cancer in the literature range from $5.6 billion (females over 45 years only) to $8.2 billion per year. One study estimated average Medicare payments per year for several cancers, including lung cancer, of about $28,000 per affected beneficiary (Riley et al., 1995).

Pneumonia cost studies primarily focused on hospitalization costs. Mean or median costs associated with pneumonia ranged from about $5,900 to $10,000 per person. Variations in these estimates reflect differences in the definitions used for pneumonia and the methods used (i.e., primary diagnosis costs versus attributable costs). Total direct medical cost estimates associated with pneumonia ranged from $5.7 to $19.4 billion per year.

Only one of the GI studies used the same disease classifications used in our COI analysis (Sandler et al., 2002). We selected the condition codes shown in Table 2-1 because they reflect the GI most closely associated with environmental exposures. Sandler et al. (2002) estimated direct medical costs associated with GI of $1.7 million per year for all age groups, and additional indirect costs of $540 million per year. Just over half of those costs were estimated to result from foodborne illnesses.

2.4 Discussion

Our review of the COI literature on the six conditions revealed large differences across studies in the methods used, the specific condition codes considered, the data sources analyzed, the age groups included, and the categories for which costs were estimated. Such differences make it difficult to compare cost estimates from different studies without first attempting to adjust them. We therefore recommended original COI analyses for the six conditions, using a consistent set of methods and data sources and focusing on the same cost categories across conditions for those 65 years and older.

In this subsection, we discuss features of COI studies in the literature that make it difficult to compare cost estimates across conditions or across studies on the same condition. We then describe how our COI approach produces comparable estimates across the six conditions.

First, the methods used to estimate disease costs vary across studies in the literature. Some analyses estimate costs for a primary diagnosis of a condition, while others provide cost estimates for any diagnosis of a condition. Still other studies generate cost estimates at the person level, as opposed to the condition level, by calculating the costs attributable to a condition (i.e., those costs that could presumably be saved if the condition were prevented) or by calculating incremental costs for people with the condition as compared to costs for people without the condition. No one approach is better than the others. In most cases, the available data dictate which methods may be used to assess costs. For

example, if condition codes are assigned to individuals with the condition as opposed to being assigned to specific health care services, it is generally preferred to estimate the incremental, or excess, cost of care for people with the condition.

COI studies in the literature rarely defined the conditions using the same set of ICD-9 codes as we selected for focus, making it difficult to compare cost estimates across studies and to our COI estimates. Our selection of ICD-9 codes for each condition was in part based on identifying health effects that are more likely to be associated with environmental exposures in older adults.

The data available for COI analysis ranged from private health insurance or Medicare claims data to national household-based survey data. Data from insurance claims are likely to provide the best source of information for identifying costs for each of the ICD-9 codes of interest. In contrast, survey data generally contain ICD-9 codes that are assigned to individuals based on self-reports of a health condition. However, because claims data provide cost and utilization information only for direct medical costs and exclude nonreimbursable medical care costs and nonmedical and indirect costs, survey data are often needed to estimate costs in these categories.

Finally, in reviewing COI analyses in the literature, we discovered that many studies focus on narrow categories of costs, such as hospitalization or employer-based costs, which makes it difficult to compare estimates across studies without accounting for the differences in the cost categories included. In our COI analyses, we attempted to estimate costs for the same set of cost categories for all six of the conditions. For some categories of costs, however, there were not enough observations with a specific condition to be able to generate reliable condition-specific cost estimates.

Differences in the information available from each data source used meant that data-specific methods were applied to estimate each category of costs. These methods were consistently applied across the six conditions. For example, because claims data contain information about the costs to diagnose or treat a specific condition, we estimated inpatient, physician, outpatient, home health, and durable medical equipment costs from Medicare claims by estimating the costs of a primary or any diagnosis of the health condition of interest (see Section 3 for details). In contrast, survey data generally contain costs for individuals but not for specific diagnoses. We therefore used survey data to estimate the incremental prescription drug and nursing home costs for people with each condition and to estimate the work loss and bed days attributable to each condition.

Because consistent COI methods, data sources, and disease classifications were used in our COI analyses for the six conditions, EPA can use the resulting COI estimates to make comparisons across the conditions. Such comparisons should help in assessing the relative burden of each condition among older adults and in making decisions about where to direct resources for the prevention or treatment of disease associated with environmental health exposures in the elderly.

3. Cost Analysis Data and Methods

To estimate the annual cost burden associated with each of the six selected conditions in 2000 among individuals 65 and older, we separately estimated direct and indirect costs for each illness. In this section, we describe the data and methods used to construct these cost estimates.

3.1 Direct Costs

To make best use of the available national data, we separated the estimation of direct costs into three mutually exclusive components:

- medical costs,
- self-administered prescription drug costs, and
- nursing home costs.

Each of these components is discussed below.

3.1.1 Medical Costs

For individuals 65 and older, Medicare claims provide the most comprehensive source of data on costs for medical services. National samples of claims data are accessible in different ways. After reviewing the alternatives, we selected the Consumer Assessment of Health Plans Surveys (CAHPS) for Medicare Fee-for-Service (MFFS) beneficiaries as the primary data source for our analysis.

3.1.1.1 Data Description

CAPHS-MFFS was selected for this part of the analysis because it was relatively easy to access and is well suited for this analysis. These data include detailed Medicare claims data and other potentially relevant demographic and health-related information for a large and nationally representative sample of older Americans.

The sampling frame for CAHPS-MFFS was drawn from CMS's Enrollment Data Base (EDB), which comprises approximately 30 million persons enrolled in fee-for-service Medicare and residing in the United States or Puerto Rico. Beneficiaries with less than 6 months' continuous enrollment in MFFS and those with a representative payee or living in an institution were excluded. To select the CAHPS-MFFS sample, a total of 276 geographic primary sampling areas were constructed, each consisting of one or more counties, and the sample was allocated to these areas to achieve a minimum of 300 respondents in each area.

The CAHPS-MFFS sample for this study included 145,875 noninstitutionalized Medicare beneficiaries, age 65 years or older, who were enrolled in MFFS and eligible for Part A and Part B benefits for at least part of 2000. Beneficiaries with proxy respondents were excluded from the analysis. It should be noted that, because the study was based on a retrospective analysis of self-reported survey data, the study sample has a disproportionate share of nondecedents. The disproportionate share of nondecedents in the sample may slightly bias the cost estimates from our analysis. However, because health care costs tend to escalate during the last few months of a person's life and drop to zero thereafter, the overall direction of this bias is not known

3.1.1.2 Analysis Methods

To estimate medical costs associated with the selected illness categories, we began by extracting Medicare claims information for the year 2000 for all Medicare-covered medical services and for all survey respondents and nonrespondents. Medicare-covered services include

- acute and nonacute inpatient services,
- hospital outpatient and other ambulatory services,
- professional fees,
- home health services, and
- durable medical equipment.

Medicare does not cover self-injected medications administered in a home or outpatient setting and nursing home or other long-term care services; therefore, costs for these services are not included in this claims-based analysis.

Costs reported in the Medicare claims data include

- payments made by Medicare,
- beneficiary payments in the form of deductibles and copayments, and
- any third-party payments.

Total medical payments are calculated as the sum of the three payments types.

We then identified medical costs associated with each of the illness categories by matching the ICD-9 codes recorded for each claim with the condition-specific ICD-9 codes listed in Table 2-1. For inpatient services, each claim consolidates payments at an admissions level. Consequently, each of these claims may be associated with multiple ICD-9 codes—one for the primary diagnosis and potentially several more codes for related secondary diagnoses. Similarly, claims for outpatient and home health services report payments that may be associated with multiple ICD-9 codes. In contrast, claims for professional fees and durable medical equipment are all condition specific and are therefore associated with a single ICD-9 code.

For this analysis, we selected all claims that were recorded with *at least one* of the ICD-9 codes listed in Table 2-1, including both primary and secondary diagnostic codes for inpatient, outpatient, and home health services. Because payments for these types of services are consolidated, they may include costs that are attributable to conditions other than the selected ICD-9 codes. As a result, for inpatient, outpatient, and home health services, the cost estimates developed in this analysis are likely to overstate the costs that are specifically attributable to the six conditions of interest. The extent of this overestimation is not known. For professional fees and durable medical equipment, no similar overestimation of costs is expected because they are all based on condition-specific claims.

Using the CAHPS-MFFS (with appropriate geographic weights for the stratified sample), we were therefore able to obtain unbiased nationally representative estimates for the roughly 26 million nonistitutionalized Medicare beneficiaries over the age of 64 enrolled in fee-for-service in 2000. Based on the sample of 145,875 respondents, we are able to estimate the number and percentage (prevalence rate) of beneficiaries, 65 and older, who were diagnosed with conditions in each of the six illness categories in 2000. It should be noted these prevalence estimates are based on claims for services in 2000; therefore, they do not include individuals who had the underlying condition in 2000 but did not for whatever reason seek care for the condition during that period. Consequently, these claims based prevalence estimates are likely to underestimate by a small amount the overall prevalence of each condition in the noninstitutionalized fee-for-service elderly population.

For these beneficiaries, we are also able to estimate the average (per capita) and aggregate medical costs associated with these illnesses in 2000. With the information in CAHPS-MFFS, it is also possible to disaggregate these estimates by

- type of medical service,
- age/gender categories, and
- Census region and state.

The results for each illness category are summarized in Section 4, with additional detail provided in Appendix C.

To extrapolate these direct medical cost estimates to the entire non-institutionalized population of individuals 65 and older in 2000, we assumed that the prevalence and average costs for each condition based on the CAHPS-FFS data were also applicable to those not participating in fee for service Medicare and not in nursing homes. According to U.S. Census data, the total 65 and older population in 2000 was 35 million, and according to the National Center of Health Statistics (NCHS, 2003) the number of nursing home residents was 1.5 million. Therefore, we applied the prevalence and average cost estimates for each condition to an assumed total population of 33.5 million. This extrapolation is like to slightly overestimate prevalence and costs for those not in fee-for service Medicare (and not institutionalized) because they are on average somewhat younger and in somewhat better health than those in Medicare fee for service (Brown et al., 1993).

3.1.2 Self-Administered Prescription Drug Costs

One of the inherent limitations in using Medicare claims data (including CAHPS-MFFS as discussed in Section 3.1.1) to assess direct costs of illness is that expenditures for self-administered prescription drugs are not reimbursable by Medicare and are therefore excluded from the claims-based cost estimates. To estimate these prescription drug costs for each of the six conditions, we used data from the 2000 Medical Expenditures Panel Survey (MEPS).

3.1.2.1 Data Description

The MEPS is a nationally representative subsample of the National Health Interview Survey (NHIS, described in some detail below in Section 3.2). One important feature of the MEPS is that it allows for the linkage of demographic data on individuals to their health care utilization, spending, and sources of payment.

The 2000 survey requested information about the number of prescription medication purchases (including refills) and total expenditures for prescription drugs by sources of payment. The sources of payment for which information was collected include self or family, Medicare, Medicaid, private insurance, TRICARE, the Veterans' Administration, workers' compensation, and other sources. The survey also contains a conditions file that includes information about all conditions reported for household residents.

Health conditions included in MEPS are those reported by a household respondent and those listed as the reason for a medical provider visit or prescribed medication. Medical conditions were recorded by the interviewer as verbatim text; professional coders later assigned three-digit ICD-9 codes.

3.1.2.2 Analysis Methods

To estimate the prescription drug costs associated with each of the six conditions, we first created a sample of individuals 65 years and older from the 2000 MEPS and then calculated mean prescription drug expenditures for each condition by age group (65 to 74, 75 to 84, and 85 years and older) and by sex. Mean expenditures and standard errors were estimated for total prescription drug spending, for Medicare spending, for total spending except Medicare, and for total spending except Medicare and self- or family-paid costs. To avoid double-counting, our reported estimates focus on the cost estimates that exclude prescription drugs where Medicare was reported as the source of payment. However, cost estimates from

our analysis of Medicare claims may also include co-pays or deductibles that represent out-of-pocket expenses. Consequently, our prescription drug cost estimates may include some out-of-pocket expenses that are also included in our cost estimates from Medicare claims analysis.

Because estimates of mean total prescription drug costs cannot be taken as attributable cost estimates, we also estimated the incremental, or additional, costs of prescription drugs for individuals with each condition as compared to persons without the condition, by age group and by sex. Incremental cost estimates represent the additional costs for those with the condition as compared to those without the condition. We chose to consider incremental costs because it allows us to interpret our estimates as representing excess costs for people with the conditions of interest. However, because it is not uncommon for individuals in the 65 and older age group to have high medical care expenses, incremental cost estimates in an older population are often close to zero or even negative. In other words, individuals in this age group who do not have the condition of interest have a fairly high likelihood of having another costly condition or disability. In comparison, total cost estimates are limited in that they represent total costs for individuals with a condition and do not account for the high degree of comordity in the over-65 population.

3.1.3 Nursing Home Costs

Another gap in our cost estimates from Medicare claims data (using CAHPS-MFFS) is the cost associated with care in a nursing home. We address this gap by analyzing nursing home charges using the 1999 National Nursing Home Survey (NNHS).

3.1.3.1 Data Description

The 1999 NNHS sample consisted of 1,496 of the approximately 18,400 nursing homes in the United States that had at least three beds and were either certified by Medicare or Medicaid or had a state license to operate as a nursing home. A sample of up to six current residents was selected from each participating nursing home for inclusion in the current resident file. Interviews were then conducted with nursing staff familiar with residents' medical records to collect demographic information, diagnoses (ICD-9 codes assigned at admission and based on current records), total charges for a specified period, and indicators for a range of different sources of payment (e.g., self pay, Medicare, Medicaid). The responding nurse referred to the resident's medical record when answering the interview questions.

3.1.3.2 Analysis Methods

To develop an estimate of the nursing home costs associated with each of the six conditions, we used the NNHS current resident file and limited our analysis to those people 65 years and older. We then calculated mean total charges by sex, age group (65 to 74, 75 to 84, and 85 years and older), and condition. These estimated charges were converted to costs by using the Medicare cost-to-charge ratio for skilled nursing facilities, which was 0.78777. Estimated costs were updated to 2000 dollars using the consumer price index for all urban consumers.

Incremental cost estimates were then generated for each condition by taking the difference of mean total costs by age group and sex for those with and without the condition of interest. We also examined frequencies of Medicare as a source of payment and the inclusion of drugs and medical supplies in the total charges reported.

Applying estimates of *mean* incremental costs for each health condition to calculate *aggregate* nursing home costs also requires estimates of the number of elderly in nursing homes with each condition. Data on nursing home trends (NCHS, 2003) indicates that there were approximately 1.5 million nursing home residents in 2000. To estimate the portion of this population that experienced each condition, we applied the prevalence rates derived from the CAPHS-MFFS data. These claims based prevalence estimates are likely to somewhat underestimate prevalence among nursing home residents because rates

of illness are typically higher in the institutionalized population and because the claims based estimates do not include those who did not seek care for their condition in 2000.

3.2 Indirect Costs

Indirect costs are those for which no payment is made, but for which an economic effect is still observed. In our analysis and in most COI studies, a human capital approach is used to value the indirect cost of time lost from productive activities due to excess morbidity or premature mortality. The human capital approach values productivity losses based on market earnings and an imputed value for household production (Drummond et al., 1997). Advantages of the human capital approach are that it assumes a societal perspective and relies on data that are readily available. A disadvantage is that estimates of the value of life and health among the retired elderly will be lower than comparable estimates for working-age adults because the estimates are based largely on measures of market productivity. The human capital approach also ignores the costs of pain and suffering associated with an illness and excludes the value of time lost from consumption activities (Tolley, Kenkel, and Fabian, 1994).

The concept of willingness to pay (WTP) is useful for addressing the limitations of the human capital approach. However, the implementation of stated or revealed preference approaches to estimate the value of health effects, or WTP, requires far more time and resources than does a human capital approach using existing data. For this reason, we used the human capital approach to value indirect costs associated with the six conditions. These estimates may be thought of as lower-bound estimates for the full indirect costs of each condition.

3.2.1 Increased Morbidity

We used data from the 2001 National Health Interview Survey (NHIS) to estimate the impact of each condition on labor force participation rates, number of work loss days for those who were working during the survey year, and number of bed days. These estimates were combined with age- and sex-specific earnings and household productivity values for 2000 to generate estimates of the increased morbidity costs associated with each condition.

3.2.1.1 Data Description

The NHIS is an annual household interview survey designed primarily to collect data about the health status, health conditions, and health care utilization of household members. The survey also requests information about basic demographics and about days lost from work, bed days, and functional limitations. Data are collected annually from about 43,000 households and about 106,000 persons within the households. Information about diseases and other health conditions among people was also collected. However, the NHIS did not contain information about pneumonia or gastrointestinal illness; as a result, these conditions are excluded from our morbidity cost estimates.

Data from the NHIS were combined with productivity estimates from Grosse (2003). Grosse provides estimates of annual earnings for those in the workforce and household productivity for all adults by age group (65 to 74 and 75 and older) and by sex.

3.2.1.2 Analysis Methods

We used the 2001 NHIS to estimate two components of labor productivity losses: the losses associated with being completely unable to work (out of the labor force) and the losses associated with missing work days. For the first component, we used estimates of the percentage of those who report that they are not currently working but worked previously as a proxy for the probability of being unable to work due to poor health. We estimated the probability of being completely unable to work because of one of the six health conditions as the excess percentage of those with the condition as compared to those

without the condition who are not currently working. Separate estimates of the probability of being unable to work were developed for all those 65 years and older for each condition.

We then estimated the per-person morbidity cost associated with being completely unable to work as the estimated probability of being unable to work because of the condition multiplied by annual earnings. Annual labor market earnings estimates were by sex for the 65 to 74 and 75 years and older age groups.

For the second component of labor productivity losses, we limited our analysis to those over 65 years of age who reported that they currently work. We then used a regression approach to estimate the impact of each condition on missed work days, controlling for a number of variables, including education, poverty status, self-reported health status, occupation, and smoking status.

Results from our regression analysis are shown in Appendix B. Using the regression results, we generated predictions of the number of missed work days attributable to each of the six conditions. These estimates were generated by condition and by sex for all age groups combined. We then estimated labor productivity losses by multiplying predicted work-loss days by sex-specific average daily earnings for those 65 to 74 years and 75 years and older in the workforce (Grosse, 2003). Per-person estimates for all those with the condition were generated by multiplying estimated productivity losses due to missed work days by the percentage with each condition that currently works. Our methods for estimating the household productivity losses associated with being sick in bed were similar.

Our bed days analysis included all those 65 years and older. We used a regression approach to estimate the impact of each condition on number of bed days, controlling for education, poverty status, self-reported health status, labor force participation status, and smoking status. Based on these results, we predicted the number of bed days attributable to each condition by sex. Household productivity losses were estimated by multiplying predicted bed days for each condition by sex-specific average household productivity for those 65 to 74 years and 75 years and older.

The estimates of labor productivity losses shown in Section 4 represent the sum of the expected costs due to being unable to work and the expected costs due to missing work for people with each condition. Household productivity losses represent the value of lost household work attributable to each condition.

Our estimates for lung cancer are limited by the small number of observations in the 65 years and older age group in the 2001 NHIS. Only 26 males and 15 females were identified with lung cancer. The number with lung cancer who reported being in the labor force was even smaller and forced us to exclude lung cancer from our work days-loss analysis. We also excluded lung cancer from our analysis of bed days attributable to lung cancer. The only morbidity costs for lung cancer included in our analysis are the costs associated with being completely unable to work.

We do not provide measures of dispersion for our indirect cost estimates, in large part because our source for the earnings and household productivity estimates did not provide standard errors or other measures of dispersion. Because the variation in earnings among older individuals who work is much greater than the variation in the percentage of older Americans who work, we chose not to estimate standard errors that would necessarily treat earnings as having no variation.

3.2.2 Premature Mortality

We used data from the 1998 National Vital Statistics Report (NVSR) to determine the number of annual deaths with one of the six conditions listed as the cause of death. These data were combined with estimates of the present value of earnings and household productivity from Grosse (2003) to estimate the cost of mortality due to each condition.

3.2.2.2 Data Description

The 1998 NVSR provides calculations from all death certificates filed in the 50 states and the District of Columbia in 1996 (Peters, Kockanek, and Murphy, 1998). We relied on the 1998 report primarily because it uses ICD-9 codes to categorize causes of death. Later reports began using the revised ICD-10 classification scheme. The NVSR provides statistics on deaths and death rates by age group (65 to 74, 75 to 84, and 85 years and older) for groupings of ICD-9 codes that closely match the disease groupings we selected for COI analysis. It also provides death rates for the overall population by age group and sex.

Grosse (2003) provides estimates of the present value of earnings and household productivity by age for several different discount rates. In our analysis, we use the Grosse (2003) present value estimates for earnings only and for earnings and household production combined. For both measures, we assume that the value of future production is discounted at an annual rate of 5 percent.

3.2.2.3 Analysis Methods

To estimate the indirect costs resulting from premature mortality among those 65 years and older, we multiplied the cause- and age group-specific number of deaths for each condition by the age group-specific present value of earnings (earnings and household production). Because Grosse (2003) does not provide an estimate for expected productivity among those 85 and older, we were not able to estimate losses (labor or household) for deaths in the 85 and older age group. The present value of productivity losses in this age group is expected to be lower than for the younger age groups.

For ischemic heart disease and pneumonia, the health condition categories provided in the NVSR exactly matched our characterization of the condition using ICD-9 codes. However, for chronic lung disease (CLD), stroke, and lung cancer, the NVSR condition categories included some ICD-9 codes that were not used in our assessment of direct costs. For gastrointestinal illness, the NVSR condition categories excluded some of the ICD-9 codes used in our direct cost analyses. Because of these discrepancies, our estimates of mortality costs for CLD, stroke, and lung cancer are slight overestimates of mortality costs, while our estimate for gastrointestinal illness is an underestimate of actual mortality costs for the conditions of interest.

4. Cost-of-Illness Estimates for Selected Conditions in Older Americans

Using the data and methods described in Section 3, we estimated the direct and indirect costs of illness associated with each of the six selected conditions in 2000 among individuals 65 and older. In this section, we separately summarize the results for CLD, ischemic heart diseases (IHD), stroke, lung cancer, pneumonia, and gastrointestinal illness. All costs reported in the results tables are expressed in 2000 dollars.

4.1 Chronic Lung Disease

As summarized in Table 4-1, we estimated that approximately 4.4 million older Americans suffered from CLD in 2000, and it was the primary cause associated with almost 100,000 deaths in individuals 65 and older. Based on these estimates, we also calculated aggregate direct and indirect costs from CLD in this population to be approximately $33.9 billion. These results are further described and disaggregated in the sections below.

Table 4-1. Costs of Illness Associated with Chronic Lung Disease—Estimated Aggregate Costs in 2000 for Individuals 65 and Older

Cost Category	Number of Affected Individuals	Mean Cost ($/person)	Aggregate Costs
Direct Costs			
Medical	4,190,512	$5,786	$24,246,304,937
Prescription Drug	4,190,512	$574	$2,405,354,137
Nursing Home	185,000	$3,471	$642,135,000
Indirect Costs			
Morbidity	4,190,512	$1,574	$6,594,623,730
Mortality	98,326	—	$9,895,808
Total Costs of Illness	—	—	$33,898,313,612

4.1.1 Direct Costs: Medical

Based on CAHPS-MFFS data, roughly 3.3 million (12.5 percent of) noninstitutionalized Medicare fee-for-service elderly beneficiaries suffered from CLD in 2000, and the annual medical costs for these beneficiaries averaged about $5,800 per year. As shown in Table 4-2, the largest component of these costs was associated with inpatient services, which averaged over $13,000 for nearly 1.2 million beneficiaries. The aggregate medical cost estimates shown in Table 4-1, were extrapolated from these estimates, assuming the same prevalence and average costs for CLD among the noninstitutionalized elderly who do not participate in Medicare fee-for-service. As described in Section 3, this extrapolation is likely to somewhat overestimate aggregate medical costs in the noninstitutionalized elderly population.

Rates of CLD among the male elderly population were found to be significantly higher than among the female elderly population in each of the three age categories listed in Table 4-2. Furthermore, whereas rates of CLD among the female population were between 10 and 12 percent for all three age categories, the rate for males climbed from 13 percent for those between 65 and 74 years to 19 percent for those 85 and older. Compared to this variation in prevalence rates, there was considerably less variation in average medical costs for CLD across age and gender categories, ranging between $5,000 and $6,500.

4.1.2 Direct Costs: Self-Administered Prescription Drugs and Nursing Home Care

Having CLD was associated with significantly higher prescription drug costs for males and females in the 65 to 74 years age group. These estimates are described in Table 4-3. Estimated costs for this age group were approximately $600 to $1,200. Estimated incremental prescription drug costs were $574 for the total population over 65 years with CLD. Excess costs for those in the two oldest age groups

Table 4-2. Direct Medical Costs Associated with Chronic Lung Disease—Number of Beneficiaries and Average Medical Payments by Type of Service and Age-Gender Category

	Beneficiaries with a Diagnosis			Direct Medical Costs ($/Person/Year)	
	Number	Percent	95%CI (±)	Mean	95%CI (±)
Total	3,264,847	12.5	(12.3, 12.7)	5,786	(5,568, 6,005)
Type of Medical Service					
Inpatient	1,196,221	4.6	(4.5, 4.7)	13,019	(12,535, 13,504)
Physician	1,611,419	8.8	(8.6, 8.9)	461	(439, 483)
Hospital outpatient	1,069,976	4.1	(3.9, 4.2)	570	(535, 610)
Home health	201,731	7.7	(0.7, 0.8)	2,643	(2,406, 2,880)
Durable medical equipment	720,079	2.7	(2.7, 2.8)	2,220	(2,142, 2,298)
Age-Gender Category					
Age 65–74 Years					
Male	754,596	12.9	(12.5,0.13.3)	5,596	(5,146, 6,046)
Female	706,640	10.1	(9.8, 10.5)	5,122	(4,655, 5,588)
Age 75–84 Years					
Male	649,188	17.1	(16.6, 17.7)	6,030	(5,539, 6,520)
Female	687,217	11.6	(11.2, 11.9)	6,461	(5,901, 7,021)
Age 85+ Years					
Male	192,794	19.0	(17.8, 20.1)	5,131	(4,610, 5,652)
Female	273,812	10.5	(10.0, 11.1)	6,219	(5,625, 6,814)

Note: Geographic weights used to obtain unbiased nationally representatives estimates for Medicare elderly population.

Table 4-3. Other Direct Costs Associated with Chronic Lung Disease—Incremental Cost Estimates for Prescription Medications and Nursing Home Services by Age-Gender Category

	Prescription Drug Incremental Costs			Nursing Home Incremental Costs		
Age	Sample Size	Mean ($/Person/Year)	95% CI (±)	Sample Size	Mean ($/Person/Year)	95% CI (±)
Age 65+ years	174	$574	(264, 884)	764	$3,471	(–3,138, 10,081)
Age 65–74 years						
Male	37	$563	(124, 1,003)	71	$28,200	(–43,331, 99,730)
Female	59	$1,215	(588, 1,843)	64	$9,574	(222, 18,927)
Age 75–84 years						
Male	24	$128	(–251, 506)	102	($651)	(–6,507, 5,206)
Female	40	$141	(–325, 607)	175	$505	(–3,286, 4,296)
Age 85+ years						
Male	4	($429)	(–701, –157)	104	$1,102	(–2,846, 5,049)
Female	10	$42	(–609, 694)	248	($634)	(–2,925, 1,657)

Notes: Prescription drug estimates exclude those with source of payment listed as Medicare. () denotes a negative value.

were not statistically significantly different from zero. The lower estimated excess drug costs for the two oldest age groups probably reflects the higher rate of comorbidity and prescription drug use among all individuals 75 years and older, which tends to make the prescription drug spending of those with CLD look similar to those without.

Table 4-3 also shows estimates of nursing home costs associated with CLD. Although the standard errors on the estimated incremental nursing home costs were large, incremental costs were fairly large for males and females in the 65 to 74 years age group, especially for males. Estimated excess nursing home costs for the other two age groups were much smaller and were not statistically different from zero. Our findings of higher excess costs for the youngest age group with CLD is consistent with the hypothesis of a large degree of costly comorbidities within the 75 years and older population.

4.1.3 Indirect Costs: Morbidity

As shown in Table 4-4, we estimate that, for those older Americans suffering from CLD, the annual per person labor productivity losses resulting the illness vary across age and sex subgroups from about $900 to $2,000. These estimates include the probability of being out of the labor force, which is about 4 percentage points higher in people with CLD than for the average older American, and work-loss days among the 10 percent of older people with CLD who continue to work. Our estimates of work-loss days attributable to CLD are 4.6 for females and 3.4 for males.

Table 4-4. Morbidity-Related Indirect Costs Associated with Chronic Lung Disease—Estimated Annual Per-Person Productivity Losses by Age-Gender Category

Age	Labor Productivity Losses	Household Productivity Losses	Total Productivity Losses
Age 65+ years	$1,420	$154	$1,574
Age 65–74 years			
Male	$1,867	$103	$1,971
Female	$836	$211	$1,047
Age 75+ years			
Male	$1,566	$95	$1,660
Female	$752	$181	$933

Estimates of annual household productivity losses resulting from increased morbidity in those with CLD are fairly low and average $154 per person for all those over 65 years of age. Estimates range from $95 per year for males older than 75 years up to $211 per year for females in the 65 to 74 years age group. Our estimates indicate that the number of bed days per year attributable to CLD is about 5 for females and 3 for males.

Total productivity losses are calculated as the sum of estimated labor and household productivity losses. They are estimated to average about $1600 for those 65 and older with CLD.

4.1.4 Indirect Costs: Mortality

Using data from NSVR, Table 4-5 shows that the annual number of deaths with CLD as the cause was estimated to be about 98,000 in 2000, with 76 percent occurring in people between 65 and 84 years of age. Because many of the expected deaths resulting from CLD are in the 65 to 74 and 75 to 84 years age groups, the present value of labor productivity losses associated with CLD is high—over $2 billion per year. The combined value of labor and productivity losses is also high—about $9.9 billion per year. As discussed in Section 3, the value of productivity losses for those 85 and older could not be estimated due to lack of data on expected productivity for this age group.

Table 4-5. Mortality-Related Indirect Costs Associated with Chronic Lung Disease—Estimated Aggregate Productivity Losses by Age Category

Age	Number of Deaths	Aggregate Labor Productivity Losses (in 1,000s)	Aggregate Labor and Household Productivity Losses (in 1,000s)
Age 65+ years	98,326	$2,120,309	$9,895,808
Age 65–74 years	29,869	$1,523,485	$5,685,484
Age 75–84 years	44,651	$596,824	$4,210,324
Age 85+ years	23,806	—	—

Notes: Chronic lung disease diagnosis in mortality data is based on ICD-9 codes of 490-496. Mortality related indirect costs for 85+ not estimated due to lack of data on expected productivity for this age group.

4.2 Ischemic Heart Disease

Of the six conditions analyzed in this report, IHD is the most prevalent condition among older Americans. We estimate that approximately 6.9 million older Americans experienced IHD in 2000, and other data indicate that almost 450,000 deaths were primarily attributable to the disease. As reported in Table 4-6, we estimate the aggregate direct (except nursing home) and indirect costs from CLD in this population to be approximately $50.1 billion in 2000. These results are further described and disaggregated in the sections below.

Table 4-6. Costs of Illness Associated with Ischemic Heart Disease—Estimated Aggregate Costs in 2000 for Individuals 65 and Older

Cost Category	Number of Affected Individuals	Mean Cost ($/person)	Aggregate Costs
Direct Costs			
Medical	6,604,030	$5,716	$37,748,632,961
Prescription drug	6,604,030	$680	$4,490,740,100
Nursing home	290,080	—	—
Indirect Costs			
Morbidity	6,604,030	$1,193	$7,878,384,878
Mortality	443,494	—	$34,535,761
Total Costs of Illness	—	—	$50,152,293,701

4.2.1 Direct Costs: Medical

Our analysis of direct medical costs, summarized in Table 4-7, indicates that over 5.1 million (20 percent of) Medicare fee-for-service elderly beneficiaries experienced IHD in 2000. The prevalence of IHD is therefore almost 60 percent greater than for CLD in this population; however, the annual medical costs per beneficiary are very similar, averaging about $5,700 per year. As with all of the conditions analyzed in this report, the largest component of estimated medical costs was associated with inpatient services, in this case averaging about $13,000 for over 1.8 million beneficiaries. When the estimated medical costs of IHD for fee-for-service beneficiaries ($5716) are extrapolated to the entire noninstitutionalized population of adults over 65 in 2000 (33.5 million), they sum to almost $38 billion, as shown in Table 4-5.

As is the case with CLD, the prevalence of IHD was found to be significantly higher among the male elderly population than the female elderly population in each of the three age categories listed in Table 4-7. However, rates of IHD for both males and females were significantly higher in the older age categories. The rate for males was 22 percent for those between 65 and 74 years and 32 percent for those

Table 4-7. Direct Medical Costs Associated with Ischemic Heart Disease—Number of Beneficiaries and Average Medical Payments by Type of Service and Age-Gender Category

	Beneficiaries with a Diagnosis			Direct Medical Costs ($/Person/Year)	
	Number	Percent	95%CI (±)	Mean	95%CI (±)
Total	5,145,229	19.6	(19.4,19.9)	5,716	(5,557, 5,875)
Type of Medical Service					
Inpatient	1,878,134	7.2	(7.0, 7.3)	13,181	(12,852, 13,511)
Physician	4,084,632	15.6	(0.1, 0.2)	641	(621, 661)
Hospital outpatient	1,859,793	7.1	(7.0, 7.2)	407	(389, 425)
Home health	265,519	1.0	(1.0, 1.1)	2,063	(1,913, 2,213)
Durable medical equipment	40,886	0.2	(0.1, 0.2)	831	(584, 1,079)
Age-Gender Category					
Age 65–74 Years					
Male	1,280,121	21.9	(21.4, 22.3)	5,707	(5,359, 6,056)
Female	832,829	11.9	(11.6, 12.3)	5,803	(5,385, 6,220)
Age 75–84 Years					
Male	1,169,587	30.8	(30.1, 31.5)	5,770	(5,429, 6,110)
Female	1,028,219	17.3	(16.8, 17.8)	5,792	(5,439, 6,146)
Age 85+ Years					
Male	320,908	31.5	(30.2, 32.9)	4,957	(4,530, 5,385)
Female	513,565	19.8	(19.0, 20.5)	5,793	(5,400, 6,186)

Note: Geographic weights used to obtain unbiased nationally representatives estimates for Medicare elderly population.

85 and older. For women, the rates of IHD were 12 and 20 percent, respectively. The average medical costs for IHD across age and gender categories varied by less than $1,000 (i.e., between $4,900 and $5,800).

4.2.2 Direct Costs: Self-Administered Prescription Drugs and Nursing Home Care

Our estimates of the excess prescription drug costs associated with heart disease were positive for all age and sex subgroups. As reported in Table 4-8, on average, prescription drug costs for those over 65 years with IHD were $680 higher than for those without. These findings suggest that heart disease drug costs exceed the cost of drugs for many other diseases that afflict the elderly. Estimated incremental prescription costs for the 65 to 74 years age group were $700 to $1,100 and statistically different from zero. For the two older age groups, estimated excess drug costs were generally positive, but much lower and not significantly different from zero.

Estimates of excess nursing home costs for individuals with heart disease are not significantly different from zero for any of the age and sex subgroups. These findings suggest that among nursing home residents older than 64 years, those with heart disease have nursing home costs that are no higher than those without the condition. The estimated negative mean value for incremental nursing home costs reported in Table 4-8 was assumed to be implausible and therefore not included in the aggregate estimates for IHD reported in Table 4-6.

Table 4-8. Other Direct Costs Associated with Ischemic Heart Disease—Incremental Cost Estimates for Prescription Medications and Nursing Home Services by Age-Gender Category

	Prescription Drug Incremental Costs			Nursing Home Incremental Costs		
Age	Sample Size	Mean ($/Person/ Year)	95% CI (±)	Sample Size	Mean ($/Person/ Year)	95% CI (±)
Age 65+ years	156	$680	(400, 961)	1,042	($1,357)	(–3,187, 474)
Age 65–74 years						
Male	45	$722	(203, 1,240)	55	($9,572)	(–27,005, 7,860)
Female	37	$1,120	(467, 1,773)	55	$3,240	(–3,486, 9,967)
Age 75–84 years						
Male	22	$18	(–233, 269)	116	($1,286)	(–6,962, 4,389)
Female	35	$675	(260, 1,091)	231	($1,969)	(–5,371, 1,433)
Age 85+ years						
Male	8	$311	(–460, 1,082)	127	($905)	(–4,847, 3,038)
Female	9	$237	(–167, 642)	458	($645)	(–3,011, 1,722)

Notes: Heart disease diagnosis based on ICD-9 code of 410-414. Sample weights used and complex survey design taken into account in calculating standard errors. Prescription drug estimates exclude those with a source of payment listed as Medicare. () denotes a negative value.

4.2.3 Indirect Costs: Morbidity

The estimated labor productivity losses resulting from increased morbidity in people with IHD are a bit lower than estimated losses for those with CLD. Table 4-9 reports estimated labor productivity losses per person with IHD of about $470 to $1,200, with a portion of those losses arising because people with heart disease have a 3 percentage point higher probability of being unable to work than the analogous population without heart disease. Among those with heart disease who do work, we estimate work-loss days attributable to heart disease of 1.7 for females and 1 for males. The average labor productivity loss across age and sex subgroups is $880 per year.

Table 4-9. Morbidity-Related Indirect Costs Associated with Ischemic Heart Disease—Estimated Annual Per-Person Productivity Losses by Age-Gender Category

Age	Labor Productivity Losses	Household Productivity Losses	Total Productivity Losses
Age 65+ years	$878	$315	$1,193
Age 65–74 years			
Male	$1,156	$210	$1,366
Female	$517	$449	$966
Age 75+ years			
Male	$969	$192	$1,162
Female	$465	$385	$850

Estimated household productivity losses in older people with heart disease are $315 and range from $192 to $449 per year within specific age and sex subgroups. These estimates are based on estimated bed days attributable to heart disease of 10 for females and 6 for males.

4.2.4 Indirect Costs: Mortality

The estimated annual number of deaths in 2000 with IHD as the cause is over 443,000—over four times the number of deaths resulting from CLD in this age group and almost three times the number of stroke deaths. The large number of deaths caused by heart disease is associated with high labor and household productivity losses. As shown in Table 4-10, the estimated annual labor productivity losses resulting from heart disease mortality are $7 billion, while the estimated annual labor and household productivity losses are almost $35 billion.

Table 4-10. Mortality-Related Indirect Costs Associated with Ischemic Heart Disease—Estimated Aggregate Productivity Losses by Age Category

Age	Number of Deaths	Aggregate Labor Productivity Losses (in 1,000s)	Aggregate Labor and Household Productivity Losses (in 1,000s)
Age 65+ years	443,494	$7,231,200	$34,535,761
Age 65–74 years	97,226	$4,959,013	$18,506,512
Age 75–84 years	169,993	$2,272,187	$16,029,249
Age 85+ years	176,275	—	—

Notes: Ischemic heart disease diagnosis in mortality data is based on ICD-9 codes of 410-414. Mortality related indirect costs for 85+ not estimated due to lack of data on expected productivity for this age group.

4.3 Stroke

As summarized in Table 4-11, we estimate that approximately 2.6 million older Americans experienced strokes in 2000. We also find that over 150,000 deaths in individuals 65 and older were primarily attributable to stroke. Based on these estimates, we calculated aggregate direct (except for nursing home) and indirect costs from stroke in this population to be approximately $18.1 billion. These results are further described and disaggregated in the sections below.

Table 4-11. Costs of Illness Associated with Stroke—Estimated Aggregate Costs in 2000 for Individuals 65 and Older

Cost Category	Number of Affected Individuals	Mean Cost ($/person)	Aggregate Costs
Direct Costs			
Medical	2,535,378	$3,725	$9,444,281,366
Prescription drug	2,535,378	$945	$2,395,931,783
Nursing home	111,000	—	—
Indirect Costs			
Morbidity	2,535,378	$2,478	$6,281,881,402
Mortality	156,000	—	$10,423,691
Total Costs of Illness	—	—	$18,132,518,242

4.3.1 Direct Costs: Medical

Table 4-12 summarizes our estimates of stroke-related medical costs among Medicare fee-for-service elderly beneficiaries. We estimate that roughly 2 million (7.5 percent of) beneficiaries experienced stroke in 2000. The annual medical costs per beneficiary averaged $3,700 per year, which is significantly lower than for CLD and IHD. Extrapolating these prevalence and average cost estimates to the entire population of noninstitutionalized adults over 65 in 2000 results in an aggregate estimate of stroke-related medical costs of $9.4 billion (shown in Table 4-11).

Table 4-12. Direct Medical Costs Associated with Stroke—Number of Beneficiaries and Average Medical Payments by Type of Service and Age-Gender Category

	Beneficiaries with a Diagnosis			Direct Medical Costs ($/Person/Year)	
	Number	Percent	95% CI (±)	Mean	95% CI (±)
Total	1,975,324	7.5	(7.4,7.7)	3,725	(3,528, 3,923)
Type of Medical Service					
Inpatient	479,335	1.8	(1.8, 1.9)	11,555	(10,959, 12,151)
Physician	1,161,419	6.1	(6.0, 6.3)	461	(439, 483)
Hospital outpatient	576,421	2.2	(2.1, 2.3)	615	(568, 662)
Home health	143,443	0.5	(0.5, 0.6)	3,282	(2,792, 3,592)
Durable medical equipment	202,001	0.8	(0.7, 0.8)	1,243	(1,091, 1,395)
Age-Gender Category					
Age 65–74 Years					
Male	376,615	6.4	(6.1,6.7)	3,658	(3,102, 4,214)
Female	334,302	4.8	(4.6, 5.0)	3,663	(3,227, 4,100)
Age 75–84 Years					
Male	433,262	11.4	(10.9, 11.9)	3,682	(3,209, 4,155)
Female	460,068	7.7	(7.4, 8.1)	3,785	(3,397, 4,172)
Age 85+ Years					
Male	136,725	13.4	(12.5, 14.4)	3,248	(2,765, 3,732)
Female	234,353	9.0	(8.5, 9.5)	4,165	(3,748, 4,581)

Note: Geographic weights used to obtain unbiased nationally representatives estimates for Medicare elderly population.

As is the case with CLD and IHD, the prevalence of stroke was found to be significantly higher for males than for females in each of the three age categories. Similar to IHD, the prevalence of stroke for both males and females was significantly higher in the older age categories, going from 6 percent of men and 5 percent of women between 65 and 74 years to 13 percent and 9 percent, respectively, for those 85 and older. The average medical costs again show relatively little variation across age and gender categories, varying between $3,600 and $4,200 for stroke.

4.3.2 Direct Costs: Self-Administered Prescription Drugs and Nursing Home Care

Our assessment of the prescription drug and nursing home costs associated with stroke, summarized in Table 4-13, resulted in generally positive incremental cost estimates for prescription drugs. For the total population 65 years and older, a stroke diagnosis in the past year was associated with significantly higher prescription drug costs of about $945 per person per year. For males and females in the 65 to 74 years age group, costs were even higher—$1,200 to $1,700 per year. Although a stroke diagnosis was also associated with positive incremental prescription drug costs for the 75 to 84 years age group, the magnitude was much smaller—approximately $500 to $1,000. For the oldest age group, stroke was not associated with significantly higher prescription drug costs.

Table 4-13. Other Direct Costs Associated with Stroke—Incremental Cost Estimates for Prescription Medications and Nursing Home Services by Age-Gender Category

	Prescription Drug Incremental Costs			Nursing Home Incremental Costs		
Age	Sample Size	Mean ($/Person/ Year)	95% CI (±)	Sample Size	Mean ($/Person/ Year)	95% CI (±)
Age 65+ years	114	$945	(596, 1,294)	73	($403)	(–5,089, 4,283)
Age 65–74 years						
Male	30	$1,708	(687, 2,728)	7	($2,103)	(–30,046, 25,840)
Female	23	$1,215	(353, 1,622)	8	$3,632	(–14,938, 22,203)
Age 75–84 years						
Male	16	$507	(–133, 1,147)	10	($9,402)	(–14,138, 4,665)
Female	23	$988	(353, 1,622)	19	($2,991)	(–9,744, 3,762)
Age 85+ years						
Male	11	($177)	(–612, 257)	4	$21,157	(–14,511, 56,826)
Female	11	$34	(–386, 455)	25	($670)	(–7,049, 5,709)

Notes:. Stroke diagnosis based on ICD-9 code of 430-434 and 436. Sample weights used and complex survey design taken into account in calculating standard errors. Prescription drug estimates exclude those with a source of payment listed as Medicare. () denotes a negative value.

Somewhat surprisingly, nursing home costs for those with a reported stroke were no higher than costs for those without stroke as a diagnosis. Although the estimated excess cost for males in the 85 years and older age group was $21,000, this estimate is not significantly different from zero. Moreover, aggregate nursing home costs for individuals in the NNHS with a stroke diagnosis were no higher than nursing home costs for those without a stroke diagnosis. Due to the small sample size and high standard errors, these estimates of stroke related nursing home costs are not included in our aggregate cost estimates.

4.3.3 Indirect Costs: Morbidity

According to the results shown in Table 4-14, the annual labor productivity losses resulting from increased morbidity in older people who experience a stroke are relatively high, ranging from about $1,000 to $2,400 per person. These losses result in large part from the estimated increase in the probability of being unable to work among people with a reported stroke—6 percentage points higher than average for the over-65 population. For those with a stroke diagnosis who did work (4.8 percent), we estimated that females had about 3.2 work-loss days that could be attributed to stroke, while males had 1.7.

Table 4-14. Morbidity-Related Indirect Costs Associated with Stroke—Estimated Annual Per-Person Productivity Losses by Age-Gender Category

Age	Labor Productivity Losses	Household Productivity Losses	Total Productivity Losses
Age 65+ years	$1,820	$658	$2,478
Age 65–74 years			
Male	$2,403	$455	$2,858
Female	$1,069	$885	$1,954
Age 75+			
Male	$2,015	$417	$2,432
Female	$961	$759	$1,720

Our estimates of annual household productivity losses among those with a stroke diagnosis range from approximately $420 to $890. Although these estimates appear to be fairly low, because of the relatively low value of household productivity in older adults ($11,000 to $16,000 per year), we estimated that the annual number of bed-loss days attributable to stroke was 20.4 for females and 13.5 for males. These estimates suggest that stroke has a large impact on the ability of older people to perform simple household duties, including cooking, cleaning, or even providing care for grandchildren. Total labor and household productivity losses associated with stroke for the 65 years and older population are almost $2,500 per person per year.

4.3.4 Indirect Costs: Mortality

As reported in Table 4-15, the productivity losses associated with stroke as the cause of death are very high. We estimate that approximately 156,000 Americans over 65 years would have likely died from stroke in 2000. Over 40 percent of those estimated deaths were among people over 85 years of age. The present value of labor productivity losses resulting from stroke deaths exceeds $2 billion. However, because a high percentage of the 65 years and older population is retired (about 73 percent based on our analysis of NHIS), the present value of labor and household productivity losses is far higher and is estimated to exceed $10 billion annually.

Table 4-15. Indirect Costs Resulting from Increased Mortality Associated with Stroke—Estimated Aggregate Productivity Losses by Age Category

Age	Number of Deaths	Aggregate Labor Productivity Losses (in 1,000s)	Aggregate Labor and Household Productivity Losses (in 1,000s)
Age 65+ years	156,000	$2,079,434	$10,423,691
Age 65–74 years	25,053	$1,277,826	$4,768,713
Age 75–84 years	59,972	$801,608	$5,654,978
Age 85+ years	70,975	—	—

Notes: Stroke diagnosis in mortality data is based on ICD-9 codes 430-438. Mortality related indirect costs for 85+ not estimated due to lack of data on expected productivity for this age group.

4.4 Lung Cancer

Compared to the other health conditions examined in this report, the prevalence of lung cancer among the elderly is relatively low; however, the mortality rate and average costs of illness are comparatively high. As shown in Table 4-16, roughly 116,000 deaths in the 65 and older population were primarily attributable to lung cancer in 2000, and the aggregate costs of illness were estimated to be $4.4 billion, even excluding prescription drug costs, nursing home costs, and most morbidity-related productivity losses (due to data limitations). Further details regarding the estimated direct and indirect costs associated with lung cancer are described below.

Table 4-16. Costs of Illness Associated with Lung Cancer—Estimated Aggregate Costs in 2000 for Individuals 65 and Older

Cost Category	Number of Affected Individuals	Mean Cost ($/person)	Aggregate Costs
Direct Costs			
Medical	393,853	$10,859	$4,276,854,803
Prescription drug	393,853	—	—
Nursing home	17,760	—	—
Indirect Costs			
Morbidity	393,853	$401[a]	$157,935,240
Mortality	116,360	—	$15,182,419
Total Costs of Illness	—	—	$4,449,972,462

[a]Does not include household productivity losses. Prescription drug and nursing home costs not included due lack of sufficient data.

4.4.1 Direct Costs: Medical

Estimates of medical costs associated with lung cancer among Medicare fee-for-service elderly beneficiaries are summarized in Table 4-17. Using CAHPS-MFFS data, we estimate that about 300,000 (1.2 percent of) beneficiaries suffered from lung cancer in 2000. This rate is lower than any of the other conditions examined, but the average medical costs per affected beneficiary, estimated to be nearly $11,000, are almost twice as high as even CLD and IHD. As shown in Table 4-16, extrapolating these prevalence and average cost estimates to the entire noninstitutionalized population of adults over 65 in 2000 results in an aggregate estimate of medical costs from lung cancer of $4.3 billion..

Table 4-17. Direct Medical Costs Associated with Lung Cancer—Number of Beneficiaries and Average Medical Payments by Type of Service and Age-Gender Category

	Beneficiaries with a Diagnosis			Direct Medical Costs ($/Person/Year)	
	Number	Percent	95% CI (±)	Mean	95% CI (±)
Total	306,853	1.2	(1.1,1.2)	10,859	(9,963, 11,756)
Type of Medical Service					
Inpatient	139,141	0.5	(0.5, 0.6)	15,308	(14,030, 16,587)
Physician	234,149	0.9	(0.8, 0.9)	3,070	(2,502, 3,638)
Hospital outpatient	148,165	0.6	(0.5, 0.6)	2,725	(2,334, 3,116)
Home health	25,928	0.1	(0.1, 0.1)	2,093	(1,570, 2,616)
Durable medical equipment	21,118	0.1	(0.1, 0.1)	1,195	(885, 1,505)
Age-Gender Category					
Age 65–74 Years					
Male	75,239	1.3	(1.2, 1.4)	11,949	(10,356, 13,542)
Female	71,305	1.0	(0.9, 1.1)	10,920	(9,119, 12,721)
Age 75–84 Years					
Male	66,395	1.8	(1.6, 1.9)	10,575	(8,363, 12,788)
Female	61,153	1.0	(0.9, 1.2)	11,341	(9,083, 13,599)
Age 85+ Years					
Male	14,594	1.4	(1.1, 1.8)	7,223	(4,851, 9,595)
Female	18,167	0.7	(0.6, 0.9)	8,443	(5,235, 11,652)

Note: Geographic weights used to obtain unbiased nationally representatives estimates for Medicare elderly population.

As with all of the other conditions examined in this report, the prevalence of lung cancer among older Americans is significantly higher for males than for females; however, the rates of lung cancer are relatively stable across the three age categories——for females they vary between 0.7 and 1 percent and for males they vary between 1.3 and 1.8 percent. In contrast, the estimated average medical costs are not significantly different between men and women. Estimated average costs are somewhat lower for men and women in the highest age group (85 and older), going from about $11,000 to $8,000, but this difference is only statistically significant for men.

4.4.2 Direct Costs: Self-Administered Prescription Drugs and Nursing Home Care

The 2000 MEPS contained information about only a handful of older people with lung cancer. Because of the small number of observations in MEPS on people with lung cancer, we were unable to generate reliable estimates of the excess prescription drug costs for age and sex subgroups for people with lung cancer. However, to be consistent with our analysis for the other five conditions, we generated

incremental cost estimates for age and sex subgroups with at least three observations, and these estimates are reported in Table 4-18. The estimated incremental cost of prescription drugs for the 65 years and older population with lung cancer is about $1,400 per year. This estimate is not quite statistically significant at the 95 percent confidence level, but the large mean suggests that the prescription drug costs associated with lung cancer among the elderly are substantially larger than prescription drug costs in those without lung cancer. Due to the very small sample sizes associated with these estimates, they are not included in our aggregate cost of illness estimates.

Table 4-18. Other Direct Costs Associated with Lung Cancer—Incremental Cost Estimates for Prescription Medications and Nursing Home Services by Age-Gender Category

	Prescription Drug Incremental Costs			Nursing Home Incremental Costs		
Age	Sample Size	Mean ($/Person/ Year)	95% CI (±)	Sample Size	Mean ($/Person/ Year)	95% CI (±)
Age 65+ years	14	$1,351	(–117, 2,819)	29	$5,367	(–4,085, 14,820)
Age 65–74 years						
Male	4	$2,279	(–1,993, 6,550)	5	($14,492)	(–36,609, 7,625)
Female	2	—	—	4	$13,049	(–13,390, 39,489)
Age 75–84 years						
Male	2	—	—	3	($8,267)	(–16,502, -33)
Female	3	$2,414	(1,470, 3,358)	6	$16,867	(–18,764, 52,499)
Age 85+ years						
Male	1	—	—	5	$11,099	(–614, 22,812)
Female	2	—	—	6	($717)	(–13,883, 12,448)

Notes: Lung cancer diagnosis based on ICD-9 codes of 162, 197, and 231. Sample weights used and complex survey design taken into account in calculating standard errors. () denotes a negative value.

The number of individuals in the NNHS with lung cancer listed as a diagnosis was also relatively small (three to six observations per age and sex subgroup). Our estimates of incremental nursing home costs for people with lung cancer vary widely, and none is significantly different from zero. Because of the small samples and resulting large standard errors, it is difficult to draw any conclusions about the likely impact of lung cancer on nursing home costs from these findings.

4.4.3 Indirect Costs: Morbidity

The indirect costs resulting from increased morbidity in people with a lung cancer diagnosis, as summarized in Table 4-19, are based solely on the estimated increased probability of being unable to work among people with lung cancer. Among the 41 respondents in NHIS with a lung cancer diagnosis, the probability of being unable to work was about 1.3 percentage points higher than for analogously defined individuals without lung cancer. Resulting cost estimates are $211 to $530 per year, and average $400 per year across all age and sex subgroups. The work loss days attributable to lung cancer could not be estimated precisely because of the small percentage of those over 65 years with lung cancer who reported working (about 7 percent). Further, lung cancer was not considered in our analysis of the number of bed days attributable to a health condition.

Table 4-19. Morbidity-Related Indirect Costs Associated with Lung Cancer—Estimated Annual Per-Person Productivity Losses by Age-Gender Category

Age	Labor Productivity	Household Productivity	Total Productivity Losses
Age 65+ years	$401	—	—
Age 65–74 years			
Male	$530	—	—
Female	$234	—	—
Age 75+ years			
Male	$444	—	—
Female	$211	—	—

4.4.4 Indirect Costs: Mortality

Mortality estimates for lung cancer are presented in Table 4-20. The estimated number of deaths among those 65 years and older with lung cancer as the cause is about 116,000 in 2000—somewhat higher than the estimated number of deaths from CLD yet lower than the estimated number of stroke deaths. Almost 50 percent of these deaths were in the 65 to 74 years age group and resulted in high estimated productivity losses. Estimated labor productivity losses resulting from lung cancer mortality have a present value of $3.5 billion; estimated labor and household productivity losses have a present value of $15 billion.

Table 4-20. Mortality-Related Indirect Costs Resulting Associated with Lung Cancer—Estimated Aggregate Productivity Losses by Age Category

Age	Number of Deaths	Aggregate Labor Productivity Losses (in 1,000s)	Aggregate Labor and Household Productivity Losses (in 1,000s)
Age 65+ years	116,360	$3,507,104	$15,182,419
Age 65–74 years	56,402	$2,876,801	$10,735,918
Age 75–84 years	47,156	$630,303	$4,446,501
Age 85+ years	12,802	—	—

Notes: Lung cancer diagnosis in mortality data is based on ICD-9 codes of 160-161 and 163-165 and excludes 197 and 231

4.5 Pneumonia

As summarized in Table 4-21, we estimate that approximately 1.9 million older Americans experienced pneumonia in 2000, and pneumonia was the primary cause of about 83,000 deaths in individuals 65 and older. Based on these estimates, we calculated aggregate direct and indirect (except for morbidity) costs from pneumonia in this population to be approximately $11 billion. These results are further described and disaggregated in the sections below.

Table 4-21. Costs of Illness Associated with Pneumonia—Estimated Aggregate Costs in 2000 for Individuals 65 and Older

Cost Category	Number of Affected Individuals	Mean Cost ($/person)	Aggregate Costs
Direct Costs			
Medical	1,779,693	$5,623	$10,007,215,290
Prescription drug	1,779,693	$302	$537,467,369
Nursing home	78,440	$4,987	$391,180,280
Indirect Costs			
Morbidity	1,779,693	—	—
Mortality	83,264	—	$4,695,729
Total Costs of Illness	—	—	$10,940,558,668

Notes: Morbidity related indirect costs not estimated due to lack of data.

4.5.1 Direct Costs: Medical

Table 4-22 summarizes our estimates of medical costs associated with pneumonia. Among Medicare fee-for-service beneficiaries in 2000, we estimate that almost 1.4 million (5.3 percent of) beneficiaries aged 65 and older suffered from pneumonia. The annual medical costs per beneficiary averaged $5,600 per year, which is very similar to the average estimates for CLD and IHD. Extrapolating these prevalence and average cost estimates to the entire noninstitutionalized population of adults over 65 in 2000, we estimate aggregate medical costs associated with pneumonia to be $10 billion (shown in Table 4-21).

The prevalence of pneumonia was found to be significantly higher among males and among those in the higher age categories. For women 65 to 74, rates of pneumonia were about 3.3 percent compared to 4.1 percent for males of the same ages. For those 85 years and older, rates of pneumonia were 8.2 and 12.3 percent, respectively, for females and males. The average medical costs for pneumonia showed relatively little variation across age and gender categories, varying between $5,100 and $6,000.

4.5.2 Direct Costs: Self-Administered Prescription Drugs and Nursing Home Care

We used the 2000 MEPS to assess the incremental prescription drug costs associated with pneumonia and the 1999 NNHS to estimate incremental nursing home costs associated with pneumonia. As described in Table 4-23, our findings suggest that excess prescription drug costs for people who reported having pneumonia during the study year were fairly low and were only significantly different from zero for females in the 75 to 84 years age group. However, estimated incremental costs for the full over-65 population with a pneumonia diagnosis are significantly different from zero—about $300 per person per year.

Incremental nursing home costs for people who had pneumonia were generally positive and quite large, ranging from about $3,500 for the oldest females to $15,000 for 75 to 84 year-old males. Although none of the estimates is significantly different from zero, the large standard errors on the mean estimate are due in large part to the wide variation in nursing home costs and the relatively small number of individuals who had pneumonia as a diagnosis. For the total population over 65 years, the incremental cost estimates suggest that a pneumonia diagnosis is associated with significantly higher nursing home costs, averaging about $5,000 per person per year.

Table 4-22. Direct Medical Costs Associated with Pneumonia—Number of Beneficiaries and Average Medical Payments by Type of Service and Age-Gender Category

	Beneficiaries with a Diagnosis			Direct Medical Costs ($/Person/Year)	
	Number	Percent	95%CI (±)	Mean	95%CI (±)
Total	1,386,567	5.3	(5.2,5.4)	5,623	(5,305, 5,940)
Type of Medical Service					
Inpatient	646,530	2.5	(2.4, 2.6)	11,028	(10,436, 11,619)
Physician	1,078,170	4.1	(4.0, 4.2)	310	(295, 324)
Hospital outpatient	321,993	1.2	(1.2, 1.3)	298	(252, 344)
Home health	111,684	0.4	(0.4, 0.5)	1,837	(1,662, 2,012)
Durable medical equipment	28,733	0.1	(0.1, 0.1)	1,089	(834, 1,345)
Age-Gender Category					
Age 65–74 Years					
Male	241,755	4.1	(3.9, 4.4)	5,626	(4,903, 3,650)
Female	229,631	3.3	(3.1, 3.5)	5,103	(4,341, 5,866)
Age 75–84 Years					
Male	270,826	7.1	(6.8, 7.5)	5,915	(4,935, 6,894)
Female	306,271	5.2	(4.9, 5.4)	5,638	(5,018, 6,2596)
Age 85+ Years					
Male	125,536	12.3	(11.4, 13.3)	5,394	(4,707, 6,082)
Female	212,548	8.2	(8.0, 9.0)	5,950	(5,275, 6,564)

Note: Geographic weights used to obtain unbiased nationally representatives estimates for Medicare elderly population.

Table 4-23. Other Direct Costs Associated with Pneumonia—Incremental Cost Estimates for Prescription Medications and Nursing Home Services by Age-Gender Category

	Prescription Drug Incremental Costs			Nursing Home Incremental Costs		
Age	Sample Size	Mean ($/Person/ Year)	95% CI (±)	Sample Size	Mean ($/Person/ Year)	95% CI (±)
Age 65+ years	145	$302	(64, 540)	175	$4,987	(824, 9,151)
Age 65–74 years						
Male	26	($199)	(–490, 91)	11	($5,160)	(–23,978, 13,658)
Female	48	$348	(–193, 889)	8	$3,995	(–4,739, 12,730)
Age 75–84 years						
Male	18	$214	(–166, 595)	24	$14,890	(–868, 30,648)
Female	35	$882	(489, 1276)	30	$4,182	(–7,699, 16,064)
Age 85+ years						
Male	6	($293)	(–665, 79)	34	$4,968	(–2,685, 12,621)
Female	12	$42	(–530, 616)	68	$3,486	(–2,057, 9,028)

Notes:. Pneumonia diagnosis based on ICD-9 code of 480-486 and 487. Sample weights used and complex survey design taken into account in calculating standard errors. () denotes a negative value.

4.5.3 Indirect Costs: Morbidity

Because pneumonia was not reported in the NHIS, we were unable to estimate the costs of increased morbidity attributable to pneumonia.

4.5.4 Indirect Costs: Mortality

Mortality costs represent the present value of all future earnings (earnings and household productivity) losses resulting from pneumonia, discounted at 5 percent. These costs are reported in Table 4-24 and are estimated to exceed $916 million in labor market earnings losses alone. The present value of earnings and household productivity losses resulting from pneumonia deaths is almost $4.7 billion. The estimated number of deaths with pneumonia indicated as the cause of death is approximately 83,000, with over half of deaths occurring among those 85 years and older.

Table 4-24. Mortality-Related Indirect Costs Associated with Pneumonia—Estimated Aggregate Productivity Losses by Age Category

Age	Number of Deaths	Aggregate Labor Productivity Losses (in 1,000s)	Aggregate Labor and Household Productivity Losses (in 1,000s)
Age 65+ years	83,264	$915,661	$4,695,729
Age 65–74 years	10,408	$530,854	$1,981,091
Age 75–84 years	28,789	$384,807	$2,714,638
Age 85+ years	44,067	$0	$0

Notes: Pneumonia diagnosis in mortality data is based on ICD-9 code of 480-486

4.6 Gastrointestinal Illness

Of the six health conditions examined in this report for older Americans, gastrointestinal illnesses are estimated to impose the lowest aggregate cost burden; however, the costs are still substantial. As summarized in Table 4-25, we estimated that in 2000 approximately 0.8 million older Americans experienced gastrointestinal illnesses that were severe enough to seek medical attention, and we calculated aggregate direct and indirect costs from gastrointestinal illness in this population to be approximately $1 billion (even excluding nursing home and morbidity related indirect costs)..

Table 4-25. Costs of Illness Associated with Gastrointestinal Illness—Estimated Aggregate Costs in 2000 for Individuals 65 and Older

Cost Category	Number of Affected Individuals	Mean Cost ($/person)	Aggregate Costs
Direct Costs			
Medical	813,519	$1,160	$943,681,600
Prescription drug	813,519	$76	$61,827,415
Nursing home	35,520	—	—
Indirect Costs			
Morbidity	813,519	—	—
Mortality	573	—	$38,675
Total Costs of Illness	—	—	$1,005,547,690

Notes: Nursing home costs and morbidity related indirect costs not estimated due to lack of sufficient data.

4.6.1 Direct Costs: Medical

Table 4-26 summarizes our estimates of medical costs associated with gastrointestinal illness for Medicare fee-for-service beneficiaries in 2000. We estimate that over 600,000 (2.4 percent of) beneficiaries aged 65 and older experienced gastrointestinal illness that was severe enough to seek medical attention. Of the six conditions analyzed in this report, gastrointestinal illness imposes the lowest annual medical costs per affected beneficiary, averaging less than $1,200 per year. When these prevalence and average cost estimates were extrapolated to the entire noninstitutionalized population of adults over 65 in 2000, we estimate aggregate medical costs associated with gastrointestinal illness to be $0.9 billion (shown in Table 4-25).

Table 4-26. Direct Medical Costs Associated with Gastrointestinal Illness—Number of Beneficiaries and Average Medical Payments by Type of Service and Age-Gender Category

	Beneficiaries with a Diagnosis			Direct Medical Costs ($/Person/Year)	
	Number	Percent	95% CI (±)	Mean	95% CI (±)
Total	633,816	2.4	(2.3,2.5)	1,160	(1,057, 1,264)
Type of Medical Service					
Inpatient	153,738	0.4	(0.4, 0.5)	5,217	(4,860, 5,574)
Physician	474,861	1.8	(1.7, 1.9)	132	(125, 139)
Hospital outpatient	184,115	0.7	(0.7, 0.7)	316	(280, 353)
Home health	11,066	0.0	(0.0, 0.1)	2,505	(1,546, 3,464)
Durable medical equipment	188	0.0	(0.0, 0.0)	793	(–1,012, 2,597)
Age-Gender Category					
Age 65–74 Years					
Male	10,530	1.8	(1.6, 1.9)	642	(386, 900)
Female	175,163	2.5	(2.3, 2.7)	1,133	(908, 1,358)
Age 75–84 Years					
Male	100,098	2.6	(2.4, 2.9)	1,031	(824, 1,238)
Female	156,930	2.6	(2.5, 2.8)	1,375	(1,175, 1,574)
Age 85+ Years					
Male	29,546	3.0	(2.4, 3.4)	1,272	(1828, 1,717)
Female	67,049	2.3	(2.3, 2.9)	1,685	(1,372, 1,999)

Note: Geographic weights used to obtain unbiased nationally representatives estimates for Medicare elderly population.

Prevalence rates for gastrointestinal illness were found to be very similar across age and gender categories. Only in the 65 to 74 age category were prevalence rates significantly different between men and women, with rates for females at 2.5 percent compared to 1.8 percent for males. As with most other conditions, the average medical costs for gastrointestinal illness showed relatively little variation across age and gender categories, varying between $600 and $1,700 per beneficiary in 2000.

4.6.2 Direct Costs: Self-Administered Prescription Drugs and Nursing Home Care

Our analysis of prescription drug costs from the 2000 MEPS, summarized in Table 4-27, suggests that the excess costs associated with gastrointestinal illness among those 65 to 74 years of age is $200 to $750 per person for year. For the other age groups, our incremental cost estimates and the associated confidence intervals indicate that prescription drug costs for those with a gastrointestinal illness diagnosis are not significantly different from the prescription costs of those without a gastrointestinal diagnosis.

Table 4-27. Other Direct Costs Associated with Gastrointestinal Illness—Incremental Cost Estimates for Prescription Medications and Nursing Home Services by Age-Gender Category

	Prescription Drug Incremental Costs			Nursing Home Incremental Costs		
Age	Sample Size	Mean ($/Person/ Year)	95% CI (±)	Sample Size	Mean ($/Person/ Year)	95% CI (±)
Age 65+ years	165	$76	(–101, 253)	32	$22,495	(–593, 45,582)
Age 65–74 years						
Male	34	$749	(438, 1,059)	2	—	—
Female	56	$215	(–167, 596)	1	—	—
Age 75–84 years						
Male	22	$181	(–327, 690)	4	$45,552	(–57,356, 148,461)
Female	44	($198)	(–489, 93)	11	$11,281	(–6,671, 29,233)
Age 85+ years						
Male	3	($685)	(–944, -425)	1	—	—
Female	6	$266	(–605, 1,137)	13	$35,123	(–13,532, 83,779)

Notes: Gastrointestinal illness diagnosis based on ICD-9 codes of 001-009 and 558. Sample weights used and complex survey design taken into account in calculating standard errors. () denotes a negative value.

Our analysis of the excess nursing home costs associated with gastrointestinal illness also produced small age and sex subgroups and large resulting standard errors. For the 65 to 74 years age group, only three individuals had a diagnosis of gastrointestinal illness; these observations were excluded from our analysis. For the over-65 nursing home population with a diagnosis of gastrointestinal illness, estimated incremental costs exceeded $22,000. This estimate was not quite statistically significant and may be driven in large part by the presence of other comorbidities that make nursing home residents more susceptible to gastrointestinal illnesses. Given the small number of observations and large standard errors, it is difficult to draw any conclusions about the likely impact of gastrointestinal illness on nursing home costs; therefore, these estimates are not included in our aggregate cost estimates.

4.6.3 Indirect Costs: Morbidity

Gastrointestinal illness was not reported in the NHIS. Consequently, we were unable to estimate the costs of increased morbidity attributable to gastrointestinal illness.

4.6.4 Indirect Costs: Mortality

As shown in Table 4-28, the estimated number of deaths in 2000 with gastrointestinal illness as the cause was much lower than estimated deaths for the other five conditions. We estimated that about 570 deaths among those 65 years and older were due to gastrointestinal illness. Because over half of those deaths occurred in the 85 years and older age group, the estimated indirect costs resulting from gastrointestinal illness mortality are much lower than for the other conditions—a present value of $7.8 million in labor productivity losses and $38.7 million in labor and household productivity losses combined.

Table 4-28. Mortality-Related Indirect Costs Associated with Gastrointestinal Illness—Estimated Aggregate Productivity Losses by Age Category

Age	Number of Deaths	Aggregate Labor Productivity Losses (in 1,000s)	Aggregate Labor and Household Productivity Losses (in 1,000s)
Age 65+ years	573	$7,837	$38,675
Age 65–74 years	98	$4,999	$18,656
Age 75–84 years	212	$2,838	$20,019
Age 85+ years	263	—	—

Notes: Gastrointestinal illness diagnosis in mortality data is based on ICD-9 codes of 004 and 006-009 and excludes 001-003, 005, and 558.9. Mortality related indirect costs for 85+ not estimated due to lack of data on expected productivity for this age group.

5. Discussion of Results

The population of older Americans is expected to increase rapidly over the next 50 years, and this trend presents important challenges in the area of environmental health. Several of the most prevalent and costly adverse health conditions among older Americans are known to be associated, at least in part, with environmental exposures, and older adults are often more vulnerable to environmental hazards.

The purpose of this report is to contribute to a better understanding of the cost burden imposed by environmentally related health effects among older Americans. In collaboration with EPA, we selected six general health conditions for which environmental exposures are known or suspected to be important contributing factors. Using available national data, we estimated direct and indirect costs for each of these conditions among individuals 65 and older in 2000.

Of the six conditions analyzed, chronic lung disease and ischemic heart disease are found to have the highest prevalence among the older population and to impose the largest aggregate cost. Both conditions were found to affect between 10 percent and 20 percent of the elderly population and to impose total costs of illness of over $35 billion in 2000. The aggregate medical costs for CLD and IHD represent roughly 15 percent and 22 percent respectively of estimated *total* medical costs among individuals 65 and older in the U.S.

The estimated prevalence and aggregate costs of stroke and pneumonia were both somewhat lower, in each case affecting between 5 and 10 percent of older Americans and costing between $10 billion and $20 billion on aggregate in 2000. As expected lung cancer was found to have the lowest prevalence among the elderly population, affecting roughly one percent, but the aggregate costs estimates are nonetheless substantial. Even without estimates of self-administered prescription drug costs, nursing home costs, or lost household productivity due to morbidity (again due to data limitations), aggregate costs were estimated to be $4.5 billion.

Gastrointestinal illnesses were found to impose the lowest cost burden of the six conditions. Affecting approximately two to three percent of the elderly population in 2000, we estimated aggregate costs of illness for GIs (without nursing home or indirect morbidity costs) of $1 billion.

Although the estimates summarized above and described in detail in previous sections provide useful and important insights into the costs of illness for these six conditions, several limitation and uncertainties associated with these estimates must be recognized. Each of these issues has been discussed in previous sections; however, we reiterate them here to ensure that they are properly interpreted.

First, the cost estimates developed in this report should *not* be interpreted as those specifically attributable to environmental exposures. Unfortunately, the science and empirical evidence regarding the epidemiological links between environmental exposures and these health outcomes are not sufficiently advanced to estimate reliably this attributable fraction. Consequently, our estimates are more appropriately interpreted as upper-bound estimates of environmentally related costs of illness for these conditions.

Second, our estimates of the prevalence of each condition are based on a nationally representative sample of Medicare fee-for-service beneficiaries, using ICD-9 codes (as listed in Table 2-1) to identify the presence of each condition in 2000. These prevalence estimates are based on *claims* for services in 2000. They do not include individuals who had the underlying condition in 2000 but did not seek care; therefore, they are likely to underestimate overall prevalence. Moreover, since Medicare FFS covered roughly 75 percent of the 65 and older population in 2000, these estimates were extrapolated to the remaining 25 percent of the population. This extrapolation is likely to overestimate prevalence in the noninstitutionalized non-FFS population and underestimate prevalence in the nursing home population.

Third, portions of the direct medical cost estimates based on the CAPHS-MFFS data cannot be interpreted as being exclusively attributable to the selected conditions. Medicare claims data for inpatient, outpatient, and home care costs, include potentially more than one diagnosis code per condition; therefore, portions of the reported costs may be attributable to other co-morbid conditions. For this

reason, the direct medical cost estimates are best interpreted as providing upper-bound estimates of these costs for each condition.

Fourth, the estimates of prescription drug and nursing home costs are based on considerably smaller samples than were used for estimating medical costs; therefore, the confidence intervals for these estimates are considerably larger. Estimates based on samples smaller than 100 are reported in Section 4, but they were not included in our aggregate estimates (i.e., they were set equal to zero) due to their lack of precision. Excluding these values implies that the aggregate direct-costs estimates for stroke, lung cancer, and gastrointestinal illness are underestimated; however, the extent of underestimation is not known.

Fifth, to approximate the portion of prescription drug and nursing home costs that are specifically attributable to the selected conditions, we calculated *incrementa*l costs (i.e., the difference between average costs for those with and without the condition). This approach provides a rather crude approximation of attributable costs, and, in some cases, the estimated incremental costs are negative. The negative estimates for nursing home costs for IHD were assumed to be implausible and replaced with a zero value in our aggregate direct cost estimates.

Sixth, our estimates of morbidity-related productivity losses are based in part on an analysis of additional work loss and bed days using NHIS data. Due to data limitations associated with NHIS, we were not able to estimate losses for pneumonia or gastrointestinal illness, and we were able to only partially estimate losses for lung cancer. For this reason, the indirect costs for these conditions are underestimates.

Seventh, to estimate the indirect costs resulting from premature mortality, we used NSVR data that defined health conditions using slightly different ICD-9 codes. Because of these discrepancies, our estimates of mortality costs for CLD, stroke, and lung cancer are slight overestimates of mortality costs, while our estimate for gastrointestinal illness is a slight underestimate of actual mortality costs for the conditions of interest.

Finally, to estimate mortality-related costs, we also applied age-specific productivity estimates from Grosse (2003). Unfortunately, this source does not provide an estimate for expected productivity among those 85 and older. By not including productivity losses (labor or household) for deaths in the 85 and older age group, we underestimated indirect costs of illness. However, these excluded losses are expected to be small relative to the productivity losses in the younger age groups.

6. References

Agency for Toxic Substance Disease Registry (ATSDR). 1990. "Toxicological Profile for Radon." PB/91/180422/AS.

Agency for Toxic Substance Disease Registry (ATSDR). 1999. "Toxicological Profile for Lead." PB/99/166704.

Agency for Toxic Substance Disease Registry (ATSDR). 2001. "Toxicological Profile for Asbestos." PB/2001/109101.

Bennett, John V., Scott D. Holmberg, Martha F. Rogers, and Steven L. Solomon. 1987. "Infections and Parasitic Diseases." *American Journal of Preventive Medicine* 3:102-114.

Brown, R.S., Clement, DG, Hill, JW and Retchin, SM: Do Health Maintenance Organizations Work for Medicare? Health Care Financing Review, 15(1):7-23. 1993.

Drummond, M.F., B. O'Brien, G.L. Stoddart, and G.W. Torrance. 1997. *Methods for the Economic Evaluation of Health Care Programmes*. 2nd Edition. Oxford: Oxford University Press.

Grosse, S.D. 2003. "Productivity Loss Tables (Appendix)." In *Prevention Effectiveness: A Guide to Decision Analysis and Economic Evaluation*, 2nd Edition, A.C. Haddix, S.M. Teutsch, P.S. Corso, eds. London: Oxford University Press.

Lucas, J.W., Schiller, J.S., and V. Benson. 2004. *Summary Health Statistics for U.S. Adults: National Health Interview Survey, 2001*. National Center for Health Statistics, *Vital Health Stat* 10(218).

Morris, R.D., and R. Levin. 1995. "Estimating the Incidence of Waterborne Infectious Disease Related to Drinking Water in the United States." In *Assessing and Managing Health Risks from Drinking Water Contamination: Approaches and Applications*. Proceedings of the Rome Symposium, September 1994.

Mounts, A.W., R.C. Holman, M.J. Clarke, J.S. Bresee, and R.I. Glass. 1999. "Trends in Hospitalizations Associated with gastroenteritis among Adults in the United States, 1979–1995." *Epidemiology and Infection* 123-8.

National Center for Health Statistics. Health, United States, 2003 With Chartbook on Trends in the Health of Americans. Hyattsville, Maryland: 2003.

Payment, P., L. Richardson, J. Siemiatycki, R. Dewar, M. Edwardes, and E. Franco. 1991. "A Randomized Trial to Evaluate the Risk of Gastrointestinal Disease due to Consumption of Drinking Water Meeting Current Microbiological Standards." *American Journal of Public Health* 81(6):703-708.

Peters, K.D., K.D. Kochanek, and S.L. Murphy. 1998. "Deaths: Final Data for 1996." *National Vital Statistics Reports* 47(9). Hyattsville, MD: National Center for Health Statistics.

Pope, C.A., R.T. Burnett, M.J. Thun, E.E. Calle, D. Krewski, K. Ito, and G.D. Thurston. 2002. "Lung Cancer, Cardiopulmonary Mortality, and Long-Term Exposure to Fine Particulate Air Pollution." *Journal of the American Medical Association* 287(9):1132-1141.

Riley, G.F., A.L. Potosky, J.D. Lubitz, and L.G. Kessler. 1995. "Medicare Payments from Diagnosis to Death for Elderly Cancer Patients by Stage at Diagnosis." *Medical Care* 33(8):828-841.

Sandler, R.S., J.E. Everhart, M. Donowitz, E. Adams, K. Cronin, C. Goodman, E. Gemmen, S. Shah, A. Avdic, and R. Rubin. 2002. "The Burden of Selected Digestive Diseases in the United States." *Gastroenterology* 122(5):1500-1511.

Tolley, G., D. Kenkel, and R. Fabian. 1994. *Valuing Health for Policy: An Economic Approach.* Chicago, IL: University of Chicago.

Trisolini M, M Klosterman, NT McCall, *et al.* 2002. *Medicare Quality Monitoring System Version 4 Specifications - M4-Frequency, Rate, Length of Stay, and Costs to Hospital Discharges for HCQIP Clinical Priority Areas of Heart Failure, Stroke, Pneumonia, and AMI by Age Group, Sex, Race, Medicare Eligibility Status, Medicaid Enrollment Status, and Geographic Area, Calendar Years 1992-2001.* CMS Contract No. 500-95-0058, T.O. #16, February 2002.

U.S. Environmental Protection Agency (EPA). 1999. *The Benefits and Costs of the Clean Air Act, 1990 to 2010.* EPA 410-R-99. Washington, DC: Office of Air and Radiation.

U.S. Environmental Protection Agency. What is the EPA Aging Initiative? <http://www.epa.gov/aging/pdfs/factsheet.pdf>. Accessed on December 21, 2003.

Appendix A

Review of Cost of Illness Studies for Selected Health Conditions: Summaries of Methods, Data Sources, and Findings by Disease

Table A-1. Chronic Lung Disease

Article Title (Authors)	Relevant Medical Condition(s)	Study Population Description	Cost Categories Included	Data Source(s)	Annual Cost Estimate(s)	Base Year	Cost Estimate(s) 2000 Dollarsb
A comparison of three approaches for attributing hospitalizations to specific diseases in cost analyses (Ward, M. M., H. S. Javitz, W. M. Smith, and A. Bakst)	COPD: –COPD and bronchitis (ICD-9 491) –Emphysema (ICD-9 492) –Unspecified obstructive pulmonary disease (ICD-9 496)	U.S. population (data source population), age 45 or older Prevalence-based	Hospitalization	National Hospital Discharge Survey 1990	Attribute all to the disease if primary diagnosis: –$3,449 per hospitalization –$711 million annual total Attribute portion to disease based on position in diagnoses and comorbidities: –$3,205 per hospitalization –$2.2 billion annual total Incremental analysis by age and gender cohort: –$2,361 per hospitalization –$1.6 billion annual total	2000[a]	Attribute all to the disease if primary diagnosis: –$3,449 per hospitalization –$711 million annual total Attribute portion to disease based on position in diagnoses and comorbidities: –$3,205 per hospitalization –$2.2 billion annual total Incremental analysis by age and gender cohort: –$2,361 per hospitalization –$1.6 billion annual total
A national study of medical care expenditures for respiratory conditions (Yelin, E., et. al.)	Respiratory conditions –All respiratory conditions (ICD-9 491-494, 496, 500, 501) –Asthma (ICD-9 493)	Data source population Prevalence-based	Hospital stays Physician visits Nonphysician visits ER visits Prescriptions filled Home health care services Other	Medical Expenditure Panel Survey (1996, household data)	–All respiratory mean for all services $3,753 –Asthma mean for all services $2,973	1996	–All respiratory mean for all services $4,289 –Asthma mean for all services $3,398

(continued)

Table A-1. Chronic Lung Disease (continued)

Article Title (Authors)	Relevant Medical Condition(s)	Study Population Description	Cost Categories Included	Data Source(s)	Annual Cost Estimate(s)	Base Year	Cost Estimate(s) 2000 Dollarsb
Acute exacerbation of chronic bronchitis: disease-specific issues that influence the cost-effectiveness of antimicrobial therapy (Saint, S., et. al.)[d]	–Acute exacerbations of chronic bronchitis (AECB) –All acute and chronic bronchitis	12,379 with AECB and 13,904 with all bronchitis Prevalence-based (per hospitalization)	Inpatient hospitalization	–University HealthSystem Consortium Clinical Database –University of Michigan Health System	AECB per hospitalization: –$6,285 from UMI data –$6,625 from UHSC data All acute and chronic bronchitis per hospitalization: –$6,287 from UMI data –$6,524 from UHSC data	1999	AECB per hospitalization: –$6,541 from UMI data –$6,895 from UHSC data All acute and chronic bronchitis per hospitalization: –$6,543 from UMI data –$6,790 from UHSC data
American Lung Association fact sheet: chronic obstructive pulmonary disease (COPD), October 2003 (American Lung Association)	COPD: –Chronic bronchitis –Emphysema	U.S. Prevalence-based	Healthcare expenditures Indirect costs	General info from ALA	–Annual cost to nation $32.1 billion –Healthcare expenditures $18.0 billion –Indirect cost of $14.1 billion	2003[a]	–Annual cost to nation $28.2 billion –Healthcare expenditures $15.8 billion –Indirect cost of $12.4 billion

(continued)

Table A-1. Chronic Lung Disease (continued)

Article Title (Authors)	Relevant Medical Condition(s)	Study Population Description	Cost Categories Included	Data Source(s)	Annual Cost Estimate(s)	Base Year	Cost Estimate(s) 2000 Dollarsb
An economic evaluation of asthma in the United States (Wiess, K. B., P. J. Gergen, and T. A. Hodgson)	Asthma (ICD-9 493)	Adults (18 or over) Prevalence-based	Hospital inpatient care Emergency room Hospital outpatient Inpatient physician services Visits to physician office Medications Loss of school days Loss of work Mortality loss	–National Center for Health Statistics –National Hospital Discharge Survey –National Ambulatory Medical Care Survey –National Health Interview Survey –National Medical Care Utilization and Expenditure Survey	–Direct $1,197.8 million –Indirect $1,268.0 million –All $2,465.8 million	1985	–Direct $2,752.3 million –Indirect $2,913.6 million –All $5,665.9 million
Capitation, managed care, and chronic obstructive pulmonary disease (Grasso, M. E., et. al.)	COPD: –Chronic obstructive bronchitis with or without mention of acute exacerbation (ICD-9 491.2) –Emphysema (ICD-9 492.x)	5% sample of Medicare beneficiaries, age 65 and over Prevalence-based (total expenditures for one year)	Hospital inpatient Hospital outpatient Physician Cost of comorbid condition	Medicare data 1992	Expenditures per capita for all aged Medicare beneficiaries with COPD $8,482 (compared to $3,511 for all Medicare beneficiaries)	1992	Expenditures per capita for all aged Medicare beneficiaries with COPD $11,637 (compared to $4,817 for all Medicare beneficiaries)

(continued)

Table A-1. Chronic Lung Disease (continued)

Article Title (Authors)	Relevant Medical Condition(s)	Study Population Description	Cost Categories Included	Data Source(s)	Annual Cost Estimate(s)	Base Year	Cost Estimate(s) 2000 Dollarsb
Comparing the national economic burden of five chronic conditions (Druss, B. G., et. al)	–Mood disorders –Diabetes –Heart disease –Asthma –Hypertension	U.S. nationally representative sample (noninstitutionalized) Prevalence-based	Direct (health costs) Work loss Total societal costs	1996 Medical Expenditure Panel Survey	Direct per capita health costs for treatment of condition: –Heart disease $6,463 –Hypertension $569 –Asthma $663 Estimated work-loss costs for persons with condition: –Heart disease $3.8 billion –Hypertension $11.5 billion –Asthma $3.4 billion	1996	Direct per capita health costs for treatment of condition: –Heart disease $7,386 –Hypertension $650 –Asthma $758 Estimated work-loss costs for persons with condition: –Heart disease $4.3 billion –Hypertension $13.1 billion –Asthma $3.9 billion
Cost estimates for environmentally related asthma(Farquhar, I., et. al.)[c]	Asthma (ICD-9 493)	Total U.S. populationPrevalence-based	DirectIndirect include: –Mortality costs–Morbidity costs (lost workdays of patient and reduced productivity of patient)	1987 National Medical Expenditure Survey	–Total economic cost $14 billion –Direct cost $12 billion–Indirect cost $2 billion	1996	–Total economic cost $16 billion –Direct cost $14 billion–Indirect cost $2 billion

(continued)

Table A-1. Chronic Lung Disease (continued)

Article Title (Authors)	Relevant Medical Condition(s)	Study Population Description	Cost Categories Included	Data Source(s)	Annual Cost Estimate(s)	Base Year	Cost Estimate(s) 2000 Dollarsb
Costs of Occupational COPD and Asthma (Leigh, J., P. Romano, M. Schenker, and K. Kreiss)	–COPD –Asthma (ICD-9, 490-496)	Representative sample of U.S. population, 65+ subgroup not included Prevalence-based	Hospital inpatient Outpatient (including ER) Home health care Physician office visits Nursing home care Prescription drugs Medical supplies (e.g., oxygen) Other medical services	National health expenditures for 1996 Expenditures allocated to COPD and asthma using data from: –National Hospital Discharge Survey –Healthcare Cost and Utilization Project –National Ambulatory Med Care Survey –National Hospital Ambulatory Med Care Survey	COPD All ages (> 34 years) –Total = $18.6 trillion –Per capita = $1,165 (total cost/estimated 1996 COPD prevalence) Asthma all ages (> 19 years) –Total = $6.5 trillion –Per capita = $445 (total cost/ estimated 1996 asthma prevalence)	1996	COPD all ages (> 34 years) –Total = $21.3 trillion –Per capita = $1,331 (total cost/ estimated 1996 COPD prevalence) Asthma all ages (> 19 years) –Total = $7.4 trillion –Per capita = $509 (total cost/ estimated 1996 asthma prevalence)

(continued)

Table A-1. Chronic Lung Disease (continued)

Article Title (Authors)	Relevant Medical Condition(s)	Study Population Description	Cost Categories Included	Data Source(s)	Annual Cost Estimate(s)	Base Year	Cost Estimate(s) 2000 Dollarsb
Direct medical cost of chronic obstructive pulmonary disease in the U.S.A. (Ward, M. M., et. al.)	COPD: –Chronic bronchitis (ICD-9 491) –Emphysema (ICD-9 492) –Unspecified obstructive pulmonary disease (ICD-9 496)	Data source population Prevalence-based	Hospitalization Inpatient physician services Emergency department visits Outpatient diagnostic/screening procedures Nursing home stays Hospice care Home healthcare Prescription medications Long-term oxygen therapy.	–1990 National Hospital Discharge Survey –1993 Medicare Public Use Files –1993 National Hospital Ambulatory Medical Care Survey –1990 National Ambulatory Medical Care Survey –National Hospital Ambulatory Medical Care Survey (outpatient visits) –1992 National Home and Hospice Care Survey (home healthcare component) –1985 National Nursing Home Survey –1987 National Medical Expenditure Survey	Total annual U.S. payment for care $6.6 billion	1994	Total annual U.S. payment for care $8.2 billion

(continued)

Table A-1. Chronic Lung Disease (continued)

Article Title (Authors)	Relevant Medical Condition(s)	Study Population Description	Cost Categories Included	Data Source(s)	Annual Cost Estimate(s)	Base Year	Cost Estimate(s) 2000 Dollarsb
Direct medical costs of chronic obstructive pulmonary disease: chronic bronchitis and emphysema (Wilson, L., E. B. Devine, and K. So)	COPD: –Chronic bronchitis (ICD-9 490, 491) –Emphysema (ICD-9 492)	U.S. (population of data sources) Prevalence-based	Inpatient care (hospital stays and hospital inpatient doctor visits) Outpatient care (doctor visits, laboratory tests and medications) Emergency care and home and long-term care (home healthcare, including equipment and supplies; and nursing home visits)	–1993 National Hospital Discharge Survey –Healthcare Cost and Utilization Project –1993 National Ambulatory Medical Care Survey –National Ambulatory Medical Care Survey: Outpatient Department –National Ambulatory Medical Care Survey: Emergency Department 1993 –National Home and Hospice Care Survey –Other sources of cost estimates (such as clinicians)	–COPD cost per prevalent case: total direct costs $896 –Chronic bronchitis cost per prevalent case: total direct costs $816 –Emphysema cost per prevalent case: total direct costs $1341	1996	–COPD cost per prevalent case: total direct costs $1,024 –Chronic bronchitis cost per prevalent case: total direct costs $933 –Emphysema cost per prevalent case: total direct costs $1,533

(continued)

Table A-1. Chronic Lung Disease (continued)

Article Title (Authors)	Relevant Medical Condition(s)	Study Population Description	Cost Categories Included	Data Source(s)	Annual Cost Estimate(s)	Base Year	Cost Estimate(s) 2000 Dollarsb
Economic analysis of the Confronting COPD survey: an overview of results (Wouters, E. F.)	–COPD –Chronic bronchitis –Emphysema –Had symptoms consistent with chronic bronchitis	U.S. population, mean age 63 Prevalence-based	Inpatient hospitalization Oxygen therapy Prescribed medication Influenza vaccination Laboratory tests Scheduled visits to PCP or specialist Unscheduled visits to PCP or specialist ER visits Lost productivity (work loss days)	Confronting COPD survey (telephone interviews with patients and physicians)	–Direct cost $4,119 –Indirect cost $1,527 –Societal cost $5,646	2002	–Direct cost $3,761 –Indirect cost $1,394 –Societal cost $5,156
Economic burden of respiratory infections in an employed population (Birnbaum, H. G., M. Morley, P. E. Greenberg, and G. L. Colice)	Respiratory infections: –Pneumonia –Chronic bronchitis –Other specific respiratory infections (ICD-9 786, 465, 462-463, 466, 461, 473, 490-491, 034, 472, 474, 480-486, 460, 464, 487)	Beneficiaries with at least one of the conditions of a national Fortune 100 manufacturer (excludes people over 65) Prevalence-based	Actual cash payments by the employer for: –Inpatient –Outpatient –Prescription drug –Office –Other Disability costs Absenteeism	1997 claims data	Health-care and work-loss costs $4,397 per beneficiary (and $6,838 per employee)	1997	Health-care and work-loss costs $4,888 per beneficiary (and $7,602 per employee)

(continued)

Table A-1. Chronic Lung Disease (continued)

Article Title (Authors)	Relevant Medical Condition(s)	Study Population Description	Cost Categories Included	Data Source(s)	Annual Cost Estimate(s)	Base Year	Cost Estimate(s) 2000 Dollarsb
Informal caregiving for chronic lung disease among older Americans (Langa, K. M., et. al.)	Chronic lung disease	Age 70 years or older, 3 cohorts: no lung disease, lung disease without associated activity limitations, and lung disease with limited associated activity limitations Prevalence-based	Informal caregiving	1993 Asset and Health Dynamics Study (AHEAD)	–Additional yearly cost of informal care per case (lung disease and activity limitation compared to informal care for individuals with no lung disease) $2,200 –National annual cost of >$2 billion for informal caregiving for chronic lung disease	2000	–Additional yearly cost of informal care per case (lung disease and activity limitation compared to informal care for individuals with no lung disease) $2,200 –National annual cost of >$2 billion for informal caregiving for chronic lung disease
Lost income and work limitations in persons with chronic respiratory disorders (Ward, M. M., H. S. Javitz, W. M. Smith, and M. A. Whan)	Chronic respiratory diseases:–Lung or respiratory problem (general)–Asthma –Bronchitis–Emphysema–Allergic rhinitis–Tuberculosis–Other lung disease	Civilian, noninstitutionalized U.S. populationPrevalence-based	Lost earnings (SIPP)Work disability (NHIS, percentage only - no dollar amounts)	–Survey of Income and Program Participation (October 91-January 92)–National Health Interview Survey (1993-1994)	Average annual earnings loss for adults with chronic respiratory conditions $3,143 – $5,272, 25-64–$1,267, 65+	1991	Average annual earnings loss for adults with chronic respiratory conditions $4,631 – $7,768, 25-64–$1,867, 65+

(continued)

Table A-1. Chronic Lung Disease (continued)

Article Title (Authors)	Relevant Medical Condition(s)	Study Population Description	Cost Categories Included	Data Source(s)	Annual Cost Estimate(s)	Base Year	Cost Estimate(s) 2000 Dollarsb
Medical Expenditures for Major Diseases, 1995 (Hodgson, T., and A. Cohen)	Broad range of diseases (ICD-9), including: –Neoplasms (140-239) –Nervous system and sense organs (320-389) –Circulatory system (390-459) –Respiratory system (460-519) –Skin and subcutaneous tissue (680-709)	U.S. Population and age- specific subgroups Prevalence-based	Hospital inpatient Outpatient (including ER) Home health care Physician office visits Nursing home care Lab and x-ray Dental Ambulance services Other professional services (e.g., podiatrists, optometrists)	HCFA Personal Health Care Expenditures for 1995 Expenditures for each health service allocated across age-, sex-, and diagnosis-specific groups using Medicare and VA claims and survey data, such as: –National Hospital Discharge Survey –National Medical Expenditure Survey –National Health Interview Survey –National Ambulatory Med Care Survey –National Nursing Home Survey	65+: Total = $300.2 billion Per capita = –$6,194, 65-74 yrs –$10,365, 75-84 yrs –$18,877, 85+	1995	65+: Total = $355.1 billion Per capita = –$7,326, 65-74 yrs –$12,259, 75-84 yrs –$22,327, 85+

(continued)

Table A-1. Chronic Lung Disease (continued)

Article Title (Authors)	Relevant Medical Condition(s)	Study Population Description	Cost Categories Included	Data Source(s)	Annual Cost Estimate(s)	Base Year	Cost Estimate(s) 2000 Dollarsb
Pharmacoeconomic evaluation of COPD (Hilleman, D. E., N. Dewan, M. Malesker, and M. Friedman)	–COPD –Emphysema –Chronic bronchitis	Patients at Creighton University Medical Center Hospital and/or outpatient clinics age 35-80, with COPD (any diagnosis), smokers (at least 20 pack years), and filled at least 70% of their prescriptions in the past year for pulmonary medication Prevalence-based	Drugs Oxygen therapy Laboratory tests Diagnostic tests Procedures Clinic visits Emergency department visits Hospitalizations	Original research	Median treatment costs incurred over the entire duration of follow-up (per patient per year): –Stage I $1,681 –Stage II $5,037 –Stage III $10,812	2000[a]	Median treatment costs incurred over the entire duration of follow-up (per patient per year): –Stage I $1,681 –Stage II $5,037 –Stage III $10,812
The burden of COPD in the U.S.A.: results from the Confronting COPD survey (Halpern, M. T., R. H. Stanford, and R. Borker)	COPD: –Chronic bronchitis –Emphysema	Age 42-89 (mean age of 64.08), all patients current or former smokers Prevalence-based	PCP visits (scheduled and unscheduled) Specialists visits (scheduled and unscheduled), Inpatient hospitalization ER visits Prescription medication (specific Rxs) Laboratory tests General categories of Indirect (work loss) and Societal (direct+indirect) costs	Confronting COPD survey (telephone interviews with patients and physicians)	Estimated mean annual cost per patient with COPD: –Total direct cost $4,120 –Indirect $1,527 –Societal $5,646	2002	Estimated mean annual cost per patient with COPD: –Total direct cost $3,762 –Indirect $1,394 –Societal $5,156

(continued)

Table A-1. Chronic Lung Disease (continued)

Article Title (Authors)	Relevant Medical Condition(s)	Study Population Description	Cost Categories Included	Data Source(s)	Annual Cost Estimate(s)	Base Year	Cost Estimate(s) 2000 Dollarsb
The cost of asthma in the emergency department and hospital (Stanford, R., T. McLaughlin, and L. J. Okamoto)	Asthma (ICD-9 493)	Patients from 27 hospitals across the U.S. with asthma, Oct 1996-Sept 1997, age 18 years or older Prevalence-based (per visit)	Emergency department Hospitalization	Premier's Perspective Comparative Database (PCD)	–Emergency department only total $234.48 –Emergency department and Hospitalization total $3,102.53	1997	–Emergency department only total $260.67 –Emergency department and Hospitalization total $3,449.02
The cost of health conditions in a health maintenance organization (Ray, G. T., et. al.)	–Asthma –Cerebrovascular disease –COPD –Congestive heart failure –Ischemic heart disease –Lung cancer –Pneumonia	Adult members of an HMO (Kaiser Permanente, Northern California) between July 1995 and June 1996 Prevalence-based	Hospital Laboratory Radiology Outpatient visit Home health Pharmacy Cost of care from non-Kaiser Permanente vendors	Original research	Annual costs attributable to condition (after adjustment for age, gender, and comorbidities): –Asthma $1,009 –Cerebrovascular disease $7,114 –COPD $6,859 –Congestive heart failure $7,176 –Ischemic heart disease $5,169 –Lung cancer $8,612 –Pneumonia $9,499	1996	Annual costs attributable to condition (after adjustment for age, gender, and comorbidities): –Asthma $1,153 –Cerebrovascular disease $8,130 –COPD $7,839 –Congestive heart failure $8,201 –Ischemic heart disease $5,907 –Lung cancer $9,842 –Pneumonia $10,856

(continued)

Table A-1. Chronic Lung Disease (continued)

Article Title (Authors)	Relevant Medical Condition(s)	Study Population Description	Cost Categories Included	Data Source(s)	Annual Cost Estimate(s)	Base Year	Cost Estimate(s) 2000 Dollarsb
The costs of treating COPD in the United States (Strassels, S. A., D. H. Smith, S. D. Sullivan, P. S. Mahajan)	COPD:–Chronic bronchitis (ICD-9 491)–Emphysema (ICD-9 492)–Chronic airway obstruction, not elsewhere classified (ICD-9 496)	Noninstitutionalized population with COPD, many former or current smokers, over 40 years old (n=228)Prevalence-based (expenditures for one year)	Inpatient admissionsOutpatient clinic visitsOffice visits (specialists, generalists, and other)Prescribed medicationsEmergency department visitsBed daysRestricted activity daysLost workdays	1987 National Medical Expenditure Survey (households)	Mean per person direct medical expenditure for people with COPD $6,469 (approximately 25% COPD related)	1987	Mean per person direct medical expenditure for people with COPD $12,968 (approximately 25% COPD related)
The economic burden of COPD (Sullivan, S. D., S. D. Ramsey, and T. A. Lee)	–COPD –Asthma –Influenza –Pneumonia –Tuberculosis –Respiratory cancer	U.S. Prevalence-based	Medical management Medical care services Hospitalization Indirect: Mortality and morbidity (loss of work time and productivity)	Division of Epidemiology National Heart, Lung, and Blood Institute 1996 report	–COPD average cost per person per year $1,522 Total annual cost (direct and indirect): –COPD $23.9 billion –Asthma $12.6 billion, –Pneumonia $7.8 billion –Respiratory cancer $25.1 billion	1993	–COPD average cost per person per year $1,971 Total annual cost (direct and indirect): –COPD $30.9 billion –Asthma $16.3 billion, –Pneumonia $10.1 billion –Respiratory cancer $32.5 billion

(continued)

Table A-1. Chronic Lung Disease (continued)

Article Title (Authors)	Relevant Medical Condition(s)	Study Population Description	Cost Categories Included	Data Source(s)	Annual Cost Estimate(s)	Base Year	Cost Estimate(s) 2000 Dollarsb
The economic burden of non-influenza-related viral respiratory tract infection in the United States (Fendrick, A. M., A. S. Monto, B. Nightengale, and M. Sarnes)	Non-influenza related viral respiratory infection (VRTI) (cold with complications including acute sinusitis, otitis media, and lower respiratory infections)	Nationwide telephone survey of U.S. households Prevalence-based	Outpatient physician visits Physician encounters in an emergency department Treatment OTC medication Prescription medication Missed caregiver workdays Missed workdays/Absenteeism	–Medical Expenditure Panel Survey (1997) –National Health Interview Survey –Bureau of Labor Statistics –Epidemiological survey (utilization only)	Extrapolated to U.S. population: –Total $40 billion –Direct $17 billion –Indirect $22.5 billion	2001	Extrapolated to U.S. population: –Total $38 billion –Direct $16 billion –Indirect $21.5 billion
The Morbidity and Mortality Chartbook on Cardiovascular, Lung, and Blood Diseases, 1996, National Heart, Lung, and Blood Institute, May 1996[c]	COPD and allied conditions (ICD-9 490-496)	Total U.S. population Prevalence-based	Direct Indirect: –Mortality –Morbidity (loss of workdays)	Survey data from: –National Center for Health Statistics –Health Care Financing Administration –Other	–Total economic cost $37.3 billion –Direct cost $21.6 billion –Indirect cost $16.2 billion	1998	–Total economic cost $40.2 billion –Direct cost $23.3 billion –Indirect cost $17.5 billion

(continued)

Table A-1. Chronic Lung Disease (continued)

Article Title (Authors)	Relevant Medical Condition(s)	Study Population Description	Cost Categories Included	Data Source(s)	Annual Cost Estimate(s)	Base Year	Cost Estimate(s) 2000 Dollarsb
Treatment cost of acute exacerbations of chronic bronchitis (Niederman, M. S., et. al.)[d]	Acute exacerbations of chronic bronchitis (AECB)	280,830 COPD patients (Medicare and non-Medicare) Prevalence-based	Hospital Physician Drug	–Medicare claims data –National Healthcare and Cost Utilization Project –National Ambulatory Med Care Survey –National Hospital Ambulatory Medical Care Survey	Mean hospital cost: –$5,497 over 65 –$5,561 under 65 –$5,516 all ages	1995	Mean hospital cost: –$6,502 over 65 –$6,577 under 65 –$6,524 all ages

[a]Publication year used as base year

[b]Annual Medical Care Consumer Price Index used for conversion. Average of January and February Medical Care CPI used for 2004.

[c]As reviewed in Kirschstein, R. 2000. "Disease-specific estimates of direct and indirect costs of illness and NIH support." Office of the Director,. National Institutes of Health, Dept of Health and Human Services.

[d]As reviewed in Halpern MT, Higashi MK, Bakst AW, Schmier JK. 2003. "The economic impact of acute exacerbations of chronic bronchitis in the United States and Canada: a literature review." J Manag Care Pharm Jul-Aug; 9(4): 353-9. Review.

Table A-2. Ischemic Heart Disease

Article Title (Authors)	Relevant Medical Condition(s)	Study Population Description	Cost Categories Included	Data Source(s)	Annual Cost Estimate(s)	Base Year	Cost Estimate(s) 2000 Dollarsb
American Heart Association. Heart Disease and Stroke Statistics - 2004 Update. Economic cost of cardiovascular diseases.	Cardiovascular disease (ICD-9 390-459, 745-747): –Heart disease –Coronary heart disease –Stroke –Hypertensive disease –Congestive heart failure –Total cardiovascular disease	U.S. population (depends on data source) Prevalence-based	Hospital Nursing home Physicians/other professionals Drugs/other medical durables Home health care Lost productivity/morbidity Lost productivity/mortality	–Hodgson, T. A. and A. J. Cohen. 1999. "Medical care expenditures for selected circulatory diseases: opportunities for reducing national health expenditures." *Medical Care* 37:994-1012. –National Health Expenditures Amounts, and Average Annual Percent Change, by Type of Expenditures: Selected Calendar Years 1980-2012 (cms.hhs.gov). –Rice, D. P., T. A. Hodgson, and A. N. Kopstein. 1985. "The economic cost of illness: a replication and update. *Health Care Financ Rev* 7:61-80. –Historic Income tables - People (census.gov) –Deaths for 358 Selected Causes by 5-Year Age Groups, Race, and Sex, United States, 2000 (cdc.nchs/default/htm). –Rice, Max, Michel, and Sung. 2003. "Present Value of Lifetime Earnings, U.S. 2000." Unpublished tables, Institute for Health and Aging, University of California, San Francisco.	–Heart disease: direct - $130.6 billion, indirect - $108.0 billion, total - $238.6 billion –Coronary heart disease: direct - $66.3 billion, indirect - $66.9 billion, total - $133.2 billion –Stroke: direct - $33.0 billion, indirect - $20.6 billion, total - $53.6 billion –Hypertensive disease: direct - $41.5 billion, indirect - $14.0 billion, total - $55.5 billion –Congestive heart failure: direct - $26.7 billion, indirect - $2.1 billion, total - $28.8 billion –Total cardiovascular disease: direct - $226.7 billion, indirect - $141.7 billion, total - $368.4 billion	2004	–Heart disease: direct - $88.6 billion, indirect - $92.4 billion, total - $204.2 billion –Coronary heart disease: direct - $56.7 billion, indirect - $57.2 billion, total - $114.0 billion –Stroke: direct - $28.2 billion, indirect - $17.6 billion, total - $45.9 billion –Hypertensive disease: direct - $35.5 billion, indirect - $12.0 billion, total - $47.5 billion –Congestive heart failure: direct - $22.8 billion, indirect - $1.8 billion, total - $24.6 billion –Total cardiovascular disease: direct - $194.0 billion, indirect - $121.2 billion, total - $315.2 billion

(continued)

Table A-2. Ischemic Heart Disease (continued)

Article Title (Authors)	Relevant Medical Condition(s)	Study Population Description	Cost Categories Included	Data Source(s)	Annual Cost Estimate(s)	Base Year	Cost Estimate(s) 2000 Dollarsb
Comparing the national economic burden of five chronic conditions (Druss, B. G., et. al)	–Mood disorders –Diabetes –Heart disease –Asthma –Hypertension	U.S. nationally representative sample (noninstitutionalized) Prevalence-based	Direct (health costs) Work loss Total societal costs	1996 Medical Expenditure Panel Survey	Direct per capita health costs for treatment of condition: –Heart disease $6,463 –Hypertension $569 –Asthma $663 Estimated work-loss costs for persons with condition: –Heart disease $3.8 billion –Hypertension $11.5 billion –Asthma $3.4 billion	1996	Direct per capita health costs for treatment of condition: –Heart disease $7,386 –Hypertension $650 –Asthma $758 Estimated work-loss costs for persons with condition: –Heart disease $4.3 billion –Hypertension $13.1 billion –Asthma $3.9 billion
Cost of medications for patients with ischemic heart disease in a rural family practice center (Patricoski, C.T., and G. Steiner)	Ischemic heart disease (chronic) (ICD 410-414)	Patients at Camden-On-Gauley Medical Center in West Virginia with chronic ischemic heart disease, age 30-97 (104 patients) Prevalence-based	Average monthly medication (cardiac and noncardiac, out-of-pocket and reimbursed)	Original research	Total cost $220.31 per month for medication ($104.77 of that for cardiac medication)	1999[a]	Total cost $229.28 per month for medication ($109.03 of that for cardiac medication)

(continued)

Table A-2. Ischemic Heart Disease (continued)

Article Title (Authors)	Relevant Medical Condition(s)	Study Population Description	Cost Categories Included	Data Source(s)	Annual Cost Estimate(s)	Base Year	Cost Estimate(s) 2000 Dollarsb
Healthcare Use among U.S. Women Aged 45 and Older (Hoerger, T., et. al.)	–Cardiovascular disease –Breast neoplasms –Gynecological neoplasms –Osteoporosis	Representative sample of U.S. women 45 and older Prevalence-based	Hospital inpatient Physician office Hospital outpatient Emergency department Nursing home Home and hospice care	For utilization: –Healthcare Cost and Utilization Project –National Ambulatory Medical Care Survey –National Hospital Ambulatory Medical Care Survey –National Nursing Home Survey –National Home and Hospice Survey For cost: –Converted charges to costs using cost-to-charge ratio –Medicare fee calculated using Medicare's resource-based relative value scale (RBRVS) –Or used information from literature	All ages (45+), Total: –Cardiovascular disease = $60.4 billion –Breast and gynecological neoplasms = $5.0 billion	1997	All ages (45+), total: –Cardiovascular disease = $67.1 billion –Breast and gynecological neoplasms = $5.6 billion
Medical Expenditures for Major Diseases, 1995 (Hodgson, T., and A. Cohen)	Broad range of diseases (ICD-9), including: –Neoplasms (140-239) –Nervous system and sense organs (320-389) –Circulatory system (390-459) –Respiratory system (460-519) –Skin and subcutaneous tissue (680-709)	U.S. Population and age-specific subgroups Prevalence-based	Hospital inpatient Outpatient (including ER) Home health care Physician office visits Nursing home care Lab and x-ray Dental Ambulance services Other professional services (e.g., podiatrists, optometrists)	HCFA Personal Health Care Expenditures for 1995 Expenditures for each health service allocated across age-, sex-, and diagnosis-specific groups using Medicare and VA claims and survey data, such as: –National Hospital Discharge Survey –National Medical Expenditure Survey –National Health Interview Survey –National Ambulatory Med Care Survey –National Nursing Home Survey	65+: Total = $300.2 billion Per capita = –$6,194, 65-74 yrs –$10,365, 75-84 yrs –$18,877, 85+	1995	65+: Total = $355.1 billion Per capita = –$7,326, 65-74 yrs –$12,259, 75-84 yrs –$22,327, 85+

(continued)

Table A-2. Ischemic Heart Disease (continued)

Article Title (Authors)	Relevant Medical Condition(s)	Study Population Description	Cost Categories Included	Data Source(s)	Annual Cost Estimate(s)	Base Year	Cost Estimate(s) 2000 Dollarsb
The cost of health conditions in a health maintenance organization (Ray, G. T., et. al.)	–Asthma–Cerebrovascular disease–COPD–Congestive heart failure–Ischemic heart disease–Lung cancer–Pneumonia	Adult members of an HMO (Kaiser Permanente, Northern California) between July 1995 and June 1996Prevalence-based	HospitalLaboratoryRadiologyOutpatient visitHome healthPharmacyCost of care from non-Kaiser Permanente vendors	Original research	Annual costs attributable to condition (after adjustment for age, gender, and comorbidities): –Asthma $1,009–Cerebrovascular disease $7,114–COPD $6,859–Congestive heart failure $7,176–Ischemic heart disease $5,169–Lung cancer $8,612–Pneumonia $9,499	1996	Annual costs attributable to condition (after adjustment for age, gender, and comorbidities): –Asthma $1,153–Cerebrovascular disease $8,130–COPD $7,839–Congestive heart failure $8,201–Ischemic heart disease $5,907–Lung cancer $9,842–Pneumonia $10,856
The Morbidity and Mortality Chartbook on Cardiovascular, Lung, and Blood Diseases, 1998, National Heart, Lung, and Blood Institute, October 1998.[c]	–Heart diseases (ICD-9 390-398, 402, 404-429) –Coronary heart diseases (ICD-9 410-414)	U.S. population Prevalence-based	Direct Indirect: mortality and morbidity (loss of workdays)	Survey data from: –National Center for Health Statistics –Health Care Financing Administration –Other Indirect costs from Dr. Dorothy Rice.	Total economic cost: –Heart disease $183.1 billion –Coronary heart disease $99.8 billion Direct: –Heart disease $101.8 billion –Coronary heart disease $53.1 billion Indirect: –Heart disease $81.3 billion –Coronary heart disease $46.7 billion	1999	Total economic cost: –Heart disease $190.6 billion –Coronary heart disease $103.9 billion Direct: –Heart disease $105.9 billion –Coronary heart disease $55.3 billion Indirect: –Heart disease $84.6 billion –Coronary heart disease $48.6 billion

[a]Publication year used as base year

[b]Annual Medical Care Consumer Price Index used for conversion. Average of January and February Medical Care CPI used for 2004.

[c]As reviewed in Kirschstein, R. 2000. "Disease-specific estimates of direct and indirect costs of illness and NIH support." Office of the Director,. National Institutes of Health, Dept of Health and Human Services.

Table A-3. Stroke (Hemorrhagic or Ischemic)

Article Title (Authors)	Relevant Medical Condition(s)	Study Population Description	Cost Categories Included	Data Source(s)	Annual Cost Estimate(s)	Base Year	Cost Estimate(s) 2000 Dollarsb
American Heart Association. Heart Disease and Stroke Statistics - 2004 Update. Economic cost of cardiovascular diseases.	Cardiovascular disease (ICD-9 390-459, 745-747): –Heart disease –Coronary heart disease –Stroke –Hypertensive disease –Congestive heart failure –Total cardiovascular disease	U.S. population (depends on data source) Prevalence-based	Hospital Nursing home Physicians/other professionals Drugs/other medical durables Home health care Lost productivity/morbidity Lost productivity/mortality	–Hodgson, T. A. and A. J. Cohen. 1999. "Medical care expenditures for selected circulatory diseases: opportunities for reducing national health expenditures." *Medical Care* 37:994-1012. –National Health Expenditures Amounts, and Average Annual Percent Change, by Type of Expenditures: Selected Calendar Years 1980-2012 (cms.hhs.gov). –Rice, D. P., T. A. Hodgson, and A. N. Kopstein. 1985. "The economic cost of illness: a replication and update. *Health Care Financ Rev* 7:61-80. –Historic Income tables - People (census.gov) –Deaths for 358 Selected Causes by 5-Year Age Groups, Race, and Sex, United States, 2000 (cdc.nchs/default/htm). –Rice, Max, Michel, and Sung. 2003. "Present Value of Lifetime Earnings, U.S. 2000." Unpublished tables, Institute for Health and Aging, University of California, San Francisco.	–Heart disease: direct - $130.6 billion, indirect - $108.0 billion, total - $238.6 billion –Coronary heart disease: direct - $66.3 billion, indirect - $66.9 billion, total - $133.2 billion –Stroke: direct - $33.0 billion, indirect - $53.6 billion, total - $53.6 billion –Hypertensive disease: direct - $41.5 billion, indirect - $14.0 billion, total - $55.5 billion –Congestive heart failure: direct - $26.7 billion, indirect - $2.1 billion, total - $28.8 billion –Total cardiovascular disease: direct - $226.7 billion, indirect - $141.7 billion, total - $368.4 billion	2004	–Heart disease: direct - $88.6 billion, indirect - $92.4 billion, total - $204.2 billion –Coronary heart disease: direct - $56.7 billion, indirect - $57.2 billion, total - $114.0 billion –Stroke: direct - $28.2 billion, indirect - $17.6 billion, total - $45.9 billion –Hypertensive disease: direct - $35.5 billion, indirect - $12.0 billion, total - $47.5 billion –Congestive heart failure: direct - $22.8 billion, indirect - $1.8 billion, total - $24.6 billion –Total cardiovascular disease: direct - $194.0 billion, indirect - $121.2 billion, total - $315.2 billion

(continued)

Table A-3. Stroke (Hemorrhagic or Ischemic) (continued)

Article Title (Authors)	Relevant Medical Condition(s)	Study Population Description	Cost Categories Included	Data Source(s)	Annual Cost Estimate(s)	Base Year	Cost Estimate(s) 2000 Dollarsb
Effects of stroke on medical resource use and costs in acute myocardial infarction. GUSTO I Investigators. Global Utilization of Streptokinase and Tissue Plasminogen Activator for Occluded Coronary Arteries Study (Tung, C. Y., et. al.)	Stroke associated with acute myocardial infarction –Hemorrhagic –Non-hemorrhagic	Sample of US GUSTO I patients, average age of stroke cohort 69 and no stroke cohort 60 Prevalence-based	Hospital Physician Stroke procedures Outpatient visits Institutional care	Global Utilization of Streptokinase and Tissue Plasminogen Activator for Occluded Coronary Arteries Study (GUSTO)	Average cost in baseline hospitalization: –Stroke $29,242 –No stroke $20,301 Baseline medical costs: –Hemorrhagic $26,619 –Nonhemorrhagic $33,799 –No stroke $20,301	1993	Average cost in baseline hospitalization: –Stroke $37,867 –No stroke $26,288 Baseline medical costs: –Hemorrhagic $34,470 –Nonhemorrhagic $43,768 –No stroke $26,288
Inpatient costs of specific cerebrovascular events at five academic medical centers. (Holloway, R. G., et. al.)	Cerebrovascular events (stroke): –Subarachnoid hemorrhage (SAH) (ICD-9 430) –Intracerebral hemorrhage (ICH) (ICD-9 431) –Ischemic cerebral infarction (ICI) (ICD-9 434 or 436) –Transient ischemic attack (TIA) (ICD-9 435)	Administrative data set of all hospital discharges from 5 academic medical centers in 1992 Prevalence-based	All hospital charges incurred during hospitalization (changed to costs using cost to charge ratio) (omitted ambulance cost)	–AMCC 192 Uniform Hospital Discharge Data Set –Medicare cost to charge ratios	Mean cost per discharge: –SAH $39,994 –ICH $21,535 –ICI $9,882 –TIA $4,653 Mean cost per admission by age: –SAH $38,417 under 65 –ICH $24,126 under 65 –ICI $10,067 under 65 –TIA $4,612 under 65 –SAH $45,891 over 65 –ICH $19,385 over 65 –ICI $9,777 over 65 –TIA $4,678 over 65	1992	Mean cost per discharge: –SAH $54,868 –ICH $9,544 –ICI $13,557 –TIA $6,383 Mean cost per admission by age: –SAH $52,705 under 65 –ICH $33,099 under 65 –ICI $13,811 under 65 –TIA $6,327 under 65 –SAH $62,958 over 65 –ICH $26,594 over 65 –ICI $13,413 over 65 –TIA $6,418 over 65

(continued)

Table A-3. Stroke (Hemorrhagic or Ischemic) (continued)

Article Title (Authors)	Relevant Medical Condition(s)	Study Population Description	Cost Categories Included	Data Source(s)	Annual Cost Estimate(s)	Base Year	Cost Estimate(s) 2000 Dollarsb
Lifetime cost of stroke in the United States (Taylor, T. N., et. al.)	Stroke: –Subarachnoid hemorrhage (SAH) –Intracerebral hemorrhage (ICH) –Ischemic stroke (ISC)	U.S. (separate sources for under and over 65) Incidence-based (lifetime cost)	Acute-care costs Long-term ambulatory care costs Nursing home costs Costs attributable to stroke recurrence Prescription drug costs Indirect costs (market and nonmarket)	Medicare claims data 1987 National Medical Expenditures Survey Insurance claims data U.S. Bureau of Economic Analysis	Lifetime costs per person for first stroke occurring in 1990: –SAH $228,030 –ICH $123,565 –ISC $90,981	1990	Lifetime costs per person for first stroke occurring in 1990: –SAH $365,296 –ICH $197,947 –ISC $145,748
Medical Expenditures for Major Diseases, 1995(Hodgson, T., and A. Cohen)	Broad range of diseases (ICD-9), including:–Neoplasms (140-239)–Nervous system and sense organs (320-389)–Circulatory system (390-459)–Respiratory system (460-519)–Skin and subcutaneous tissue (680-709)	U.S. Population and age-specific subgroupsPrevalence-based	Hospital inpatientOutpatient (including ER)Home health carePhysician office visitsNursing home careLab and x-rayDental Ambulance servicesOther professional services (e.g., podiatrists, optometrists)	HCFA Personal Health Care Expenditures for 1995Expenditures for each health service allocated across age-, sex-, and diagnosis-specific groups using Medicare and VA claims and survey data, such as:–National Hospital Discharge Survey–National Medical Expenditure Survey–National Health Interview Survey–National Ambulatory Med Care Survey–National Nursing Home Survey	65+: Total = $300.2 billionPer capita = –$6,194, 65-74 yrs–$10,365, 75-84 yrs–$18,877, 85+	1995	65+: Total = $355.1 billionPer capita = –$7,326, 65-74 yrs–$12,259, 75-84 yrs–$22,327, 85+

(continued)

Table A-3. Stroke (Hemorrhagic or Ischemic) (continued)

Article Title (Authors)	Relevant Medical Condition(s)	Study Population Description	Cost Categories Included	Data Source(s)	Annual Cost Estimate(s)	Base Year	Cost Estimate(s) 2000 Dollarsb
National Center for Health Statistics, Centers for Disease Control and Prevention (Thomas A. Hodgson)[c] National Heart, Lung, and Blood Institute, NIH (Thomas J. Thom)[c]	Cerebrovascular disease (stroke) (ICD-9 430-438)	Total U.S. population Prevalence-based	Direct Indirect: –Mortality –Morbidity (loss of workdays)	Framingham Heart Study base data	–Total economic cost $43.3 billion –Direct cost $28.3 billion –Indirect cost $15 billion	1998	–Total economic cost $46.6 billion –Direct cost $30.5 billion –Indirect cost $16.2 billion
Outcomes and costs after hip fracture and stroke: A comparison of rehabilitation settings (Kramer, A. M., et. al.)	Stroke (ICD-9 342.9, 430, 431, 432.0, 432.1, 432.9, 434.0, 434.1, 434.9, 436, 437.3, 438)	Patients diagnosed with condition, Medicare coverage, 65 or older, acute hospital stay in the last 30 days, and no previous SNF or rehab admission for this event Prevalence-based	Rehabilitation facility Skilled nursing facility Acute hospital Outpatient care Physician Durable medical equipment Home health or hospice care Other	Original research (Medicare reimbursements to sample)	Average Medicare Reimbursement during the 6 months after admission: –RF total $23,133 –Subacute SNF total $15,522 –Traditional SNF total $11,299	1997[a]	Average Medicare Reimbursement during the 6 months after admission: –RF total $25,716 –Subacute SNF total $17,255 –Traditional SNF total $12,561

(continued)

Table A-3. Stroke (Hemorrhagic or Ischemic) (continued)

Article Title (Authors)	Relevant Medical Condition(s)	Study Population Description	Cost Categories Included	Data Source(s)	Annual Cost Estimate(s)	Base Year	Cost Estimate(s) 2000 Dollarsb
The cost of health conditions in a health maintenance organization (Ray, G. T., et. al.)	–Asthma –Cerebrovascular disease –COPD –Congestive heart failure –Ischemic heart disease –Lung cancer –Pneumonia	Adult members of an HMO (Kaiser Permanente, Northern California) between July 1995 and June 1996 Prevalence-based	Hospital Laboratory Radiology Outpatient visit Home health Pharmacy Cost of care from non-Kaiser Permanente vendors	Original research	Annual costs attributable to condition (after adjustment for age, gender, and comorbidities): –Asthma $1,009 –Cerebrovascular disease $7,114 –COPD $6,859 –Congestive heart failure $7,176 –Ischemic heart disease $5,169 –Lung cancer $8,612 –Pneumonia $9,499	1996	Annual costs attributable to condition (after adjustment for age, gender, and comorbidities): –Asthma $1,153 –Cerebrovascular disease $8,130 –COPD $7,839 –Congestive heart failure $8,201 –Ischemic heart disease $5,907 –Lung cancer $9,842 –Pneumonia $10,856
Variations in average charges for strokes and TIAs: United States, 1995 (Mushinski, M.)	–Stroke (ICD-9 430-434.9) –Transient ischemic attack (TIA) (ICD-9 435-435.9)	Stroke or TIA as primary diagnosis, age 40 or over (approximate median of 70) Prevalence-based (per hospitalization)	Inhospital charge (hospital stay and physician charge)	MetLife Study	Average inhospital charge: –Stroke $11,010 –TIA $4,940	1995	Average inhospital charge: –Stroke $13,022 –TIA $5,843

[a]Publication year used as base year

[b]Annual Medical Care Consumer Price Index used for conversion. Average of January and February Medical Care CPI used for 2004.

[c]As reviewed in Kirschstein, R. 2000. "Disease-specific estimates of direct and indirect costs of illness and NIH support." Office of the Director,. National Institutes of Health, Dept of Health and Human Services.

Table A-4. Lung Cancer

Article Title (Authors)	Relevant Medical Condition(s)	Study Population Description	Cost Categories Included	Data Source(s)	Annual Cost Estimate(s)	Base Year	Cost Estimate(s) 2000 Dollarsb
Healthcare Use among U.S. Women Aged 45 and Older (Hoerger, T., et. al.)	–Cardiovascular disease –Breast neoplasms –Gynecological neoplasms –Osteoporosis	Representative sample of U.S. women 45 and older Prevalence-based	Hospital inpatient Physician office Hospital outpatient Emergency department Nursing home Home and hospice care	For utilization: –Healthcare Cost and Utilization Project –National Ambulatory Medical Care Survey –National Hospital Ambulatory Medical Care Survey –National Nursing Home Survey –National Home and Hospice Survey For cost: –Converted charges to costs using cost-to-charge ratio –Medicare fee calculated using Medicare's resource-based relative value scale (RBRVS) –Or used information from literature	All ages (45+), Total: –Cardiovascular disease = $60.4 billion –Breast and gynecological neoplasms = $5.0 billion	1997	All ages (45+), total: –Cardiovascular disease = $67.1 billion –Breast and gynecological neoplasms = $5.6 billion
Medical Expenditures for Major Diseases, 1995 (Hodgson, T., and A. Cohen)	Broad range of diseases (ICD-9), including: –Neoplasms (140-239) –Nervous system and sense organs (320-389) –Circulatory system (390-459) –Respiratory system (460-519) –Skin and subcutaneous tissue (680-709)	U.S. Population and age- specific subgroups Prevalence-based	Hospital inpatient Outpatient (including ER) Home health care Physician office visits Nursing home care Lab and x-ray Dental Ambulance services Other professional services (e.g., podiatrists, optometrists)	HCFA Personal Health Care Expenditures for 1995 Expenditures for each health service allocated across age-, sex-, and diagnosis-specific groups using Medicare and VA claims and survey data, such as: –National Hospital Discharge Survey –National Medical Expenditure Survey –National Health Interview Survey –National Ambulatory Med Care Survey –National Nursing Home Survey	65+: Total = $300.2 billion Per capita = –$6,194, 65-74 yrs –$10,365, 75-84 yrs –$18,877, 85+	1995	65+: Total = $355.1 billion Per capita = –$7,326, 65-74 yrs –$12,259, 75-84 yrs –$22,327, 85+

(continued)

Table A-4. Lung Cancer (continued)

Article Title (Authors)	Relevant Medical Condition(s)	Study Population Description	Cost Categories Included	Data Source(s)	Annual Cost Estimate(s)	Base Year	Cost Estimate(s) 2000 Dollarsb
Medicare payments from diagnosis to death for elderly cancer patients by stage at diagnosis (Riley, G. F., A. L. Potosky, J. D. Lubitz, and L. G. Kessler)	Lung cancer (also includes breast, prostate, colon/rectum, and bladder cancer)	Age 65 and older Incidence and Prevalence (includes one estimate of annual costs, but all others are by phase or from diagnosis to death)	Inpatient hospital Physician/supplier Outpatient Other Costs include Medicare payments for all covered services, including care for conditions unrelated to cancer.	–Medicare payments –National Cancer Institute's Surveillance, Epidemiology, and End Results (SEER) Program	–Average payments per year $17,371 –Diagnosis to death $29,184 Average Medicare payments total (also lists by age and gender): –Less than 1 year survival $19,199 –Initial $17,518 –Continuing care $4,305 –Pre-final $9,985 –Final $13,217	1990	–Average payments per year $27,828 –Diagnosis to death $46,752 Average Medicare payments total (also lists by age and gender): –Less than 1 year survival $30,756 –Initial $28,063 –Continuing care $6,896 –Pre-final $15,996 –Final $21,173
The costs of cancer care in the United States: implications for action (Schuette, H. L., T. C. Tucker, M. L. Brown, and A. L. Potosky)	Lung cancer	Data source population Prevalence-based	Direct Overall –Morbidity –Mortality –Direct by value and percentage	1990 National Center for Health Statistic study	Estimated annual costs of cancer care (U.S. 1990 Malignant neoplasm only): –Mortality $58,773 million (61.1%) –Morbidity $8,895 million (10.3%) –Direct costs $27,458 (28.6%)	1990	Estimated annual costs of cancer care (U.S. 1990 Malignant neoplasm only): –Mortality $94,152 million (61.1%) –Morbidity $14,249 million (10.3%) –Direct costs $43,987 (28.6%)

(continued)

Table A-4. Lung Cancer (continued)

Article Title (Authors)	Relevant Medical Condition(s)	Study Population Description	Cost Categories Included	Data Source(s)	Annual Cost Estimate(s)	Base Year	Cost Estimate(s) 2000 Dollarsb
The economic burden of cancer (Brown, M. L., and L. Fintor)[a]	Lung cancer (ICD-9 162.2-162.9)	Total U.S. population Prevalence-based	Direct Indirect	–National Cancer Institute's Surveillance Epidemiology and End Results (SEER) program –Medicare claims records (diagnosed between 1974 and 1981)	Direct $5.1 billion	1990	Direct $8.2 billion
The economic burden of COPD (Sullivan, S. D., S. D. Ramsey, and T. A. Lee)	–COPD –Asthma –Influenza –Pneumonia –Tuberculosis –Respiratory cancer	U.S. Prevalence-based	Medical management Medical care services Hospitalization Indirect: Mortality and morbidity (loss of work time and productivity)	Division of Epidemiology National Heart, Lung, and Blood Institute 1996 report	–COPD average cost per person per year $1,522 Total annual cost (direct and indirect): –COPD $23.9 billion –Asthma $12.6 billion, –Pneumonia $7.8 billion –Respiratory cancer $25.1 billion	1993	–COPD average cost per person per year $1,971 Total annual cost (direct and indirect): –COPD $30.9 billion –Asthma $16.3 billion, –Pneumonia $10.1 billion –Respiratory cancer $32.5 billion
The Period Prevalence and Costs of Treating Nonmelanoma Skin Cancers in Patients over 65 Years of Age Covered by Medicare (Joseph A., T. Mark, and C. Mueller)	Nonmelanoma skin cancers (ICD-9 173)	U.S. Medicare population age 65 years and older Prevalence-based	Physician office treatment charges (v. costs)	5% Sample of Medicare claims for 1995	Total = $285 million Per capita = $329	1995	Total = $337 million Per capita = $389

[a]As reviewed in Kirschstein, R. 2000. "Disease-specific estimates of direct and indirect costs of illness and NIH support." Office of the Director. National Institutes of Health, Dept of Health and Human Services.

[b]Annual Medical Care Consumer Price Index used for conversion. Average of January and February Medical Care CPI used for 2004.

Table A-5. Pneumonia

Article Title (Authors)	Relevant Medical Condition(s)	Study Population Description	Cost Categories Included	Data Source(s)	Annual Cost Estimate(s)	Base Year	Cost Estimate(s) 2000 Dollarsb
Efficacy and Cost-Effectiveness of Vaccination against Influenza among Elderly Persons Living in the Community (Nichol, K, K. Margolis, J. Wuorenma, and T. Von Sternberg)	–Influenza –Pneumonia (ICD-9 480-487)	Sample of enrollees of HMO in Minneapolis; 65 years or older (approx. 25,000 in each claims year) Prevalence-based	Hospital inpatient charges (v. costs)	Minnesota HMO administrative data	Cost per enrollee (adjusted for health status): –With influenza immunization = $46 –Without influenza immunization = $67	1993	Cost per enrollee: –With influenza immunization = $60 –Without influenza immunization = $87
Hospitalization for pneumonia among older adults (Callahan, C. M., and F. D. Wolinsky)	Pneumonia and influenza (ICD-9 480-487.8, 507-507.1, 507.8, 997.3)	7,527 community dwelling adults aged 70 and older in 1984 (mean age of 76.5 in 1984) Prevalence-based (per hospitalization)	Hospitalization	Longitudinal study of aging (LSOA) (some link to NHIS) connected to Medicare Automated Data Retrieval System (Medicare Claims data)	Pneumonia primary discharge diagnosis: –Median cost $5,100 per hospitalization Pneumonia secondary discharge diagnosis: –Median cost $10,100 per hospitalization	1984	Pneumonia primary discharge diagnosis: –Median cost $12,454 per hospitalization Pneumonia secondary discharge diagnosis: –Median cost $24,664 per hospitalization
Hospitalized community-acquired pneumonia in the elderly: age- and sex-related patterns of care and outcome in the United States (Kaplan, V., et. al.)	Community-acquired Pneumonia (ICD-9 481, 482, 485, or 486) or bacterial pneumonia with pulmonary complaint at admission	Age 65+ with CAP as admission and diagnosis discharge or bacterial pneumonia listed as discharge diagnosis coupled with pulmonary complaint at admission Prevalence-based (cost per hospital admission)	Hospital cost	–1997 Medicare Provider Analysis and Review hospital discharge database (MedPAR) –CB97-64, Population Estimates Program, U.S. Bureau of the Census –1997 Provider Specific File –Hospital Cost Report Minimum Dataset	Mean hospital cost $6,949	1997	Mean hospital cost $7,725

(continued)

Table A-5. Pneumonia (continued)

Article Title (Authors)	Relevant Medical Condition(s)	Study Population Description	Cost Categories Included	Data Source(s)	Annual Cost Estimate(s)	Base Year	Cost Estimate(s) 2000 Dollarsb
Outcome and attributable cost of ventilator-associated pneumonia among intensive care unit patients in a suburban medical center (Warren, D. K., et. al.)	Ventilator associated pneumonia	ICU patients at Missouri Baptist Medical Center in St. Louis (10 bed surgical ICU and 10 bed medical ICU) from Jan. 19, 1998, to Dec. 31, 1999, requiring mechanical ventilation, mean age 69 Prevalence-based (per hospitalization)	Hospitalization	Original research	Estimated attributable cost of ventilator associated pneumonia (controlling for other factors) $11,897 Hospital cost of patients, mean: –With VAP $70,568 –Without $21,620	2003[a]	Estimated attributable cost of ventilator associated pneumonia (controlling for other factors) $10,443 Hospital cost of patients, mean: –With VAP $61,946 –Without $18,978
Relation between length of hospital stay and costs of care for patients with community-acquired pneumonia(Fine, M. J., et. al.)	Community-acquired pneumonia	Patients at 3 hospital sites (two in Pittsburgh, PA and one in Boston, MA) in the Pneumonia Patient Outcomes Research Team (PORT) cohort study, age 18 years or olderPrevalence-based (cost per hospital stay)	Hospital roomLaboratory tests and proceduresEmergency departmentPharmacy and intravenous solutionsRadiology tests and proceduresOther	Hospital bills (obtained for each participant)	Median cost of hospitalization –Total $5,942 –Hospital room $3,465–Non-room $2,422	2000[a]	Median cost of hospitalization –Total $5,942 –Hospital room $3,465–Non-room $2,422

(continued)

Table A-5. Pneumonia (continued)

Article Title (Authors)	Relevant Medical Condition(s)	Study Population Description	Cost Categories Included	Data Source(s)	Annual Cost Estimate(s)	Base Year	Cost Estimate(s) 2000 Dollarsb
The cost of health conditions in a health maintenance organization (Ray, G. T., et. al.)	–Asthma –Cerebrovascular disease –COPD –Congestive heart failure –Ischemic heart disease –Lung cancer –Pneumonia	Adult members of an HMO (Kaiser Permanente, Northern California) between July 1995 and June 1996 Prevalence-based	Hospital Laboratory Radiology Outpatient visit Home health Pharmacy Cost of care from non-Kaiser Permanente vendors	Original research	Annual costs attributable to condition (after adjustment for age, gender, and comorbidities): –Asthma $1,009 –Cerebrovascular disease $7,114 –COPD $6,859 –Congestive heart failure $7,176 –Ischemic heart disease $5,169 –Lung cancer $8,612 –Pneumonia $9,499	1996	Annual costs attributable to condition (after adjustment for age, gender, and comorbidities): –Asthma $1,153 –Cerebrovascular disease $8,130 –COPD $7,839 –Congestive heart failure $8,201 –Ischemic heart disease $5,907 –Lung cancer $9,842 –Pneumonia $10,856
The Cost of Treating Community-Acquired Pneumonia (Niederman, M., J. McCombs, A. Unger, A. Kumar, and R. Popovian)	Community acquired pneumonia (ICD-9 480-487)	Representative sample of U.S. population and 65+ subgroup Prevalence-based	Hospital inpatient Inpatient physician services Physician office visits Emergency department Outpatient clinic Other facilities (e.g., skilled nursing, nursing home)	For 65+: –National Health and Nutrition Examination Survey III (to estimate incidence) –Medicare Standard Analytical Files (Parts A and B; to estimate utilization/costs)	65+: –Total = $4.8 billion –Per capita = approximately $8000 (total cost/0.6 million people with inpatient stay)	1995	65+: –Total = $5.7 billion –Per capita = approximately $9,500 (total cost/ 0.6 million people with inpatient stay)

(continued)

Table A-5. Pneumonia (continued)

Article Title (Authors)	Relevant Medical Condition(s)	Study Population Description	Cost Categories Included	Data Source(s)	Annual Cost Estimate(s)	Base Year	Cost Estimate(s) 2000 Dollarsb
The economic burden of COPD (Sullivan, S. D., S. D. Ramsey, and T. A. Lee)	–COPD –Asthma –Influenza –Pneumonia –Tuberculosis –Respiratory cancer	U.S. Prevalence-based	Medical management Medical care services Hospitalization Indirect: Mortality and morbidity (loss of work time and productivity)	Division of Epidemiology National Heart, Lung, and Blood Institute 1996 report	–COPD average cost per person per year $1,522 Total annual cost (direct and indirect): –COPD $23.9 billion –Asthma $12.6 billion, –Pneumonia $7.8 billion –Respiratory cancer $25.1 billion	1993	–COPD average cost per person per year $1,971 Total annual cost (direct and indirect): –COPD $30.9 billion –Asthma $16.3 billion, –Pneumonia $10.1 billion –Respiratory cancer $32.5 billion
Unpublished (Thomas Thom, NHLBI)[c]	Pneumonia and influenza (ICD-9 480-487)	Total U.S. population Prevalence-based	Direct Indirect: –Mortality	Survey data from: –National Center for Health Statistics –Health Care Financing Administration –Other Indirect costs from Dr. Dorothy Rice.	–Total economic cost $25.6 billion –Direct cost $18.6 billion –Indirect $7.0 billion	1999	–Total economic cost $26.6 billion –Direct cost $19.4 billion –Indirect $7.3 billion

[a]Publication year used as base year

[b]Annual Medical Care Consumer Price Index used for conversion. Average of January and February Medical Care CPI used for 2004.

[c]As reviewed in Kirschstein, R. 2000. "Disease-specific estimates of direct and indirect costs of illness and NIH support." Office of the Director, National Institutes of Health, Dept of Health and Human Services.

Table A-6. Gastrointestinal Illness

Article Title (Authors)	Relevant Medical Condition(s)	Study Population Description	Cost Categories Included	Data Source(s)	Annual Cost Estimate(s)	Base Year	Cost Estimate(s) 2000 Dollarsb
Cost of Digestive Diseases in the U.S. (Broun, D. M, and J. E. Everhart)*	–Digestive diseases (ICD-9 01-09, 070, 150, 151, 153-154, 155, 157, 152, 156, 158, 159, 211, 455, 456.0-456.2, 530-579, 787, 789) –Gallbladder (ICD-9 574-575)	Total U.S. population Prevalence-based	Direct Indirect: –Mortality –Morbidity (loss of workdays)	Hospital statistics	Digestive disease: –Total economic cost $56.2 billion –Direct cost $41.5 billion –Indirect cost $14.7 billion Gall bladder –Total economic cost $4.7 billion –Direct cost $4.4 billion –Indirect cost $0.4 billion	1985	Digestive disease: –Total economic cost $129.1 billion –Direct cost $95.4 billion –Indirect cost $33.8 billion Gall bladder –Total economic cost $10.8 billion –Direct cost $10.1 billion –Indirect cost $0.9 billion
Excess costs from gastrointestinal disease associated with nonsteroidal anti-inflammatory drugs (Smalley, W. E., M. R. Griffin, R. L. Fought, and W. A. Ray)	–Gastrointestinal disease –Gastroduodenal ulcer disease (ICD-9 531-534) –Gastritis/duodenitis (ICD-9 535) –Gastrointestinal hemorrhage (ICD-9 578) –Nonneoplastic gastrointestinal disease (ICD-9 146-171, 174-190) (by procedure for outpatient visits and by type of medication for prescriptions)	Tennessee Medicaid enrollees age 65 or older (in 1989) Prevalence-based (payments per person year)	Hospital stay Outpatient visits Prescription medication	Medicare/Medicaid payments	Adjusted mean annual payment for all types of medical care for study gastrointestinal disorders: –Nonuser $134 –Occasional user $180 –Regular user $244	1996[a]	Adjusted mean annual payment for all types of medical care for study gastrointestinal disorders: –Nonuser $153 –Occasional user $206 –Regular user $279

(continued)

Table A-6. Gastrointestinal Illness (continued)

Article Title (Authors)	Relevant Medical Condition(s)	Study Population Description	Cost Categories Included	Data Source(s)	Annual Cost Estimate(s)	Base Year	Cost Estimate(s) 2000 Dollarsb
Gastrointestinal illness in managed care: healthcare utilization and costs (Lim, D., et. al.)	Gastrointestinal illness (ICD-9 used to separate into subcategories of GI): –Peptic ulcer disease –Nonulcer peptic disease –Lower GI tract disease –Abdominal pain –Hepatitis –Liver disease –Gallbladder/biliary tract –GI tract hemorrhage –Other GI tract problems	50,000 patients in database who met eligibility criteria Prevalence-based (per episode)	Professional charges Nonadmission charges Admission charges Prescriptions	Claims data in a proprietary health services research database	Total claims submitted $152 million	1997[a]	Total claims submitted $169 million
Health Impact of Peptic Ulcer in the United States (Sonnenberg, A., et. al.)* Cost of Digestive Diseases in the U.S. (Broun, D. M, et. al.)*	Digestive diseases –Peptic Ulcer (ICD-9 531-534)	Total U.S. population Prevalence-based	Direct (including other related nonhealth costs) Indirect: –Mortality –Morbidity (loss of workdays)	Hospital statistics	–Total economic cost $4.92 billion –Direct cost $3.55 billion –Indirect cost $1.37 billion	1989	–Total economic cost $8.59 billion –Direct cost $6.20 billion –Indirect cost $2.39 billion

(continued)

Table A-6. Gastrointestinal Illness (continued)

Article Title (Authors)	Relevant Medical Condition(s)	Study Population Description	Cost Categories Included	Data Source(s)	Annual Cost Estimate(s)	Base Year	Cost Estimate(s) 2000 Dollarsb
Prevalence and cost of hospitalization for gastrointestinal complications related to peptic ulcers with bleeding or perforation: comparison of two national databases (Kong, S. X., et. al.)	Upper gastrointestinal complications (peptic and gastroduodenal ulcers with bleeding or perforation) (ICD-9 531.0-6, 532.0-6, 533.0-6, 534.0-6)	Patients with upper gastrointestinal complications as diagnosis, average age 66 (HCUP-3) and 52 (MarketScan) Prevalence-based (charge per admission)	Hospitalization	–Healthcare Cost & Utilization Project (HCUP-3) –MarketScan	Average charge per admission all diagnoses: –$8,661 in 1991 –$9,742 in 1992 Average charge per admission with UGIC as primary diagnosis: –$12,970 in 1991 –$14,294 in 1992	1991, 1992	Average charge per admission all diagnoses: –$12,762 in 1991 (2000 dollars) –$13,365 in 1992 (2000 dollars) Average charge per admission with UGIC as primary diagnosis: –$19,111 in 1991 (2000 dollars) –$19,610 in 1992 (2000 dollars)
The burden of selected digestive diseases in the United States(Sandler, R. S., et. al.)	–Nonfoodborne gastroenteritis and other intestinal infections (ICD-9 001-009 (subset), 558.9)–Foodborne illness (ICD-9 001-009 (subset), 558.9, 070.0, 070.1)–Additional digestive diseases	Data source populationPrevalence-based	Direct/IndirectHospital facilityInpatient physician servicesHospital OPDHospital emergency roomOffice visitsDrugsLost work days	–National Hospital Discharge Survey–National Ambulatory Medical Care Survey–National Hospital Ambulatory Medical Care Survey	Nonfoodborne: –Total $2,107 million–Direct $1,602 million–Indirect $505 millionFoodborne: –Total $1,119 million–Direct $886 million–Indirect $233 million	1998	Nonfoodborne: –Total $2,270 million–Direct $1,726 million–Indirect $544 millionFoodborne: –Total $1,205 million–Direct $954 million–Indirect $251 million

[a]Publication year used as base year

[b]Annual Medical Care Consumer Price Index used for conversion. Average of January and February Medical Care CPI used for 2004.

[c]As reviewed in Kirschstein, R. 2000. "Disease-specific estimates of direct and indirect costs of illness and NIH support." Office of the Director, National Institutes of Health, Dept of Health and Human Services.

Appendix B

Detailed Methods for Estimating Missed Work Days and Bed Days Attributable to Stroke, Heart Disease, and Chronic Lung Disease

In Section 3, we provided a general description of our methods for estimating the indirect costs resulting from increased morbidity. This appendix provides additional details on our approach for estimating the missed work days attributable to stroke, heart disease, and chronic lung disease.

We used the 2001 NHIS to predict days of work missed and bed days attributable to each condition. For the work-loss days analysis, we restricted our sample to those 65 years and older who were employed in the labor market. We also excluded those with missing data. Our final analysis sample included only 524 adults. For our bed-days analysis, we restricted the sample to all those 65 years and older, regardless of employment status. Our final sample for this analysis included 3,930 older adults.

Because of the discrete nature of the variables of interest for our analysis (i.e., counts of days of work lost and days spent in bed), we used a negative binomial regression with a long link to estimate missed work days and bed days for people 65 years and older. By including indicator variables for stroke, heart disease, and chronic lung disease, we were able to estimate the impact of each condition on work loss and bed days. The regressions also controlled for other factors expected to influence the number of missed work days, including sex, race, education, income, smoking status, and a variable indicating the presence of a functional limitation (e.g., difficulty walking or standing). The work-loss days regression also included variables to control for hourly versus salaried workers and specific categories of occupations. The bed-days regression included variables to control for labor-force participation status (i.e., working, retired, never worked, etc.).

Results from these regressions are shown in Tables B-1 and B-2. In the work-loss days analysis, our estimates are positive, suggesting that people with a reported stroke, chronic lung disease, and/or heart disease have more work-loss days than those with none of these conditions. However, these estimates are not statistically significant for any of the conditions. Results from the bed-days regression are positive and highly statistically significant for stroke and heart disease, suggesting that those with these conditions experience more bed days than those without, even controlling for a number of other factors likely to affect serious illness.

To estimate the dollar value of work-loss and bed days attributable to stroke, heart disease, and chronic lung disease, we used the following procedure:

1. Predicted annual work-loss (bed) days for each person in the sample.
2. For those with reported stroke, heart disease, and/or chronic lung disease, repeat Step 1 setting the indicator variable for the condition to zero. The resulting predictions represent estimated work-loss (bed) days for those without the condition of interest who have similar characteristics (i.e., sex, race, employment status, etc.).
3. Calculate the difference between predicted work-loss (bed) days for those with and without the condition of interest (i.e., subtract value calculated in Step 2 from Step 1 value). This calculation produces an estimate of the work-loss (bed) days attributable to each condition.
4. Multiply estimated sex-specific labor earnings (household productivity values) (Grosse, 2003) by estimates of work-loss days attributable to each condition from Step 3.

Table B-1. Missed Work Days Analysis—Negative Binomial Regression (NBR) Results

Variable Descriptions. All except constant term are indicator variables that = 1 if:	NBR Coefficients	Robust Standard Errors	P-value
High school grad	–1.04	0.40	0.01
Had some college	–0.77	0.42	0.07
College grad	–0.72	0.59	0.22
Graduate degree	0.08	0.81	0.92
Female	0.20	0.43	0.64
Low income (<200% of poverty line)	–1.74	0.90	0.06
Middle income (<500% of poverty line)	–1.72	0.84	0.04
High income (≥500% of poverty line)	–1.47	0.87	0.09
Former smoker	0.31	0.52	0.55
Never smoked	0.33	0.48	0.50
Non-Hispanic white	–0.88	0.53	0.10
Non-Hispanic black	0.28	0.68	0.68
Non-Hispanic other	–2.64	1.04	0.01
Salaried employee	0.31	0.37	0.40
No functional limitation reported	–1.05	0.31	0.00
Professional specialty occupation	1.47	0.64	0.02
Technician or related support occupation	1.33	0.95	0.16
Sales occupation	1.28	0.53	0.02
Administrative support occupation	0.91	0.45	0.04
Private household occupation	–3.26	0.89	0.00
Protective services occupation	–1.76	0.85	0.04
Household	0.27	0.53	0.61
Farming, forestry, and fishing occupation	0.27	0.95	0.77
Precision production, craft, and repair occupation	0.56	0.60	0.35
Operator, fabricator, or laborer	1.37	0.59	0.02
Transportation or material-moving occupation	0.33	0.82	0.68
Handler, equipment cleaner, helper, or laborer	–0.30	0.89	0.74
Self-report of STROKE	**0.54**	**0.92**	**0.56**
Self-report of CHRONIC LUNG DISEASE	**0.98**	**0.69**	**0.15**
Self-report of HEART DISEASE	**0.30**	**0.39**	**0.44**
Constant term	2.53	1.14	0.03

Notes: Estimates only for those 65 years and older in the 2001 NHIS who were currently working. Unweighted sample size is 524.

Table B-2. Bed-Days Analysis—Negative Binomial Regression (NBR) Results

Variable Descriptions. All except constant term are indicator variables that = 1 if:	NBR Coefficients	Robust Standard Errors	P-value
High school grad	–0.19	0.23	0.40
Had some college	–0.13	0.25	0.60
College grad	–0.47	0.26	0.07
Graduate degree	–0.11	0.31	0.72
Female	0.27	0.16	0.10
Low income (<200% of poverty line)	0.04	0.24	0.86
Middle income (<500% of poverty line)	0.11	0.26	0.68
High income (>=500% of poverty line)	–0.49	0.31	0.12
Former smoker	0.32	0.21	0.13
Never smoked	0.04	0.21	0.85
Smoking status unknown	–16.14	0.83	0.00
Non-Hispanic white	–0.26	0.23	0.26
Non-Hispanic black	0.19	0.29	0.50
Non-Hispanic other	0.36	0.44	0.42
Retired	0.81	0.22	0.00
Not working but previously worked	2.10	0.30	0.00
Never worked	1.38	0.38	0.00
No functional limitation reported	–1.34	0.18	0.00
Self-report of STROKE	**0.96**	**0.26**	**0.00**
Self-report of CHRONIC LUNG DISEASE	**0.32**	**0.21**	**0.12**
Self-report of HEART DISEASE	**0.78**	**0.18**	**0.00**
Constant term	0.57	0.38	0.14

Notes: Estimates only for those 65 years and older in the 2001 NHIS. Unweighted sample size is 3930.

Our estimates of work loss and bed days attributable to each condition are shown by sex in Tables B-3 and B-4, respectively. Among older adults who worked, chronic lung disease was responsible for the largest impact on work loss, or about 3 to 4.5 days of missed work per year. Considering bed days, stroke was responsible for the largest number of bed days among the three conditions—13 annual bed days for males and 20 annual bed days for females.

Note that, although our estimates for attributable work-loss days are not statistically different from zero, we used them to estimate the cost associated with work loss in the 65 and older population that works. We chose to include these work-related cost estimates because it is likely that our lack of statistically significant results is due to the small overall sample size and the small number with each condition of interest. In addition, because only about 5 to 11 percent of those with any of the conditions worked, the estimated cost of losing 1 to 4.6 work days per year was low.

Table B-3. Predicted Missed-Work Days for Workers 65 Years and Older by Condition and Sex

Condition and Sex	Number of Respondents	Predicted Missed-Work Days Attributable to Condition
Stroke		
Male	9	1.72
Female	4	3.19
Chronic Lung Disease		
Male	30	3.42
Female	26	4.59
Ischemic Heart Disease		
Male	72	0.93
Female	46	1.74

Note: Predictions of work days missed were calculated using NBR results in Table B-1.

Table B-4. Predicted Bed Days for Respondents 65 Years and Older by Condition and Sex

Condition and Sex	Number of Respondents	Predicted Missed Work Days Attributable to Condition
Stroke		
Male	135	13.45445
Female	209	20.43143
Chronic Lung Disease		
Male	209	3.036422
Female	316	4.85797
Ischemic Heart Disease		
Male	561	6.198227
Female	669	10.35484

Note: Predictions of bed days were calculated using NBR results in Table B-2.

Appendix C

Direct Medical Costs Associated with Selected Health Conditions: Annual Medicare Payments in 2000 by Region and State

Table C-1. Direct Medical Costs Associated with Pneumonia—Annual Medicare Payments in 2000 by Region and State

Region (State)	Beneficiaries with a Diagnosis			Direct Medical Costs ($/Person/Year)	
	Number	Percent	CI (±)	Mean	CI (±)
New England					
Total	75,925	5.5	(5.0, 6.0)	6,719	(5,050, 7,989)
Connecticut	20,277	6.0	(5.0, 7.0)	6,163	(4,122, 8,204)
Maine	7,102	4.1	(2.9, 5.3)	5,887	(2,921, 8,843)
Massachusetts	35,954	6.3	(5.3, 7.3)	8,079	(5,802, 10,355)
New Hampshire	5,850	4.3	(3.0, 5.5)	2,978	(1,102, 4,854)
Rhode Island	4,234	4.7	(2.8, 6.5)	6,494	(2,907, 10,081)
Vermont	2,508	3.5	(1.9, 5.1)	3,192	(245, 6,139)
Middle Atlantic					
Total	229,597	5.9	(6.0, 6.3)	6,359	(5,218, 7,501)
New Jersey	49,307	5.8	(5.1, 6.5)	8,740	(4,677, 12,803)
New York	115,794	6.5	(5.9, 7.1)	6,065	(4,693, 7,436)
Pennsylvania	64,496	5.2	(4.7, 5.7)	5,068	(4,143, 5,993)
East North Central					
Total	252,991	5.3	(5.0, 5.7)	4,899	(4,349, 5,449)
Indiana	33,873	5.0	(4.3, 5.7)	4,963	(3,959, 5,967)
Illinois	58,323	4.8	(4.0, 5.6)	4,877	(3,590, 6,163)
Michigan	70,181	6.5	(5.8, 7.3)	4,865	(3,635, 6,094)
Ohio	65,599	5.7	(5.1, 6.3)	5,133	(4,079, 6,187)
Wisconsin	25,014	4.0	(3.4, 4.6)	4,347	(3,424, 5,270)
West North Central					
Total	116,909	5.4	(5.0, 5.8)	5,892	(4,800, 6,984)
Iowa	21,523	5.4	(4.4, 6.3)	5,015	(3,741, 6,288)
Kansas	19,598	6.4	(5.2, 7.6)	4,905	(3,551, 6,260)
Minnesota	19,272	4.1	(3.3, 4.8)	8,023	(2,882, 13,163)
Missouri	34,387	5.8	(5.0, 6.6)	6,582	(4,641, 8,523)
Nebraska	10,011	4.8	(3.6, 6.1)	4,683	(2,360, 7,006)
North Dakota	5,162	5.8	(3.8, 7.8)	2,801	(957, 4,645)
South Dakota	6,958	6.8	(4.7, 8.9)	6,104	(3,902, 8,306)
South Atlantic					
Total	249,410	4.8	(4.5, 5.0)	5,076	(4,526, 5,627)
Delaware	5,529	6.3	4.7, 7.9)	6,843	(4,033, 9,653)
District of Columbia	2,620	4.8	(2.9, 6.6)	15,097	(2,331, 27,863)
Florida	72,173	4.3	(3.8, 4.7)	4,568	(3,766, 5,389)
Georgia	35,091	5.2	(4.5, 5.9)	5,309	(3,808, 6,810)
Maryland	24,246	5.0	(4.2, 5.9)	6,423	(4,551, 8,295)
North Carolina	45,245	5.3	(4.7, 5.9)	4,187	(3,414, 4,960)
South Carolina	20,371	4.6	(3.7, 5.4)	5,261	(3,078, 7,443)
Virginia	29,932	4.3	(3.7, 5.0)	5,221	(2,623, 7,818)
West Virginia	14,204	6.0	(4.8, 7.2)	4,515	(3,257, 5,773)

(continued)

Table C-1. Direct Medical Costs Associated with Pneumonia—Annual Medicare Payments in 2000 by Region and State (continued)

Region (State)	Beneficiaries with a Diagnosis			Direct Medical Costs ($/Person/Year)	
	Number	Percent	CI (±)	Mean	CI (±)
East South Central					
Total	101,233	5.5	(5.0, 6.0)	5,363	(4,1538, 6,187)
Alabama	23,355	4.8	(4.1, 5.6)	5,773	(4,359, 7,187)
Kentucky	28,643	6.5	(5.5, 7.6)	5,062	(3,537, 6,586)
Mississippi	16,875	5.4	(4.4, 6.4)	7,021	(4,004, 10,038)
Tennessee	32,360	5.3	(4.5, 6.0)	4,469	(3,284, 5,653)
West South Central					
Total	152,602	5.8	(5.4, 6.2)	5,985	(4,950, 7,020)
Arkansas	18,737	5.7	(4.7, 6.7)	4,665	(2,731, 6,599)
Louisiana	21,588	5.6	(4.7, 6.5)	6,409	(4,684, 8,133)
Oklahoma	22,113	5.9	(4.9, 6.9)	5,346	(3,776, 6,917)
Texas	90,165	5.9	(5.3, 6.4)	6,314	(4,702, 7,926)
Mountain					
Total	59,498	4.5	(4.0, 5.0)	5,048	(4,170, 5,925)
Arizona	15,785	4.5	(3.4, 5.6)	4,370	(2,835, 5,904)
Colorado	11,948	5.1	(4.0, 6.2)	6,821	(4,921, 9,352)
Idaho	5,589	4.6	(2.8, 6.4)	5,109	(2,304, 7,914)
New Mexico	6,777	4.5	(3.3, 5.8)	4,730	(2,649, 6,811)
Montana	3,873	3.4	(1.9, 5.0)	4,683	(1,533, 7,834)
Utah	8,171	4.8	(3.5, 6.1)	3,296	(1,841, 4,750)
Nevada	5,530	4.3	(3.0, 5.5)	5,374	(2,173, 8,576)
Wyoming	1,815	3.4	(1.9, 5.0)	7,946	(–2,312, 18,205)
Pacific					
Total	131,330	5.0	(4.5, 5.4)	6,304	(5,073, 7,534)
Alaska	2,080	6.1	(4.1, 8.2)	5,984	(3,352, 8,416)
California	91,048	5.0	(4.4, 5.6)	7,496	(5,766, 9,225)
Hawaii	4,606	5.0	(3.5, 6.5)	4,389	(1,710, 7,069)
Oregon	11,671	4.8	(3.7, 5.8)	3,828	(2,434, 5,222)
Washington	21,925	5.0	(4.1, 5.8)	3,104	(2,064, 4,143)

Table C-2. Direct Medical Costs Associated with Stroke —Annual Medicare Payments in 2000 by Region and State

Region (State)	Beneficiaries with a Diagnosis			Direct Medical Costs ($/Person/Year)	
	Number	Percent	CI (±)	Mean	CI (±)
New England					
Total	94,443	5.9	(5.4, 6.5)	4,242	(3,288, 5,197)
Connecticut	25,113	7.5	(6.3, 8.6)	3,045	(1,833, 4,256)
Maine	10,735	6.2	(4.7, 7.7)	2,770	(1,646, 3,894)
Massachusetts	40,135	7.1	(6.0, 8.1)	5,334	(3,400, 7,268)
New Hampshire	9,934	7.2	(5.6, 8.9)	3,111	(1,486, 4,736)
Rhode Island	4,763	5.3	(3.3, 7.2)	4,731	(1,743, 7,719)
Vermont	3,762	5.3	(3.3, 7.2)	7,162	(1,017, 13,307)
Middle Atlantic					
Total	307,495	6.4	(6.0, 6.7)	3,686	(3,237, 4,135)
New Jersey	71,158	8.4	(7.5, 9.2)	4,478	(3,532, 5,424)
New York	138,898	7.8	(7.1, 8.4)	3,374	(2,617, 4,131)
Pennsylvania	97,439	7.8	(7.2, 8.5)	3,552	(2,945, 4,159)
East North Central					
Total	367,642	7.8	(7.4, 8.2)	3,823	(3,222, 4,424)
Indiana	52,894	7.8	(7.0, 8.6)	4,014	(3,081, 4,948)
Illinois	86,491	7.2	(6.2, 8.2)	4,512	(2,593, 6,431)
Michigan	102,437	9.5	(8.7, 10.4)	2,613	(2,043, 3,184)
Ohio	91,660	8.0	(7.3, 8.7)	4,380	(3,081, 5,579)
Wisconsin	34,160	5.4	(4.7, 6.2)	3,911	(2,948, 4,873)
West North Central					
Total	133,861	6.2	(5.7, 6.6)	3,653	(2,992, 4,314)
Iowa	25,497	6.4	(5.3, 7.4)	2,585	(1,702, 3,467)
Kansas	21,262	6.9	(5.7, 8.2)	3,907	(2,397, 5,417)
Minnesota	17,996	3.8	(3.1, 4.5)	3,461	(1,988, 4,934)
Missouri	44,835	7.6	(6.7, 8.5)	3,821	(2,749, 4,893)
Nebraska	13,316	6.4	5.0, 7.9)	5,854	(1,571, 10,137)
North Dakota	5,323	6.0	(4.0, 8.0)	2,053	(659, 3,446)
South Dakota	5,453	5.3	(3.4, 7.2)	3,105	(1,218, 4,992)
South Atlantic					
Total	449,303	8.6	(8.3, 9.0)	3,433	(3,084, 3,783)
Delaware	8,462	9.6	(7.8, 11.5)	3,862	(2253, 5,471)
District of Columbia	2,620	4.8	(2.9, 6.6)	4,587	(1,224, 7,949)
Florida	178,328	10.5	(9.9, 11.2)	3,028	(2,617, 3,440)
Georgia	54,206	8.1	(7.2, 8.9)	3,322	(2,585, 4,060)
Maryland	91,854	19.1	(17.6, 20.6)	6,882	(5,687, 8,077)
North Carolina	61,526	7.2	(6.5, 7.9)	3,076	(2,360, 3,972)
South Carolina	33,093	7.4	(6.4, 8.4)	4,681	(2,604, 6,758)
Virginia	55,077	7.9	(7.1, 8.8)	3,391	(1,898, 4,885)
West Virginia	19,069	8.0	(6.6, 9.4)	3,689	(2,316, 5,062)

(continued)

Table C-2. Direct Medical Costs Associated with Stroke (Ischemic or Hemorrhagic)—Annual Medicare Payments in 2000 by Region and State (continued)

	Beneficiaries with a Diagnosis			Direct Medical Costs ($/Person/Year)	
Region (State)	Number	Percent	CI (±)	Mean	CI (±)
East South Central					
Total	149,178	8.0	(7.6, 8.6)	4,271	(3,699, 4,843)
Alabama	42,206	8.8	(7.7, 9.8)	4,096	(3,126, 5,067)
Kentucky	35,404	8.1	(7.0 , 9.2)	4,077	(2,850, 5,303)
Mississippi	23,622	7.5	(6.4, 8.7)	3,844	(2,795, 4,892)
Tennessee	47,946	7.8	(6.9, 8.7)	4,788	(3,604, 5,952)
West South Central					
Total	212,888	6.4	(7.6, 8.6)	4,017	(3,441, 4,592)
Arkansas	27,484	8.4	(7.1, 9.6)	3,821	(2,748, 4,893)
Louisiana	32,981	8.6	(7.5, 9.7)	3,271	(2,393, 4,149)
Oklahoma	27,133	7.3	(6.2, 8.4)	3,456	(1,855, 5,058)
Texas	125,290	8.2	(7.5, 8.8)	4,377	(3,521, 5,233)
Mountain					
Total	65,373	5.0	(4.4, 5.5)	3,430	(2,685, 4,174)
Arizona	19,835	56.7	(4.5, 6.9)	2,962	(1,546, 4,378)
Colorado	10,657	45.7	(3.5, 5.6)	3,319	(1,694, 4,943)
Idaho	5,356	4.4	(2.6 . 6.2)	6,798	(2,061, 11,535)
New Mexico	6,128	4.1	(2.9, 5.3)	3,027	(1,437, 4,617)
Montana	6,024	5.3	(3.4, 7.3)	4,295	(1,536, 7,055)
Utah	8,184	4.8	(3.5, 6.2)	2,652	(813, 4,491)
Nevada	7,174	5.5	(4.1, 7.0)	2,995	(1,426, 4,563)
Wyoming	2,017	3.8	(2.2, 5.4)	3,011	(314, 5,708)
Pacific					
Total	173,089	6.6	(6.0, 7.1)	3,557	(2,764, 4,350)
Alaska	1,950	5.7	(3.7, 7.7)	5,253	(2,260, 8,426)
California	127,335	7.0	(6.2, 7.7)	3,600	(2,565, 4,635)
Hawaii	7,004	7.6	(5.8, 9.4)	5,164	(2,196, 8,133)
Oregon	10,118	4.1	(3.1, 5.1)	3,569	(1,418, 5,720)
Washington	26,681	6.0	(5.1, 7.0)	2,798	(1,878, 3,718)

Table C-3. Direct Medical Costs Associated with Chronic Lung Disease—Annual Medicare Payments in 2000 by Region and State

Region (State)	Beneficiaries with a Diagnosis			Direct Medical Costs ($/Person/Year)	
	Number	Percent	CI (±)	Mean	CI (±)
New England					
Total	173,635	12.6	(11.9, 13.4)	6,648	(5,703, 7,593)
Connecticut	40,571	12.1	(10.7, 13.4)	6,682	(5,200, 8,164)
Maine	20,917	12.1	(10.0, 14.1)	6,367	(4,357, 8,378)
Massachusetts	75,950	13.4	(11.9, 14.8)	7,380	(5,521, 9,238)
New Hampshire	16,796	12.3	(10.2, 14.3)	6,004	(4,317, 7,692)
Rhode Island	10,761	11.9	(9.1, 14.7)	5,851	(3,363, 8,340)
Vermont	8,640	12.1	(9.3, 14.9)	2,981	(1,545, 4,418)
Middle Atlantic					
Total	467,332	12.0	(11.6, 12.5)	6,228	(5,588, 6,867)
New Jersey	102,374	12.0	(11.0, 13.0)	7,300	(5,343, 9,258)
New York	210,086	11.8	(11.0, 12.5)	5,447	(4,581, 6,314)
Pennsylvania	154,872	12.5	(11.7, 13.3)	6,577	(5,755, 7,400)
East North Central					
Total	581,380	12.3	(11.8, 12.8)	5,761	(5,252, 6,270)
Indiana	86,337	12.7	(11.7, 13.7)	5,375	(4,147, 6,604)
Illinois	133,561	11.1	(1.0, 12.2)	6,474	(4,922, 8,026)
Michigan	152,208	14.2	(13.1, 15.2)	5,877	(5,000, 6,754)
Ohio	147,656	12.9	(12.0, 13.7)	5,583	(4,823, 6,342)
Wisconsin	61,618	9.8	(8.9, 10.8)	4,897	(4,034, 5,561)
West North Central					
Total	240,049	11.0	(10.5, 11.6)	6,485	(5,286, 7,684)
Iowa	47,337	11.8	(10.4, 13.2)	4,784	(3,670, 5,899)
Kansas	36,878	12.0	(10.4, 13.6)	5,971	(4,244, 7,697)
Minnesota	42,074	8.9	(7.8, 1.0)	5,779	(3,725, 7,834)
Missouri	74,433	12.6	(11.5, 13.7)	8,086	(4,717, 11,455)
Nebraska	18,689	9.0	(7.3, 11.0)	8,485	(4,672, 12,298)
North Dakota	10,485	11.8	(9.1, 14.5)	5,355	(3,207, 7,503)
South Dakota	10,154	9.9	(7.4, 12.4)	4,960	(3,018, 6,903)
South Atlantic					
Total	680,253	13.0	(12.6, 13.4)	5,579	(5,205, 5,593)
Delaware	9,172	10.4	(8.5, 12.4)	9,498	(5,608, 13,387)
District of Columbia	4,191	7.6	(5.3, 9.9)	9,841	(3,268, 16,414)
Florida	250,009	14.7	(14.0, 15.5)	5,382	(4,731, 6,033)
Georgia	84,409	12.6	(11.5, 13.6)	5,356	(4,514, 6,198)
Maryland	58,363	12.1	(10.9, 13.4)	7,561	(5,878, 9,244)
North Carolina	106,788	12.5	(11.5, 13.5)	5,452	(4,666, 6,238)
South Carolina	51,419	11.5	(10.3, 12.8)	4,649	(3,662, 5,637)
Virginia	82,241	11.8	(10.8, 12.9)	5,151	(3,926, 6,376)
West Virginia	33,660	14.1	(12.4, 15.9)	5,431	(4,140, 6,721)

(continued)

Table C-3. Direct Medical Costs Associated with Chronic Lung Disease—Annual Medicare Payments in 2000 by Region and State (continued)

	Beneficiaries with a Diagnosis			Direct Medical Costs ($/Person/Year)	
Region (State)	Number	Percent	CI (±)	Mean	CI (±)
East South Central					
Total	252,568	13.7	(13.0, 14.3)	4,974	(4,534, 5,415)
Alabama	68,419	1.4	(13.0, 15.5)	5,244	(4,370, 6118)
Kentucky	65,299	14.9	(13.4, 16.4)	4,863	(4,042, 5,685)
Mississippi	38,944	12.4	(11.0, 13.9)	4,891	(3,699, 6,083)
Tennessee	79,906	13.0	(11.8, 14.1)	4,874	(4,098, 5,651)
West South Central					
Total	336,899	12.8	(12.3, 13.4)	6,317	(5,675, 6,959)
Arkansas	42,442	12.9	(11.4, 14.4)	5,712	(4,427, 7,176)
Louisiana	47,496	12.4	(11.1, 13.7)	6,710	(5,574, 7,845)
Oklahoma	50,308	13.5	(12.0, 15.0)	5,841	(4,345, 7,337)
Texas	196,653	12.8	(12.0, 13.6)	6,475	(5,531, 7,419)
Mountain					
Total	167,846	12.7	(11.9, 13.5)	4,817	(4,238, 5,396)
Arizona	45,171	12.9	(11.2, 14.6)	4,016	(2,839, 5,192)
Colorado	36,154	15.5	(13.7, 17.3)	6,174	(4,850, 7,497)
Idaho	14,205	11.7	(8.9, 14.4)	4,780	(2,566, 6,993)
New Mexico	18,911	12.7	(10.6, 14.7)	3,878	(2,713, 5,043)
Montana	13,984	12.4	(9.6, 15.2)	4,662	(2,913, 6,410)
Utah	13,909	8.2	(6.5, 9.9)	3,423	(2,145, 4,701)
Nevada	18,857	15.0	(12.3, 16.7)	5,802	(3,578, 8,027)
Wyoming	6,655	12.5	(9.7, 15.3)	6,094	(3,473, 8,714)
Pacific					
Total	308,164	11.7	(11.0, 12.3)	5,911	(4,942, 6,881)
Alaska	4,550	13.4	(10.5, 16.3)	6,569	(3,716, 9,421)
California	213,616	11.7	(10.8, 12.6)	6,447	(5,093, 7,802)
Hawaii	8,847	9.6	(7.5, 11.6)	6,550	(3,141, 9,960)
Oregon	26,258	10.7	(9.2, 12.3)	4,660	(3,497, 5,823)
Washington	54,893	12.4	(11.1, 13.8)	4,266	(3,247, 5,285)

Table C-4. Direct Medical Costs Associated with Ischemic Heart Disease—Annual Medicare Payments in 2000 by Region and State

Region (State)	Beneficiaries with a Diagnosis			Direct Medical Costs ($/Person/Year)	
	Number	Percent	CI (±)	Mean	CI (±)
New England					
Total	282,552	20.5	(19.6, 21.5)	6,303	(5,632, 6,973)
Connecticut	73,319	21.8	(20.0, 23.6)	5,973	(4,954, 6,992)
Maine	36,360	21.0	(18.5, 23.6	5,116	(3,880, 6,353)
Massachusetts	119,789	21.1	(19.4, 22.7)	7,413	(6,100, 8,726)
New Hampshire	24,898	18.2	(15.7, 20.6)	4,628	(3,305, 5,591)
Rhode Island	16,759	18.5	(15.1, 21.9)	5,247	(2,989, 7,505)
Vermont	11,427	16.0	(12.8, 19.2)	5,750	(3,077, 8,422)
Middle Atlantic					
Total	885,001	22.8	(22.2, 23.4)	5,886	(5,400, 6,372)
New Jersey	208,261	24.5	(23.1, 25.8)	6,426	(5,182, 7,670)
New York	404,025	22.6	(21.6, 23.6)	5,691	(4,935, 6,446)
Pennsylvania	272,715	22.0	(21.0, 23.0)	5,764	(5,184, 6,343)
East North Central					
Total	977,693	20.6	(20.1, 21.2)	5,892	(5,508, 6,275)
Indiana	133,417	2.0	(18.5, 20.9)	5,559	(4,904, 6,213)
Illinois	224,414	18.6	(17.1, 20.1)	6,544	(5,285, 7,802)
Michigan	285,749	26.6	(25.3, 27.9)	5,364	(4,766, 5,962)
Ohio	233,021	20.3	(19.3, 21.3)	6,075	(5,511, 6,639)
Wisconsin	101,092	16.1	(14.9, 17.3)	5,953	(5,169, 6,737)
West North Central					
Total	381,285	17.5	(16.9, 18.2)	5,760	(5,304, 6,217)
Iowa	65,222	16.3	(14.7, 17.8)	4,874	(3,996, 5,753)
Kansas	61,420	20.0	(18.1, 22.0)	4,746	(3,871, 5,622)
Minnesota	64,542	13.6	(12.3, 14.9)	6,070	(5,096, 7,043)
Missouri	122,870	20.8	(19.4, 22.1)	6,283	(5,447, 7,119)
Nebraska	33,317	16.1	(1.4, 1.8)	6,274	(4,573, 7,974)
North Dakota	16,614	18.7	(15.4, 22.0)	6,651	(4,212, 9,091)
South Dakota	17,300	16.8	(13.7, 20.0)	5,994	(1,906, 10,082)
South Atlantic					
Total	1,066,047	20.4	(19.9, 20.9)	5,370	(5,093, 6,648)
Delaware	21,009	23.9	(21.1, 26.7)	5,469	(4,090, 6,848)
District of Columbia	6,811	12.4	(9.6, 15.2)	10,614	(3,861, 17,367)
Florida	432,873	25.5	(24.6, 26.4)	4,750	(4,370, 5,131)
Georgia	115,271	17.2	(16.0, 18.4)	5,960	(5,065, 6,854)
Maryland	91,854	19.1	(17.6, 20.6)	6,882	(5,687, 8,077)
North Carolina	146,238	17.1	(16.0, 18.2)	5,140	(4,500, 5,780)
South Carolina	81,512	18.3	(16.8, 19.8)	5,936	(4,717, 7,154)
Virginia	116,923	16.8	(15.6, 18.1)	5,257	(4,286, 6,227)
West Virginia	53,556	22.5	(20.4, 24.6)	5,835	(4,805, 6,864)

(continued)

Table C-4. Direct Medical Costs Associated with Ischemic Heart Disease—Annual Medicare Payments in 2000 by Region and State (continued)

	Beneficiaries with a Diagnosis			Direct Medical Costs ($/Person/Year)	
Region (State)	Number	Percent	CI (±)	Mean	CI (±)
East South Central					
Total	346,972	18.8	(18.2, 19.5)	5,930	(5,342, 6,518)
Alabama	87,164	18.1	(16.7, 19.5)	5,657	(4,853, 6,462)
Kentucky	88,595	20.2	(18.6, 21.9)	5,993	(5,051, 6,935)
Mississippi	55,910	17.9	(16.2, 19.6)	6,000	(4,914, 7,087)
Tennessee	115,302	18.7	(17.4, 20.0)	6,054	(4,648, 7,460)
West South Central					
Total	500,632	19.1	(18.4, 19.8)	5,879	(5,444 , 6,314)
Arkansas	65,705	20.0	(18.2, 21.8)	5,182	(4,283, 6,081)
Louisiana	75,143	19.6	(18.1, 21.2)	5,951	(5,069, 6,833)
Oklahoma	73,744	19.7	(18.1, 21.4)	6,757	5,364, 8,151)
Texas	286,040	18.6	(17.7, 19.5)	5,794	(5,198, 6,391)
Mountain					
Total	210,157	15.9	(15.1, 16.8)	5,014	(4,459, 5,586)
Arizona	66,016	18.9	(16.8, 20.9)	4,074	(3,118, 5,030)
Colorado	34,250	14.7	(12.9, 16.5)	5,929	(4,566, 7,292)
Idaho	19,561	16.1	(12.9, 19.2)	6,791	(4,049, 9,533)
New Mexico	21,949	14.7	(12.5, 16.9)	5,062	(3,458, 6,666)
Montana	16,351	14.5	(11.5, 17.5)	4,916	(3,122, 6,710)
Utah	23,429	13.8	(11.7, 15.9)	4,119	(2,856, 5,383)
Nevada	22,349	17.2	(14.8, 19.6)	5,408	(3,737, 7,079)
Wyoming	6,252	11.7	(9.7, 14.5)	6,392	(3,588, 9,196)
Pacific					
Total	429,332	16.3	(15.5, 17.0)	5,955	(5,263, 6,640)
Alaska	4,355	12.8	(9.9, 15.7)	10,150	6,256, 14,043)
California	317,040	17.4	(16.3, 18.4)	6,284	(5,384, 7,185)
Hawaii	14,599	15.8	(13.3, 18.3)	5,069	(3,139, 6,999)
Oregon	30,314	12.4	(10.8,14.0)	4,460	(3,262, 5,659)
Washington	63,023	14.3	(12.8, 15.7)	4,911	(3,992, 5,829)

Table C-5. Direct Medical Costs Associated with Lung Cancer—Annual Medicare Payments in 2000 by Region and State

Region (State)	Beneficiaries with a Diagnosis			Direct Medical Costs ($/Person/Year)	
	Number	Percent	CI (±)	Mean	CI (±)
New England					
Total	16,862	1.2	(1.0, 1.4)	11,928	(6,172, 17,685)
Connecticut	3,116	0.9	(0.5, 1.3)	14,866	(2,288, 27,445)
Maine	2,424	1.4	(0.7, 2.1)	7,629	(2,366, 12,892)
Massachusetts	8,212	1.4	(1.0, 1.9)	14,367	(3,563, 25,171)
New Hampshire	1,142	0.8	(0.3, 1.4)	7,589	(–822, 16,001)
Rhode Island	1,411	1.6	(0.5, 2.6)	6,836	(–2,159, 15,830)
Vermont	557	0.8	(0.0, 1.5)	51	(–13, 115)
Middle Atlantic					
Total	53,771	1.4	(1.2, 1.6)	11,950	(9,833, 14,067)
New Jersey	10,976	1.3	(0.9, 1.6)	12,854	(8,754, 16,954)
New York	28,147	1.6	(1.3, 1.9)	11,920	(8,860, 15,281)
Pennsylvania	14,648	1.2	(0.9, 1.4)	11,330	(8,101, 14,560)
East North Central					
Total	55,466	1.2	(1.0, 1.3)	8,431	(6,968, 9,893)
Indiana	7,460	1.1	(0.8, 1.4)	8,552	(5,639, 11,466)
Illinois	10,714	0.9	(0.6, 1.2)	7,188	(3,882, 10,494)
Michigan	18,217	1.7	(1.3, 2.1)	9,181	(5,949, 12,413)
Ohio	13,489	1.2	(0.9, 1.4)	7,852	(5,295, 10,410)
Wisconsin	5,586	0.9	(0.6, 1.2)	9,603	(6,000, 13,205)
West North Central					
Total	22,121	1.0	(0.8, 1.2)	9,076	(6,975, 11,177)
Iowa	3,390	0.8	(0.5, 1.2)	9,481	(5,420, 13,543)
Kansas	4,372	1.4	(0.8, 2.0)	10,908	(4,969, 16,847)]
Minnesota	5,483	11.6	(0.8, 1.6)	8,587	(5,146, 12,028)
Missouri	5,575	0.9	(0.6, 1.3)	8,561	(3,763, 13,359)
Nebraska	1,742	0.8	(0.3, 1.4)	9,284	(–412, 18,980)
North Dakota	807	0.9	(0.1, 1.7)	10,094	(–15,752, 35,939)
South Dakota	752	0.7	(0.0, 1.4)	2,402	(–4,962, 9,765)
South Atlantic					
Total	61,018	1.2	(1.0, 1.3)	11,552	(9,432, 13,671)
Delaware	1,319	1.5	(0.7, 2.3)	9,030	(3,166, 14,894)
District of Columbia	524	1.0	(0.1, 1.8)	8,287	(–5,511, 22,085)
Florida	20,028	1.2	(1.0, 1.4)	10,145	(7,637, 12,653)
Georgia	5,321	0.8	(0.5, 1.1)	7,350	(4,223, 10,477)
Maryland	6,006	1.2	(0.8, 1.6)	14,596	(8,176, 21,016)
North Carolina	11,084	1.3	(1.0, 1.6)	13,871	(9,656, 18,086)
South Carolina	6,199	13.9	(0.9, 1.8)	11,061	(6,458, 15,664)
Virginia	7,695	1.1	(0.8, 1.4)	10,012	(201, 19,823)
West Virginia	2,841	1.2	(0.6, 1.7)	20,863	(–3,824, 45,550)

(continued)

Table C-5. Direct Medical Costs Associated with Lung Cancer—Annual Medicare Payments in 2000 by Region and State (continued)

Region (State)	Beneficiaries with a Diagnosis			Direct Medical Costs ($/Person/Year)	
	Number	Percent	CI (±)	Mean	CI (±)
East South Central					
Total	23,270	1.3	(1.0, 1.5)	9,662	(7,446, 11,879)
Alabama	6,982	1.4	(1.0, 1.9)	9,649	(5,304, 13,993)
Kentucky	4,260	1.0	(0.6, 1.4)	8,928	(3,573, 14,284)
Mississippi	5,013	1.6	(1.0, 2.2)	11,549	(5,677, 17,421)
Tennessee	7,015	1.1	(0.8, 1.5)	8,773	(5,425, 12,121)
West South Central					
Total	29,891	1.1	(1.0, 1.3)	14,719	(11,150, 18,289)
Arkansas	2,838	0.9	(0.5, 1.3)	13,599	(6,611, 20,587)
Louisiana	4,089	1.1	(0.7, 1.5)	13,295	(7,863, 18,727)
Oklahoma	4,395	1.2	(0.7, 1.6)	14,258	(7,372, 21,145)
Texas	18,569	1.2	(0.9, 1.5)	15,313	(9,938, 20,688)
Mountain					
Total	11,858	0.9	(0.7, 1.1)	8,655	(5,685, 11,625)
Arizona	3,550	1.0	(0.5, 1.6)	3,860	(777, 6,942)
Colorado	1,142	0.5	(0.1, 0.9)	6,321	(–3,060, 15,701)
Idaho	1,863	1.5	(0.5, 2.6)	14,291	(5,763, 22,818)
New Mexico	992	0.7	(0.2, 1.2)	13,289	(–54, 26,633)
Montana	645	0.6	(0.0, 1.2)	14,372	(–17,078, 45,821)
Utah	951	0.6	(0.1, 1.0)	3,225	(–163, 6,613)
Nevada	1,808	1.4	(0.6, 2.2)	11,900	(–2,033, 25,833)
Wyoming	908	1.7	(0.6, 2.8)	8,873	(2,650, 15,097)
Pacific					
Total	31,000	1.2	(0.9, 1.4)	10,985	(7,363, 14,607)
Alaska	390	1.1	(0.2, 0.2)	16,169	(–494, 32,831)
California	21,098	11.5	(0.9, 1.5)	11,712	6,504, 16,920)
Hawaii	1,871	2.0	(1.0, 3.1)	11,613	(5,164, 18,062)
Oregon	2,964	12.1	(0.7, 1.8)	10,368	(5,778, 14,957)
Washington	4,677	1.1	(0.6, 1.5)	7,415	(3,610, 11,221)

Table C-6. Direct Medical Costs Associated with Gastrointestinal Illness—Annual Medicare Payments in 2000 by Region and State

Region (State)	Beneficiaries with a Diagnosis			Direct Medical Costs ($/Person/Year)	
	Number	Percent	CI (±)	Mean	CI (±)
New England					
Total	37,400	2.7	(2.3, 3.1)	1,341	(735, 1,947)
Connecticut	7,866	2.3	(1.7, 3.0)	872	(385, 1,359)
Maine	4,563	2.6	(1.6, 3.6)	1,300	(373, 2,227)
Massachusetts	17,945	3.2	(2.4, 3.9)	1,776	(565,2,987)
New Hampshire	3,125	2.3	(1.3, 3.3)	586	(12, 1,259)
Rhode Island	2,646	2.9	(1.5, 4.4)	845	(–11, 1,700)
Vermont	1,254	1.8	(0.6, 2.9)	1,134	(1,132, 3,401)
Middle Atlantic					
Total	99,429	2.6	(2.5, 2.8)	1,144	(866, 1,422)
New Jersey	22,230	2.6	(2.1, 3.1)	904	(538, 1,270)
New York	50,104	2.8	(2.4, 3.2)	1,085	(681, 1,489)
Pennsylvania	27,095	2.2	(1.8, 2.5)	1,449	(821, 2,077)
East North Central					
Total	104,447	2.2	(2.0, 2.4)	1,193	(912, 1,474)
Indiana	11,516	1.7	(1.3, 2.1)	1,376	(715, 2,038)
Illinois	34,024	2.8	(2.2, 3.5)	1,396	(713, 2,079)
Michigan	25,309	2.4	(1.9, 2.8)	663	(368, 957)
Ohio	22,868	2.0	(1.6, 2.3)	1,511	(893, 2,129)
Wisconsin	10,730	1.7	(1.3, 2.1)	924	(588, 1,260)
West North Central					
Total	47,352	2.2	(2.0, 2.4)	1,042	(781, 1,303)
Iowa	8,672	2.2	(1.5, 2.8)	834	(428, 1,238)
Kansas	9,397	3.1	(2.2, 3.9)	862	(394, 1,330)
Minnesota	6,038	1.3	(0.8, 1.7)	1,617	(525, 2,710)
Missouri	14,474	2.4	(1.9, 3.0)	1,279	(681, 1,877)
Nebraska	5,332	2.6	(1.6, 3.5)	5,332	(216, 1,025)
North Dakota	1,936	2.2	(1.0, 3.4)	1,082	(277, 1,888)
South Dakota	1,504	1.5	(0.5, 2.5)	210	(23, 396)
South Atlantic					
Total	125,383	2.4	(2.2, 2.6)	1,102	(925, 1,278)
Delaware	2,529	2.9	(1.8, 3.9)	776	(305, 1,248)
District of Columbia	524	1.0	(0.1, 1.8)	91	(–4, 181)
Florida	40,424	2.4	(2.0, 2.7)	896	(604, 1,187)
Georgia	18,115	2.7	(2.2, 3.2)	1,502	(1,034, 1,971)
Maryland	12,907	2.7	(2.1, 3.3)	1,092	(595, 1,590)
North Carolina	19,257	2.3	(1.8, 2.7)	1,187	(754, 1,620)
South Carolina	9,420	2.1	(1.5, 2.7)	1,106	(304, 1,908)
Virginia	14,948	2.2	(1.7, 2.6)	927	(407, 1,447)
West Virginia	7,261	3.0	(2.2, 3.9)	1,582	(517, 2,646)

(continued)

Table C-6. Direct Medical Costs Associated with Gastrointestinal Illness—Annual Medicare Payments in 2000 by Region and State (continued)

Region (State)	Beneficiaries with a Diagnosis			Direct Medical Costs ($/Person/Year)	
	Number	Percent	CI (±)	Mean	CI (±)
East South Central					
Total	50,148	2.7	(2.4, 3.0)	1,267	(756, 1,778)
Alabama	10,006	2.1	(1.6, 2.6)	538	(263, 813)
Kentucky	12,340	2.8	(2.1, 3.5)	2,126	(175, 4,078)
Mississippi	8,936	2.9	(2.1, 3.6)	1,081	(655, 1,507)
Tennessee	18,867	3.1	(2.5, 3.6)	1,180	(758, 1,603)
West South Central					
Total	73,659	2.8	(2.5, 3.1)	1,384	(1,099, 1,669)
Arkansas	12,024	3.7	(2.8, 4.5)	963	(456, 1,470)
Louisiana	7,207	1.9	(1.4, 2.4)	1,531	(583, 2,480)
Oklahoma	10,738	2.9	(2.2, 3.6)	1,464	(536, 2,392)
Texas	43,689	2.8	(2.5, 3.2)	1,456	(1,082, 1,829)
Mountain					
Total	29,821	2.3	(1.9, 2.6)	841	(536, 1,146)
Arizona	8,874	2.5	(1.7, 3.3)	914	(249, 1,580)
Colorado	5,029	2.2	(1.4, 2.9)	1,316	(369, 2,263)
Idaho	2,096	1.7	(0.6, 2.8)	657	(–253, 1,566)
New Mexico	2,594	1.7	(0.9, 2.5)	1,966	(118, 3815)
Montana	3,657	3.2	(1.7, 4.8)	544	(86, 1,002)
Utah	2,440	1.4	(0.7, 2.2)	210	(43, 378)
Nevada	3,586	2.8	(1.7, 3.8)	177	(118, 236)
Wyoming	1,613	3.0	(1.6, 4.5)	487	(–128, 1,102)
Pacific					
Total	54,108	20.5	(1.8, 2.3)	1,154	(793, 1,515)
Alaska	520	1.5	(0.5, 2.6)	1,336	(–1,132, 3,803)
California	40,392	2.2	(1.8, 2.6)	1,265	(801, 1,728)
Hawaii	2,257	2.4	(1.4, 3.5)	722	(31, 1,413)
Oregon	3,595	1.5	(0.8, 2.1)	626	(46, 1,205)
Washington	7,343	1.7	(1.2, 2.2)	924	(226, 1,622)