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Foreword

This paper was originally prepared for presentation at the Fourteenth Australian Conference of Health Economists in Canberra in September, 1992. The present publication is an edited and updated version of that conference paper, prepared for a wider circulation and readership, and incorporates more recent data. It is hoped that the paper will help to stimulate discussion and provide a useful contribution to health policy on infectious diseases.

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Summary

- From an economic perspective, a useful way of setting priorities for prevention is to consider 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.
- This discussion paper addresses the first of these steps for tuberculosis (TB) and syphilis. It provides prevalence-based estimates of the costs to the health care delivery system of TB and syphilis in the year 1989–90. Preliminary estimates for the indirect impact on production in the broader economy are also provided.
- Total costs for TB were estimated to be $12.0 million in 1989–90, comprised of $8.4 million for the direct cost of treatment, $2.5 million in morbidity costs (measured as the value of foregone earnings), and $1.1 million in mortality costs (measured as the value of foregone earnings for nine premature deaths).
- Total costs for syphilis were estimated to be $1.5 million, including $1.2 million for the direct cost of treatment, $0.2 million for morbidity costs, and $0.1 million in mortality costs from one premature death in 1989–90.
- Trends in the United States indicate an increase in the incidence of TB, due to the inadequacy of health services, AIDS, and multi-drug resistant TB. An ageing population and changes in ethnicity may also be contributory factors.
- The possibility that the incidence of tuberculosis in Australia could similarly increase in the future, stresses the need for Australian diagnostic and treatment programs for this disease to be maintained and improved where necessary. The cost-effectiveness of using isoniazid prophylaxis for patients with a positive Mantoux skin test should be carefully considered.
- Congenital syphilis is a preventable, serious disease which can lead to the neonatal death or substantial long-term institutionalisation of children. Further analysis seems desirable in Australia to determine the adequacy of current screening programs in terms of the population they serve.
- The scope and limitations of this study should be borne in mind when using the cost-of-illness (COI) estimates. In particular, while COI studies have various useful applications, they do not provide sufficient information on their own to determine whether the resource allocation is efficient. It is also important to consider quality of life factors, despite the greater challenge posed by their measurement.
- The Disease Costs and Impacts Study (DCIS) series is part of an ongoing collaborative research program with the National Centre for Health Program Evaluation, in which the methods and data sets are constantly being reviewed, revised and updated. While soundly based, COI estimates released at this point of the research program should be regarded as work-in-progress estimates.

1 Introduction

Background

As a general rule, only a small percentage of the total budget for health care will be available for prevention activities. The need for establishing priorities for available funds is becoming more acute. Another important reason for establishing priorities is the need to gain the acceptance of the population that is being encouraged to participate in such programs. The enthusiasm of the population could quickly wane if those who could benefit from prevention programs are pushed in too many directions at the same time.

Despite this need to establish priorities, it is not yet possible to offer a suggested order for prevention programs based on economic analysis. More work needs to be done, both with conventional microeconomic analysis at the project appraisal level, and at the broad conceptual level. The Australian Institute of Health and Welfare has commenced a collaborative work program with the National Centre for Health Program Evaluation to address the issue at the macro level. The approach being developed is to establish a broad overview of priorities through a sequence of three steps:

- assess the public health significance or burden of suffering of health problems (the Disease Costs and Impacts Study series);
- assess the theoretical and practical preventability of the health problems; and
- assess the efficiency of the individual preventive measures designed to achieve potential benefits (the Macro Economic Evaluation Model (MEEM)).

While it is true that from an economic perspective the third step of establishing efficiency embraces the first two steps, the staged approach provides a more thorough understanding of the broader issues involved. It also holds promise of improving the dialogue between economics and other disciplines and provides a better platform for public consultation.

This paper is a publication in the Disease Costs and Impacts Study series. Its focus is on step one, and more specifically on providing soundly based estimates for the cost-of-illness due to tuberculosis (TB) and syphilis.

Cost-of-illness studies

The need to calculate costs associated with the treatment of syphilis and tuberculosis reflected the absence of Australian cost data concerning these diseases, and the reported negligible decline in their incidence in recent years. Further, these diseases are considered by the National Health and Medical Research Council to be significant public health concerns in Australia. There is high potential for morbidity and mortality associated with congenital syphilis.(2) Tuberculosis also remains a significant public health problem in Australia due to an ageing population, changes in ethnicity and the emergence of AIDS.(3)

At a minimum, cost-of-illness (COI) studies are useful for identifying how resources are allocated between different types of costs, diseases and services. COI studies can also attempt to measure the value that illness subtracts from the productive potential of a country.(4) For the health services sector, direct costs are the costs of foregone alternatives: if there was less illness, then a proportion of the resources spent on diagnosing and treating the sick could be put to other uses. Indirect costs are the value of the output that is lost because people are too ill to work or have died prematurely.

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 the use 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 use. This occurs because health care professionals do not regard certain diseases as important or there are few effective interventions available for their treatment.(5)

COI studies can also provide data on the cost side of the cost-effectiveness equations for a later economic evaluation(6) and provide a simple, single index of the burden of illness.(7) 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 (i.e. hospitals, medical services, pharmaceuticals, etc.) and also from comparisons of the results of different COI studies undertaken in different locations.(8) Estimating future COI projections can also assist those planning health services, especially where they are estimated under alternative scenarios.

It is also possible for COI calculations to provide a baseline against which new interventions can be assessed.(6, 8) The incidence-based COI estimates can model the 'do nothing', or current care option.(8) COI calculations could also assist in the determination of medical research priorities,(9) although the implied priorities may not differ greatly from those identified by considering mortality and morbidity alone.

Cost-of-illness studies alone, however, do not provide economic guidance for decision-making about whether more resources should be devoted to treating certain diseases. This requires information about both costs and outcomes, together with what is happening at the margin (as opposed to average costs or benefits). A substantial economic burden could indicate that significant resources have been allocated to the treatment for specific diseases, but future decisions on the allocation of limited health care resources should depend on the availability of treatment options, their costs and their effectiveness.(8)

Nevertheless, an interesting perspective is provided by Davey and Leeder(7) who argue that COI studies 'provide an initial indication for health care authorities as to where health care efficiency may be improved, by providing a league table of health problems according to their costs. 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'. The cost estimates obtained from the current study should provide insights into the burden of these diseases on the health system and facilitate some of the uses identified above.

Public health significance of syphilis

Syphilis is still a commonly reported communicable disease in many developed nations.(10) The US Centers for Disease Control(11) report that the incidence of primary and secondary cases of syphilis in adults has increased 32% in 1987 from the previous year in the United States. The increase in incidence was greater amongst women than men. This increase amongst women is a disturbing trend as it increases the potential for morbidity and mortality associated with congenital syphilis.(2)

Detailed epidemiological information on syphilis is hard to obtain in Australia due to the different reporting methods throughout the States. In New South Wales, notifications of syphilis increased by 55% from 1,007 cases in 1978 to 1,560 in 1985. Information for Victoria shows that reports of syphilis have been consistent at approximately 100 new cases per year, except in the early 1980s where notification increased to 260 cases per year. A high risk group for syphilis are young single women of low socioeconomic status who have received little or no prenatal care.[2] In recent years in Victoria, about 30 cases per year are reported in women.[12]

Congenital syphilis, which affects infants of women who have primary or secondary syphilis during their pregnancy, is a serious but preventable disease. However, despite the fact that it is notifiable, there is little information about the incidence of congenital syphilis in Australia except for anecdotal evidence by Lane and Oates[13] and Garland and Kelly.[2] They report that, between 1953 and 1986 at the Camperdown Children's Hospital, 33 cases of congenital syphilis were reported, of which five cases were fatal. Gilbert[12] reports that there is an average of one recognised case of congenital syphilis each year at the Children's Hospital in Sydney, which is consistent with an incidence of 1–5 per 100,000 live born infants.

Economic literature on syphilis

Although none of the Australian or international literature reviewed reported direct cost analysis of syphilis on a national scale, some do deal with the cost-effectiveness of syphilis screening. Two of these were screening for syphilis in pregnant women to prevent infants contracting congenital syphilis. An overview of the findings from these studies are reported below. A detailed analysis of these studies is beyond the scope of this paper.

Garland and Kelly[2] conducted their study at the Royal Women's Hospital in Melbourne where routine serological screening has been standard practice. They calculated the cost of the syphilis screening program to be $74,225 for a seven-year period ($10,604 per annum) and found an incidence of 0.02% for active maternal syphilis. They concluded that antenatal screening was cost-effective.

A study conducted in a Thailand hospital by Phaosavasdi et al.[14] also recommended that screening for syphilis during pregnancy was cost-effective, with repeated serological tests being worthwhile in the final trimester. The cost of the preventive program was calculated to be Bht 205,100 for 14,000 pregnant women. They estimated the economic benefit of the program to be Bht 466,112, which is 2.8 times the cost of the program. Stray-Pederson[15] suggests that even if the incidence of maternal syphilis is as low as 0.005%, the benefit equals the cost of the prevention program. He assumes that half of the infants born with congenital syphilis who survived the neonatal period would require expensive long-term institutional care and the other half would need special education and training. The benefits of the screening in reducing institutional costs alone would outweigh the cost of the screening intervention. Gilbert[12] conservatively estimates lifelong institutional care for one individual to cost $500,000, compared to $74,225 for the screening program over a seven-year period.

American studies that analyse the benefit of screening for syphilis come up with a wide variety of costs for cases of syphilis detected. Ernst et al.[16] estimate that the cost per case detected is US$104.90. This study was conducted on a sample of patients who presented at hospital with symptoms of other sexually transmitted diseases to determine the influence of unsuspected syphilis. Haskell[17] calculated that the premarital screening cost was US$240,000 per case detected. In their study of screening programs for Veterans' Administrative employees, Normand et al.[10] calculated the cost per case detected to be US$3,418.

Public health significance of tuberculosis

In Australia, the incidence of tuberculosis has declined from a level of 60 per 100,000 population in 1952 to seven per 100,000 in 1985.[18, 19] Since 1986 the rate of new cases of tuberculosis has remained fairly constant with an average annual incidence of about 5.5 per 100,000 population.[20]

Tuberculosis remains an important public health problem in Australia. This is due to an ageing population, changes in ethnicity and the emergence of AIDS.[3] These factors, and the negligible recent decline in incidence, make it imperative that Australia's diagnostic and management programs be maintained.[21]

The risk of tuberculosis is low in Australian-born people except for the elderly, the homeless and Aboriginal people.[18] The rate of active tuberculosis is 20 times higher in Aboriginal people than others born in Australia, and is particularly prevalent amongst Aboriginals in the 45–54 and 55–64 age groups. The rate of notification for Aboriginal men is three times the rate for women.[18]

Only one-third of people with tuberculosis in Australia are Australian-born.[3] There were 986 notifications of TB infections during 1985. Of these, 60% of cases occurred in people born outside Australia and 22% of these had been in Australia for less than 12 months.[18, 22] The high prevalence of tuberculosis in South-East Asia is of concern to Australia.[20]

Whilst there is little information on the impact of HIV infection on the incidence of tuberculosis in Australia, Plant et al.[23] report that 1.94% of reported AIDS cases up to 1987 in New South Wales had a concurrent mycobacterial infection. In Victoria, as at January 1988, 2.8% of Group IV AIDS patients were diagnosed with tuberculosis. There have been no reported cases of tuberculosis amongst AIDS patients in Queensland.[22] It is estimated that if the number of AIDS cases increases and Australia experiences a similar pattern of AIDS-related opportunistic infections as the United States, then there will be an accompanying rise in infections with both Mycobacterium tuberculosis and atypical tuberculosis. Mycobacteria are an important cause of morbidity in patients with AIDS.[23]

Economic literature on tuberculosis

Tuberculosis is reported as a significant public health issue in developing countries where government resources for health services are limited, and in North America where an increase in incidence has been noted in the United States.[25, 26] These changes are due to an increased reservoir of infection in nursing home patients and because tuberculosis is an opportunistic infection in patients with AIDS.[27]

Literature on the cost of tuberculosis focuses on the cost-effectiveness of chemotherapy to prevent reactivation of dormant tuberculosis in skin-test positive patients. These findings will be discussed in a later section. Only one article reported a disease cost analysis of tuberculosis. No details were provided of the methodology used to calculate the costs.

Table 1 provides a comparison of the amount spent on tuberculosis in various countries. The contrast between the amount spent by Japan per case of tuberculosis (US$31,653 in 1981) and Canada (US$10,600 in 1974) with countries like Thailand, Philippines and Burma (between US$19 and US$31 during 1982) is striking. Korean expenditure per case in 1982 was higher at US$312.[25]

Table 1: *Annual expenditure on tuberculosis in six countries*

		Annual expenditure in US dollars	
Country	Year	Per capita	Per case
Japan	1981	8.10	31,653
Canada	1974	1.82	10,600
Korea	1982	0.68	312
Philippines	1982	0.06	19
Thailand	1982	0.06	19
Burma	1982	0.05	31

Source: Grzybowski [25]

2 Methodology

The health status of a population is usually described in terms of the absence of health, namely morbidity and mortality. Numerous indicators are available to provide some impression of mortality and morbidity, however none can measure the costs of all their dimensions, particularly human suffering.

Identification of costs

The disease costs of TB and syphilis represent the monetary burden on society of the morbidity and premature mortality associated with these illnesses. The costs of illness are usually divided into two components—direct and indirect costs.

The direct costs of illness focus on the costs of heath care services for diagnosing and treating illness, together with support costs such as research, administration and training. The indirect costs of illness focus on the impact of illness on production in the economy and comprise both morbidity and mortality costs. Morbidity costs are the value of lost output due to the reduced productivity caused by the illness, usually measured as 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.[28, 29]

Those interested in potential 'savings' from reducing disease incidence should note that the net present value of estimates of forgone production do not estimate the resources that may become available to the community for health programs. Only direct costs should be used in this 'opportunity cost' context.

The direct costs included in this study relate to hospital inpatient services, pharmaceuticals, medical services by general practitioners and specialists, nursing homes and allied professional services. These were calculated for both public (Commonwealth, State and Territory, 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 is to take known aggregate expenditures and apportion these on a disease-specific basis using Australian data (i.e. the hospital morbidity series, the National Survey of Morbidity and Treatment in General Practice, and the National Health Survey). The paper provides estimates which are as soundly based as is currently possible for the cost impact of disease on the health care system. It is important to note, however, that the Disease Costs and Impacts Study and the Macro Economics Evaluation Model are part of an ongoing research program in which the methods and data sets are constantly being reviewed, refined and updated. The current estimates should therefore be regarded as work-in-progress estimates, and are quite conservative.

Indirect costs included in this study relate to sick leave for morbidity associated with health care services and the mortality costs of forgone earnings due to premature death. Costs relating to reduced worker productivity at work and absenteeism not associated with visits to, or service by, a medical practitioner were not included.

The indirect component of COI studies is a particularly contentious area and only preliminary estimates using conventional methods are provided. These estimates should be used very cautiously, in full knowledge of their limitations.

A category of costs called 'intangibles' (such as 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.

Human capital method

The human capital approach is often used for valuing forgone productivity. In this 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.(29) Further, for short-term absences, an individual's work may be covered by others, or made up on return to work. For long-term absences, the unemployed can be used. Therefore, while work absence may cost the individual and the employer, it may not cost society very much.(8) New methods of estimating production losses are being explored to take into account some of these criticisms. One method that costs only the mortality production loss until the worker is replaced (the 'friction approach') provides estimates of indirect costs much lower than those obtained by considering lifetime lost earnings due to premature death.(30)

Willingness-to-pay is an alternative approach, but is 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.(29, 31, 32) Objections to this method are that the value of individual lives depends 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.(33)

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.(34) The strengths and weaknesses of these two methodologies are discussed in articles by Hodgson and Meiners(28) and Hodgson.(35) The human capital approach is most frequently used and is the basis for the preliminary estimates developed in this study and detailed in Appendix B.

Prevalence and incidence approaches

Two basic approaches can be applied to estimate the cost of illness. Incidence-based costing measures the net present value of the total lifetime cost of all cases with disease onset in the base year. Incidence-based costing is difficult 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 during the duration of the illness; and the impact of the illness on lifetime employment, housekeeping and earnings.(29)

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.(34, 35, 36) 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-based estimates may understate savings to the extent that new cases prevented involve long episodes of care that extend beyond one year.

In practice, the extra information required by the incidence approach 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.

3 Results

An overview of the cost-of-illness results is provided below, and is based on the costs shown in Tables 2 to 4. More detailed tables showing age/gender disaggregation are included in Appendix C.

Tuberculosis imposed a $12.2 million burden on the Australian economy in 1989–90. Direct treatment and support costs comprised 70% of the total for 1989–90. Morbidity costs (the value of reduced or lost productivity) were 21%. Mortality costs were 9% based on a 5% discount rate of the value of productivity forgone in future years as a result of premature mortality in 1989–90.

Syphilis imposed a $1.5 million burden in 1989–90. Direct treatment and support costs comprised 81% of the total. Morbidity costs comprised 14% and mortality costs 5%.

Direct costs

Direct costs included the amounts spent in 1989–90 for personal health care for individuals suffering from TB and syphilis, 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.

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

Tuberculosis

Total direct medical treatment and support amounted to $8.6 million—70% of total disease costs. About 8% of these direct costs ($677,318) was expenditure for medical services, including general practitioners (GPs), specialists and tests/investigations. The estimate for medical services is likely to be an underestimate as it uses the Bridges-Webb National Survey of Morbidity and Treatment in General Practice and very little tuberculosis is diagnosed or managed under general practitioners (usually diagnosed/managed in special clinics or sometimes by specialist physicians).

Expenditure for hospitalised TB patients, with TB as the primary diagnosis, was $6.2 million or 73% of direct costs. This represented 968 hospital discharges, who used 18,176 days of care associated with tuberculosis. Costs associated with conditions where TB was a secondary diagnosis were not calculated.

Other treatment costs included $1.4 million for nursing homes, amounting to 16% of total direct costs. Allied professional services amounted to $127,282 or 1% of total direct costs. Drugs were estimated at $160,360 or 20% of total costs. This estimate should be interpreted with caution as most drugs for tuberculosis are provided under the state health systems (in special clinics) and therefore do not appear under the Pharmaceutical Benefits Schedule. Drugs provided during hospitalisation are included in the hospital costs via the diagnosis related groups (DRG) weights.

Syphilis

Total direct medical treatment and support amounted to $1.2 million or 81% of total disease costs. About 5% of direct costs was expenditure for medical services, including GPs, specialists and tests/investigations ($58,131).

Expenditure for hospitalised syphilis patients, with syphilis as the primary diagnosis, was $540,487 or 46% of direct costs. This represented 229 hospital discharges and 1,246 days of care. Costs associated with conditions where syphilis was a secondary diagnosis were not calculated.

There were no costs identified for treatment in nursing homes. Allied professional services were estimated at $585,146 or 49% of direct costs. Drugs were estimated at $1,759 or approximately 0.1% of total direct costs.

Indirect costs

Morbidity costs

Tuberculosis morbidity costs are the estimated value of goods and services not produced in 1989–90 because of TB. Included are the value of reduced and lost productivity for the population suffering from TB. Total morbidity costs for TB amounted to $2.5 million, or 69% of total indirect costs. Morbidity costs related to medical consultations amounted to $237,613 and accounted for 7% of all indirect costs. Morbidity costs for hospitalised persons amounted to $2.3 million or 63% of indirect costs.

Total morbidity costs for syphilis amounted to $208,760 or 75% of indirect costs. Morbidity costs related to absenteeism involving a medical visit or service amounted to $63,308 and accounted for 30% of all indirect costs. Morbidity costs for hospitalised persons amounted to $145,452 or 70% of indirect costs.

Mortality costs

Mortality costs for tuberculosis are the present value of lifetime earnings lost by all who died in 1989–90 as a consequence of TB. The costs were calculated by multiplying the potential years of life lost between the ages of 15 and 65 attributable to TB by the workforce participation rate and average weekly earnings. A 5% discount rate was used to convert aggregate earnings over a lifetime to their present worth. Mortality costs are summarised in Table 2 and are shown in more detail in Table 4.

In 1989–90, nine individuals died from TB in the age range 15–64 years. Those deaths were measured as a loss of $1.1 million to the economy at a 5% discount rate, or $123,328 per death. This figure appears low. However, 45% of total TB deaths were for individuals aged 60 years and over.

There was one death associated with syphilis in the age group 15–64 years during 1989 resulting in a cost of $70,888. Forgone earnings due to syphilis are detailed in Table 5.

Costs by age and sex

Tuberculosis

An analysis of costs by age and sex is shown in Appendix C. The direct and indirect costs were distributed by age and sex. These costs include amounts spent on the treatment and support of individuals with TB, together with the morbidity and mortality indirect costs associated with the disease. The total economic cost of TB for men was 59% higher than that for women ($7.4 million compared to $4.6 million—Tables 6 and 7). The higher costs for men reflect their higher use of nursing homes, accounting for $1.4 million. There were no nursing home costs identified for females with tuberculosis.

The 60–69 year age group accounted for the largest share of total costs (20%), followed by the 30–39 year age group which accounted for 16% of the total.

Syphilis

The direct and indirect costs of $1.5 million include amounts spent on treatment and support of persons with syphilis, as well as the morbidity and mortality costs. The total economic cost of syphilis was higher for men than for women ($1.0 million and $0.5 million—Tables 9 and 10).

The 40–49 age group accounted for the highest share of total costs (51%), followed by the 20–29 age group, which accounted for 17% of the total.

Table 2: *Disease costs of tuberculosis in Australia, 1989–90*

	$
Direct costs	
Hospitals	
Government	6,051,649
Private	203,528
Total hospitals	*6,255,177*
Nursing homes	
Private and government	1,359,453
Medical—government funded	
General practitioners	
Department of Veterans' Affairs	16,064
Department of Health, Housing Local Government and Community Services	114,515
Total general practitioner	*130,579*
Specialists	
Department of Veterans' Affairs	19,730
Department of Health, Housing Local Government and Community Services	115,539
Total specialists	*135,269*
Tests	
Pathology	68,913
Radiology	205,629
Other tests	690
Total tests	*275,232*
Total government medical	*541,080*
Medical—private funded	136,238
Total medical services	*677,318*
Allied professional services	
Government and private	127,282
Pharmaceutical costs	
Government and private	160,360
Total direct costs	**8,579,590**
Indirect costs	
Morbidity	
Medical consultation	237,613
Hospitalisation	2,286,053
Total morbidity	*2,523,666*
Mortality	1,109,955
Total indirect costs	**3,633,621**
Total costs	**12,213,211**

Table 3: *Disease costs of syphilis in Australia, 1989–90*

	$
Direct costs	
Hospitals	
Government	500,131
Private	40,356
Total hospitals	*540,487*
Nursing homes	
Private and government	Nil
Medical—government funded	
General practitioners	
Department of Veterans' Affairs	1,442
Department of Health, Housing, Local Government and Community Services	42,524
Total general practitioner	*43,966*
Specialists	Nil
Department of Veterans' Affairs	195
Department of Health, Housing Local Government and Community Services	
Total Specialists	*195*
Tests	
Pathology	2,278
Radiology	Nil
Other tests	Nil
Total tests	*2,278*
Total government medical	*46,439*
Medical—private funded	11,692
Total medical services	*58,131*
Allied professional services	
Government and private	585,146
Pharmaceutical costs	
Government and private	1,759
Total direct costs	**1,185,523**
Indirect costs	
Morbidity	
Medical consultation	63,308
Hospitalisation	145,452
Total morbidity	*208,760*
Mortality	70,888
Total indirect costs	**279,648**
Total costs	**1,465,171**

Table 4: *Forgone earnings from tuberculosis, 1989–90*

Age group and sex	PYLL 15–65 discounted @ 5% 1989	Workforce participation rate 1990–91	Average weekly wage November 1989	Forgone earnings ($)
Men				
15–19	0.0	0.53	540.00	0.00
20–24	0.0	0.82	540.00	0.00
25–29	0.0	0.90	540.00	0.00
30–34	0.0	0.90	540.00	0.00
35–39	0.0	0.91	540.00	0.00
40–44	0.0	0.91	540.00	0.00
45–49	0.0	0.87	540.00	0.00
50–54	8.9	0.87	540.00	217,423.00
55–59	12.0	0.71	540.00	239,242.00
60–64	4.6	0.46	540.00	59,417.00
Total				**516,082.00**
Women				
15–19	0.0	0.51	349.30	0.00
20–24	0.0	0.71	349.30	0.00
25–29	0.0	0.62	349.30	0.00
30–34	32.1	0.62	349.30	361,492.00
35–39	0.0	0.68	349.30	0.00
40–44	0.0	0.68	349.30	0.00
45–49	0.0	0.58	349.30	0.00
50–54	0.0	0.58	349.30	0.00
55–59	0.0	0.31	349.30	0.00
60–64	4.6	0.15	349.30	12,533.00
Total				**374,025.00**
Housekeepers				
15–19	0.0	0.32	360.00	0.00
20–24	0.0	0.32	360.00	0.00
25–29	0.0	0.32	360.00	0.00
30–34	32.1	0.32	360.00	192,292.00
35–39	0.0	0.32	360.00	0.00
40–44	0.0	0.32	360.00	0.00
45–49	0.0	0.32	360.00	0.00
50–54	0.0	0.32	360.00	0.00
55–59	0.0	0.32	360.00	0.00
60–64	4.6	0.32	360.00	27,556.00
Total				**219,848.00**
Total				**1,109,955.00**

Table 5: *Forgone earnings from syphilis, 1989–90*

Age group and sex	PYLL 15–65 discounted @ 5% 1989	Work force participation rate 1990–91	Average weekly wage November 1989	Forgone earnings ($)
Men				
15–19	0.00	0.53	540.00	0.00
20–24	0.00	0.82	540.00	0.00
25–29	0.00	0.90	540.00	0.00
30–34	0.00	0.90	540.00	0.00
35–39	0.00	0.91	540.00	0.00
40–44	0.00	0.91	540.00	0.00
45–49	0.00	0.87	540.00	0.00
50–54	0.00	0.87	540.00	0.00
55–59	0.00	0.71	540.00	0.00
60–64	0.00	0.46	540.00	0.00
Total				**0.00**
Women				
15–19	0.00	0.51	349.30	0.00
20–24	0.00	0.71	349.30	0.00
25–29	0.00	0.62	349.30	0.00
30–34	0.00	0.62	349.30	0.00
35–39	0.00	0.68	349.30	0.00
40–44	0.00	0.68	349.30	0.00
45–49	0.00	0.58	349.30	0.00
50–54	0.00	0.58	349.30	0.00
55–59	6.10	0.31	349.30	34,347.00
60–64	0.00	0.15	349.30	0.00
Total				**34,347.00**
Housekeepers				
15–19	0.00	0.32	360.00	0.00
20–24	0.00	0.32	360.00	0.00
25–29	0.00	0.32	360.00	0.00
30–34	0.00	0.32	360.00	0.00
35–39	0.00	0.32	360.00	0.00
40–44	0.00	0.32	360.00	0.00
45–49	0.00	0.32	360.00	0.00
50–54	0.00	0.32	360.00	0.00
55–59	6.10	0.32	360.00	36,541.00
60–64	0.00	0.32	360.0	0.00
Total				**36,541.00**
Total				**70,888.00**

4 Discussion

Limitations

This section outlines some of the more important issues of scope and interpretation for this cost-of-illness study. A more detailed treatment of the current methodology is set out in a companion discussion paper dealing with costs of drug abuse.[37]

The cost estimates presented in this study were based on the most current and reliable Australian data available as at November 1993. As noted earlier, the estimates are part of an ongoing research program in which the methods and data sets are constantly being reviewed, refined and updated. The estimates should be regarded as 'work-in-progress' estimates, and are conservative for a number of reasons. Firstly, the estimates of costs have been restricted to categories of cost for which reasonable data exists to allocate a share to TB or syphilis. The direct costs of community health services, aids and appliances, health promotion and illness prevention, administration, research, ambulance, and repatriation/ psychiatric hospitals, were not measured for this reason resulting in an underestimation of costs. These excluded health expenditure categories represented approximately 18% of the total recurrent expenditure in Australia for all diseases in 1989–90 (i.e. 18% of $27 billion).

Secondly, some of the cost estimates for categories of health expenditure included may be low because of the methodology adopted. For example, hospital analyses of costs focused only upon cases where TB or syphilis was the principal diagnosis. Cases where such diseases were co-morbidities relating to other conditions were not included. This methodology also affected the calculations of nursing home costs, which are based on the principal diagnosis of patients transferring from hospital to nursing homes. The impact on out-of-hospital services is heavily dependent on the Bridges-Webb National Survey of Morbidity and Treatment in General Practice. Little TB, however, is diagnosed and/or managed by general practitioners, but is rather handled by special clinics. Further, the cost of drugs provided under state health systems (apart from hospital inpatients) will not appear under the Pharmaceutical Benefits Schedule and will have been missed.

Thirdly, several known costs are excluded because data are unavailable. No estimates were made for TB or syphilis income losses among the transient (homeless). No attempt is made to value the services of family members and friends who care for individuals with TB or syphilis. This 'informal care' is likely to be significant, especially for the elderly with TB and babies with syphilis, 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 TB or syphilis may not be the state-of-the-art care that could ideally be received. The estimates of direct costs are therefore very conservative and do not reflect all that the nation could be spending on care of individuals with these diseases.

With regard to the syphilis cost estimates, no data were available for costs associated with long-term care in institutions, special education and training required for children who have the disease. These costs can be substantial. Gilbert[12] conservatively estimates lifetime institutional care for one individual to cost $500,000. The estimates compiled in this study therefore represent an underestimate of the annual costs associated with syphilis.

In calculating the 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 a 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, the opportunity cost method, could have been adopted. This values household work in terms of the earnings forgone by devoting time to unpaid production rather than to paid employment, with forgone market wage being the appropriate valuation for time spent on household activities.[38] If this approach had been adopted the mortality cost for housekeepers would have been higher. The methodology used to estimate indirect costs for housekeepers is under review and the estimate provided here should be considered as preliminary only.

A discussion of the costs associated with syphilis and tuberculosis is presented in the following section. Some considerations for policy-makers relating to these estimates and to the cost-effectiveness of treatment and prevention strategies are also considered.

Policy-makers may be tempted to assume that COI studies indicate whether more resources should be devoted to a specific disease. It is important to re-state that they do not. Some may argue that if substantial resources are consumed as a consequence of illness, then more resources should be committed to its treatment. However, the treatment may be inefficient in the first instance, and simply allocating more resources to it encourages inefficiency.[6]

On the other hand, it may be incorrectly assumed that too many resources are being allocated, and that cost savings should be sought, whereas to achieve efficient care, more (or different) treatment may be the answer. These issues can only be addressed by considering the costs and effectiveness of interventions for the disease in question.[8]

Implications

Tuberculosis

Only a few studies have been undertaken on the costs associated with TB. The current analysis found that the total direct and indirect cost was $12.0 million during 1989–90. This represents a per capita expenditure of $0.71.

Trends in the United States indicate an increase in the prevalence of TB, due to the inadequacy of health services, the fact that TB is an opportunistic infection in patients with AIDS, and multi-drug resistant TB. In Australia there has been a negligible decline in incidence up until 1989. However, it is likely that the incidence could increase in the future due to an ageing population, changes in ethnicity and the emergence of AIDS. The total burden to the Australian economy during 1989–90 of approximately $12.0 million is not insignificant, and yet this is a very conservative estimate.

These factors make it imperative that Australian diagnostic and treatment programs be maintained and improved where necessary. In particular, the cost-effectiveness of using isoniazid (INH) prophylaxis for patients with a positive Mantoux skin test who are at risk of TB should be carefully considered in the Australian setting.

Fitzgerald and Gafni[39] have undertaken an extensive analysis of the literature concerning the cost-effectiveness of using isoniazid prophylaxis for patients with a positive Mantoux skin test who are at risk of tuberculosis. Much of the following is based on their findings.

Currently, the established practice is to use isoniazid prophylaxis for patients who have a positive skin test to prevent reactivation of a dormant infection at a later date. However, the major concern with using INH is the risk of hepatitis which in some cases causes death. Therefore, the use of INH for groups with a low risk of reactivation is controversial.[39]

Rose et al.[40] suggest that all patients with a positive Mantoux skin test, irrespective of age, should undergo INH prophylaxis. Other authors support this view. In high risk tuberculin reactors there were net medical care savings through the application of the INH prophylaxis. In low risk reactors, they calculate that it would cost US$12,625 to gain one year of life and US$35,011 to avert one death.[39, 41, 42]

However Snider Jr et al.[43] suggest that prophylaxis is less than ideal because of the high health care costs associated with monitoring for hepatoxic effects, and the difficulty of patient compliance for 12 months. They calculated the cost per case prevented for the 24-week regimen to be US$7,112 and US$16,024 for the 52-week regimen.

They conclude that a regimen of prophylaxis for 24 weeks is more cost-effective than a 12- or 52-week regimen. Although Fitzgerald and Gafni[39] acknowledge that the costing in that study was more comprehensive than others, they suggest that some direct costs such as hospital costs appear low and time lost from work was not taken into account despite the societal perspective adopted. They also question the validity of calculating the cost per QALY as the concept of a QALY being used as a weighted index has been previously questioned by Mehrez and Gafni[44] and Gafni.[45]

Grzybowski's study[25] supports well-applied chemotherapy, citing a study in the Netherlands which shows that 97.8% of skin-test positive patients are cured with chemotherapy.[46]

Schechter et al.[47] assessed the cost-effectiveness of tuberculin screening and administration of isoniazid prophylaxis for those with positive skin test results. They found that screening at 50 years of age is most cost-effective, costing US$41,672 per quality-adjusted life year gained.

Fitzgerald and Gafni[39] conclude that chemoprophylaxis, particularly in 20-year-old patient, is very cost-effective. Costs varied from CDN$8,586 in a 20-year-old patient to CDN$40,102 in a 70-year-old patient per case prevented based on direct costs. They acknowledge a weakness in their data which does not take into account the early high risk of reactivation that occurs after contact. They included both direct and indirect costs per case prevented. The inclusion of indirect costs makes prophylaxis more cost-effective due to the significant prevention of loss of earnings which results from INH prophylaxis.

These authors did not calculate cost of death prevented because these costs would be extremely high due to the low number of deaths caused by TB. They felt that this would be misleading and not support the argument for chemoprophylaxis which is more concerned with decreasing the risk of individuals getting active TB than with preventing deaths. The need to not only prevent deaths from tuberculosis but to reduce the risk of active TB was also emphasised by other authors.

Syphilis

No studies analysed the disease costs associated with syphilis using a prevalence-based methodology. The current study found that total direct and indirect costs in Australia was $1.5 million during 1989–90. This represents per capita expenditure of only $0.10.

Compared to TB, this cost does not appear large. However, in Australia, there is an estimated incidence of 0.02% for active maternal syphilis. Congenital syphilis is a preventable, but serious disease which can lead to neonatal death or substantial long-term institutionalisation of children with syphilis.

Studies conducted in both Australia and overseas support the cost-effectiveness of antenatal screening for syphilis. Further analyses should be undertaken in Australia to determine the adequacy of current screening programs in terms of the population they serve.

Appendix A

Methodology for estimates of direct costs

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 outliers and the length of stay differences between the DRGs and principal diagnosis. The DRG cost weights are based on United States weights, adjusted for differences in average length of stay variations between the United States and New South Wales DRG data. Other adjustments were also made since the average DRG weight was not equal to 1 because DRG weights were derived on different data sets to those used in the study. The general formula used in this hospital costing exercise was developed by Gillett[48] and 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 TB/syphilis in DRG_i

W_i = DRG_i cost weight

Z_i = ICD-9-CM adjustment for DRG_i

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

AvCt = average cost per separation (adjusted for outpatients)

OC = total outlier cost

= f_o * 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 Health Department of Victoria, which was based on the Yale refinement project, and the Australian DRG refinement project at the University of New South Wales.[49]

The average cost per separation for public hospitals includes 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 Government and State and Territory Governments, health insurance funds, workers compensation, and motor vehicle third party insurance. The DRG costs have been adjusted to include the effect of outpatient services (i.e. the average cost per inpatient separation is adjusted downwards to reflect the fact that hospital resources also go to outpatients). Capital has not been included. DRG methodology is under active consideration in Australia (including the development of appropriate DRGs for outpatients and related services) and it is quite likely that the DRG weights will be consistently upgraded for some time to come.

Public hospital morbidity data were available for the Australian Capital Territory, the Northern Territory, New South Wales, Victoria and South Australia. DRG costing was undertaken for each of these States and Territories. Such expenditure for each of the remaining States for syphilis and TB was estimated from the State or Territory with similar hospital servicing per capita (separations per 1,000 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 casemix adjusted hospital expenditure for each disease was calculated by ICD-9-CM three-digit code, age, and sex for Victoria and South Australia. This expenditure in the relevant State or Territory 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 1,000 population.

Private hospital sources of funds covered those outlined above for public hospitals, except State Government. Private hospital morbidity data were available for New South Wales and South Australia. DRG costing was undertaken for these States. Expenditure in the remaining States or Territories 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 1,000 population and average length of stay. Per capita casemix adjusted expenditure by ICD-9-CM three-digit code, age and sex were applied to the population structure of the 'estimated' State or Territory. Adjustments were made for interstate differences in the cost structure by applying a ratio of the two States' cost per occupied bed day for total non-capital costs.[49]

Nursing homes

Estimates of nursing home costs were based on the diagnosis, age, sex and patterns of use (bed-day) for patients who transfer from hospitals to nursing homes. The analysis assumes that the patterns of bed-day use 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.

This is a very questionable assumption, but unfortunately better data classifying nursing home patients by disease category are not available. Attribution of nursing home expenditure to disease categories is an issue that requires further consideration. It may well be, for example, that specification of principal diagnosis for some nursing home patients is simply not possible and probably not appropriate. In the current application, total bed-days for syphilis and TB patients transferring from public and private hospitals in each State were compiled by age and sex. 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 or Territory that transferred into nursing homes.

In States or Territories where there were no private hospital data, the percentage distribution was based on the public hospital transfers only. For States or Territories 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 1,000 population) for the disease of interest.

Total number of nursing home bed-days for 1989–90 was obtained for each State. The 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. There is no adjustment in the current methodology for the resource intensity of each nursing home bed-day, analogous to the hospital inpatient DRG weights. 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 components (payments by individuals, workers compensation, and motor vehicle third party insurance funds) and public components of expenditure (Commonwealth Government, State and Territory 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.(49)

National survey—medical, pharmaceutical and allied professional services

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

The data covers general practitioners, 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. A total of 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 three), problems/diagnoses managed at encounter (up to four), drugs prescribed/other treatments (up to four per problem), tests and investigations, admissions, referrals (up to two), and follow-up.(50)

(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 were coded using the International Classification of Process in Primary Care (IC-Process-PC). A drug classification (compatible with MIMS and with IC-Process-PC) developed by the Family Medicine Department at the University of Sydney was applied to the drugs prescribed.(50)

The ICPC has a biaxial 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 ICD-9 and with other ICD-9 derived systems being used in primary care. A conversion from ICPC to ICD-9 has been undertaken by Lamberts and Wood.(51) Where possible, the three-digit main ICD-9 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 ICD-9 codes. In some cases, the ICD-9 code is more specific than the ICPC code; in other cases the ICD-9 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 and Territory. New South Wales had the highest drop-out rate, yielding only 88.08% of 3.5% to produce a 3.08% sample. Weighting factors for each State and Territory were applied to bring them in line with New South Wales, thereby producing a 3.08% national sample.[50] The methodology used in the costing exercise is outlined below and was developed by Antioch.[49]

Calculation of public medical expenditure

(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, these data require adjustment because more than one diagnosis may be covered in each patient 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.

$$APM_d = \frac{TPM_d}{TE_d}$$

where:

APM_d = average number of problems managed per encounter for disease of interest

TPM_d = total problems (or diagnoses) managed at encounters where the 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:

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

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 use in each age sex cell that is attributable to the disease of interest. Age groupings are ten-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 use 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.

Matrix defined by PTU_{ijd} above was applied to out of hospital medical services provided by by general practitioners as recorded by the Department of Health, Housing, Local Government and Community Services and the 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 were calculated as follows:

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

where:

MB_{cd} = medical GP benefits for Commonwealth department c for disease type d

PTU_{ijd} = proportion of total GP use 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 Commonwealth department c 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 include, 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 (APM_d) was applied. APM_d 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

$$TSS_{xijcd} = \frac{ARS_{xijc}}{APM_{xij}} * S_{xdij}$$

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 of Morbidity and Treatment in General Practice data set).

This was calculated by deriving:

$$ARS_{xijc} = \frac{RS_{xijc}}{APM_d}$$

where:

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

See section on GPs for derivation of APM_d

RSP_{xij} = number of referrals to specialty x, age i, sex j, all diseases (from the National Survey of Morbidity and Treatment in General Practice)

S_{xdij} = number of services for specialty x, Commonwealth department d, age i, sex j.

Step 2

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

$TCSS_{xijcd}$ = total cost of services for specialty x, age i, sex j, for disease type 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 type c for Commonwealth department d (determined in step 1).

Data in Step 2 were summed across all specialities, age and sex groups for the disease of interest for the specified Commonwealth department to derive total specialist costs.[49] 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 underestimating costs for pathology, an adjustment factor was applied based on data shown in a report by Deeble and Lewis.[52] 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 RS_{xijc} and RSP_{xij} were analysed separately for pathology, diagnostic imaging and other.[49]

Calculation of private costs

Private expenditure on medical services was derived from total private expenditure estimates on medical services compiled in Australian Institute of Health and Welfare 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.[49]

Pharmaceuticals

The data on therapeutics were analysed as follows:

$$TC_c = \sum_{j=1}^{N2} \sum_{i=1}^{N1} \frac{BP_{(ijc)}}{BP_{ij}} * TPE_{ij}$$

where:

TC_c = total cost prescriptions listed under the Pharmaceutical Benefits Schedule for disease c

BP_{ijc} = number of benefit prescriptions for disease c, age i and sex j (from the National Survey of Morbidity and Treatment in General Practice)

BP_{ij} = number of benefit prescriptions by age i and sex j for all diseases (from the National Survey of Morbidity and Treatment in General Practice)

TPE_{ij} = total pharmaceutical expenditure for age i and sex j

N1 = number of age group categories

N2 = number of sex categories

Data sources for pharmaceutical study

Total pharmaceutical expenditure by age and sex (TPE_{ij}) was calculated from estimates based on 1985 pharmaceuticals survey data in Wynyard, Burnie and Mount Gambier.

Allied professional services

Expenditure on allied professional services (APS) attributable to the disease of interest for each age/sex group was calculated based on data from the National Survey of Morbidity and Treatment in General Practice data set. The expenditure data for each age/sex group were summed to derive total costs for the disease. This methodology is outlined below.

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

$CAPS_c$ = 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 formula calculates the allied professional services expenditure attributable to a particular age/sex group for all diseases:

$$EAPS_{ij} = \frac{RAPS_{ij}}{RAPS} * TEAPS$$

where:

$EAPS_{ij}$ = allied professional services expenditure attributable to age i, sex j, all diseases.

Appendix B

Methodology for estimates of indirect costs

Indirect costs

Morbidity costs

The methodology outlined below is based on that by Collins and Lapsley.[53] The authors identify three types of absences from work:

(i) absences associated with hospital episodes;

(ii) absences associated with receipt of medical services; and

(iii) absences 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 visit of people in the workforce.[53]

Collins and Lapsley[53] estimate that each hospital bed-day used by a member of the work force involves on average a further absence of two days work and that each medical service supplied to a member of the work force 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. Collins and Lapsley do not provide details on how they calculated the costs. Outlined below is the methodology used by Antioch[49] 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 to apportion an additional two days for recuperation for each bed-day, i.e.:

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

where:

$TCAH_d$ = total cost of absenteeism attributable to hospitisation for disease type d

NBD_{ijd} = number of bed-days in each age group i and sex j for disease type 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 work force involves on average a loss of 0.37 of a day's work, rather than 0.5 of a day suggested by Collins and Lapsley.[53] The former fraction was derived from analyses of the Australian Bureau of Statistics 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 above mentioned WPR_{ij} and $AWPD_{ij}$ were included in the formula as follows:

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

where:

$TCAM_d$ = total cost of absenteeism attributable to medical services for disease type d

NMS_{ijd} = total number of medical services for age group i, sex j and disease type 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.[49]

$$TCA_d = TCAM_d + TCAH_d$$

where TCA_d = total cost of absenteeism attributable to lost productivity from morbidity for hospitalisations and medical services for disease type 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[54] and Crowley et al.[38]

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.[55]

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 work force participation rates and average annual earnings. A discount rate of 5% was used to convert the stream of lifetime costs into present value equivalent.

Market place earnings underestimate the loss resulting from TB and syphilis 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.

There are no accurate statistics on the number of housekeepers in Australia. For the purpose of this paper it is assumed that 32% of the PYLL (potential years of life lost) lost by females in each female cohort between the ages of 15 and 65 is lost by housekeepers. This was based on earlier estimates by Richardson.[54] The average wage rate assigned to housekeepers was assumed to be the wage rate for a paid housekeeper, then $9 per hour ($360 for a 40-hour week). These assumptions were also adopted in the current study. This methodology may underestimate the costs associated with housekeepers.

Appendix C

Cost-of-illness tables for tuberculosis and syphilis showing age/gender disaggregation

Table 6: *Tuberculosis costs for males by age, 1989–90 ($)*

Age/gender	Hospital	Nursing homes	Medical services		Allied professionals	Pharmaceuticals	Total direct costs	Morbidity	Mortality	Total indirect costs	Total costs
			Government	Private							
Male											
0–9	75,922	0	2	0	0	0	75,924	0	0	0	75,924
10–19	88,016	0	2	0	0	0	88,018	31,476	0	31,476	119,494
20–29	377,487	0	49,413	12,442	0	0	439,342	426,830	0	426,830	866,172
30–39	445,520	0	68	17	0	0	445,605	345,015	0	345,015	790,620
40–49	522,864	0	9,244	2,328	0	0	534,436	403,730	0	403,730	938,166
50–59	490,244	116,588	6,896	1,736	0	0	615,464	386,096	456,665	842,761	1,458,225
60–69	627,289	406,706	221,962	55,887	0	65,443	1,337,287	194,338	59,417	253,755	1,631,042
70–79	376,929	0	45,738	11,516	0	0	434,183	0	0	0	434,183
80+	342,276	836,159	881	222	0	0	1,179,538	0	0	0	1,179,538
Total	**3,346,547**	**1,359,453**	**334,206**	**84,148**	**0**	**65,443**	**5,189,797**	**1,787,485**	**516,082**	**2,303,567**	**7,493,364**

Table 7: *Tuberculosis costs for females by age, 1989–90 ($)*

Age/gender	Hospital	Nursing homes	Medical services		Allied professionals	Pharmaceuticals	Total direct costs	Morbidity	Mortality	Total indirect costs	Total costs
			Government	Private							
Female											
0–9	107,461	0	1	0	0	0	107,462	0	0	0	107,462
10–19	122,387	0	2	1	0	0	122,390	25,671	0	25,671	148,061
20–29	541,387	0	50,729	12,773	0	0	604,889	195,679	0	195,679	800,568
30–39	414,272	0	14	3	0	0	414,289	162,419	553,784	716,203	1,130,492
40–49	263,249	0	45,094	11,354	127,282	21,359	468,338	159,004	0	159,004	627,342
50–59	184,579	0	1,417	357	0	0	186,353	99,258	0	99,258	285,611
60–69	588,917	0	33,761	8,501	0	73,558	704,737	94,150	40,089	134,239	838,976
70–79	496,817	0	74,878	18,853	0	0	590,548	0	0	0	590,548
80+	189,561	0	979	247	0	0	190,787	0	0	0	190,787
Total	**2,908,630**	**0**	**206,875**	**52,089**	**127,282**	**94,917**	**3,389,793**	**736,181**	**593,873**	**1,330,054**	**4,719,847**

Table 8: *Tuberculosis costs for persons by age, 1989–90 ($)*

Age/gender	Hospital	Nursing homes	Medical services: Government	Medical services: Private	Allied professionals	Pharmaceuticals	Total direct costs	Morbidity	Mortality	Total indirect costs	Total costs
Person											
0–9	183,383	0	3	0	0	0	183,386	0	0	0	183,386
10–19	210,403	0	4	1	0	0	210,408	57,147	0	57,147	267,555
20–29	918,874	0	100,142	25,215	0	0	1,044,231	622,509	0	622,509	1,655,740
30–39	859,792	0	82	20	0	0	859,894	507,434	553,784	1,061,218	1,921,112
40–49	786,113	0	54,338	13,682	127,282	21,359	1,002,774	562,734	0	562,734	1,565,508
50–59	674,823	116,588	8,313	2,093	0	0	801,817	485,354	456,665	942,019	1,743,836
60–69	1,216,206	406,706	255,723	64,388	0	139,001	2,082,024	288,488	99,506	387,994	2,470,018
70–79	873,746	0	120,616	30,369	0	0	1,024,731	0	0	0	1,024,731
80+	531,837	836,159	1,860	469	0	0	1,370,325	0	0	0	1,370,325
Total	**6,225,177**	**1,359,453**	**541,081**	**136,237**	**127,282**	**160,360**	**8,579,590**	**2,523,666**	**1,109,955**	**3,663,621**	**12,213,211**

Table 9: *Syphilis costs for males by age, 1989–90 ($)*

Age/gender	Hospital	Nursing homes	Medical services: Government	Medical services: Private	Allied professionals	Pharmaceuticals	Total direct costs	Morbidity	Mortality	Total indirect costs	Total costs
Male											
0–9	1,074	0	0	0	0	0	1,074	0	0	0	1,074
10–19	0	0	0	0	0	0	0	0	0	0	0
20–29	70,056	0	0	0	0	0	70,056	18,135	0	18,135	88,191
30–39	22,157	0	3,349	843	0	1,759	28,108	16,204	0	16,204	44,312
40–49	23,394	0	32,310	8,135	585,146	0	648,985	67,374	0	67,374	716,359
50–59	12,227	0	2	1	0	0	12,230	24,004	0	24,004	36,234
60–69	30,047	0	74	19	0	0	30,140	14,343	0	14,343	44,483
70–79	6,374	0	53	13	0	0	6,440	0	0	0	6,440
80+	9,139	0	10,596	2,668	0	0	22,403	0	0	0	22,403
Total	**174,468**	**0**	**46,384**	**11,679**	**585,146**	**1,759**	**819,436**	**140,060**	**0**	**140,060**	**959,496**

Table 10: *Syphilis costs for females by age, 1989–90 ($)*

Age/gender	Hospital	Nursing homes	Medical services: Government	Medical services: Private	Allied professionals	Pharmaceuticals	Total direct costs	Morbidity	Mortality	Total indirect costs	Total costs
Female											
0–9	11,823	0	0	0	0	0	11,823	0	0	0	11,823
10–19	50,723	0	0	0	0	0	50,723	2,646	0	2,646	53,369
20–29	134,927	0	0	0	0	0	134,927	27,966	0	27,966	162,893
30–39	43,003	0	0	0	0	0	43,003	3,077	0	3,077	46,080
40–49	19,981	0	0	0	0	0	19,981	4,338	0	4,338	24,319
50–59	46,081	0	3	1	0	0	46,085	28,451	70,888	99,339	145,424
60–69	35,105	0	21	5	0	0	35,131	2,222	0	2,222	37,353
70–79	22,409	0	21	5	0	0	22,435	0	0	0	22,435
80+	1,967	0	10	2	0	0	1,979	0	0	0	1,979
Total	**366,019**	**0**	**55**	**13**	**0**	**0**	**366,087**	**68,700**	**70,888**	**139,588**	**505,675**

Table 11: *Syphilis costs for persons by age, 1989–90 ($)*

Age/gender	Hospital	Nursing homes	Medical services: Government	Medical services: Private	Allied professionals	Pharmaceuticals	Total direct costs	Morbidity	Mortality	Total indirect costs	Total costs
Person							0			0	0
0–9	12,897	0	0	0	0	0	12,897	0	0	0	12,897
10–19	50,723	0	0	0	0	0	50,723	2,646	0	2,646	53,369
20–29	204,983	0	0	0	0	0	204,983	46,101	0	46,101	251,084
30–39	65,160	0	3,349	843	0	1,759	71,111	19,281	0	19,281	90,392
40–49	43,375	0	32,310	8,135	585,146	0	668,966	71,712	0	71,712	740,678
50–59	58,308	0	5	2	0	0	58,315	52,455	70,888	123,343	181,658
60–69	65,152	0	95	24	0	0	65,271	16,565	0	16,565	81,836
70–79	28,783	0	74	18	0	0	28,875	0	0	0	28,875
80+	11,106	0	10,606	2,670	0	0	24,382	0	0	0	24,382
Total	**540,487**	**0**	**46,439**	**11,692**	**585,146**	**1,759**	**1,185,523**	**208,760**	**70,888**	**279,648**	**1,465,171**

Appendix D

Department of Veterans' Affairs—specialist use and costs

The specialist use and cost data provided by the Department of Veterans' Affairs is not disaggregated by age and sex. An alternative methodology to that currently used to analyse Department of Health, Housing and Community Services (DHHCS) data has been developed to analyse the Department of Veterans' Affairs data.

The National Survey of Morbidity and Treatment in General Practice 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 (APM_d) was applied to the analysis. APM_d 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 Department of Veterans' Affairs data are outlined below.

$$ESCD_{cd} = \frac{ATSC_c}{TSCA} * TSC_d * ACSC_d$$

where:

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

$ATSC_c$ = adjusted total specialist consultations for disease c (from the National Survey of Morbidity and Treatment in General Practice)

where:

$$ATSC_c = \frac{TRS_c}{APM_d}$$

TRS_c = total referrals to specialists, disease c (from the National Survey of Morbidity and Treatment in General Practice)

$$APM_d = \frac{TPM_d}{TE_d}$$

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 of interest handled

TE_d = total GP encounters for disease of interest

TSCA = total specialist consultations all diseases (from the National Survey of Morbidity and Treatment in General Practice)

TSC_d = total specialist consultations for Department of Veterans' Affairs

$ACSC_d$ = average cost per specialist consultation for Department of Veterans' Affairs, calculated by:

$$ACSC_d = \frac{TSBP_d}{TSC_d}$$

where $TSBP_d$ = total specialist benefits paid for Department of Veterans' Affairs

TSC_d = total specialist consultations for Department of Veterans' Affairs.

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