Costs of Hepatitis C

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Objective: To estimate the direct and indirect costs of the hepatitis C virus (HCV) in the United States in 1997.

Design: Aggregation and analysis of national data sets collected by the National Center for Health Statistics, the Health Care Financing Administration, and other government bureaus and private firms. To estimate costs, we used the human capital method, which decomposes costs into direct categories, such as medical expenses, and indirect categories, such as lost earnings and lost home production. We consider HCV that results in chronic liver disease separate from HCV that results in primary liver cancer.

Results: We estimate $5.46 billion as the cost of HCV in 1997. Costs are split as follows: 33% for direct and 67% for indirect costs. Hepatitis C virus that results in chronic liver disease contributes roughly 92% of the costs, and HCV that results in primary liver cancer contributes the remaining 8%. The total estimate of $5.46 billion is conservative, because we ignore costs associated with pain and suffering and the value of care rendered by family members.

Conclusions: To our knowledge, only one estimate of the annual costs of HCV in the 1990s has appeared in the literature, $0.6 billion. However, that estimate was not supported by an explanation of the methods. Our estimate, which relies on detailed methods, is nearly 10 times the original estimate. Our estimate of $5.46 billion is on a par with the cost of asthma ($5.8 billion [1994]).

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THE HEPATITIS C virus (HCV) was identified in 1988 and has received increasing attention from physicians and researchers ever since. Because HCV has only been recently identified, national statistics are difficult to obtain. Initial estimates suggested that the annual mortality due to chronic liver disease (CLD) from HCV was between 8000 and 10000.[1] Recent work[2] has assumed 8000 to be the more reasonable estimate. An initial estimate of the prevalence of HCV based on the anti-HCV antibody was 3.9 million persons.[3] However, more recently, Alter et al[4] estimate the prevalence of active HCV infection at 2.7 million persons. Whereas the incidence of the disease has been decreasing, the overall prevalence is large, roughly 4 times as large as that of the human immunodeficiency virus.[5] Sixty-five percent of persons with an HCV infection are aged 30 to 49 years. The highest rates of new infections are among persons aged 20 to 39 years.[6] It is the single most common reason for liver transplantations in the United States.[5] Risk factors include sharing of contaminated needles by drug users, multiple sex partners, employment as a health care worker, receipt of a blood transfusion any time before 1988, and, more generally, poverty, low educational attainment, and having been divorced or separated.[4]

Several studies[7-10] have investigated the cost-effectiveness and cost-benefits of various therapies for hepatitis C. A MEDLINE search from January 1, 1988, through September 30, 1999, did not uncover a single published cost-of-illness study in the United States for which the main purpose was to estimate the cost of this disease. A study by Wong et al[2] in October 2000 estimated the future mortality, morbidity, and costs for the years 2010 to 2019. But, as we will show, the strengths of the Wong et al study are in forecasting mortality and morbidity, not cost. In any case, they do not provide an estimate of current costs. A Centers for Disease Control and Prevention fact sheet[3] indicates a cost of $600 million in 1991 dollars, excluding transplantation. But the method underlying that estimate does not appear on the fact sheet. It is unfortunate that a reliable defensible estimate of the cur-

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MATERIALS AND METHODS

In this section, we address the unique features of this disease, indicate how we count cases, and describe how we estimate costs.

GENERAL DESCRIPTION

Brief descriptions of HCV and treatments are available.[5,7,8] Roughly 15% to 45% of persons with HCV spontaneously eliminate the virus.[8] Most of the remaining 55% to 85% develop chronic hepatitis but show no symptoms until the development of end-stage liver disease. The natural history of chronic HCV infection is variable and remains controversial. Estimates of the progression of HCV to cirrhosis range from 2% to more than 50%.[8] Roughly 1% to 5% of persons will develop primary liver cancer (PLC).

Treatment for 6 or 12 months with interferon alfa-2b and ribavirin is recommended for persons with HCV. It is expensive ($5000 per year) and can produce adverse effects such as flulike symptoms and fatigue.

Within any year, roughly 3.1% of persons with cirrhosis (whether they have HCV or not) will receive a liver transplant.[7] Liver transplantation costs more than $200 000, and the subsequent yearly care is also quite expensive.[9] Approximately 4000 people (most without HCV) receive a liver transplant every year.[10]

EPIDEMIOLOGICAL FEATURES

We used the prevalence of HCV and CLD to estimate deaths and costs associated with HCV. Prevalence may overstate disease burden given that there is a downward trend in incidence. But for patients with HCV, there is an upward trend in morbidity and mortality.[2] An alternative method—using incidence—creates greater problems. Using incidence would necessitate forecasting the future course of disease, treatment, and cost. Most cost-of-illness studies[11-14] have preferred the prevalence method precisely because it allows analysis of reliable data that are available and requires fewer forecasting assumptions than the incidence method.

Mortality due to HCV has been estimated at 8000 to 10 000 deaths per year.[3] This range is regarded as a little high, so that recent analyses[2] have used 8000 as the preferred point estimate. We, too, will use 8000 as our preferred point estimate and allow a lower bound of 7000 and an upper bound of 10 000.

Estimates of the contribution of HCV to hepatocellular carcinoma (HCC) differ considerably between populations. Between 11% and 52.5% of patients in the United States with HCC are anti-HCV seropositive.[15] Case-control studies suggest that 11% to 20% of HCC cases in the United States can be attributed to HCV. Based on these studies,[15] we estimate that 30% of HCC-related deaths are due to HCV.

Primary liver cancer included HCC and other cancers, such as hepatoblastomas and cholangiocarcinomas. For those younger than 20 years, HCC accounts for only 33% of PLCs, whereas in adults, 90% of PLCs are due to HCC.[16]

ECONOMICS

Costs are estimated using the human capital cost-of-illness method, whereby 2 broad categories are constructed: direct and indirect costs. Within the direct category, there are medical expenses and administrative expenses. Medical costs include payments to hospitals, physicians, drug companies, nursing homes, and vendors of medical supplies. Insurance administration includes the cost of processing claims, prosecuting fraud, managing financial accounts, paying bills, advertising, sales commissions, rate credits, dividends, and profits or losses. The administrative expenses are in turn split into administration for medical and administration for indemnity (disability) insurance.

Indirect costs include lost wages, lost fringe benefits, and lost home production. Lost wages are meant to capture not just the hardship on the person and family without the wages but the cost to the economy in terms of lost output. Lost fringe benefits are included for the same reason. The total economic loss is assumed to be what is required for the business to attract a qualified person to the job. This would include wages and fringe benefits. Home production includes time costs of child care, making home repairs, preparing meals, and so on.

General discussions of advantages and disadvantages of the human capital cost-of-illness method are available.[17-20] We will omit that discussion herein and simply note that despite its weaknesses, the human capital cost-of-illness method is the most popular method for estimating the costs of any illness or injury.

Direct Costs

Our "top-down" approach to estimating direct costs is similar to those of Rice[11] and Leigh[13] and colleagues. Estimates rely on a ratio involving hospital days multiplied by national estimates of medical spending (see upcoming equation). This hospital day ratio acts as an anchor in the estimation of all direct costs. Hospitalization data are highly regarded, are collected annually, and are standardized within the same definition (days in the hospital), thus permitting comparisons across diseases. Similar data are not available for drug use or most other categories of spending, such as medical durable products (eg, wheelchairs). Moreover, hospitalizations are the most expensive (broad) category of medical care, contributing to 40% of medical costs.[21] Physicians' services are second at 22%.[21] Other cost studies[11,13] assume that spending on all other direct costs is proportional to days in the hospital. This assumption is controversial for hepatitis C. Interferon, ribavirin, and especially liver transplantations are expensive. We will adjust for this expense as indicated with our inpatient and outpatient categories. Our adjustments represent an improvement over prior cost studies.[11-14]

Our top-down approach begins with an estimate of national expenditures on medical care—$1035 billion ($1.035 trillion) or 13.6% of the gross domestic product in 1996.[21] This year (1996) was the latest year available with critical information on out-of-pocket expenses, insurance administration, and dental services. We update these figures with a medical care inflation factor. This $1.035 trillion is equivalent to spending $3633 per person. Medicare and Medicaid (including Medi-Cal) contributed 20.0% and 14.7%, respectively; other third-party government spending contributed 11.4%; and direct out-of-pocket expenditures contributed 17.6%. The remainder, 36.3%, was contributed by private health insurance and health maintenance organizations. This $1035 billion ($1.035 trillion) in health care expenditures included payments for hospitalizations, physician visits, nursing home care, drugs, medical supplies, and dental services, among others. Also included are public health care expenditures, such as the construction of hospitals and offices, government public health activities, and research, and some estimate of program administration and net cost of health insurance. We include public health care expenditures on the grounds that without hepatitis C, some portion of these public expenditures would not be necessary. We did not include the Levit et al[21] estimate of the last category—"program administration and net cost of public health insurance"—in our calculations, however. We believe the Levit et al estimate to be too low. The Levit et al estimate is $60.9 billion. This would be the equivalent of roughly 6.3% of expenditures [$60.9/($1035 – $60.9) = 0.0625]. Studies[22-24] have shown that administrative costs can add an additional 45% to the total cost of medical care. Danzon[23] has been especially critical of the low estimates for Medicare and Medicaid. For example, she argues that private insurers allow fewer fraudulent claims than government insurers. Ferreting out fraudulent claims requires administrative resources, however. The overall result, in her view, is that the private sector provides more medical care to patients who need it and less to those committing fraud when compared with government-provided care. Another example pertains to buffer funds that private insurance companies require. These are captured in premiums. For any given year, however, they may or may not be paid out as benefits. These buffer funds are sometimes viewed as wasteful administration. They are not. Governments do not require buffer funds since they can rely on raising taxes. The increase in taxes to shore up the Medicare Hospital Insurance trust fund was a case in point.[23] For both of these reasons and others,[22-24] the "true" administrative costs of Medicare and Medicaid are higher than the costs that Levit et al suggest. The estimate of Cutler[24] of 15% appears to be the most reliable and has been used in previous analyses.[13,25] As a result, we will exclude the $60.9 billion (6.3%) but include a 15% administrative expense to our calculations.

We also exclude dental services ($47.6 billion), reasoning that HCV should not influence dental costs. We, therefore, use the following formula to begin our calculations: [($1035.1 – $60.9) – $47.6] = $926.6 billion.

Our analysis is divided into 2 parts: one for CLD and another for PLC. In the description of methods that follows, we will use CLD as the example. The same methods are applied to PLC.

Using the National Hospital Discharge Survey,[26] we first calculate the total number of days spent in the hospital by the number of patients with a principal diagnosis of CLD and cirrhosis (*International Classification of Diseases, Ninth Revision* code 571). We use the code for liver disease rather than the code for hepatitis C (*International Classification of Diseases, Ninth Revision* code 70), because the latter code is underrecorded on hospital records.[4] But we do not use the 1997 hospital days for liver disease "as is" (600 000). We only use 31.78% of 600 000, or 190 680. This 0.3178 is the ratio of hepatitis C–related deaths (n = 8000) (Alter[1] suggested 8000-10 000, and we selected 8000) to liver disease–related deaths (n = 25 175). These total days of hospitalization for hepatitis C, 190 680, we attribute to hospital days resulting from hepatitis C. This 190 680 is then divided by total hospital days for all diseases and injuries in the United States in 1997 (190 668/157 458 000 = 0.0012109) (additional data available from the authors). This percentage (0.12109%) is then multiplied by $971 billion (1997 dollars), which equals $1.1758 billion. Finally, we account for disease-specific inpatient and outpatient adjustments. The procedure is displayed in the following equation:

$$Med\$CLD = \$971 \times [(0.3178 \times CLDDays)/TotalDays] + \text{Inpatient Adjustment} + \text{Outpatient Adjustment},$$

where *Med$CLD* is our estimate of the medical dollars spent for hepatitis C due to CLD; *CLDDays*, the number of days in the hospital attributed to CLD; and *TotalDays*, the number of days in the hospital attributed to all diseases and injuries in the United States.

The hospital days ratio in the equation assumes that all hospital days have equal costs, regardless of the disease (ie, circulatory disease, cancer, hepatitis C, or asthma). It also assumes that all nonhospital (outpatient) costs are proportional to hospital days. Since this simple method has been so widely used in the past,[11,13] we will apply it to data on hepatitis C. However, we will make adjustments to reflect the higher costs that are unique to medical care for hepatitis C. The inpatient and outpatient adjustments are unique to this study and, we believe, an improvement over prior methods.

The Agency for Health Care Policy and Research[27] maintains cost data per disease per hospital day on a Web site and in its Research Note Series. We calculate that, on average, a hospital day for hepatitis C resulting in CLD costs 111.91% of the typical hospital day for all diseases and injuries. That is, hepatitis C resulting in CLD is roughly 12% more expensive than average. We multiply the 0.1191 by the percentage of total US medical costs attributed to hospitalizations and nursing home care (less program administration and dental care, 0.47). The product (0.1191 × 0.47), is then multiplied by the following: $971 × [(0.3178 × *CLDDays*)/*TotalDays*] (ie, the first half of the equation). We refer to this procedure as the inpatient care adjustment (additional data available from the authors).

An outpatient adjustment using physician visits was problematic. Reliable physician visit data are not available on hepatitis C, CLD, or PLC from the authoritative Ambulatory Care Visits series of the National Center for Health Statistics.[28] We, therefore, assume that all spending other than that on hospital and nursing home care would be proportional to the ratio of hospital days for hepatitis C to all hospital days, and to the higher per-day cost of hepatitis C hospitalizations. In our preferred point estimate, we essentially assume that physician visits are proportionately as expensive as hospital costs for hepatitis C resulting in CLD (additional data available from the authors). In the sensitivity analysis, we allow an alternative assumption that

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outpatient costs are 20% rather than 12% more than medical costs associated with hospitalizations for CLD (additional data available from the authors).

The equation estimates do not account for the administrative costs, however. To obtain administrative costs, we subtract out-of-pocket expenses from national estimates and then apply our 15% administrative estimate (additional data available from the authors).

Indirect Costs

Indirect mortality costs capture wages, fringe benefits, and home production for years of life lost due to early death. Indirect morbidity costs capture the same 3 categories for persons who have not died. Indirect mortality costs are estimated using a standard present value equation (data available from the authors). The present value equation uses age-, sex-, and disease-specific mortality data from the National Center for Health Statistics, Vital Statistics Division, and life table estimates,[29-31] combined with earnings and labor force participation data from the US Bureau of Labor Statistics' *Employment and Earnings*[32] (additional data available from the authors).

Finally, we calculate national disease-specific ratios for morbidity costs to mortality costs from Rice et al.[11] For CLD, we use the digestive disease estimates. For PLC, we use all cancer estimates (additional data available from the authors). In our sensitivity analysis, we use a morbidity to mortality cost ratio from an acquired immunodeficiency syndrome cost study during the 1980s.[14]

rent cost apparently does not exist. Costs have become a critical variable in the debate on medical care.

Our purpose in this study is to generate estimates of costs that incorporate the best methods from prior studies. We use standard methods with some simple improvements, eg, we adjust for the high per-day hospital costs for HCV. As a result, our estimates may be compared with estimates for other diseases.

RESULTS

EPIDEMIOLOGICAL FEATURES

Table 1 presents the results for CLDs (including cirrhosis) and PLC. Our estimates of deaths by age and sex appear in the first 3 columns of Table 1 for HCV resulting in CLD. We estimate 5168 male deaths and 2832 female deaths, for a total of 8000. For HCV resulting in PLC, we estimate 1002 male deaths and 444 female deaths, for a total of 1446. The total for both sexes and diseases is 9446.

COSTS

We calculated the direct costs of hepatitis C due to CLD and the indirect mortality costs due to CLD. We also calculated the indirect morbidity and mortality costs for PLC (data available from the authors). **Table 2** combines the more important estimates from these calculations.

Table 2 presents the total of direct plus indirect costs. We estimate total costs at $5.46 billion. Roughly 33% of that ($1.80 billion) is for direct costs and roughly 67% ($3.66 billion) is for indirect costs. Within CLD, direct costs are $1.66 billion (33%) and indirect costs are $3.37 billion (67%), for a total of $5.03 billion. Within PLC, direct costs are $0.14 billion (32%) and indirect costs are $0.29 billion (68%), for a total of $0.43 billion. Chronic liver disease contributes 92% and PLC contributes 8% to the total.

Table 1. Total HCV-Related Deaths in 1997 Due to CLD and PLC*

	HCV-Related Deaths			
	Due to CLD		Due to PLC§	
Age Group, y	Men†	Women‡	Men	Women
20-24	4	2	2	2
25-34	107	57	11	5
35-44	784	332	45	15
45-54	1337	453	160	32
55-64	1162	509	219	66
65-74	1097	751	323	135
≥75	677	728	242	189
Total	**5168**	**2832**	**1002**	**444**

*HCV indicates hepatitis C virus; CLD, chronic liver disease; and PLC, primary liver cancer.

†Percentage of all CLD-related deaths within a given age category multiplied by 8000 and by 0.646; 8000 is from Alter[1] and Wong et al,[2] and 0.646 is the percentage of all (male and female) CLD-related deaths among men. Percentage in age bracket is from the following: http://www.cdc.gov/nchs/data/gm291a_1.pdf.

‡Percentage of all CLD-related deaths within a given age category multiplied by 8000 and by 0.354; 8000 is from Alter[1] and Wong et al,[2] and 0.354 is the percentage of all (male and female) CLD-related deaths among women. Percentage in age bracket is from the following: http://www.cdc.gov/nchs/data/gm291a_1.pdf.

§All PLC-related deaths among men and women older than 19 years in a given age category multiplied by 0.90 and by 0.30; the 0.90 represents the 90% of PLC-related deaths attributed to hepatocellular cancer,[16] and the 0.30 represents the 30% of hepatocellular cancer cases attributed to HCV.[15] Data on PLC-related deaths are from the following: http://www.cdc.gov/nchs/data/gm291a_1.pdf.

Table 2. Total Costs

	Costs*		
Category	Due to CLD	Due to PLC	Total
Direct	**1.66** (33)	**0.14** (32)	**1.80** (33)
Medical only	1.32	0.11	**1.43**
Administrative			
Medical insurance	0.16	0.02	**0.18**
Indemnity insurance	0.18	0.01	**0.19**
Indirect	**3.37** (67)	**0.29** (68)	**3.66** (67)
Earnings	2.39	0.20	**2.59**
Fringe benefits	0.50	0.05	**0.55**
Home production	0.48	0.04	**0.52**
Total	**5.03**	**0.43**	**5.46**

*Data are given as the cost in billions of US dollars (1997). Values in parentheses are the percentage of the total. CLD indicates chronic liver disease; PLC, primary liver cancer.

Table 3. Sensitivity Analysis*

Possible Adjustment	Costs: Direct	Costs: Indirect	Costs: Total	Difference From the Preferred Estimate
Assume CLD causes 7000, not 8000, deaths (multiply CLD-related deaths by 7/8 = 0.875) (1)	1.59	3.24	**4.83**	−0.63
Assume CLD causes 10 000, rather than 8000, deaths (multiply CLD-related deaths by 10/8 = 1.25) (2)	2.20	4.50	**6.70**	1.25
Assume HCV is responsible for only 11.0% of the cases of hepatocellular cancer (multiply the PLC estimate by 11.0/30 = 0.3667) (3)	1.71	3.48	**5.19**	−0.26
Assume HCV is responsible for 52.5% of the cases of hepatocellular cancer (multiply the PLC estimate by 52.5/30 = 1.75) (4)	1.90	3.88	**5.78**	0.32
Many new patients with HCV are drug users, and most existing patients with HCV are not; earnings among users are low (reduce indirect costs for all persons by 10%) (5)	1.79	3.30	**5.09**	−0.36
Assume that the outpatient adjustment for CLD is $0.0504 billion higher because of high drug costs (6)	1.85	3.66	**5.51**	0.05
Assume the morbidity-mortality cost ratio from a 1987 AIDS study applies[14] (lower CLD and PLC indirect costs) (7)	1.80	2.81	**4.61**	−0.85

*Data are given as the cost in billions of US dollars. The range of costs is from $3.3528 to $7.0804 billion, assuming all decreases (numbers 1, 3, 5, and 7) apply for the lower range and 2 increases (numbers 2 and 4) apply for the upper range. CLD indicates chronic liver disease; HCV, hepatitis C virus; PLC, primary liver cancer; and AIDS, acquired immunodeficiency syndrome.

Table 3 presents our sensitivity analysis. Several key assumptions are addressed. The first assumption pertains to the CLD-related death range of 8000 to 10 000, suggested by Alter.[1] We selected 8000 as our preferred amount and assumed a lower range of 7000. However, if 7000 applies, our total cost estimate, combining CLD and PLC, would fall to $4.8 billion. This represents a decrease of 12% from our preferred $5.46 billion. If, on the other hand, 10 000 rather than 8000 applies, our total cost estimate would increase to $6.7 billion, some 23% above $5.46 billion. These results appear in the first 2 rows of Table 3.

The second assumption pertains to the percentage of PLCs caused by HCV. Our preferred percentage is 30%, suggested by DiBisceglie[15] and roughly midway between 11.0% and 52.5%. Suppose instead we choose 11.0%. Our estimated total costs, combining CLD with PLC, would be $5.19 billion. This represents roughly a 5% decrease from our preferred amount of $5.46 billion. A 52.5% assumption would yield an estimate of $5.78 billion, roughly 6% above our preferred estimate. These results are in rows 3 and 4 of Table 3.

Another assumption is that the average earnings of US workers are applied to calculate lost earnings for people with HCV or for those who died of HCV. Hepatitis C disproportionately affects people of low socioeconomic status. Although ethical concerns can be raised if we place a low value ($0) on the years of life lost for some people based on the circumstances of their lives,[33] suppose we allow indirect costs to be reduced by 10%. Our new estimate for total costs, combining CLD with PLC, is $5.09 billion, which represents a decrease of roughly 7% from our preferred estimate (row 5 of Table 3).

Row 6 of Table 3 allows for an outpatient adjustment ($0.0504 billion) based on ambulatory care visits. Row 6 assumes outpatient costs are 20% more than the ratio of hospital days for HCV to hospital days for all other diseases and conditions. Row 7 of Table 3 allows for morbidity to be calculated based on acquired immunodeficiency syndrome costs during the 1980s. This acquired immunodeficiency syndrome adjustment generates the largest effect: a 16% decrease below the preferred estimate.

If all of the cost-reducing assumptions are applied, then our estimate would be $3.35 billion. This represents a 39% decline from the preferred estimate. All of the cost-increasing assumptions suggest an upper bound of $7.08 billion. Our range is, therefore, $3.35 billion to $7.08 billion, with $5.46 billion being the best point estimate. We believe it is extremely unlikely that HCV costs less than $3.35 billion.

COMMENT

OTHER STUDIES

Since its identification in 1988, HCV has attracted increasing attention from physicians, researchers, and the public. Yet a literature search through September 30, 2000, did not uncover a single study with the primary aim of estimating the national cost of HCV. The only estimate that was cited ($600 million in 1991) appears on a Centers for Disease Control and Prevention fact sheet on hepatitis C without any citation or discussion.[3] Our preferred estimate of $5.46 billion is more than 9 times this $0.6 billion estimate.

In October 2000, Wong et al[2] published a study on the future burden (years 2010-2019) of HCV. We believe our methods provide a more accurate estimate of the total costs of HCV. Wong et al focus attention on mortality, morbidity, and treatment costs, not total costs. Our cost methods rely on national estimates for bed days, physician visits, and total dollars spent. Their methods rely on estimates from a single university hospital. In addition, they use marginal costs, whereas we use average costs. Marginal costs ignore fixed (equipment) costs. But fixed costs can be significant, especially for liver transplantation. Cost-of-illness studies[11,13,14] that measure the overall burden of disease use average and total costs, not marginal costs. Marginal costs are appropriate for cost-effectiveness studies, and these are precisely the studies that Wong et al rely on to generate their cost estimates. Wong et al do not mention the costs of administration. They do mention that they explicitly ignored "overhead." This is critical. With the rise of managed care, these costs have become increasingly important. Also, they do not properly account for fringe benefits or home production. Despite these criticisms, we believe that the Wong et al study is valuable, especially in forecasting morbidity and mortality.

Our $5.46 billion estimate is significant. It is comparable to the national costs of asthma, $5.8 billion in 1994,[12] and rheumatoid arthritis,[34] $7.1 billion in 1994 (assuming that rheumatoid arthritis contributes 11% to the total cost of arthritis). Although not of the same magnitude, the hepatitis C estimate can be compared with the cost of the human immunodeficiency virus ($30 billion in 1992[35]), epilepsy ($11.1 billion in 1995[36]), chronic obstructive pulmonary disease ($23.9 billion in 1993[37]), and cancer ($107 billion in 1994[38]). Perhaps more significant, none of these diseases are forecasted to increase their burden as rapidly as hepatitis C. The Centers for Disease Control and Prevention predicts that HCV-related mortality might double or triple within the next 10 to 20 years.[3]

LIMITATIONS

There are several limitations to our study. First, disease-related deaths and hospital days were counted as occurring in 1997. However, the exposures leading to the deaths and hospitalizations could have occurred 20 or 30 years before the death or hospitalization. But the same argument applies to all other cost-of-illness studies, even those that use the incidence method. Thus, our estimates are still comparable to others.

Second, we did not adjust for current employment status in the present value of earnings tables. We merely adjusted for the labor force participation rate. In doing so, we undervalued the earnings of those employed. That is, those employed are not a random sample of all persons in the labor market. Those employed probably had better lifetime employment prospects than all persons in the labor force. All persons in the labor force included those persons unemployed. This limitation suggests that we underestimated costs.

Third, we ignored pain and suffering costs and quality-of-life issues. It is difficult to estimate costs for these, however. Lawsuits involving nonfatal injuries almost always involve some payment for pain and suffering. A rule of thumb frequently cited in the courts is that pain and suffering costs equal 3 to 4 times the medical expenses and lost wages.[39] This would mean adding another roughly $15 to $20 billion to our costs.

We did not include the costs of family caregivers' time or the costs of health problems that occur among caregivers. These costs are undoubtedly large but are difficult to estimate. McFloyd and Flanagan[40] document the deleterious psychological consequences on spouses who provide care. One highly regarded study[41] estimated family (so-called informal) caregiving to be equal to 20% of direct costs. A 20% figure would add an additional $0.45 billion to our combined estimate.

We indirectly adjusted for the high cost of liver transplantations, interferon, and ribavirin, with inpatient and outpatient adjustment factors based on the increased cost of hospitalization for CLD and PLC. We believe that outpatient costs may have been underestimated given the high drug costs. In addition, we assume that outpatient costs are proportional to mortality. This is also likely to be an underestimate as outpatient costs are also related to the identification and treatment of HCV-infected asymptomatic individuals. An alternative calculation (in the sensitivity analysis, row 6 of Table 3) added another $0.05 billion, assuming all outpatient costs are 20% higher for patients with HCV than for all others.

We also excluded indirect costs involving costs to employers for hiring and training new workers to replace those who die or experience long absences.

Despite the limitations, there are merits to our approach. Apart from a few improvements, we use a standard cost-of-illness method. This allows comparisons to other disease and injuries. Some methods we introduce improve on prior cost-of-illness estimates. First, we exclude dental services in our macro top-down calculations. Second, we make adjustments for average costs for inpatient and outpatient care for HCV. Last, we do not rely on National Center for Health Statistics' estimates for "program administration," ie, administration costs. These have been sharply criticized by economists.[22-24] Moreover, the National Center for Health Statistics' estimates ignore insurance administration for indemnity (disability) benefits.

In conclusion, our study estimates the national cost of HCV to have been $5.46 billion in 1997. Because the incidence of this disease is decreasing, because more people with HCV are expected to experience symptoms in the next 10 to 20 years, and because medical care for HCV is rapidly improving, these cost figures will need to be reassessed in the future.

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