

Indirect Cost of Ischemic Heart Disease to Employers

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Background: The management of healthcare programs by employers requires accurate information about the indirect and direct costs of important chronic diseases.

Objective: To determine the indirect costs of ischemic heart disease from the perspective of the employer in private industry in the United States.

Design: Indirect cost of illness analysis using the human capital approach, taking the perspective of the employer rather than that of society.

Methods: Ischemic heart disease was identified in a proprietary claims database of 3.1 million insured persons using an algorithm based on administrative codes. Economic data were derived from the Bureau of Labor Statistics, the Employment Management Association, and published sources. Work-loss data were taken from the National Center for Health Statistics' Health Interview Survey. The indirect cost was calculated as the sum of the costs due to morbidity and mortality. From the perspective of the employer, morbidity costs come from lost productivity, idle assets, and nonwage factors resulting from absenteeism and mortality costs are expenditures for replacing and retraining workers. This differs from calculations from the societal perspective, in which indirect costs are the value of an individual's lost income—both current and potential.

Results: The total indirect cost of ischemic heart disease to employers in private industry was \$182.74 per enrollee. Ninety-five percent of the indirect cost was the consequence of work loss due to morbidity rather than of mortality costs.

Conclusion: From the perspective of the employer, the indirect cost of ischemic heart disease is overwhelmingly due to morbidity costs.

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indirect cost is the value of the work loss due to illness. The intangible cost is the value equated with the pain and suffering felt by patients and is the most difficult component to quantify. Different approaches to calculating indirect costs have been taken.^{2,3} The human capital approach, which values people by their earnings, is the most commonly used and is based on data that are empirical and obtainable. By this approach, the indirect cost of illness is the sum of earnings lost due to morbidity and mortality. From the perspective of society, the morbidity cost is the value of the earnings lost by people who are unable to work because of the disease and the mortality cost is the present value of future earnings forgone because of premature deaths.⁴

In this article, we describe the calculation of indirect costs from the perspective of the employer. The perspective of the employer differs from the societal perspective in that the cost of mortality includes the cost of hiring and training replacement workers and the cost of morbidity is the value of lost productivity, idle assets, and nonwage costs due to absenteeism. Understanding the burden of both indirect and direct costs should enhance the ability of employers to plan programs that implement pre-

The economic costs of illness fall into 3 categories—direct, indirect, and intangible.¹ Direct costs are the medical and nonmedical resources expended in the care of patients. The

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Table 1. Data Element Definitions and Sources

Data Element	Definition	Explanation	Data Source
c	Average cost per hire	The average cost for the United States in 1996 of \$4183 was adjusted to a value of \$4279 for 1997 using the 1997 average inflation rate of 2.29% (provided by the US Department of Commerce).	Employment Management Association
d	Average no. of days of work lost per IHD patient (Average of 1993 and 1994 NHIS data)		National Health Interview Survey ⁵
e	Average hourly earnings	Employer costs for employee compensation in private industry for September 1997. The value used in the model is \$13.47.	Bureau of Labor Statistics, 1997
f	Additional associated cost factor	Additional associated costs are the nonwage costs incurred by the employer in maintaining the workplace and the position of the absent employee. Nonwage factors include idle capital assets, indirect business taxes, nontax liabilities, and net interest. The factor, <i>f</i> , is the ratio of wage costs plus these additional nonwage costs to wage costs. According to estimates of the Bureau of Economic Analysis, wage costs were 53.8% of the gross product of private industry in 1994 and nonwage costs were 46.2%. ⁶ The additional associated cost factor, <i>f</i> , is therefore 1.859 (ie, the sum of 53.8 and 46.2 divided by 53.8).	Bureau of Economic Analysis ⁶
h	Average number of hours worked per day	8 h considered the industry standard	Bureau of Labor Statistics
m	Death rate due to IHD per 100,000	Death rates for IHD (ICD-9-CM codes 410-414) for 1995 by age group	National Center for Health Statistics ⁷
n	No. of individuals continuously enrolled Jan 1–Dec 31, 1995		MedStat's MarketScan [®] Database, 1995
p	Prevalence of IHD (%) in the MedStat MarketScan population		MedStat's MarketScan [®] Database, 1995
t	No. of hours of training	The number of hours a new worker spends in on-the-job training during the first 3 months of employment. The total hours spent (151.1 hours) was the sum of the following 5 categories: (1) hours spent by specially trained personnel in providing the recently hired worker with formal training (10.9 hours); (2) hours spent by line supervisors and management personnel in providing informal individualized training and extra supervision (54.3 hours); (3) hours spent by coworkers away from other tasks in providing informal individualized training and extra supervision (26.9 hours); (4) hours spent by the new employee watching other workers do the job rather than doing it himself or herself (53.1 hours); and (5) hours spent by company personnel in providing orientation (5.9 hours).	Barron et al, 1989 ⁸
y	Average hourly benefits	Average cost to the employer per employee per hour for benefits. The value used in the model is \$5.02.	Bureau of Labor Statistics, 1997

IHD = ischemic heart disease.

ventive and therapeutic services for their employees. The purpose of this study is to calculate the indirect cost of a common chronic illness, ischemic heart disease (IHD), from the perspective of the employer in private industry. We describe the model and discuss its validity and applicability as a prototype for providing employers with a broad perspective of their economic burden.

... METHODS ...

Indirect Cost Analysis

The annual indirect cost of IHD was analyzed from the perspective of the employer in private industry. The indirect cost of IHD is the sum of 2 components: the value of the work loss, idle assets, and nonwage costs incurred due to morbidity and the costs of the loss to the workforce due to mortality. The loss of productivity due to morbidity is essentially the product of the time off work due to illness and earnings and benefits plus the cost of idle assets and nonwage factors—including indirect business taxes, nontax liabilities, and net interest—per unit time. The loss to the workforce due to mortality is valued as the cost of rehiring and retraining replacements for workers who died of IHD. The cost of mortality to the employer differs from the cost calculated from the societal perspective because it excludes the present value of future earnings forgone due to premature death, which is a critical component from the societal perspective, whereas the cost of morbidity differs because it includes the cost of idle assets and nonwage factors.

Definition of Ischemic Heart Disease

Ischemic heart disease was identified using an unpublished algorithm consisting of diagnostic (*International Classification of Diseases, Ninth Revision, Clinical Modification* [ICD-9-CM]) codes for IHD (411.xx, 412, 414.xx, and 429.x), angina pectoris (413.x), and acute myocardial infarction (410.xx); procedural (*Current Procedural Terminology-4* [CPT-4]) codes for coronary artery bypass graft, percutaneous transluminal coronary balloon angioplasty, atherectomy, and stents; and pharmacy (*National Drug Code*) codes for prescribed nitrates. Any single occurrence of the listed codes was sufficient for a positive diagnosis.

Data Sources

The sources of data are given in **Table 1**. The source for demographic data and the prevalence of IHD in a working population in private industry was

MedStat's MarketScan® Enrollment-Linked Medical and Prescription Database.⁹⁻¹⁴ This database contains insurance claims for encounters between the healthcare system and insured persons in the health benefit programs of more than 40 large employers located in the northeastern, north central, southern, and western regions of the United States. Three quarters of the employee population included reside in the north central states. Insured persons are employees and their dependents and are insured by more than 100 fee-for-service payers. Claims are from 3 different types of health insurance plans, ie, fee-for-service plans, preferred provider organizations, and point-of-service plans. The database does not contain claims from capitated plans, Medicare, or health maintenance organizations. Only active employees—full-time and part-time—and employees receiving disability were included in this analysis and are defined as “enrollees” for the purpose of this analysis. Less than 2% of enrollees are older than 65 years, and these persons were excluded from the analysis. The database contains administrative codes describing the nature of each encounter. The principal diagnosis or procedure and a limited number of secondary diagnoses or procedures are recorded as ICD-9-CM or physicians' CPT-4 codes.

The average number of days of work lost was derived from the National Health Interview Survey (NHIS),⁵ which is a continuing nationwide household survey of a probability sample of the civilian, noninstitutionalized population of the United States. The survey measured work-loss days due to IHD for currently employed persons, where a work-loss day is one on which a currently employed person 18 years of age and older missed more than a half-day from a job or business. To match the NHIS population to the MedStat population, only currently employed persons with medical insurance coverage were included in the analyses.

Data for wages and benefits were from the Bureau of Labor Statistics (BLS). Data from the BLS are collected in ongoing monthly state surveys of the payroll records of all nonfarm businesses with at least 250 employees and a representative sample of smaller establishments. Data are available for private industry, state and local government, and civilian sectors and also by private industry category. In this analysis we used data for private industry (a weighted average across private industry categories).

The source for the relative contributions of wage and nonwage costs to private industry was the Bureau of Economic Analysis, US Department of Commerce.⁶ The Bureau estimates the wage and

nonwage components of the gross product for each industry group.

The costs of hiring replacement workers were derived from the Employment Management Association's annual Cost-per-Hire Survey. Data from this employer survey are provided for exempt and nonexempt employees by region (east, central, west, and Canada).

Data Elements and Calculations

The data elements are listed in Table 1. Hours lost (HL) due to IHD is calculated as $HL = npdh$. The number of deaths (ND) due to IHD is calculated as $ND = nm$. Loss of productivity (LP) due to absenteeism because of IHD, ie, the morbidity cost, is calculated as $LP = HL(e + y)f$. Loss to the workforce (LW) from death from IHD, ie, the mortality cost, is calculated as $LW = ND(c + t[e + y])$. The indirect cost (IC) is calculated as $IC = LP + LW$.

Values for n , p , d , e , and m are provided by sex and age category. Values for n , LP, LW, and IC for each age and sex category were summed to obtain values for the total population. Costs were adjusted to 1997 \$US levels using the consumer price index. The calculations excluded people 65 years and older. People in this age category made a negligible

contribution to indirect costs in the population studied because they represented <2% of the total enrollment and were largely retirees.

Sensitivity Analyses

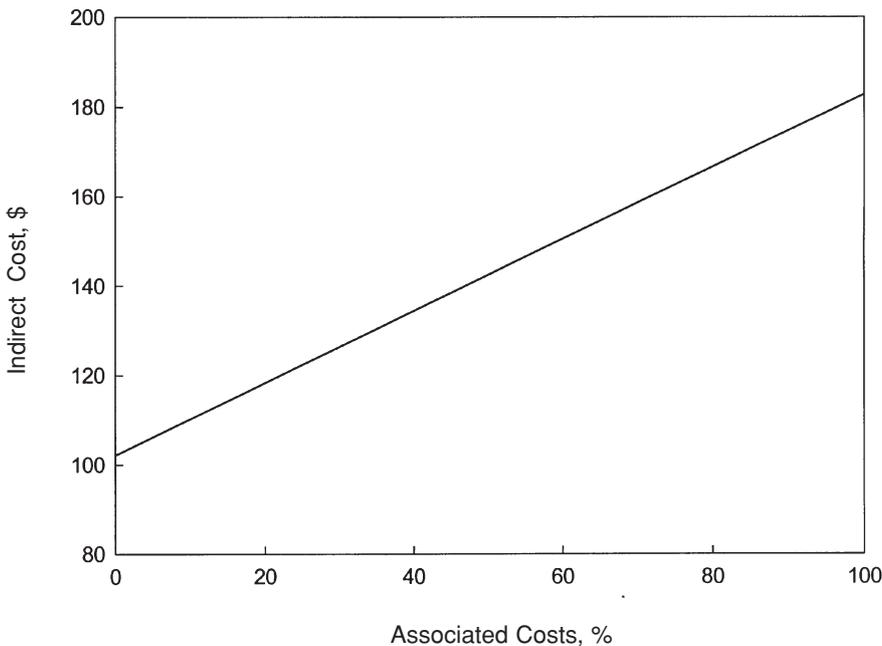
Sensitivity analyses were performed based on the proportion of the associated costs that an employer might actually lose. We varied this from complete loss to no loss (Figure 1). A separate sensitivity analysis was conducted to demonstrate the differences in the associated cost factor f by industry (Figure 2).⁶

... RESULTS ...

Table 2 gives values for data elements by age and sex category. There were 380,625 persons who were continuously enrolled and younger than 65 years. Ischemic heart disease was most prevalent in men and in the 55 to 64 years age category. The indirect cost of IHD for the MarketScan® population younger than 65 years was \$182.74 per enrollee per year (Table 3), ie, \$4298.89 per IHD patient per year (Table 4). The indirect cost was overwhelmingly the consequence of lost productivity due to morbidity rather than of loss to the workforce due to mortality, which made up only 4.8% of the indirect cost. The indirect cost per enrollee increased with age and was about 5 times higher for men vs women younger than 65 years (\$270.19 vs \$50.39).

The results of sensitivity analyses for the proportion of associated costs actually lost and the variation in the associated cost factor f by industry are shown in Figures 1 and 2. If (unrealistically) the associated costs were zero (ie, $f = 1$), then the indirect cost of IHD per enrollee would be \$102.20 rather than the \$182.74 using the base case value for f of 1.86. If the associated costs were half of our base case value, the indirect cost per enrollee would be \$142.47.

Figure 1. Indirect Cost for Values of the Associated Costs Varied Between 0% and 100% of the Base Case Value



... DISCUSSION ...

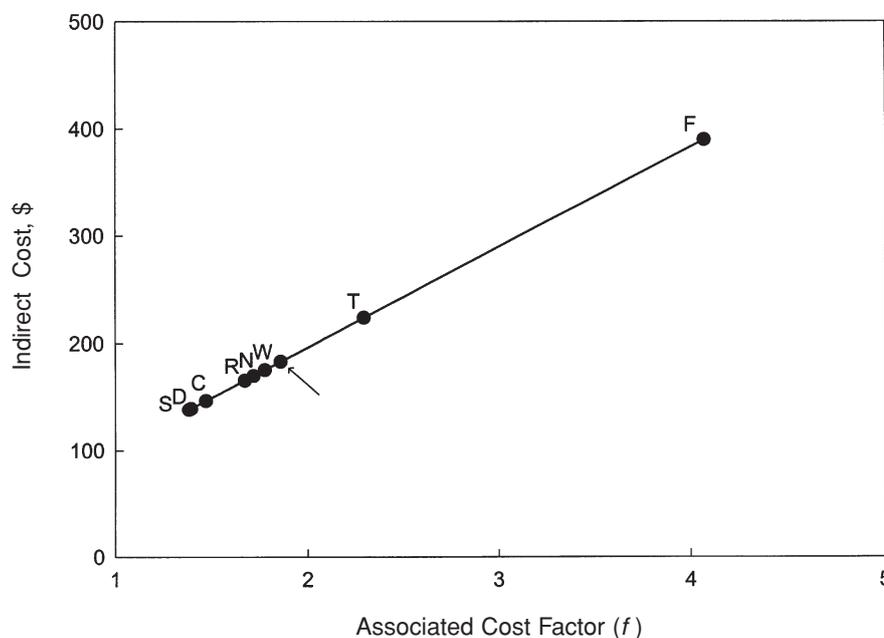
This model provides a framework for considering indirect costs of IHD relevant to private industry in the United States. This model may be adapted to other diseases and injuries for which identification algorithms are available from claims data and mortality rates and for which work loss can be determined.

An important contribution of this analysis is that it accounts in a novel way for the cost of idle assets and other nonwage factors. These costs vary, however, with industry sector and with the prevailing economic conditions. It will also depend on the availability and quality of alternate labor sources to continue to use capital assets. In private industry, the lowest associated costs occur in the service and durable goods manufacturing sectors and the highest associated costs occur in the finance, insurance, and real estate sector. Availability of quality temporary labor will tend to mitigate the costs associated with the idling of capital assets. Availability of temporary labor, in turn, depends on general levels of employment; eg, in situations of high unemployment, the impact on the associated costs would tend to be reduced. If (unrealistically) these associated costs were zero, then the indirect cost of IHD per enrollee would be lower by approximately 45%.

The analysis, nevertheless, has several limitations. The prevalence data are applicable only to a fee-for-service population, as represented by the MarketScan® population, which is a convenience sample of privately insured employees and their dependents. Other data sources sampled different populations, and the NHIS data reflect a national sample of employees with IHD irre-

spective of insurance status. Different definitions of IHD were used for the MarketScan® and NHIS populations. The cost data were from various sources. The costs of wages and benefits applied to private industry as a whole rather than to the companies represented in the MarketScan® database. The loss to the workforce included only loss due to death and not other reasons such as long-term disability. Some employers limit the amount of paid sick time, whereas others may give employees the option of receiving a cash payment representing a specified fraction of unused sick time when they retire or lose eligibility for the sickness plan. In these instances, part of the cost of the sick time is borne by the employee rather than by the employer. The reduced capacity of employees with IHD who returned to work was not accounted for. Replacement costs vary substantially by the type of worker being replaced and the level of unemployment. All of these factors may increase or

Figure 2. Sensitivity of Indirect Cost of Ischemic Heart Disease per Enrollee to Variation in Capital and Nonlabor Costs



Indirect cost is plotted against the associated cost factor (f) for different industries. The arrow marks the private industry average, which is the value used in the base case analysis. Labeled points on the line correspond to private industry sectors: services (S); manufacturing of durable goods (D); construction (C); retail trade (R); manufacturing of nondurable goods (N); wholesale trade (W); transportation and public utilities (T); and finance, insurance, and real estate (F). Adapted from reference 6.

Table 2. Data Elements and Hours Lost by Age and Sex Category*

Population	Number (n)	Prevalence of IHD per 100 (p)	Work-Loss Days per IHD Patient (d)	Death Rate per 100,000 (m)	Hours Lost [†]
Men					
<25 y	1960	0.41	0	3.4	0
25-34 y	33,106	0.53	0	11.1	0
35-44 y	70,087	1.95	25.79	46.0	281,977
45-54 y	80,326	6.66	18.27	166.9	781,914
55-64 y	43,718	13.60	13.88	465.7	660,205
<65 y	229,197	—	—	—	1,724,095
Women					
<25 y	2046	0.29	0	2.1	0
25-34 y	25,762	0.36	0	5.7	0
35-44 y	51,556	1.10	6.39	17.0	28,991
45-54 y	50,721	2.87	8.96	56.7	104,344
55-64 y	21,343	5.67	7.46	193.0	72,222
<65 y	151,428	—	—	—	205,557

IHD = ischemic heart disease.

*See Table 1 and the text for an explanation of column headings.

[†]Hours lost (HL) was calculated as $HL = npdh$.

Table 3. Loss of Productivity, Loss to Workforce, and Indirect Cost per Enrollee

Population	Loss of Productivity (LP), \$	Loss to Workforce (LW), \$	Indirect Cost (IC), \$
Men			
<25 y	0.00	0.24	0.24
25-34 y	0.00	0.79	0.79
35-44 y	138.63	3.25	141.88
45-54 y	334.64	11.80	346.45
55-64 y	518.94	32.94	551.88
<65 y	258.66	11.53	270.19
Women			
<25 y	0.00	0.15	0.15
25-34 y	0.00	0.40	0.40
35-44 y	19.28	1.20	20.49
45-54 y	70.69	4.01	74.70
55-64 y	116.33	13.65	129.98
<65 y	46.64	3.75	50.39
Total	174.31	8.43	182.74

decrease estimated total indirect costs. As more refined methods are developed, more accurate estimates should be generated.

Finally, this model did not account for comorbidities (stroke, diabetes, etc). If one views these comorbidities as part of a general cardiovascular disease propensity, this model probably underestimates the total indirect costs of IHD.

Another approach to calculating indirect costs is the friction cost method,³ which measures the amount of production lost due to disease based on the time span organizations need to restore the initial production, so that production losses are assumed to be confined to the period needed to replace a sick worker, ie, the friction period. The friction cost method calculates indirect costs from the societal perspective—although it yields results quite different from those of the human capital approach—and requires data that can be difficult to obtain.

Employers subsidize healthcare for dependents and retirees as well as workers, but this does not affect the indirect cost of illness because it is only the value of the employees' time that is lost due to illness. Rather, it is the direct costs that are affected, ie, employers bear the direct costs of IHD in

retirees and dependents. In addition to determining the indirect costs to the employer, we have determined the direct costs of the healthcare resources used by IHD patients using the MarketScan® database (unpublished analyses: Christine J. Guico-Pabia, MD, MBA, James F. Muray, PhD, Pamela B. Landsman, MPH, Margaret M. Coughlin; January 1998). Together, the direct and indirect costs provide a cross-sectional picture of the impact of IHD on the employer. In our studies, the indirect cost was 48% of the direct cost (\$382.57 per enrollee) and 32% of the total direct and indirect cost (\$565.31 per enrollee). There seem to be few if any documented analyses of IHD in the United States with which these values can be compared. Results of the few studies that have reported the indirect cost of IHD or related diseases have varied with time and place. In studies in New Zealand and Switzerland, the indirect mortality costs of IHD varied from slightly less than to almost 6 times the indirect morbidity costs.^{15,16} The reasons for this variability are unclear. Other studies providing data for diseases of the circulatory system or for cardiovascular disease cited results within the ranges reported for IHD.^{4,17} All of these studies reported direct costs, indirect costs due to morbidity, and indirect costs due to

Table 4. Loss of Productivity, Loss to Workforce, and Indirect Cost per IHD Patient*

Population	Loss of Productivity (LP), \$	Loss to Workforce (LW), \$	Indirect Cost (IC), \$
Men			
<25 y	0.00	58.92	58.92
25-34 y	0.00	146.84	146.84
35-44 y	7091.90	166.44	7258.34
45-54 y	5024.38	177.23	5201.62
55-64 y	3816.82	242.25	4059.08
<65 y	4613.87	205.67	4819.53
Women			
<25 y	0.00	50.65	50.65
25-34 y	0.00	110.49	110.49
35-44 y	1759.62	109.71	1869.33
45-54 y	2464.13	139.79	2603.92
55-64 y	2050.28	240.57	2290.85
<65 y	2120.20	170.34	2290.54
Total	4100.49	198.40	4298.89

mortality (ie, the present value of foregone future earnings) from the societal perspective and were human capital, prevalence-based studies. Our results differ from those of the previously mentioned studies in that indirect morbidity costs greatly outweighed indirect costs of mortality, largely because we eliminated calculation of mortality costs in terms of discounted foregone future earnings. The higher the proportion of indirect to total costs, the more important they are to employers. As employers are able to quantify and appreciate this, they should be more supportive of appropriate therapeutic services and worksite preventive healthcare programs.

We reported the indirect costs of IHD per enrollee and per patient. The indirect cost per enrollee may be useful in prioritizing healthcare programs across different diseases. The indirect cost per patient may be useful in estimating the cost savings that can be achieved by IHD prevention programs. The calculations we presented are based on period prevalence data and provide a snapshot of the 1-year indirect costs of IHD to an employer. Determining the effectiveness of a program of disease treatment requires an incidence-based approach. Administrative databases can provide incidence data in the form of serial, cross-sectional datasets. In the case of IHD, both prevalence and incidence approaches will be important in tracking the direct and indirect costs of illness and the effects of preventive and therapeutic interventions.

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