Disease costs of hepatitis B in Australia

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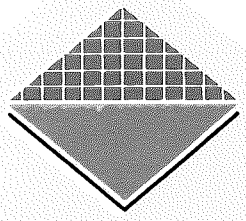
An information paper



AUSTRALIAN INSTITUTE OF
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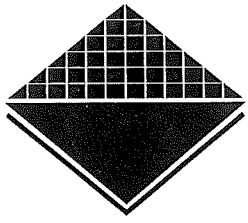
July 1993



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Summary

- This discussion paper is one of a series prepared by the Institute as an offshoot to the Macro Economic Evaluation Project. Others in the series include *The cost of diet-related disease in Australia*, and *The disease costs of syphilis and tuberculosis in Australia*. The papers suggest an approach to developing health promotion priorities that takes into account the public health significance of particular conditions; the preventability of these conditions; and the efficiency of specific initiatives aimed at realising the potential for prevention.
- Total costs for hepatitis B (excluding chronic sequelae) were estimated to be $46.7 million in 1989–90. This is comprised of $40.7 million for the direct cost of treatment and prevention; $1.1 million in morbidity costs (measured as the value of forgone earnings); and $4.9 million in mortality costs (measured as the value of forgone earnings due to 38 premature deaths).
- The chronic sequelae of hepatitis B, viz hepatic cancer and cirrhosis, cost $27.8 million in total. Total direct costs for these sequelae for hospitals and nursing homes were $3.5 million; indirect costs were $1.2 million for morbidity and $22.3 million for premature mortality. The total health bill for hepatitis B and its chronic sequelae amounted to $74.5 million, comprising $45.1 million for direct and $29.4 million for indirect costs. The estimates may be considered lower limits of the true costs to society of these diseases in Australia.

Introduction

Background

The Institute has undertaken a research program, with financial assistance under the National Health Advancement Program of the Commonwealth Department of Human Services and Health, to develop a macro approach to economic evaluation (Carter et al. 1992), that will assist in developing the economics of health promotion. This discussion paper is one of a series of cost-of-illness studies prepared as an offshoot of that work program. Others in the series include *The cost of diet-related diseases in Australia* and *Disease costs of syphilis and tuberculosis in Australia*.

The cost-of-illness series is part of a suggested approach to developing health promotion priorities that reflect:

- the public health significance or burden of suffering of particular conditions;
- the preventability of these conditions; and
- the efficiency of specific initiatives aimed at realising the potential for prevention.

Under the title Disease Costs and Impact Study, this work is being continued as a joint project by the Australian Institute of Health and Welfare and the National Centre for Health Program Evaluation (Melbourne).

Public health significance of hepatitis B

Hepatitis B is reported as being the second most common internal infection in the world today (Thomas 1990). Although it has a far lower public profile, the hepatitis B virus is over 100 times more infectious than the AIDS virus. Unlike the AIDS virus, its relative stability allows it to survive for several days on environmental surfaces (Commonwealth Serum Laboratories and Merck Sharp & Dohme 1990). It is estimated that there are 200–300 million carriers world-wide (Hallam and Kerlin 1991 and Burrell 1984), 230,000 of whom reside in Australia (Thomas 1990). The complications of this infection are believed to cause approximately 1,200 deaths per year in this country (Gust 1992). There are an estimated 3,000 new cases per year, and the incidence of hepatitis B virus (HBV) infection is rising (Gust 1992; Zuckerman 1984).

Although many people have no symptoms at all, the symptoms of hepatitis B infection are usually flu-like and may include fatigue, fever, aches, nausea, loss of appetite, abdominal pain, diarrhoea or even jaundice. Those infected persons that become chronic carriers are then able to spread the disease to others for an indefinite period of time and are the group most likely to develop long-term complications, such as chronic active hepatitis, chronic persistent hepatitis, cirrhosis and primary liver cancer. Hepatitis B carriers are over 250 times more likely to contract liver cancer than those in the general population (Commonwealth Serum Laboratories and Merck Sharp & Dohme 1990).

The carriage rates of hepatitis B surface antigen (HBsAg) vary widely, ranging from less than 1% in the US, Western Europe, and Australia; to 5%–25% in parts of Africa, Asia and South East Asia (Burrell 1984). Of the 75,000–150,000 chronic HBV carriers in Australia, about three quarters are in high risk groups (Burrell et al. 1983). The groups generally considered to be at high risk include Asians, Aboriginals, promiscuous homosexuals, IV drug abusers, prostitutes, prisoners, and medical and dental personnel (Burrell et al. 1983; Pavli et al. 1989). Although 1% of Australia's population are chronic carriers of HBV (Gust 1992), some studies of antenatal patients have found between 2% and 3% of patients to be hepatitis B surface antigen (HBsAg) seropositive (Pesce et al. 1989). Chronic carriage rates also vary with ethnicity: 10–25% among Aboriginals and Torres Strait Islanders, 5–15% of immigrants from South-East Asia and the Pacific Islands, and 2–5% of those coming from Europe and the Mediterranean (Gust 1992).

Dandoy and Kirkman-Liff (1983) conclude that health personnel, particularly those working in hospitals, are at a more than four-fold higher risk of contracting hepatitis B than are people in the general population. They argue that the high cost to the employer, in the form of time lost from work, medical care costs, and workers' compensation payments warrant greater effort in the areas of primary prevention and proper post-exposure treatment.

Economic literature on hepatitis B

Australian cost-of-illness studies

Gross et al. (1987) estimated, using a cost-of-illness approach, that the total cost of hepatitis B in 1985 was within the range $37.7 million to $45.5 million. The direct cost per acute case was $1,030–$2,195 and the total cost was $6,600–$12,600 when the indirect cost of wages lost through hospitalisation or premature death was included. The indirect costs per case were approximately five times that of the direct costs.

Direct costs included all diagnosis, treatment and immediate disease prevention costs, and indirect costs included costs due to work loss, reduced productivity and premature death.

For the direct costs, inpatient costs were based on bed-day costs, including the costs of laboratory tests, of A$425.82, with 10 days hospitalisation. Outpatient costs allowed for three follow-up specialist physician visits, three follow-up liver function tests and hepatitis serology, and assumed a charge equal to 85% of the Medical Benefit schedule fee. For individuals not hospitalised, Gross assumed patients saw a GP for at least 3 visits, received an initial full blood count, two liver function tests and one serology. The 85% rebate was also used. The costs of hepatitis B Immune Globulin (HBIG), screening and hepatitis B vaccine were also costed.

Deaths from acute hepatitis B were estimated at 1% with the age and sex structure of mortality based on the laboratory reporting system of the Commonwealth Department of Health. Other assumptions made were that 5% of deaths from cirrhosis were secondary to HBV, and that 80% of deaths from primary hepatocellular carcinoma were secondary to HBV.

In calculating morbidity costs, the study assumed patients with end-stage cirrhosis and primary hepatocellular cancer were hospitalised for 10 days in their last year of life and that they lost four weeks earnings. Time lost from work due to illness was estimated and multiplied by the average weekly earnings in June 1985.

More recently, Gross and Tiffin (1990) undertook further cost estimates broadly following the methodology used in their earlier study, except they disaggregated costings to include 6 stages of illness. These included asymptomatic patients; patients with moderate pain and impairment; patients requiring hospitalisation for severe hepatitis; patients with chronic, persistent hepatitis causing disability but not hospitalisation or major limitation of normal activity; patients with moderate-severe chronic disability requiring hospitalisation or limited activity because of chronic active hepatitis, cirrhosis or primary hepatocellular carcinoma, and death following fulminant hepatitis and the chronic sequelae of the disease.

The total costs of hepatitis B in this second study were estimated to be $103.3 million. The estimated baseline direct costs of hepatitis B in 1990 were $60 million, comprising $21 million for treatment costs, $18.5 million for costs of HBIG, blood screening, and hepatitis B vaccine. An additional $20.5 million was for payments to GPs for vaccinations. Gross and Tiffin estimated the indirect costs of hepatitis B to be $43.3 million, comprising $31.1 million due to sick leave, $11 million due to premature death from cirrhosis, and $1 million due to premature death of housekeepers not in the paid workforce. Direct costs were 1.4 times higher than indirect costs.

Compilation of national hospital costs in the 1985 study by Gross and colleagues were based on a sample from the Fairfield Hospital in Victoria. There were no other data available at the time of the study to assess the validity of the estimate. In the 1990 study, hospitalisation costs for patients with severe hepatitis were based on average length of stay in Prince Henry Hospital and all NSW hospitals. Costs per day were based on Prince Henry's Hospital, Sydney. Gross and Tiffin attempted to adjust for differences in case mix between various hepatitis B patients. For patients with severe hepatitis, the average length of stay in NSW was used. They assumed that this utilisation was applicable to all 'severe' hepatitis B patients in hospital. Methodological details of hospital costing for patients with chronic active hepatitis were not provided. For cirrhosis patients, the cost of the period of hospitalisation after 9 years was based on US estimates. For patients with primary hepatocellulare carcinoma, the cost of hospitalisation was based on a weighted hospitalisation cost per case, assuming 15 days of stay, with high and low sensitivity estimates being 'guesstimates'. For patients with moderate pain and mild system reactions, who are housebound or in bed, the percentage of original cases receiving visits from physicians and also the number of visits per case were based on US figures.

A preferred approach is to use different utilisation data for the various States (i.e. hospital separations and average length of stay) and to undertake analyses by DRG and cost weights to control for differences in the case mix and associated variations in utilisation and resource intensity. The current research uses different cost weights for various DRGs to reflect the varying cost structures of different hospital case mix. We use data for three States and the

two territories. Where hospital morbidity data were not available for various states, cost estimates have been based on data from States with similar per capita servicing and adjustments have been made to reflect varying cost structures between the States. For out-of-hospital patients the current research uses utilisation of specialists, GPs, and tests ordered by GPs for hepatitis patients based on a national survey of GPs conducted by the University of Sydney. Estimates derived by Gross and Tiffin (1990) for HBIG, screening and vaccine were applied in the current study. The current research also includes a methodology to cover nursing home costs, not estimated in the Gross and Tiffin study.

International studies

There were only a few disease cost articles concerning hepatitis B in the international literature. Some information on disease costs was included in cost-effectiveness studies. There was very little information provided on the methodology to calculate national disease costs. Some studies cost the chronic sequelae of hepatitis B, including cirrhosis and liver cancer. The current research compiles both direct and indirect cost estimates for such chronic sequelae.

In the US, direct medical costs for hepatitis B in 1981 were reported to be $224 million, the indirect work loss costs were estimated at $140 million, and the total costs were $364 million (Schatz et al. 1985).

Another US study (Mauskopf et al. 1991) that looked at the cost of hepatitis B calculated the cost of prophylaxis, medical care and lost productivity. This was done by estimating the value of hepatitis B cases avoided as a result of a vaccination program. The program was valued at $124 million annually. When the value of avoided pain and suffering was included, the total dollar benefit increased to $679 million.

A UK study reported the medical costs of hepatitis B to be £300 per case, and the work loss costs to be £4,700, i.e. a total of £5,000 (Adler et al. 1988).

Methodology

Identification of cost categories

The disease costs of hepatitis B represent the monetary burden on society of the morbidity and premature mortality associated with this illness. Costs are usually divided into two components: direct and indirect costs.

The direct costs of illness are the costs of heath care services for diagnosing and treating illness, together with support costs such as research, administration and training. Indirect costs-of-illness comprise morbidity and mortality costs. Morbidity costs are the value of lost output due to the reduced productivity caused by the illness, including the value of lost housekeeper days and lost work days due to illness and disability. Mortality costs are the value of lost output due to premature death and are usually measured by discounting the

stream of potential lifetime earnings (Hodgson and Meiners 1982; Max, Rice and MacKenzie 1990).

It is important to note for those interested in potential 'savings' from reducing disease incidence that the net present value of estimates of forgone production do not estimate the resources that would become available to the community for expenditure on other health programs. Only direct costs should be used in this context.

The direct costs included in this study relate to hospital inpatient and out-patient services, pharmaceuticals, medical services by general practitioners and specialists, nursing homes and allied professional services, hyperimmune globin, screening and hepatitis vaccine. These were calculated for both public (Commonwealth, State and Local government) and private sectors, including expenditure by health insurance funds, out-of-pocket expenditure by individuals, motor vehicle third party insurance and workers compensation. The methodology used for quantifying these costs is set out in Appendix A. The basic approach for direct costs has been to take known aggregate expenditures and apportion these on a disease specific basis. The paper provides as soundly based estimates as are possible using Australian data, on the impact of hepatitis B on the health care delivery system.

Indirect costs included absenteeism for morbidity associated with health care services. Costs relating to reduced worker productivity at work and absenteeism not associated with health care services (i.e. 'sickies') were excluded. Mortality costs of foregone earnings due to premature death (including housekeepers) were included. The indirect component of cost-of-illness studies is a contentious area among economists and only preliminary estimates using conventional methods are provided in this study. Appendix B provides more information on the issues involved, together with an outline of the methodology used.

A category of costs called 'intangibles' (i.e. pain, bereavement, anxiety, and suffering) is difficult to express in monetary terms and was excluded from the study. Carer costs and direct travel costs by patients were also excluded.

Prevalence and incidence approaches

Two basic approaches can be applied to estimate the costs of illness: the incidence approach or the prevalence approach. Incidence costs in a given base year are the net present value of the total lifetime cost of all cases with disease onset in the base year. Incidence cost is difficult to estimate because it requires knowledge of the likely course of an illness and its duration, including survival rates since onset; the amount and cost of medical care to be used and its cost over the duration of the illness; and the impact of the illness on lifetime employment, housekeeping and earnings (Max, Rice and Mackenzie 1990).

Prevalence based costing on the other hand, measures the direct and indirect costs incurred in a specific period of time (the base period) as a consequence of all cases of illness during the same time period, usually one year. It includes the cost of base year manifestations of illness or associated disability with onset in the base year or any previous period. It measures the value of resources used or lost during a specified period of time irrespective of the time of onset of the

illness (Hodgson 1983; Skitovsky 1982; and Max, Rice and MacKenzie 1990). This study uses the prevalence based cost approach.

The estimation of costs based on incidence rather than prevalence establishes a more appropriate ceiling against which health initiatives to *prevent* diseases should be assessed. Estimates based on prevalence of diseases may inflate costs because they include the continuing costs of treatment for persons with established disease who are unlikely to benefit from a primary or secondary prevention program. On the other hand, prevalence estimates may understate savings to the extent that new cases prevented involve long episodes of care that extend beyond one year.

The extra information required by the incidence approach, however, often limits its utility. Both approaches can be used to describe expenditure and resource patterns, rank diseases in terms of the burden they place on society and estimate potential savings, provided the results are interpreted in view of the underlying assumptions.

Results

Hepatitis B costs (excluding chronic sequelae)

An overview of these results are outlined below, and are based on the costs shown in Tables 1 through to 3.

Hepatitis B imposed a $46.7 million burden on the Australian economy in 1989–90. Direct treatment and support costs comprised 87% of the total for 1989–90. Morbidity costs, the value of reduced or lost productivity were 2%. Mortality costs were 10% based on a 5% discount rate of the value of productivity foregone in future years as a result of premature mortality in 1989–90.

Direct costs

Direct costs included the amounts spent in 1989–90 for personal health care for individuals suffering from hepatitis B, including hospital and nursing home care, general practitioners and specialists, tests and investigations such as pathology, allied professional services and prescription drugs listed under the Pharmaceutical Benefits Schedule. Costs of hyperimmune Globin (HBIG), screening and hepatitis vaccine and associated GP administration were also costed.

Included in expenditure by the public sector is the Commonwealth, State and Local government levels. Private sector costs include payments by individuals, workers compensation, motor vehicle third party and insurance funds.

Total direct medical treatment and support amounted to $40.7 million, 87% of total disease costs. About 2% of these direct costs ($0.9 million) was expenditure for medical services (excluding vaccination administration) of GPs, specialists and tests/investigations. Prevention costs, including hyperimmune globulin (HBIG), screening and hepatitis vaccine with associated GP administration accounted for $38.9 million or 96% of direct costs (See Table 1).

Expenditure for hospitalised hepatitis B patients (i.e. patients presenting with primary diagnosis of hepatitis B) was $0.7 million or 2% of direct costs. This represented 289 hospital discharges, who used 2054 days of care associated with hepatitis B.

Other treatment costs included $0.15 million for nursing homes, amounting to 0.4% of total direct costs. There were no costs for Allied Professional Services (i.e. there were no referrals to Allied Professionals from GPs for hepatitis B in the AMTS used as the basis for the attribution formula). Drugs were estimated at $0.031 million or approximately 0.1% of total direct costs.

Indirect costs

Hepatitis B morbidity costs are the value of goods and services not produced in 1989–90 because of the disease. Included are the value of reduced and lost productivity for the population suffering from hepatitis B. Total morbidity costs for hepatitis B amounted to $1.1 million, or 18% of total indirect costs. Morbidity costs related to medical consultations (unrelated to vaccine

administration) amounted to $0.7 million and accounted for 11% of all indirect costs. Morbidity costs for hospitalised persons amounted to $0.4 million or 6% of indirect costs.

Mortality costs are the present value of lifetime earnings lost by all who died in 1989–90 as a consequence of hepatitis B. The costs were calculated by multiplying the potential years of life lost between the ages of 15 and 65 attributable to hepatitis B by the workforce participation rate and average annual earnings. A 5% discount rate was used to convert aggregate earnings over a lifetime to their present worth. Mortality costs were $4.9 million or 82% of indirect costs.

In 1989–90, 29 individuals died from hepatitis B in the age range 15 to 64 years. Those deaths resulted in a loss of $4.9 million to the economy at a 5% discount rate, or $0.2 million per death. 76% of total male and female hepatitis B deaths were for individuals under 65 years.

Costs by age and sex

An analysis of the disease costs (excluding prevention) by age are shown in Table 2. The results by sex are shown in Appendix C.

The total costs of, $7.7 million included amounts spent on the treatment of individuals with the disease, together with the indirect morbidity and mortality costs associated with the disease. These figures exclude preventive direct costs for Hyperimmune Globulin (HBIG), screening and hepatitis B vaccine and associated GP administration since these data were not available by age and sex.

For all persons, the 30–39 year age group accounted for the largest share of total costs, 27%, followed by the 50–59 year age group, which accounted for 24% of the total.

The total economic cost of hepatitis B shown for men was 140% higher than for women, $5.5 million compared to $2.3 million respectively (Appendix C). The higher costs for men reflect their higher foregone earnings due to premature mortality, particularly for those between 30–69 years. This is reflected in the higher number of deaths (PYLL), higher 'work force participation' rates, and 'average weekly earnings' in this age group for men. Males in this age group had mortality costs higher by $3.0 million relative to females. Males also had higher morbidity costs ($0.6 million) compared to females (0.4 million).

Costs of chronic sequelae of hepatitis B

Indirect costs

When the chronic sequelae of the disease are also considered, the costs increase significantly. The chronic sequelae of the disease are hepatic cancer and cirrhosis. Mortality costs for both amounted to $22.3 million, and comprised $5.9 million for liver cirrhosis, and $16.4 million for hepatic cancer. Total morbidity costs due to absenteeism because of hospitalisation and medical attendance amounted to $1.2 million for both of these diseases. 33% was for cirrhosis, and 66% was for hepatic cancer. Total indirect costs (morbidity and mortality) amounted to $23.5 million.

Direct costs

Table 3 shows that total private and public hospital costs for these two diseases amounted to $3.11 million. 22% were for cirrhosis, and 78% were attributable to hepatic cancer. Total nursing home costs for these two diseases was $0.43 million. 35% was attributable to cirrhosis, and 65% to hepatic cancer. Total direct medical treatment and support amount to $0.46 million, Drugs were estimated at $0.35 million and referrals to allied professional from GPs for cirrhosis amount to $0.01 million Total direct costs amounted to $4.36 million. 21% were for cirrhosis, and 79% were for hepatic cancer.

Table 1: *Disease costs of hepatitis B in Australia, 1989–90 (excluding chronic sequelae)*

Direct costs		
1. Hospitals		
Government	$716,359	
Private	$33,122	
Total		$749,481
2. Nursing homes		
Government and private		$149,774
3. Medical (excluding vaccination)		
Government		
General practitioners		
Department of Veterans' Affairs	$3,808	
Department of Health Housing and Community Services	$206,245	
Total	*$210,053*	
Specialists		
Department of Veterans' Affairs	$27,994	
Department of Health Housing and Community Services	$137,924	
Total	*$165,918*	
Tests		
Pathology	$253,494	
Radiology	$51,594	
Other tests	$1,807	
Total tests	*$306,895*	
Total government	$682,866	
Total private	$171,937	
Total medical		$854,803
4. Allied Professional Services		nil
5. Pharmaceuticals (government and private)		$31,070
6. Prevention		
Hyperimmune Globulin (HBIG)	$189,000	
Screening	$3,000,000	
Hepatitis vaccine and GP administration	$35,750,000	
Total		*$38,939,000*
Total direct costs		$40,724,128
Indirect costs		
1. Morbidity (total)		$1,059,698
Medical consultation	$681,320	
Hospitalisation	$378,378	
2 Mortality (total)		$4,887,155
Total indirect costs		$5,946,853
Total costs		$46,670,981

Table 2: *Hepatitis B total costs in 1989–90 (excluding prevention) showing age disaggregation*

	Hospital	Nursing homes	Medical Govt	Medical Private	APS	Drugs	Total (direct)	Morbidity	Mortality	Total (indirect)	Total
0–9	27,104		4,670	1,176			32,950				32,950
10–19	137,282		37,362	9,409			184,053	80,838	552,189	633,027	817,080
20–29	258,220		199,450	50,233		26,258	534,161	433,447	424,570	858,016	1,392,177
30–39	157,086		159,018	40,087		4,812	361,003	273,277	1,445,650	1,718,927	2,079,930
40–49	66,052		76,179	19,286			161,517	137,892	669,483	807,375	968,892
50–59	36,060		69,417	17,734			123,211	98,957	1,598,259	1,697,216	1,820,427
60–69	55,724	10,610	38,345	13,251			117,930	35,288	197,005	232,292	350,222
70–79	11,952	139,164	66,622	20,047			237,785				237,785
80+				716			716				716
DVAs Medical			31,802				31,802				31,802
Total	749,481	149,774	682,866	171,937	nil	31,070	1,785,128	1,059,698	4,887,155	5,946,853	7,731,981 (a)

(a) Excluding prevention of $38,939,000 (see Table 1)

Table 3 : *Costs for the chronic sequelae of hepatitis B*

	Cirrhosis ($m)	Hepatic Cancer ($m)	Total ($m)
Direct costs			
Hospital	0.68	2.43	3.11
Nursing homes	0.15	0.28	0.43
Medical	0.04	0.42	0.46
Pharmaceuticals	0.04	0.31	0.35
Allied Professional	0.01		0.01
Total Direct	0.93	3.43	4.36
Indirect costs			
Mortality	5.86	16.40	22.26
Morbidity	0.4	0.80	1.20
Total indirect	6.26	17.20	23.46
Total (direct and indirect)	7.19	20.63	27.82

Discussion

Use of cost-of-illness studies

Several insights can be gained from cost-of-illness (COI) studies, Firstly, they can highlight the importance of a particular disease in addition to estimates of mortality and morbidity. The ranking of diseases in terms of economic burden may reflect the ranking by other methods, although this is not always the case. For example, chronic diseases such as arthritis may not lead to many deaths, but may significantly reduce the quality of life and increase utilisation of health care resources. Alternatively, diseases such as migraine, may affect the quality of life but impose modest economic burdens in terms of health care utilisation. This occurs because health care professionals do not regard certain diseases as important or there are few effective interventions available for their treatment (Blau and Drummond 1991; Osterhaus et al. 1992).

COI studies provide data on the cost side of the cost-effectiveness equation for a later economic evaluation (Davey and Leeder 1993) and provide a simple, single index of the burden of illness (Davey and Leeder 1992). Separating components of direct costs may assist decision makers to identify budgets incurring the major economic burden. COI studies may be used to investigate the impact of different treatment practices. This follows naturally from separately identifying the components of costs (e.g. hospitals, medical services, pharmaceuticals etc.) and also from comparisons of the results of different COI studies undertaken in different locations (Drummond 1992). Estimating future COI projections can assist those planning health services, especially where they are estimated under alternative scenarios. For example, resource expansion could follow increased incidence or, alternatively, the status quo in real resource allocation could be maintained (Drummond 1992).

It is also possible for COI calculations to provide a baseline against which new interventions can be assessed (Davey and Leeder 1993; Drummond 1992). The incidence-based COI estimates can model the 'do nothing', or current care option (Drummond 1992).

COI calculations could also assist in the determination of medical research priorities (Black and Pole 1975), although the implied priorities may not differ greatly from those identified by considering mortality and morbidity alone (Drummond 1992).

COI studies alone do not assist in decision-making about whether more resources should be devoted to treating certain diseases. A substantial economic burden could indicate that significant resources have been allocated to the treatment for specific diseases. However, future decisions on the allocation of scarce health care resources should depend on the availability of treatment options and their cost-effectiveness (Drummond 1992).

Nevertheless, an interesting perspective is provided by Davey and Leeder (1992) who argue that COI studies

> ...provide an initial indication for health care authorities as to where healthcare efficiency may be improved, by providing a league table of health problems according to their cost. Thus, if equal percentage improvements in efficiency could be expected in all treatment areas, then the absolute savings would be greatest from the increases in efficiency in those health problems with the greatest cost.

Limitations of this study

The cost estimates presented in this study were based on the most current and reliable Australian data available, using new methodology developed specifically for the study. Nevertheless, several qualifications are in order. No estimates were made for hepatitis B income losses among the transient (homeless). Direct costs were excluded for community health services, aids and appliances, administration, research, ambulance, and repatriation/psychiatric hospitals, resulting in an underestimation of costs.

Some of the cost estimates may be low because of the methodology adopted. For example, hospital analyses of costs focused only upon cases where hepatitis B was the principal diagnosis. Cases where such diseases were co-morbidities relating to other conditions were not included. This methodology also impacted on the calculations of nursing home costs, which are based on the principal diagnosis of patients transferring from hospital to nursing homes.

Several known costs are excluded because data are unavailable. No attempt is made to value the services of family members and friends who care for individuals with hepatitis B. This 'informal care' is likely to be significant but there are no reliable data from which to base estimates.

No attempt was made to capture the costs of pain and suffering. Additionally, the care received by individuals with hepatitis B may not be the state-of-the-art care that could ideally be received. The estimates are therefore conservative and do not reflect all that the nation could be spending on care of individuals with these diseases.

A 5% discount rate was used to estimate the present value of future earnings lost. Use of a lower discount rate would yield higher mortality costs.

In calculating the cost of mortality costs associated with housekeeping, it was assumed that the average wage rate assigned to housekeepers is the wage rate for a paid housekeeper, currently $9 per hour ($360 for 40 hour week). This uses a replacement cost approach which values time spent on household production as the cost of hiring a housekeeper to undertake those activities.

Another approach could have been adopted (i.e. the opportunity cost method) which values household work in terms of the earnings foregone by devoting time to unpaid production rather than to paid employment, with the foregone market wage being the measure used to value time spent on household activities (Crowley, Antioch and Carter et al. 1992). If this approach had been adopted the mortality cost for housekeepers would have been higher.

Data provided by the National Survey of Morbidity and Treatment in General Practice related to hepatitis B, C and A. This data was only used for cost estimates of hepatitis B (excluding chronic sequelae). It was not possible to

disaggregate the data by type of hepatitis. This effect is not expected to have a significant effect on the cost estimates for two reasons. Firstly, the incidence and prevalence of hepatitis B relative to the other two types of hepatitis is large. Secondly, the data estimated from the national survey only accounted for a relatively small component of direct costs (6%) included in this study.

The indirect morbidity costs included for hepatitis B (excluding chronic sequelae) did not relate to cases where a vaccine was administered. Hence the indirect costs reported represent the lower limit estimate of such costs.

Australian and international cost comparisons

Drawing from an American study (Schatz et al. 1985), Jonsson (1987) comments on the significant contribution that indirect costs make towards the total costs of hepatitis B infection in the US in 1981. From the reported total cost of $364 million, $224 million are direct medical costs and $140 million are indirect work loss costs. This estimate was for hepatitis B and its chronic sequelae. This calculation does not include work loss due to premature mortality.

Jonsson (1987) also compares these results with two European studies that show a different relationship between direct and indirect costs. The study from Spain (Rivera et al. 1984) reports medical costs (including consultations, tests, and hospitalisation) of Pts 43,000, and work loss costs (including absenteeism and premature death) of Pts 820,000, a total of Pts 863,000. The study from the UK reports the medical costs to be £300, and the work loss costs to be £4,700, a total of £5,000. These European studies suggest that for an average case of hepatitis B virus infection, costs due to work loss maybe 15 to 20 times higher than the direct medical costs (Adler et al. 1983). One reason for the significant differences between these and the US studies is that the costs for premature deaths have been included in the European data. Jonsson (1987) explains that even if the costs for premature deaths were excluded, indirect costs would still be at least ten times higher than the direct costs.

Another reason given for the differences is that the subjects of the European studies are drawn from subpopulations that have a higher labour force participation rate than the average infected person, i.e. hospital personnel and homosexuals. However, a significant number of the total infections come from these groups. The fact that the estimated medical costs per case are 3 to 5 times higher per capita in the US compared to UK and Spain is also acknowledged. Further, the different intensity of treatment of the disease and methods of calculating costs contributes to the discrepancy.

The US study uses a prevalence model, including both acute and chronic situations, whereas the European studies are described as using incidence calculations that are likely to have underestimated the direct costs of chronic hepatitis B. Not surprisingly, Jonsson comments on the need for further studies to more precisely estimate both indirect and direct costs of HBV infection.

In the current study, direct costs for hepatitis B and its chronic sequelae were $45.1 million, which is 1.6 times higher than total indirect costs of $29 million. In this study, indirect costs exclude morbidity costs for absenteeism for individuals obtaining a vaccine. This may account for the relatively lower indirect costs relative to the UK and Spain. Nevertheless, the relationship

between direct and indirect costs found is exactly the same as that identified in the US study and is also similar to that uncovered by Gross and Tiffin (1990), where they found that direct costs are 1.4 times higher than indirect costs.

Like the US expenditure comparisons, per capita expenditure of direct health costs in Australia, are much higher than that in the UK. For example, during 1984–85, per capita health expenditure in Australia was 62% higher than in the UK. Further, health expenditure as a proportion of GDP was 7.8% in Australia, compared to only 5.7% in the UK. This may account for the higher contribution of direct costs to the total costs in the Australian setting. Like the US analysis, a prevalence approach was also used which may account for the higher contribution to direct costs.

Further, the results could indicate different treatment patterns, preventive health approaches and mortality experience between countries and methodologies to calculate costs. These factors could be investigated in further research.

Australian studies on cost-effectiveness of screening and vaccination for hepatitis B

The significant prevalence and cost of hepatitis B has prompted Australian studies on the cost-effectiveness of screening and vaccination as a means of controlling the disease here. These are outlined below.

Based on mid-1988 vaccine costs, Thomas (1990) concluded that universal screening and vaccination of all babies of high risk group mothers was appropriate for their clinic in Brisbane, Queensland, adding that selective screening may be more appropriate in a low risk private practice.

This conclusion was based on the findings that restricting screening to the high risk group cost $97 per carrier identified. Universal screening cost $354 to identify each carrier. Screening costs of the low risk group was $14,036 or $2,005 per carrier identified.

Highly effective vaccines enable virtually complete prevention of vertical transmission of hepatitis B. During 1988, vaccine costs, in terms of hepatitis B prevention per baby were $2,432 for vaccination of babies born to mothers in the high risk group, irrespective of maternal serology and $9,729 for universal vaccination (Thomas 1990).

Due to what was considered to be the high costs to the community of chronic hepatitis B virus carriage, Pesce et al (1989) in a NSW study, and Gilbert (1984) in Victoria, recommended the screening of all antenatal clinic patients for the presence of HBsAg, as a cost-effective practice. Pesce et al (1989) screened 1,193 pregnant women for hepatitis B. 26 patients were seropositive and one of these showed no identifiable risk factor. 19% of the 26 patients would not have been identified by the previously accepted screening procedures. 442 patients showed at least one conventional risk factor and 558 showed at least one risk factor by Pesce et al. (1989) extended criteria.

Opinions vary on the issue of vaccination of the entire population. A NSW paper by Farrell (1988) argued that the low general incidence of HBV infection and the cost of the vaccine provide a case against such action. Hallam et al.

(1991) from Queensland suggested incorporating the HBV vaccine into the routine regimen of childhood immunisation, if cost-effectiveness can be proven.

While the hepatitis B vaccine is considered to be effective (Hallam et al. 1991), Australia's current policy of selective vaccination is seen by Gust (1992) as being unlikely to significantly reduce the pool of chronic carriers. It is interesting to note then, that in both the UK and in the US, where the low incidence rates are similar to Australia's, it has been decided to introduce mass vaccination campaigns (Gust 1992).

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Appendix A

Methodology for estimates of direct costs

Hospital costs

The hospital estimates were based on costs per separation in 1989–90 being allocated to the total number of cases of each disease as indicated in the hospital morbidity data collections held by the AIHW. The hospital morbidity data collections classify disease according to the International Classification of Diseases (ICD-9 CM). The principal diagnosis for cases was used in this study. The methodology applied diagnostic related group (DRG) cost weights, average cost per separation, number of DRG separations and adjustments for length of stay differences between the DRGs and principal diagnosis. The DRG cost weights are based on US weights, adjusted for differences in average length of stay variations between the US and NSW DRG data. The general formula (Gillett 1992) used in this hospital costing exercise is outlined below.

$$TC_d = \sum_{1}^{N} (F_i * W_i * Z_i * AvCt) + OC$$

where:

TC_d = Total cost for disease d;

F_i = number of cases with primary diagnosis of hepatitis B in DRG_i;

W_i = DRG_i cost weight;

Z_i = ICD-9-CM adjustment for DRG_i

$$= \frac{\text{Average length of stay for ICD-9-CM code (principal diagnosis)}}{\text{Average length of stay for } DRG_i}$$

= average DRG weight;

AvCt = Average cost per separation;

OC = total outlier cost

$= f_0 * CNHTD$

where f_o = number of outlier days;

CNHTD = cost of a nursing home type day.

Adjustments for costing DRG length of stay outliers were undertaken using criteria for outliers applied by the Department of Victoria, the Yale refinement

project, and the Australian DRG refinement project at the University of NSW (Antioch 1992).

The average cost per separation for public hospitals include non-salary recurrent expenditure, salaries, wages and related payments, and the medical costs for treating private patients in public hospitals. Source of funds for the public hospitals used to calculate the average cost per separation include public sector outlays by the Commonwealth and State Governments, health insurance funds, workers compensation, and motor vehicle third party insurance. The DRG costs have been adjusted to include out-patient services. Capital has not been included. DRG methodology is under active consideration in Australia and it is quite likely that the DRG weights will be consistently upgraded for some time to come (Antioch 1992).

Public hospital morbidity data were available for ACT, NT, NSW, Victoria and SA. DRG costing was undertaken for each of these States. Such expenditure for each of the remaining States for hepatitis B, cirrhosis and liver cancer was estimated from the State with similar hospital servicing per capita (separations per 1000 population) by ICD codes relating to those diseases.

Victoria was used to estimate public hospital costs for Queensland and Tasmania. South Australia was used to estimate Western Australia. Per capita case-mix adjusted hospital expenditure for each disease was calculated by ICD-9-CM 3-digit code, age, and sex for Victoria and SA. This expenditure in the relevant State was multiplied by the population in each age/sex group in the 'estimated' State. The costs were adjusted for the interstate difference in the public hospital operating costs per 1000 population.

Private hospital sources of funds covered those outlined above for public hospitals, except State government. Private hospital morbidity data were available for NSW and SA. DRG costing was undertaken for these States. Expenditure in the remaining States was estimated using similar methodology to that for the public hospitals.

States with similar per capita servicing were determined by comparisons of occupied bed days per 1000 population and average length of stay. Per capita case mix adjusted expenditure by ICD9 CM 3 digit code, age and sex were applied to the population structure of the ' estimated' State. Adjustments were made for inter-state differences in the cost structure by applying a ratio of the two states' cost per occupied bed day for total non-capital costs (Antioch 1992).

Nursing homes

Estimates of nursing home costs were based on the diagnosis, age, sex and utilisation (bed day) patterns of patients who transfer from hospitals to nursing homes. The analysis assumes that the bed day utilisation patterns of these transferring patients is the same as the whole group of nursing home patients. Previous analyses undertaken by the Australian Institute of Health and Welfare indicate that 63% of patients that apply to go to nursing homes are transferring from hospitals. Total bed days for hepatitis B, liver cancer and cirrhosis patients transferring from public and private hospitals in each State were compiled by age, sex and diagnosis at the three digit level. A percentage distribution of these data was calculated to show, in each diagnostic, age and sex cell, the proportion

of total bed days for all ICD-9-CM codes in the State that transferred into nursing homes.

In States where there were no private hospital data, the percentage distribution was based on the public hospital transfers only. For States where there were no public hospital data, the percentage distribution was based on the public hospital bed day distribution of the State that had the most similar servicing per capita (separations per 1000 population) for the disease of interest.

Total nursing home bed days for 1989–90 was obtained for each State. The utilisation percentage distributions discussed above were applied to the total bed day figures by State. This calculated the total nursing home bed days by State, diagnostic disease group, age and sex.

The average bed day cost for nursing homes was multiplied by the number of bed days in each 'cell' for each State. The average bed day cost was derived from total costs for nursing homes divided by the total number of bed days. The total costs for 1988–89 nursing homes was extracted from health expenditure compiled by the AIHW, which uses a national accounting framework. It includes private (payments by individuals, workers compensation, and motor vehicle third party insurance funds) and public components of expenditure (Commonwealth, State and Local government). The cost figure was inflated to expenditure in 1989–90 using the Hospital and Clinical deflator compiled by the Australian Bureau of Statistics. Data for each State was aggregated to determine a national estimate of nursing home costs (Antioch 1992).

National survey—medical, pharmaceutical and allied professional services

The National Survey of Morbidity and Treatment in General Practice in Australia 1990–1991 has been undertaken by Professor Bridges-Webb and his colleagues in the Family Medicine Department at the University of Sydney.

The data covers GPs, referrals to specialists and allied professional services, pharmaceutical scripts and orders for tests and investigations. The disease costing exercise reported in this paper used data from this study.

The national study is a one year survey of morbidity managed and treatments provided by a stratified random sample of 530 general practitioners, each recording information about all surgery and home consultations during two separate periods of one week, six months apart. 526 GPs were recruited into the survey from a stratified random sample of 2,100 practitioners who claimed at least 1,500 general practice items of service during 1989.

The morbidity and treatment data collection includes date of encounter (i.e. visit) and item of service, patient age, sex, status to the practice (i.e. new or

existing patient), patient reasons for encounter (up to 3), problems/ diagnoses managed at encounter (up to 4), drugs prescribed/other treatments (up to 4 per problem), tests and investigations, admissions, referrals (up to 2), and follow-up (Bridges-Webb 1991).

(i) Classification of data

Reasons for encounter and the diagnoses/problems managed were coded according to the International Classification of Primary Care (ICPC). Therapeutic procedures and psychological counselling sere coded using the International Classification of Process in Primary Care (IC-Process-PC). A drug classification (compatible with MIMS and with the University of Sydney was applied to the drugs prescribed (Bridges-Webb 1991).

The ICPC has a bi-axial structure: 17 chapters on one axis, each with an alpha code, and seven identical components with rubics bearing a two digit numeric code as the second axis. ICPC as a diagnostic classification system has relations both with ICD9 and with other ICD9 derived systems being used in primary care. A conversion from ICPC to ICD9 has been undertaken by Lamberts and Wood (1990). Where possible, the 3 digit main ICD9 rubics are represented. A four digit code is only used where necessary. However, in some cases there is no one-to-one matching of ICPC and ICD9 codes, In some cases, the ICD9 code is more specific than the ICPC code; in other cases the ICD9 code is less specific.

(ii) Method of weighting

In order to obtain a 3.5% national sample of active general practitioners a stratified sample of 3.5% for each State was calculated. *Actual* GP recording weeks were calculated as a proportion of the *expected* number of recording weeks required to produce a 3.5% sample, by State. NSW had the highest drop out rate, yielding only 88.08% of 3.5% to produce a 3.08% sample. Weighting factors for each State were applied to bring them in line with NSW, thereby producing a 3.08% national sample (Bridges-Webb). The methodology used in the costing exercise is outlines below and was developed by Antioch (1992).

Medical costs

(i) General practitioners

The National Survey of Morbidity and Treatment in General Practice includes data on the number of encounters (i.e. visits) by age and sex where the disease of interest was handled. However this data requires adjustment because more than one diagnosis may be covered in each encounter. That is, diagnoses *in addition to* the disease of interest could be dealt with in each encounter. The adjustment factor was the APM_d (Average number of problems managed per encounter for the disease of interest). The calculation of APM_d is outlined below:

$$APM_d = TPM_d / TE_d$$

where:

APM_d = Average number of problems managed per encounter for disease of interest;

TPM_d = Total problems (or diagnoses) managed at encounters where then disease of interest was handled;

TE_d = Total encounters for disease of interest.

Total number of adjusted encounters for the disease of interest were calculated as follows:

$$TAE_d = \sum_{j=1}^{N2} \sum_{i=1}^{N1} \left(E_{ijd} / APM_d \right)$$

where:

TAE_d = Total adjusted number of encounters for disease type d;

E_{ijd} = encounters for age i, sex j, disease type d;

APM_d = number of problems managed per encounter for disease type d;

N1 = Number of age group categories;

N2 = Number of sex categories.

A matrix showing the 'adjusted' number of encounters for the disease of interest was calculated. This matrix was divided by a matrix of all encounters for all diseases, by age and sex, to determine the proportion of *all* utilisation in each age sex cell that is attributable to the disease of interest. Age groupings are 10 year groupings: 0–9, 10–19, 20–29, 30–39, etc up to 80+.

The cell data for this matrix was calculated as follows:

$$PTU_{ijd} = AE_{ijd} / TE_{ij}$$

where:

PTU_{ijd} = Proportion of total GP utilisation for age i, sex j, attributable to disease type d;

AE_{ijd} = Adjusted encounters for age i and sex j, for disease type d;

TE_{ij} = Total encounters for all diseases for age i, sex j.

The matrix defined by PTU_{ijd} above was applied to out of hospital medical utilisation by general practitioners as recorded by the Department of Health, Housing and Community Services and Department of Veterans Affairs. The services derived were multiplied by the average benefits for GPs for each age/sex group. Medical GP benefits for each Commonwealth Department for the disease of interest was calculated as follows:

$$MB_{cd} = \sum_{j=1}^{N2} \sum_{i=1}^{N1} \left(PTU_{ijd} * MSGP_{ijc} * ABGP_{ijc} \right)$$

where:

MB_{cd} = Medical GP benefits for c Commonwealth Department for disease type d;

PTU_{ijd} = Proportion of total GP utilisation for age i, sex j, attributable to disease type d;

$MSGP_{ijc}$ = Out of hospital Medical services for GPs for Commonwealth Department c for age i, sex j;

$ABGP_{ijc}$ = Average benefits for GPs for c Commonwealth Department for age i, and sex j;

N1 = Number of age group categories;

N2 = Number of sex categories.

The medical services costed for GPs exclude dental and optometry since they were analysed separately.

(ii) Specialists

The National Survey of Morbidity and Treatment in General Practice data sets includes, for encounters where the disease of interest is handled, the total number of new specialist referrals made in each age group. However, referral information is encounter based, and the referrals listed by disease will not always have been made for the disease of interest. The survey collects data on up to two referrals for each encounter, which can include specialists and/or allied professionals.

To prevent overestimation of specialist costs, an adjustment (APMd) was applied. APMd was identified in the analysis of the GPs, and is the average number of problems (diagnoses) managed per encounter where the disease of interest was handled.

Methodology:

Step 1

$TSS_{xijcd} = (ARS_{xijc} / RSP_{xij}) * S_{xdij}$

TSS_{xijcd} = Total number of services for specialty x, age i, sex j, disease c for Commonwealth Department d.

ARS_{xijc} = Number of adjusted referrals to specialty x, age i, sex j, disease type c. (National survey data set)

This was calculated by deriving:

$ARS_{xijc} = RS_{xijc} / APM_d$

where:

RS_{xijc} = Number of referrals to speciality x,age i, sex j, disease type c;

See section on GPs for the derivation of APM_d;

RSP_{xij} = No. referrals to specialty x, age i, sex j, all diseases (National Survey data set);

S_{xdij} = No. services for specialty x, Commonwealth Department d, age i, sex j.

Step 2

$TCSS_{xijcd} = ACSS_{xij} * TSS_{xijcd}$

$TCSS_{xijcd}$ = Total cost of services for specialty x, age i, sex j, for disease c, Commonwealth Department d.

$ACSS_{xijd}$ = Average cost of services for specialty x for age i, sex j, Commonwealth Department d.

TSS_{xijcd} = Total number of services for specialty x for age i, sex j for disease c for Commonwealth Department d (Determined in step 1).

Data in Step 2 was summed across all specialities, age and sex groups for the disease of interest for the specified Commonwealth Department to derive total specialist costs. Department of Veterans' Affairs specialist data was not available by age and sex and an alternative methodology was used (See Appendix D).

(iii) Tests/investigations

The types of tests included in the National Survey of Morbidity and Treatment in General Practice were pathology, diagnostic imaging and 'other' (including ECG, spirography, multiphasic screening etc). In the National Survey data set, tests and investigations ordered at an encounter are not necessarily ordered for the diagnosis of interest. Further, test types, rather than individual tests are recorded. For example a request for a HIV test and serum cholesterol test at one encounter would be recorded as one 'blood test'.

To prevent under-estimating costs for pathology, an adjustment factor was applied based on data shown in a report by Deeble and Lewis (1991). There were 2.5 pathology services per episode. Therefore the number of pathology tests in the National Survey data set was multiplied by 2.5.

There is no way of identifying whether the tests were for the diagnosis of interest. We only know that they were ordered during the encounter at which the diagnosis of interest was handled. To prevent over-estimation of costs, an adjustment was applied (i.e. adjustment figure identified in the analysis of the GPs (APM_d). The number of tests was divided by APM_d.

The pathology, diagnostic imaging and 'other'data were analysed separately. The number of services and average cost for services by specialists for these tests were calculated (i.e. S_{xdij} and $ACSS_{xijd}$).

The data runs used for the analyses (using the previous equations for specialists) were as follows:

RS_{xijc} = number of tests ordered for speciality (diagnostic imaging, pathology or other) by age i, sex j, and disease type c.

RSP_{xij} = number of tests ordered for speciality (diagnostic imaging, pathology or other) by age i, sex j for all diseases.

The data for RSxijc and RSPxij were analysed separately for pathology, diagnostic imaging and other (Antioch 1992).

Private expenditure on medical services was derived from total private expenditure estimates on medical services compiled in AIHW bulletins of National Health Expenditure, which uses a National Accounting framework. This includes expenditure by health insurance funds, individuals, workers compensation and motor vehicle third party insurance funds. The proportion of total government medical expenditure attributable to the disease of interest was applied to the private total.

Costs of hyperimmune globulin (HBIG)

In addition to the cost of treatment for patients with hepatitis B, the cost of HBIG was estimated. This was based on estimates provided by Gross and Tiffin (1990). Averaging the number of doses dispensed for the 1989–90 and 1988–89 financial years data from the Commonwealth Serum Laboratories the total cost was $189,000 for 5150 pediatric doses at an estimated $10.40 each, and 3820 adult doses at $36.40 each.

Screening

Gross and Tiffin (1990) estimates that screening all blood products for HBV involves approximately 1 million donations screened annually. An estimate of $3 per test was used in their costing and was also used in the current research, to total $3m.

Hepatitis vaccine

Estimates of the hepatitis vaccine of $35.75m provided by Gross and Tiffin (1990) were used for the current study. This included vaccine costs and GP costs for administration of the vaccine. The total number of doses sold by the Commonwealth Serum Laboratories in 1989–90 was added to the number of doses sold by SmithKline Biologicals.

The cost per dose differs for government contracts and private scripts, the number of private scripts are 3–4 times the number of government contract doses. During 1989–90, the rates of adult to paediatric doses was approximately 40:1. Gross and Tiffin (1990) estimated the total number of doses used in 1989–90 as 2.04m. This included 1.88 million adult doses at an average weighted price of $7.65 and 0.16m paediatric doses at an average weighted price of $5.56.

GP costs for medical visit for administering vaccine were not included in the data set used from the National Morbidity Survey of GPs. This was costed at the lowest MBS schedule fee ($10-MBS item 3) by Gross and Tiffin (1990) and was used in the current study.

Pharmaceuticals

The data on therapeutics using the National Morbidity Survey of GPs was analysed as follows (Antioch 1992):

$$TC_c = \sum_{d=1}^{N3} \sum_{j=1}^{N2} \sum_{i=1}^{N1} \left(BP_{ijcd} * TPH_{ij} * BBP_d / BP_{ijt} \right)$$

where:

TC_c = Total cost of prescriptions listed under the Pharmaceutical Benefits Schedule for disease c;

BP_{ijcd} = Number of benefit prescriptions for disease c for drug d (e.g. Metrochopromide) in the National survey for age i and sex j;

BP_{ijt} = Number of benefit prescriptions by agei and sexj for total diseases in the National survey sample t;

TPH_{ij} = Total number of benefit prescriptions listed under the Pharmaceutical Benefits Schedule for age i and sex j;

BBP_d = Total cost ($) per script for drug d;

N1 = Number of age group categories;

N2 = Number of sex categories;

N3 = Number of drug categories.

Data sources for pharmaceutical study

Aggregate national benefit prescriptions listed under the Pharmaceutical Benefits Schedule for pharmaceuticals by age and sex (TPH_{ij}) were calculated from estimates compiled by the Health Services Division of the AIHW. These are based on 1985 survey data in Wynyard, Burnie and Mt. Gambier which have been applied to national 1989–90 population estimates, to derive utilisation data for 'general', 'pensioner', 'concessional' and 'total' categories. These data were applied to 1989–90 pharmaceutical utilisation data (Antioch 1992).

Allied professional services

Expenditure on Allied Professional Services (APS) attributable to the disease of interest for each age/sex group was calculated based on utilisation data from the National survey data set. The expenditure data for each age/sex group were summed to derive total costs for the disease. This methodology is outlined below (Antioch 1992):

$$CAPS_c = \sum_{j=1}^{N2} \sum_{i=1}^{N1} \left(RAPS_{ijc} / RAPS_{ij}\right) * \left(RAPS_{ij} * TEAPS / RAPS\right)$$

$CAPS_c$ = Cost of all Allied Professional Services for disease c;

$RAPS_{ijc}$ = Referrals to all Allied Professional Services in age group i, sex j, disease c;

$RAPS_{ij}$ = Total referrals to all Allied Professional Services in age group i, sex j, all diseases;

RAPS = Total referrals to all Allied Professional Services age/sex groups, all diseases;

TEAPS = Total (government and private) expenditure on Allied Professional Services;

N1 = Number of age group categories;

N2 = Number of sex categories.

Note that part of the formulae calculates the allied professional services expenditure attributable to a particular age/sex group for all diseases:

$$EAPS_{ij} = (RAPS_{ij} * TEAPS / RAPS)$$

where:

$EAPS_{ij}$ = Allied Professional Services expenditure attributable to age i, sex j, all diseases.

Appendix B

Methodology for estimation of indirect costs

There are two principal methodologies for estimating the indirect cost-of-illness: the human capital method and the willingness-to-pay method. In the human capital method, an individual is perceived as producing a stream of output over time that is valued at market earnings or given an imputed value of housekeeping services. The main criticism of this methodology is that it excludes important intangibles, only counts earnings, and undervalues some groups relative to others because earnings may not accurately reflect one's ability to produce. It yields very low estimates for children and the retired elderly (Max, Rice and MacKenzie 1991).

Willingness-to-pay is an alternative approach, which is very difficult to implement. It captures other aspects of the value of life not reflected by production effects. It values human life according to what people would be willing to pay for a change that reduces the probability of illness or death (Schelling 1968; Acton 1975; Max, Rice and MacKenzie 1990). Objections to this method are that the value of individual lives depend on the income distribution, with the rich able to pay more than the poor. Further, it is very difficult for individuals to place a value on small reductions in the probability of death (Rice, Hodgson and Kopstein 1985).

Lifetime earnings, as calculated by the human capital approach, are at least a lower bound to a person's willingness to pay for a decreased risk of death (Linnerooth 1989). The strengths and weaknesses of these two methodologies are discussed in articles by Hodgson and Meiners (1982) and Hodgson (1980). The human capital approach is most frequently used and is the basis for the estimates developed in this study.

Morbidity costs

The methodology outlined below is based on that by Collins and Lapsley (1991). The authors identify three types of absences from work:

(i) associated with hospital episodes;

(ii) associated with receipt of medical services; and

(iii) not associated with any health care services (often referred to as a 'sickie').

The value of production loss resulting from morbidity (i and ii refers) can be calculated from estimating the number of work days lost as a result of each hospital bed-day and medical service visits of people in the workforce (Collins and Lapsley 1991).

Collins and Laspley (1991) estimate that each hospital bed-day used by a member of the workforce involves on average a further absence of two days work and that each medical service supplied to a member of the workforce involves on average a loss of half a day's work. These authors were unable to

locate any information about absenteeism unassociated with the delivery of health-care services.

The lost productivity from absenteeism from morbidity for hospitalisation and medical services were estimated using this approach. These authors do not provide details on how they calculated the costs. Outlined below is the methodology developed by Antioch (1992) for this study.

(i) Absenteeism costs attributable to hospitalisation

The total number of bed days associated with the disease of interest by age and sex were calculated from the hospital morbidity sets. This was adjusted (Antioch 1992) to apportion an additional two days for each bed day, i.e.:

$$TCAH_d = \sum_{j=1}^{N2}\sum_{i=1}^{N1}\left(NBD_{ijd} + \left(2 * NBD_{ijd}\right)\right) * WPR_{ij} * AWPD_{ij}$$

where:

$TCAH_d$ = Total cost of absenteeism attributable to hospitisation for disease d;

NBD_{ijd} = Number of bed days in each age group i and sex j for disease d;

WPR_{ij} = Work participation rate for age i, sex j;

$AWPD_{ij}$ = Average wage per day for age i, sex j;

N1 = Number of age group categories;

N2 = Number of sex categories.

(ii) Absenteeism costs attributable to medical services

The analysis assumed that each medical service supplied to a member of the workforce involves on average a loss of 0.37 of a day's work, rather than .5 of a day suggested by Collins and Lapley (1991). The former fraction was derived from analyses of the ABS National Health Survey 1989–90. The number of medical services by age and sex for the disease of interest was multiplied by 0.37 and the abovementioned WPR_{ij} and $AWPD_{ij}$ were included in the formula as follows:

$$TCAM_d = \sum_{j=1}^{N2} \sum_{i=1}^{N1} NMS_{ijd} * \left(0.37 * WPR_{ij} * AWPD_{ij}\right)$$

where:

$TCAM_d$ = Total cost of absenteeism attributable to medical services for disease d;

NMS_{ijd} = Total number of medical services for age group i, sex j and disease d;

N1 = Number of age group categories;

N2 = Number of sex categories.

The total figures calculated for hospitalisations and medical services were summed to derive the total costs attributable to absenteeism (lost productivity from morbidity) for the disease of interest.

$$TCA_d = TCAM_d + TCAH_d$$

where:

TCAd = Total cost of absenteeism attributable to lost productivity from morbidity for hospitalisations and medical services for disease d.

Indirect costs due to morbidity were calculated for housekeepers assuming a 'housekeeper work force' participation rate of 32%. This estimate was based on an earlier study by Richardson (1989) and Crowley, Antioch and Carter et al. (1992).

Mortality costs

Mortality costs are defined as the value of productivity lost due to premature deaths resulting from the disease of interest. The estimated mortality costs are the product of the number of deaths and the expected value of a person's future earnings, with age and sex taken into account (Rice, Kelman and Miller 1991).

The estimate for lifetime earnings was based on age/sex specific labour force participation rates. It is assumed that individuals will be productive during their expected lifetime in accordance with the current pattern of employment experience for their age and sex group.

Productivity losses were based on annual mean earnings by gender. Mortality costs in this study were calculated by multiplying the potential years of life lost between the ages of 15 and 65 attributable to the disease of interest by the workforce participation rates and average annual earnings. A discount rate of 5

per cent was used to convert the stream of lifetime costs into present value equivalent. This was based on the methodology used by Crowley, Antioch and Carter et al. (1992).

Market place earnings underestimate the loss resulting from hepatitis B because some of the individuals are not in the labour force. Many of them may perform household services. The value of household work, therefore must be added to earnings.

Crowley, Antioch and Carter, et al. (1992) assumed that 32% of all females are housekeepers and hence a 32% 'household workforce participation rate' for housekeepers. This was based on earlier estimates by Richardson (1989). The average wage rate assigned to housekeepers was assumed to be the wage rate for a paid housekeeper, currently $11 per hour ($440 for 40 hour week). These assumptions were also adopted in the current study. This methodology may underestimate the costs associated with housekeepers and is considered further in a later section.

Costing the chronic sequelae of hepatitis B (liver cancer and cirrhosis)

The direct costs of cirrhosis and liver cancer were calculated for hospitals and nursing homes. The indirect costs for premature mortality and absenteeism due to hospitalisation were also estimated. Costs for other areas were not available. The methodology outlined in the foregoing sections was applied to these diseases. The proportion of utilisation and deaths from these diseases that are attributable to hepatitis B was based on Gross et al (1985) data which assumed 5% of cirrhosis deaths and 80% of liver cancer deaths were due to hepatitis B.

Appendix C

Supporting tables showing gender and age detail on the disease costs of hepatitis B in 1989–90 (excluding prevention)

Table C1: *Hepatitis B male total costs in 1989–90 (excluding prevention) showing age disaggregation*

	Hospital	Nursing homes	Medical Govt.	Medical Private	APS	Drugs	Total (direct)	Morbidity	Mortality	Total (indirect)	Total
0–9	7,201		4,670	1,176			13,047				13,047
10–19	74,832						74,833	27,462		27,462	102,295
20–29	199,748		68,269	17,199		4,236	289,452	264,351	424,570	688,921	978,373
30–39	95,473		80,754	20,373		4,812	201,412	177,155	1,174,193	1,351,348	1,552,760
40–49	48,252		22,366	5,715			76,333	73,358	669,483	742,841	819,174
50–59	24,737		56,357	14,309			95,403	83,836	1,456,482	1,540,317	1,635,720
60–69	46,929	10,610	18,872	7,350			83,761	20,267	176,960	197,227	280,988
70–79			39,707	12,308			52,015				52,015
80+				287			287				287
DVAs Medical			21,639				21,639				21,639
Total	497,171	10,610	312,634	78,717		9,048	908,182	646,428	3,901,688	4,548,116	5,456,298

Table C2: *Hepatitis B female total costs in 1989–90 (excluding prevention) showing age disaggregation*

	Hospital	Nursing homes	Medical Govt.	Medical Private	APS	Drugs	Total (direct)	Morbidity	Mortality	Total (indirect)	Total
0–9	19,904						19,904				19,904
10–19	62,450		37,362	9,408			109,220	53,376	552,189	605,565	714,785
20–29	58,473		131,181	33,034		20,022	244,710	169,096		169,096	413,806
30–39	61,613		78,263	19,714			159,590	96,122	271,456	367,578	527,168
40–49	17,800		53,813	13,570			85,183	64,534		64,534	149,717
50–59	11,323		13,061	3,425			27,809	15,121	141,778	156,899	184,708
60–69	8,795		19,473	5,901			34,169	15,020	20,044	35,065	69,234
70–79	11,952	139,164	26,915	7,737			185,768				185,768
80+				428			428				428
DVAs Medical			10,162				10,162				10,162
Total	252,309	139,164	370,231	93,219		22,022	876,946	413,270	985,467	1,398,737	2,275,683

Appendix D

Department of Veterans' Affairs-Specialist utilisation and costs

The specialist utilisation and cost data provided by DVAs is not disaggregated by age and sex. An alternative methodology to that currently used to analyse DHHCS data has been developed to analyse the DVA data.

The Bridges-Webb data set includes, for encounters where the disease of interest is handled, the total number of new specialist referrals made in each age group. However, referral information is encounter based, and the referrals listed by disease will not always have been made for the disease of interest. To prevent overestimation of specialist cost, an adjustment (APMd) was applied to the analysis. APMd is the average number of problems (or diagnoses) managed per encounter where the disease of interest was handled. Details of the analysis to be used to analyse the DVA data are outlined below (Antioch 1992):

$$ESCD_{cd} = (ATSC_c / TSCA) * TSC_d * ACSC_d$$

where:

$ESCD_{cd}$ = Specialist expenditure for disease c, department DVA;

$ATSC_c$ = Adjusted total specialist consultations for disease c (National Survey data).

where:

$$ATSC_c = TRS_c / APM_d$$

TRS_c = Total referrals to specialists, disease c (National Survey);

$$APM_d = TPM_d / TE_d$$

APM_d = Average number of problems (diagnoses) managed per encounter for disease of interest;

TPM_d = Total problems (diagnoses) managed at encounter where disease of interest handled;

TE_d = Total GP encounters for disease of interest;

TSCA = Total specialist consultations all diseases (National Survey);

TSC_d = Total specialist consultations for department DVA;

$ACSC_d$ = Average cost per specialist consultation for Dept. DVA, calculated by:

$$ACSC_d = TSBP_d / TSC_d$$

where:

$TSBP_d$ = Total specialist benefits paid for Department DVA;

TSC_d = Total specialist consultations for Department DVA.