The Economic Impact of Viral Hepatitis in the United States

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VIRAL HEPATITIS is a disease of major public health significance in the United States, in terms not only of overall morbidity—which has been increasing in recent years (*1*)—but also of economic consequences and demand on medical resources. In this paper we present estimates of the economic impact of viral hepatitis in the United States in 1970.

"Viral hepatitis" is a generic term that covers at least two etiologically distinct forms of hepatitis, each having different epidemiologic characteristics (*2*). Hepatitis, type A (hepatitis-A), previously known as "infectious hepatitis," is the generally accepted term for epidemic, community-acquired disease ordinarily transmitted by the fecal-oral route. Hepatitis, type B (hepatitis-B), previously known as "serum hepatitis," is ordinarily transmitted by the parenteral route and is commonly associated with parenteral drug abuse and transfusion of blood and blood products. Hepatitis-B is also frequent among hemodialysis patients and is an occupational hazard to hemodialysis staff, clinical laboratory workers, and certain other medical personnel. There is evidence that hepatitis-A can be transmitted parenterally and hepatitis-B by nonparenteral routes (*3*), but the relative contribution of these forms of transmission to the total morbidity is not known at this time.

In instances where epidemiologic and serologic data do not permit characterization specifically as hepatitis-A or B, the term viral hepatitis "type unspecified" is usually employed.

Morbidity and Mortality

Viral hepatitis has been a nationally reportable disease since 1952. Through an agreement with the Association of State and Territorial Health Officers, hepatitis cases are reported to the Center for Disease Control (CDC) by State health departments on a weekly basis (Morbidity and Mortality Weekly Reports—MMWR). In 1970, viral hepatitis cases were reported specifically as "infectious" or "serum" hepatitis; cases reported as viral hepatitis but unspecified as to type were included as "infectious" (*4*). Diagnoses in all cases were made by reporting physicians; generally, they were based on clinical and epidemiologic data but not serologic tests for hepatitis-B.

Although hepatitis is a notifiable disease in every State, not all cases are reported to local or State health authorities. The reasons for nonreporting of cases include incorrect diagnoses by physicians and failure of patients to seek medical aid. Therefore, the true incidence of viral hepatitis is undoubtedly much higher than the reported occurrence. During epidemic periods, reporting of viral hepatitis cases has ranged from 20 to 80 percent, as judged by evaluation of hepatitis reporting in outbreaks of viral hepatitis investigated by CDC. During nonepidemic periods, however, reporting of cases might well diminish and possibly drop to about 10 percent, which is similar to the extent of underreporting observed for other infectious diseases (*5,6*).

To estimate overall costs arising from illness and death in 1970, viral hepatitis infections must be grouped into epidemiologic subcategories because of observed differences in morbidity and mortality. Group 1 includes cases of hepatitis-A and those cases classified in reporting only as acute viral hepatitis, type unspecified or unknown. Group 2 incorporates all transfusion-associated hepatitis (TAH). Group 3 comprises all hepatitis-B cases in patients who received no transfusions in the 6 months before the onset of illness. The estimated 1970 viral hepatitis morbidity and mortality figures for the three groups were as follows:

Morbidity and Mortality	*Group 1*	*Group 2*	*Group 3*
Morbidity, total	500,000	92,000	70,000
Medically attended	250,000	61,400	46,600
Inpatient	57,000	30,700	23,300
Outpatient	193,000	30,700	23,300
Not medically attended	250,000	30,700	23,300
Mortality	1,014	3,700	460

Group 1—acute viral hepatitis, type A and type unspecified. Viral hepatitis cases reported as type unspecified or unknown often comprise a significant proportion of total cases (*7*) and, therefore, must be included

in any overall estimate of morbidity and mortality due to viral hepatitis. In at least one epidemiologic study, the morbidity and mortality associated with viral hepatitis, type unknown, has been shown to be similar to that of hepatitis-A; therefore, we have included these cases in group 1 (*8*).

In 1970, 56,797 case reports of "acute infectious and unspecified" hepatitis were received at CDC (*9*). If all viral hepatitis is underreported by a factor of 10, then approximately 570,000 cases of acute infectious and unspecified hepatitis actually occurred in 1970. Hepatitis-A mortality data from the National Center for Health Statistics show that 1,014 persons died as a result of hepatitis-A in 1970 (*9*). Based on the generally accepted case-fatality ratio for hepatitis-A of 0.2 percent (*10*), we estimate that the 1,014 deaths resulted from among approximately 500,000 cases of acute viral hepatitis occurring in 1970. This figure is fairly close to the 570,000 cases projected from CDC reports.

Clinical illness due to infection with hepatitis-A virus varies from the asymptomatic to symptomatic icteric disease. The spectrum of illness is well illustrated by a common-source outbreak of hepatitis-A which affected nearly 93 persons (mostly young men)—approximately one-third were ill with jaundice, about one-third were ill but not jaundiced, and the remainder were infected but asymptomatic (*11*). Classically, hepatitis-A has primarily affected children, with those 5-14 years of age having the highest case rates. Furthermore, hepatitis-A is usually a milder disease in children than in adults, with a ratio of anicteric to icteric cases somewhere in the range of 5-10:1 (*12*). For these reasons, we have assumed that roughly half (250,000) of the 1970 cases were mild and the affected persons did not seek medical attention and the other half of the affected persons received medical attention either as inpatients or outpatients.

An estimate of the number of the medically attended "hepatitis-A like" cases which require hospitalization is available from the Commission on Professional and Hospital Activities (CPHA) data. The CPHA is a nonprofit, nongovernmental, scientific, and educational organization which, with the support of its numerous participating hospitals and its sponsoring organizations, provides a quality control system for auditing patient care; in the process, the system has developed a significant data base of hospital statistics. Information provided by the CPHA indicates that 57,000 hepatitis-A patients were discharged in 1970 (data from the Hospital-Records Survey, a joint study of CPHA and Lea, Inc., of Ambler, Pa.).

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Group 2—transfusion-associated acute viral hepatitis. TAH may have either long or short incubation periods and, therefore, may theoretically be caused by hepatitis-A virus or other as yet undefined agents (*13*). Case-fatality ratios in studies of TAH have varied but generally ranged from 10 to 12 percent (*14*). The Viral Hepatitis Surveillance Program (VHSP) is a cooperative effort between State and local health departments and CDC through which detailed epidemiologic and clinical information is obtained on some reported cases of viral hepatitis. The case-fatality ratio for TAH cases reported to the VHSP during 1970 was 6 percent. Confining mortality to symptomatic cases, we estimate that 3,700 deaths resulted from TAH in 1970.

In a cooperative study of the risk of TAH, 4,648 patients who had had transfusions were followed up by questionnaire only and 494 by serial-SGPT determinations (*15*). The hepatitis case rate for the serial-SGPT group (10.9 percent) was higher than the rate for the questionnaire-only group (2.9 percent) by a factor of 3.8, which is comparable to the range of TAH risk for intensive followup compared to routine followup (2:1 to 4:1) previously noted by Grady and Chalmers (*16*). This factor permits calculation of expected cases related to the total units of blood and blood products transfused in the two groups, obtaining a risk estimate of 14.1 hepatitis cases per 1,000 units transfused. This rate, applied to the estimated 6.5 million units transfused in 1970 (*17*), projects approximately 92,000 cases of TAH for that year.

In the cooperative study, followup of the serial-SGPT group determined that one-third of the cases were "severely symptomatic—hepatitis sufficient to confine the patient to bed for one week or more," one-third were "symptomatic—patients with symptoms lasting less than one week," and one-third were "asymptomatic —those with evidence (of hepatitis) only biochemically or from biopsy." If we assume that this distribution of severity of illness applies generally to all TAH cases, approximately one-third, or 30,700 cases, fell into each of these three "severity groups" in 1970. This estimate of 30,700 "severely symptomatic" cases is close to the figure of 30,000 serious, overt cases of TAH published in a statement by the National Academy of Sciences-National Research Council (*18*). We assumed that all 30,700 patients with severe cases were hospitalized and that all 61,400 with symptomatic cases came to medical attention.

Group 3—acute viral hepatitis, type B (nontransfusion associated). Although matched populations strictly comparable in age, state of health, and nutrition have not been studied, there is evidence to suggest that the case-fatality ratio for TAH may be higher than that of hepatitis-B which is not transfusion associated (*14*). Also, in the years since 1966, persons 15 to 30 years old (a majority are admitted or suspected illicit intravenous drug abusers) have comprised the majority of re-

ported hepatitis-B cases; the overwhelming majority of these have not been transfusion associated (*19*).

VHSP data received at CDC on 14,338 cases of hepatitis-B over the 4-year period 1969–72 revealed that 84 percent of these cases were nontransfusion associated. Applying this figure to the 8,310 hepatitis-B cases reported to CDC in 1970 (*9*) and again assuming that only 10 percent of viral hepatitis is actually reported, we estimate that about 70,000 nontransfusion-associated hepatitis-B cases occurred in 1970. As with group 2, it is likely that one-third of these patients were severely ill and therefore hospitalized; one-third were symptomatic; and one-third were asymptomatic.

Case-fatality ratios for nontransfusion hepatitis-B have varied considerably, and they obviously depend upon such factors as strain virulence, age of patient, presence of other disease processes, and size of inoculum. Two large outbreaks among U.S. populations had associated case fatality ratios of 0.3 percent and 2.6 percent respectively (*14*). The majority of patients with reported hepatitis-B cases are 15-30 years of age and presumably otherwise healthy. Therefore, we estimated that 1 percent of symptomatic persons who developed nontransfusion-associated hepatitis-B died in 1970—an estimated 460 deaths.

Economic Costs

Viral hepatitis costs include both direct and indirect costs. In economic terms, direct costs represent expenditures and consumption of resources directly resulting from the disease, while indirect costs represent productivity losses due to restricted activity and premature death. Direct costs for viral hepatitis cover diagnosis, treatment, and prevention.

Direct costs. The following are the medical costs (in millions) for patients with viral hepatitis in 1970:

Medical services	*Hepatitis-A (group 1)*	*Transfusion-associated hepatitis (group 2)*	*Nontransfusion hepatitis-B (group 3)*
Preventive	$16.0		
Curative	15.4	$ 5.6	$ 4.3
Physician, office care	7.1	1.1	0.9
Physician, hospital care	8.3	4.5	3.4
Laboratory	22.5	5.5	4.2
Hospital	55.2	29.8	22.6
Total	$109.1	$40.9	$31.1

Physician charges were calculated from the fee used by Rice (*20*), brought forward to 1970 charges by the physician fee component of the Consumer Price Index (*21*). Relative value tables (*22*) were used to key charges for each type of physician encounter to a routine office visit fee of $7.53 in 1970. All medically attended outpatients, 247,000 cases, are considered to have had an initial physician visit with complete history and physical examination ($26.36) and one routine followup visit ($7.53); half of these required an additional brief followup visit ($6.02). Inpatients, 111,000 cases, are considered to have had a complete examination on admission ($45.18) and daily routine followup visits ($7.53); after discharge, followup is the same as for outpatients. Thus, viral hepatitis patients have more than 2.2 million physician encounters annually, at a total cost of approximately $25 million.

Hospital expense per patient day averaged $80.81 in 1970 (*23*). An average stay for all patients with a single diagnosis of hepatitis-A was 12 days in 1969; hospital stays for hepatitis-B patients should be similar (*24*). On this basis, the cost of hospitalization was $970 per patient with viral hepatitis in 1970, or a total of approximately $108 million. This estimate could be low if hospitals follow appropriate isolation practices, such as private room and glove-and-gown requirements. It is also low if the average length of stay is longer—Grady and Chalmers reported a mean interval from hepatitis onset until hospital discharge of about 35 days for selected viral hepatitis patients (*8*).

Costs of convalescent care in institutions have not been calculated. Although some patients in hospitals are undoubtedly discharged to extended care facilities, medical opinion suggests that patients well enough to be discharged to their homes are able to meet their basic needs during convalescence. Costs related to the care of sick children at home have been estimated as indirect costs—lost productivity of working parents who lose work time to care for the children.

Immune serum globulin (ISG) is effective in protecting against hepatitis-A but not hepatitis-B. The Public Health Service Advisory Committee on Immunization Practices (*25*) has recommended specific dosage based on body weight and exposure (0.01 ml per pound), which may be approximated by giving 0.5 ml, 1.0 ml, or 2.0 ml depending on whether the person's weight is <50, 50–100, or >100 pounds, respectively. However, it is likely that 5 ml doses are the rule in practice. The net distribution of ISG has averaged 6,650,000 ml annually in recent years (*26*); as an index of use, this figure suggests that at least 1.3 million persons received ISG in 1970. Thus, the cost of an office visit plus ISG costs of $1 per ml for each person brings the total cost of hepatitis-A preventive treatment to approximately $16 million. Additional costs for laboratory screening of contacts may exist but are not included.

Testing of donors for hepatitis-B surface antigen (HB_SAg) is a preventive measure. However, such screening was not widespread during 1970; the American Red Cross began to require HB_SAg testing in April 1971 and the American Association of Blood Banks in October 1971. Consequently, no substantive costs for screening are included in the 1970 costs.

Administrative costs of governmental surveillance programs at the local, State, and Federal levels are insignificant relative to the magnitude of the overall

direct costs. Data on research and development support in 1970 are not available. However, in 1973, Dr. June Dunnick, then at the National Institute of Allergy and Infectious Diseases, compiled an informal estimate of U.S. grants and contracts which support hepatitis research programs. The total yearly grant and contract support of hepatitis projects in progress as of December 1972 was about $7 million.

Indirect costs. The indirect costs of viral hepatitis are the productivity losses of persons in the labor force losing time from work because of illness plus the losses of productivity due to premature death. Earnings losses are computed from mean earnings, labor force participation rates, and average time lost from work for several age and sex groups.

An average of 7 weeks away from work has been reported for hepatitis-A patients (*27*). No significant differences were noted by age or sex of the patients. Presumably, hepatitis-B patients have at least as severe a course as those with hepatitis-A. Labor force participation factors for the 12 months from July 1969 to June 1970, when the unemployment rate was 4 percent (hence, a full-employment year), were used to estimate the number of patients with lost earnings (*28*). Productivity losses for men and women in the work force are based on mean earnings in each group; imputed earnings for women keeping house are based on mean earnings of private household workers (*29*). Productivity losses associated with time spent obtaining preventive services (ISG) for hepatitis-A and for parents who lost work time to care for sick children at home were similarly estimated. Premature death results in loss of current and future productivity. We calculated the value of earnings in future years according to the method described by Rice (*29*). The present worth of lifetime earnings is discounted at 6 percent.

The indirect costs (in millions) for viral hepatitis in 1970 were as follows:

	Productivity losses due to—		
Hepatitis group	*Time lost from work for treatment and convalescence*	*Lost earnings, premature death*	*Total, all sources*
Hepatitis-A (group 1)	$114.3	$ 66.7	$181.0
Transfusion-associated hepatitis (group 2) .	42.5	167.7	210.2
Nontransfusion-associated hepatitis-B (group 3)	21.2	57.7	78.9
Total	$178.0	$292.1	$470.1

Some permanent disability is probably associated with relapse and with chronic hepatitis. Available data are not adequate to assess the extent and costs for this aspect of hepatitis; thus, to the extent that hepatitis produces permanent disability, this analysis underestimates productivity losses. Similarly, it has been assumed that persons not prompted by their illness to seek medical attention suffer no productivity loss. Reduced vitality and inefficiency may exist in this group, but quantification of the value of such losses has not been attempted.

Discussion

Comparisons with other diseases may help to put the costs of viral hepatitis in perspective. Axnick and coworkers have estimated the economic cost of measles (rubeola) at $747 million from 1963 to 1968—a mean of $125 million annually (*30*). Weisbrod (*31*) estimated the cost of cancer at $2,607,000, tuberculosis at $724 million, and poliomyelitis at $26 million in 1954. Rice (*29*) reported an estimated total economic cost of illness in the United States in 1963 at $84 billion; diseases of the circulatory system alone accounted for $19 billion of this total.

Comparison of estimates of different diseases in different years requires some caution. The cost of tuberculosis, for example, is undoubtedly much lower now (in constant dollars) due to declines in cases and massive shifts from inpatient to less costly outpatient treatment practices. On the other hand, both inflation and real price increases, as well as earnings increases, have pronounced impact on estimated costs. Finally, different methodologies and discount rates must be considered.

The distribution of costs by type of disease reveals important differences in the economic impact of each type. Overall, the total costs for hepatitis-A and TAH are quite similar. However, hepatitis-A accounts for more than $3 of every $5 in direct medical care expenditures, while TAH alone caused nearly half of all productivity losses. Productivity losses associated with hepatitis-A are largely due to time lost from work; hepatitis-B indirect costs, on the other hand, are heavily weighted by the impact of losses resulting from premature death.

All existing prevention and control methods for viral hepatitis, such as appropriate ISG administration, hepatitis-B antigen testing, and careful surveillance, should be continued. In addition, further scientific investigation is warranted. Although no data are available on the relative funding of hepatitis research compared to that of research on all other reportable communicable diseases, the estimated $650 million cost associated with viral hepatitis contrasts sharply with the estimated $7 million invested by various Federal agencies in support of viral hepatitis research at the end of 1972. These economic data suggest that maintenance of nationwide surveillance of hepatitis, efforts to develop and produce effective methods of active and passive immunization against all forms of viral hepatitis, and minimization of the risk of hepatitis following blood transfusion, could help to reduce the direct and indirect costs associated with viral hepatitis.

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SYNOPSIS

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Morbidity and mortality data were used to estimate the economic impact of viral hepatitis in the United States during 1970.

Total direct costs (preventive, physician, laboratory, hospital, and administrative services) were approximately $181 million; illness caused by viral hepatitis, type A (including viral hepatitis, type unspecified) accounted for 60 percent of total direct costs. Indirect costs, representing productivity losses due to time off work for illness and medical care and losses due to premature death (losses in future years discounted at 6 percent), amounted to $470 million; nearly 45 percent of total indirect costs were attributable to transfusion-associated hepatitis alone.

The total economic impact of viral hepatitis in the United States in 1970, estimated to be in excess of $650 million, contrasts sharply with the total financial investment made by U.S. Government agencies in support of viral hepatitis research as of the end of 1972, which has been estimated to be about $7 million. Efforts to develop and produce effective methods of active and passive immunization against all forms of viral hepatitis and to minimize the risk of hepatitis following blood transfusion would reduce the cost of viral hepatitis.