Counting the costs of tobacco and the benefits of reducing smoking prevalence in New South Wales

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Executive summary

This report provides estimates of the social costs of tobacco use in NSW for the financial year 1998/9. It also presents estimates of the value of the social benefits if there were to be a reduction in smoking prevalence in NSW from the 2001 prevalence figure of 18.1 per cent to 13.1 per cent by the end of 2006.

The following table summarises the cost estimates.

Social costs of tobacco abuse in NSW in 1998/9

	$m	**% of total costs**
Tangible	1,782.2	27.1
Intangible (loss of life)	4,794.0	72.9
Total	6,576.2	100.0

The main conclusions of the report can be summarised as follows:

- The total social costs of smoking in NSW in 1998/9 were about $6.6 billion;
- Of these costs, 27.1 per cent were tangible costs and 72.9 per cent were intangible costs;
- NSW bore 31.2 percent of the total Australian social costs of smoking in 1998/9;
- Of the total NSW costs, about 45 percent were avoidable, that is they were costs which were potentially susceptible to reduction as a result of the implementation of appropriate public policies;
- Individuals bore about 58 percent of the total *tangible* costs, businesses bore about 29 percent and governments about 13 percent. Individuals bear 100 percent of *intangible* costs;
- As a result of NSW smoking the 1998/9 Federal budget deteriorated by almost $200 million, that is Federal smoking-attributable expenditures exceeded smoking-attributable revenues by that amount;
- NSW tax revenues from tobacco abuse in 1998/9 exceeded smoking-attributable expenditures in that State by almost $950 million. However, the GST arrangements introduced in 2000 mean that NSW no longer has the power to tax tobacco.

The study also estimates the social benefits which would result from reductions in smoking prevalence in NSW by five percentage points over five years. It presents estimates calculated on the “most conservative” and “most plausible” bases.

The social benefits of smoking prevalence reductions of five percentage points in NSW

Basis of estimation	Present value of benefits $m.	Present value of benefits per smoker $
Most conservative	2,366.0	9,046
Most plausible	5,835.5	22,311

Under the most conservative method of estimation, the present value in the year 2001/2 of the social benefits of the reduction in smoking prevalence would be $2,366 million. This represents $9,046 for each person prevented from smoking by the anti-smoking interventions. These figures represent the present value of the benefits accruing over the whole of an assumed twenty year period, not the benefits which would accrue in the year 2001/2. The estimated benefits are much higher if the most plausible basis for calculation is adopted.

It is the view of the authors that, to avoid any possibility of overstatement of the "true" costs and benefits, the estimates calculated on the most conservative basis should be adopted for the purposes of policy discussion. The fact that there were various categories of smoking-attributable social costs which were not able to be calculated supports the belief that the estimates presented in this paper are, in fact, underestimates.

It is useful to compare the benefits of anti-smoking programs with the benefits available to other public health programs in Australia. The following table compares estimates by the present authors and by other researchers of the benefit/cost ratios accruing to various public health initiatives in Australia.

Comparison of estimated returns on investment in various areas of public health in Australia

Program to reduce:	Benefit/cost ratio
Coronary heart disease	11.5
HIV/AIDS	5.2
Measles	167.7
Hib disease	1.1
Road trauma	1.8
Tobacco consumption (Victoria)	15.8
Tobacco consumption (Australia)	49.0

To summarise, the present study demonstrates that there are potentially very high social benefits to be gained from effective anti-smoking programs. Other studies indicate that such anti-smoking programs yield very high rates of return compared with many other public health programs. There are few other areas of public health expenditure, or indeed of public expenditure generally which would be likely to yield such a high rate of return. Such rates of return would also be considered high in the private sector.

Acknowledgments

We wish to thank Dr John Sanders, Manager of the Tobacco and Health Branch of the NSW Health Department, who willingly provided us with information and assistance throughout our work on this project. We also wish to thank Mark Cooper-Stanbury of the Australian Institute of Health and Welfare for his assistance with information on smoking prevalence.

This study draws heavily on analysis contained in our 1998/9 Australian estimates and so we must also thank the people acknowledged in that report for their indirect contribution to the present work.

Significant contributions to the methodological analysis and data development have been made by

- Professor John Pollard of Macquarie University, whose demographic estimates are presented as Appendix A;
- Dr James Codde of the Western Australian Department of Health, who provided us with invaluable epidemiological assistance.

We continue to draw on the epidemiological work of Holman, Armstrong *et al*, English, Holman *et al* and now that of Ridolfo and Stevenson, without all of whose painstaking calculation of aetiological fractions it would not be possible to undertake this study.

We are greatly indebted to all who assisted us. If errors and omissions remain, despite all the information and assistance provided, they are entirely our responsibility.

1. Introduction

Tobacco prevalence in NSW has fallen from 36 per cent in 1984 to 18.1 per cent in 2001 (Australian Institute of Health and Welfare, 2002a) This reduction has been as a result of a number of different factors, including programs and interventions at State and Commonwealth levels, by governments and non-government organizations. These interventions have included higher taxation, an increased regulatory environment, health promotion activities and access to cessation therapies. While all States have recorded downward trends in tobacco consumption, the experience and rate of reduction in smoking have varied, as have resources used to achieve these reductions.

It has been acknowledged that certain economic measures have been effective in tobacco control. Economic policies combine with public health, health promotion and regulatory measures to reduce tobacco consumption. The identification of costs has been one contribution to tobacco policy formulation.

This study estimates the social costs of tobacco use which were borne in NSW in the financial year 1998/9. It follows on from previous studies of the social costs of tobacco in Victoria and Western Australia (Collins and Lapsley, 1999, 2001 and 2004) which represented the first estimates in Australia of smoking costs borne at the State level. It also presents estimates of the value of the benefits which would result in the future from reductions in the prevalence of smoking in NSW.

In 2002 the present authors produced new estimates of the social costs of tobacco for Australia as a whole, for the financial year 1998/9 and on a more comprehensive basis than previously attempted (Collins and Lapsley, 2002). For the first time it was possible to produce estimates of the costs of involuntary (that is, passive) smoking, and of tobacco-attributable absenteeism, fires and pharmaceutical use. In the present report this improved estimation methodology is applied at the State level.

This study uses estimation methodology developed in a number of earlier pieces of research by the present authors (Collins and Lapsley, 1991, 1996, 1999, 2001, 2002 and 2004). Three of the earlier works estimated the nationally-borne social costs of three categories of drugs - tobacco, alcohol and illicit drugs - while the 1999, 2001 and 2004 papers estimated the costs borne in Victoria and Western Australia of tobacco alone. The methodology used in the present report is essentially the same as that used in Collins and Lapsley (2002). It has been accepted by researchers attending international conferences on the estimation of the social costs of substance abuse and by the World Health Organisation (see Single *et al*, 2003).

The research methodology of this work has been extensively explained in the three earlier Australian studies. We present in Section 2 a broad summary of this methodology, particularly in relation to the estimation of State costs, even though the latter were dealt with in a very similar fashion in the earlier Western Australian and Victorian studies. This is done in order that the present study can stand on its own. Section 3 explains in

more detail the estimation of four categories of costs which can now be calculated at the State level. These two sections together should be sufficient to provide the reader with a general understanding of the research process and with the ability to interpret the cost results. Readers seeking more detailed elucidation should consult the three earlier national studies.

In the remainder of this report, estimates of some of the individual social costs of smoking in NSW are presented in Section 4, with the aggregate results appearing in Section 5. Section 6 discusses methodological issues involved in estimating the benefits likely to arise from a reduction in the prevalence of smoking in NSW and the results of this research are presented in Section 7. Section 8 draws together some conclusions from this paper.

2. Estimating the costs of tobacco abuse in NSW

This section provides a summary of the issues involved in estimating the social costs of tobacco consumption. It reproduces in large part the methodological discussion of the previous Western Australian and Victorian papers. For a more comprehensive treatment of the issues see Collins and Lapsley (1996, chapters 2 and 3, and 2002, chapters 2 and 3).

The study estimates the social costs of smoking which are *borne by NSW*. This is not the same as the costs of *smoking in NSW* since some of the costs borne by NSW may result from smoking undertaken elsewhere. For example, people living in other States may smoke for many years before moving to NSW, whose health system will then bear the smoking-related illness costs. The reverse process is equally true, for example as a result of smokers, having lived their working life in NSW, moving to other States as their health-related smoking costs rise.

In order to be able to produce estimates of the social costs of smoking it is necessary to identify two types of information, relating to:

- causality; and
- costs.

Causality

Information on causality is in large part epidemiological- identifying and quantifying the causal relationships between tobacco consumption, on the one hand, and mortality and morbidity, on the other. This causal information is, however, not confined to epidemiology. For example, the relationship between tobacco use and workplace productivity is a matter for several related disciplines, including industrial relations.

The quantification of tobacco costs relies upon the prior quantification of the causal relationships discussed above. Where causal relationships can be identified and quantified, the costs of smoking can almost always be estimated (although with varying degrees of accuracy).

The pioneering Australian work on the estimation of attributable fractions for tobacco, alcohol and illicit drugs was undertaken by Holman, Armstrong *et al* (1990) at the University of Western Australia. They estimated smoking attribution factors for all conditions for which it was possible to identify quantifiable causal relationships with smoking. The University of Western Australia also provided a team which produced a second comprehensive study on this topic (English, Holman *et al*,1995). Their work was more recently updated by researchers at the Australian Institute of Health and Welfare (Ridolfo and Stevenson, 2001).

Table 1 below presents a listing of all the causes of mortality and morbidity which these studies identify as being causally associated with the consumption of tobacco.

Table 1, Mortality and morbidity causally associated with the consumption of tobacco

Oropharyngeal cancer	Oesophageal cancer	Stomach cancer
Anal cancer	Pancreatic cancer	Laryngeal cancer
Lung cancer	Endometrial cancer	Cervical cancer
Vulvar cancer	Penile cancer	Bladder cancer
Renal parenchymal cancer	Renal pelvic cancer	Respiratory carcinoma *in situ*
Tobacco abuse	Parkinson's disease*	Ischaemic heart disease
Pulmonary circulatory disease	Cardiac dysrhythmias	Heart failure
Stroke	Atherosclerosis	Pneumonia
Peptic ulcer	Chronic obstructive pulmonary disease	Ectopic pregnancy
Crohn's disease	Ulcerative colitis*	Hypertension in pregnancy*
Spontaneous abortion	Antepartum haemorrhage	SIDS (and smoking during pregnancy)
Low birthweight	Premature rupture of membranes	Fire injuries
Asthma (under 15 years)	Lower respiratory illness (under 18 years)	SIDS (and post-natal smoking)
Lung cancer (passive)	Ischaemic heart disease (passive)	

* indicates negative association
Source: Ridolfo and Stevenson (2001)

The attributable fractions in relation to tobacco consumption are almost all positive. In other words, there are only very minor protective effects of tobacco consumption. The consumption of tobacco, even at low levels, is damaging to health.

Costs

Once the causal relationships have been established and quantified, the allocation of tangible costs is relatively straightforward. The major types of information used here are:

- National accounts data on consumption, output and income;
- Medical, hospital and nursing home costs and usage data;
- Data on pharmaceuticals usage and costs;
- Data on workforce, wage rates and earnings; and
- Budgetary data on tax revenues and public expenditures.

We consider that the approach adopted by this study confronts more directly than do most other studies the issue of the exact nature of social costs. It can also be argued that the methodology of this study leads to a much more comprehensible concept of cost.

The definition of the costs of tobacco use is very closely related to the definition of the costs of drug abuse used in Collins and Lapsley (2002). It is:

> *The value of the net resources which in a given year are unavailable to the community for consumption or investment purposes as a result of the effects of past and present tobacco consumption, plus the intangible costs imposed by this consumption.*

This definition reflects a distinction between tangible and intangible costs. Tangible costs are costs such as hospital costs which, when reduced, release resources for other uses. When intangible costs, such as pain and suffering, are reduced there is no release of resources. The beneficiaries cannot pass on these benefits to anyone else. Intangible costs are generally much more difficult to value than tangibles because there is no market in intangibles. Labour and capital resources are bought and sold, so that a market price exists. On the other hand, there is no market in pain, suffering and loss of life, with the result that it is more difficult to place a value on them. Intangibles are, however, important costs of tobacco use and they cannot sensibly be ignored by researchers and policymakers.

The above definition of tangible costs relates to the resources *which would have been available* had there been no smoking. This removes the need to consider the alternative uses to which these resources would, or would not, have been put. For example, if the alternative uses were to be specifically considered, the costs of smoking would vary according to the rate of unemployment. If unemployment were high, it could be argued, the costs of smoking would be lower because dead workers would have been either unemployed or replaced by the unemployed and little or no output would have been lost. This approach treats unemployment as a target of public policy rather than simply as a given. Governments and society can make their own decisions about the way they wish to react to the increase in the amount of available productive resources which would result from reduced tobacco consumption.

The total costs of abuse to the community consist of private costs and social costs (the latter are often referred to in the economic literature as “external” costs). If the costs of smoking are knowingly and freely borne by rational smokers, they constitute private costs. If these conditions are not satisfied, smoking costs become social costs. In the conventional terminology, the total costs of smoking to the community as a whole (both smokers and non-smokers) consist of the costs borne by informed and rational smokers (private costs) and the costs borne by the rest of the community (social costs). Thus:

Total costs = private costs + social costs

From the point of view of public policy it is social costs, not private costs, which are relevant. The social costs which smoking imposes on the community are important in determining the appropriate levels of tobacco consumption and in deciding appropriate public policies, for example tobacco tax rates and the resources devoted to smoking education programs. This study estimates the *social* costs of smoking in New South Wales.

Production losses attributable to smoking

Two broad approaches have been adopted to the estimation of the costs of substance use in general, and of tobacco use in particular - the widely adopted "human capital" approach and the more recent "demographic" approach . Both approaches are accepted and supported in the WHO's *International Guidelines for Estimating the Costs of Substance Abuse (Single* et al, 2003). Both relate to the valuation of the loss of production arising from the tobacco-related deaths of otherwise productive members of society. Both approaches compare production and abuse costs in the actual situation with those in a hypothetical alternative situation which would have existed had there been no past or present tobacco use. The difference between the two approaches relates to the way in which the production costs of premature mortality are treated.

The human capital approach is to estimate the value of the worker's future production stream, brought back to present day values by the use of an appropriate discount rate. A thousand dollars received this year is worth more than a thousand dollars received next year (even if there is no inflation) because this year's resources become available for investment purposes a year earlier and so produce interest receipts or profits a year earlier. The use of a discount rate acknowledges this fact and adjusts for the difference between present and future values. Two major issues arise in the human capital approach - how to forecast future production levels and how to choose the appropriate discount rate.

The demographic approach compares the actual population size and structure with the size and structure of a hypothetical alternative non-smoking population. From this comparison the actual and hypothetical outputs are compared to yield the production costs in *that year* of past and present tobacco use. The major problem in this approach is the estimation of the alternative population structure, which is a demographic exercise. One major advantage of the demographic approach is that the need for arbitrary selection of a discount rate is avoided.

The present study adopts the demographic approach for two reasons:

- It avoids the very serious problem of determining an appropriate discount rate; and
- The results of this approach are much easier and more sensible to interpret.

Smoking, through its effects on mortality and morbidity, reduces both the number of people in the paid work force and the productivity of some people remaining in the work force. It also affects the output of people who are not in the paid work force but who are,

nevertheless, contributing to real national output. This unpaid work includes domestic activities, childcare, and volunteer and community work. This study estimates the value of the loss of unpaid work resulting from smoking.

Additional areas of cost estimation

There are some additional cost categories which are now able to be estimated and which are therefore incorporated in this NSW study. As a result of research undertaken for the Collins and Lapsley (2002) national research report, it is now possible to make estimates of the costs of involuntary smoking, tobacco-attributable fires, workplace absenteeism and selected prescribed pharmaceuticals. Details of the methodologies used to estimate these costs are presented in Section 3.

Cost categories not estimated

It is not, with the currently available information, possible to assign values to all of the types of social costs which smoking imposes. The major types of costs which are not estimated in this study are:

- Some prescribed pharmaceuticals consumed outside hospitals and non-prescribed pharmaceutical consumption;
- Domiciliary care and allied health professional services;
- Reduced on-the-job productivity;
- Litter;
- Ambulances; and
- Pain and suffering experienced by smokers and others.

Consumption resources saved

The tangible costs of tobacco use are defined in this study as:

The value of the net resources which in a given year are unavailable to the community for consumption or investment purposes as a result of the effects of past and present tobacco consumption.

Accordingly, a comparison is made between the actual smoking outcome in the year under study and a hypothetical counterfactual situation of no past or present smoking. In the main, smoking reduces the productive resources available to the community as a result of premature mortality, excess morbidity and other effects, such as smoking-attributable fires. There is, however, a mechanism by which smoking can also *release* resources. The premature mortality of smokers means that fewer people have to be fed, clothed and catered for in other ways. In other words, as a result of smoking the community uses fewer consumption resources than it would in a smoking-free world. A

logical implication of the above definition of tangible costs is that these consumption "benefits" must also be accounted for, that is set against the gross costs of smoking. (The same logic applies to the treatment of any health care savings that result from smoking-attributable premature mortality). This "benefit" appears in Table 7 and Table 9 as "Consumption resources saved".

Avoidable costs

This study estimates the social costs of smoking to NSW. It must be emphasised that it would not be possible to implement public policies which would eventually reduce all these social costs to zero. Public policies may be very successful in further reducing the prevalence of smoking but it is not within the current realms of possibility that smoking will disappear completely. Thus, of these total social costs of smoking, a component is *avoidable* with the remainder being *unavoidable*. This study estimates both total and avoidable costs. The method of estimation of avoidable costs is explained in Collins and Lapsley (2002).

Estimates of the total costs of drug abuse comprise both avoidable and unavoidable costs. Unavoidable costs comprise the costs which are currently borne relating to past drug abuse, together with those resulting from the fact that some proportion of the population will continue to abuse drugs. Avoidable costs are those costs which are potentially amenable to public policy initiatives and behavioural changes.

Estimates of the avoidable percentages of mortality and morbidity are made in a comparative study by Armstrong (1990). Armstrong proposes an "Arcadian normal", which is the lowest age-standardised mortality rate for the relevant mortality or morbidity category amongst twenty selected, comparable Western countries. The Arcadian normal is the lowest percentage of preventable morbidity and mortality achieved in any of the chosen countries. An implication of its use is to suggest that no further improvement is possible. This constitutes an extremely conservative assumption. Nevertheless the Arcadian normal is a very useful tool for quantification of the percentage of preventable morbidity and mortality and their associated costs which can be reduced, and ultimately avoided. These estimates of potentially preventable mortality and associated morbidity provide the basis for the economic calculations of avoidable costs in this study.

Some avoidable costs of abuse (for example, injuries in road accidents and fires) result in acute harm, and avoidance would result in both immediate and longer term cost savings. Chronic harm, while avoidable, may be reduced or eliminated only over relatively long lead times. (Collins and Lapsley, 2002).

Thus avoidable cost estimates assume a sufficiently long time period for the effects of past abuse to be totally removed from the system and for any anti-abuse policies to take full effect. In no sense can the whole amount of the estimated avoidable costs presented

here be interpreted to represent potential rapid returns to anti-abuse policies and programs.

In summary, avoidable costs can be interpreted as being those costs which are susceptible to reduction as a result of the implementation of the appropriate public policies. They indicate the benefits potentially available to public policy initiatives.

Costs incidence

Collins and Lapsley (2002) discuss the problems of identifying which sections of the community bear the social costs imposed by tobacco use (individuals, government or business). It is, in practice, possible to estimate only the impact incidence of tangible tobacco costs. For example, businesses which face higher production costs as a result of a smoking-attributable decline in productivity might pass on some or all of these tangible cost increases to their customers by charging higher prices. This type of reaction is referred to as cost-shifting. No attempt has been made to estimate any shifting behaviour adopted in response to the initial impact of these costs. By their nature, all intangible costs are borne by individuals.

The budgetary impact of smoking

In addition to the imposition which tobacco use places on real resources (such as the labour and capital used in supplying health care services) it also puts pressure on government budgets, as a result of the need to fund public expenditures on these types of services. However, the consumption of tobacco also produces government revenue, at the Federal level through customs and excise duties and, until the disruption caused by the 1997 *Ha and Lim* and *Hammond* High Court decisions, at the State level through franchise fees. These franchises were subsequently replaced, until the advent of the Goods and Services Tax (GST) in July 2000, by Revenue Replacement Payments (RRPs) from the Federal Government to the States.

The implementation of the GST led to a major reform of federal-state financial relations. One important result of this reform was that the States effectively and finally ceded tobacco taxing powers to the Commonwealth. While the States receive some tobacco tax revenue through their share of GST revenues, they now receive no benefit at all from any increase in tobacco excise rates. At the same time, it appears to be impossible in practice for the States to achieve an increase in the GST rate. Thus the States have lost access to a tax which was both an important source of revenue growth and an important tool of anti-smoking policy. The estimated impact of smoking on the 1998/9 NSW budget presented here represents, therefore, a historical record of what happened in that year rather than an indication of the current 2005 budgetary impact of smoking.

On the outlay side of the government budget, there will clearly be increased expenditures attributable to tobacco use but there will also be some attributable reductions. In

particular, the premature mortality resulting from tobacco consumption will lead to some reduction in health expenditures. These "benefits", as well as the costs, are estimated in this study.

On the revenue side, in addition to the evident gains there will also be losses in revenue. For example, premature mortality will lead to reduced output, incomes and consumption and so there will be reductions in revenue from income tax and indirect taxes. This analysis does not, however, include the relatively minor effects on revenues from corporate taxes such as company income tax, fringe benefits tax and payroll tax, for the reasons explained in Collins and Lapsley (1996).

The estimation of the budgetary impact of smoking is an exercise subsidiary to that of estimating the tangible and intangible costs of smoking. The latter represent the impact of smoking on the community as a whole. The budgetary impact is largely an indication of the funding impact of smoking on government.

Data requirements

Estimation of the social costs of smoking borne in NSW established substantial additional data requirements. In summary, disaggregated State data were obtained for:

- Mortality;
- Morbidity;
- Hospital occupancy and costs;
- Nursing home occupancy and costs;
- Medicare services;
- Health expenditure and sources of funding;
- Diagnosis related groups (DRG) costs;
- Consumption expenditures;
- Award rates of pay;
- Employee earnings and hours of work;
- Household incomes and wages, salaries and supplements;
- Population size and structure;
- Demographic impact of smoking;
- Income tax and indirect tax revenues;
- Workforce;
- Prices; and
- Smoking program costs.

3. New areas of cost estimation

As indicated earlier, this study (following Collins and Lapsley,2002) estimates areas of smoking-attributable costs which it had not previously been possible to estimate. These areas are involuntary smoking, pharmaceuticals used for treating tobacco-attributable diseases, workplace absenteeism and fires caused by smoking. More detailed explanations are presented here of the calculation of these costs. These explanations follow closely those in Collins and Lapsley (2002) but with extra information about calculation of costs at the State level.

Active and involuntary smoking

This study disaggregates the health-related costs of smoking into active and involuntary components. As Collins and Lapsley (2002) explain, the more usual distinction is between active and passive smoking (sometimes called sidestream smoke or environmental tobacco smoke). However, all three phrases have their limitations in that they appear to indicate that the only mechanism by which smoking affects non-smokers is by the latter's inhalation of tobacco smoke. There are, however, other mechanisms by which smoking can affect non-smokers. As an illustration, pregnant mothers who smoke are likely to impose adverse health effects on their unborn children (for example, through low birthweight or sudden infant death syndrome). Thus the term "involuntary smoking" is to be preferred and is adopted in this study.

To clarify this distinction, medical conditions attributable to active smoking occur as a result of smokers inflicting adverse health effects on themselves. Conditions attributable to involuntary smoking occur when smokers inflict adverse health effects on others (including the unborn).

This study assumes that all smoking-attributable conditions suffered by people aged less than fifteen years reflect involuntary smoking. The grounds for this assumption are that juveniles under the age of 15 either will be non-smokers or will not have smoked for a period of time long enough to have acquired smoking-attributable medical conditions. In relation to ages of 15 and above, costings have been applied only to those conditions specifically identified by Ridolfo and Stevenson (2001) as resulting from passive smoking, which are assumed to reflect involuntary smoking.

Table 2 below lists the conditions assumed by this study as resulting from involuntary smoking.

Table 2, Involuntary smoking-attributable conditions

0-14 years of age	15 years of age and over
Tobacco abuse	Lung cancer (passive)
Antepartum haemorrhage	Ischaemic heart disease (passive)
Hypertension in pregnancy*	
Low birthweight	
Premature rupture of membranes	
SIDS (and smoking during pregnancy)	
Fire injuries	
Asthma (under 15 years)	
Lower respiratory illness (under 18 months)	
SIDS (and post natal smoking)	

* In relation to this condition, there is evidence that smoking has a slight protective effect.

Pharmaceuticals

The estimates presented below relate to the costs of selected pharmaceuticals prescribed for the treatment of tobacco-attributable conditions identified in the Ridolfo and Stevenson (2001), and for which hospital and medical services are provided. This is only a partial calculation since it does not include costs of non-prescribed (across-the-counter) drugs consumed in relation to tobacco-attributable conditions, and it has only costed those included in the highest volume Pharmaceutical Benefits Scheme (PBS) drugs.

An increasing component of treatment and care is provided on a non-inpatient basis, and the estimated costs presented below apply only to pharmaceuticals provided outside the hospital sector. In-patient pharmaceutical costs are incorporated, but not separately identified, in DRG hospital costs.

The estimates of national pharmaceutical costs presented in Collins and Lapsley (2002) are adjusted for the purposes of the NSW calculations by data from Australian Institute of Health and Welfare (2001) on the proportion of total Australian expenditures on benefit paid pharmaceuticals which is expended in NSW.

Fires caused by smoking

There is significant evidence that smoking and its associated activities can cause fires. Quantitative evidence for this assertion in Australia comes from research conducted by the Queensland Fire and Rescue Service, which attributes 1.9 per cent of all fires to smokers' materials (excluding matches and lighters). The QFRS also estimates the value

of property damage caused by fires (although it does not list the value of damage by vegetation-only fires).

Assuming that Queensland fire experience reflects that of the rest of Australia and of the individual States, it is possible to estimate average smoking-attributable property damage for NSW. If it is further assumed that the cost of attendance at a smoking-attributable fire can be represented by the average cost of all attendances, it is also possible to estimate aggregate smoking-attributable fire service costs in NSW.

Australia-wide and NSW data on numbers of fires and expenditures on fire services are derived from the *Report on Government Services 2000* (Steering Committee, 2000, Attachment 10A). In some of its fire service-related calculations for this publication the Productivity Commission appears to have adopted analogous averaging procedures to those adopted here.

Ridolfo and Stevenson (2001) identify separately tobacco-attributable fire injuries, deaths and hospital beddays, from which it is possible to calculate medical, hospital and nursing home costs at the State level. Health costs in this category predominantly reflect the costs of burn injuries caused by fires in bedding and furniture after smokers fall asleep with lighted cigarettes. It also becomes possible to estimate the impact of smoking-attributable fires at the State level on labour output in the workplace and in the home, and on lives lost.

Since fire costs do not include valuation of public property damage, such as national parks loss of animals and of amenity during bush regeneration, they represent conservative estimates of the costs of fires resulting from smoking.

Tobacco-attributable absenteeism

Following Collins and Lapsley (2002), it is now possible at the State level to use a more refined estimation technique for drug-attributable absenteeism. Bush and Wooden (1994 and 1995) studied the impact of smoking and alcohol on absences from the workplace. Their conclusions can be summarised in the following quotations from their 1994 paper:

> *After controlling for the effects of other variables, smokers were found to be 1.4 times more likely to be absent, and ex-smokers to be 1.3 times more likely to be absent than those who have never smoked.*

> *In particular, interaction between smoking status and sex produced probabilities of absence that were different for men and women. For male smokers the probability climbed to 1.7 times greater than those who have never smoked and for female smokers the probability of absence decreased slightly to 1.2 times greater than those who have never smoked.*

These conclusions were applied to Australian Bureau of Statistics (catalogue number 6342.0) surveys of employee absences from work and their causes in two week periods in August 1995, August 1997 and August 2000, the only surveys conducted by the ABS during the relevant period. The data on absences are classified by type of leave taken so that it is possible to disaggregate sick leave from other causes of absences. The estimated fortnightly data for August 1998 are grossed up to annual values by use of Health Insurance Commission data on the numbers of Medicare professional attendances for the month of August and for the full financial year, and are then applied to NSW.

4. Some disaggregated costs

This section provides detailed estimates of the smoking-attributable costs of health care, production losses and fires. The next section provides an overall summary of the social costs of tobacco. This form of presentation is adopted to provide more comprehensive information on these areas of costs than is practicable in the aggregate tables. In the case of the smoking-attributable costs of fires, it is also a means of avoiding a problem of the double counting of some costs. Fire costs include both health costs and productivity losses, for which separate aggregate smoking cost estimates are made. Productivity and health costs cannot be included in both areas without double counting, and yet to exclude them from fire costs would give the impression that the total costs of smoking-attributable fires were lower than they in fact are. This problem is overcome by presenting the overall costs as well as costs "n.e.i." (not elsewhere included) which are the values carried over to the aggregate tables. In this way all double counting is avoided.

Health

Drug-attributable morbidity imposes health care costs for medical services, hospitals, nursing homes and pharmaceuticals. However, the premature deaths caused by drug abuse can relieve the community of some health care cost burdens. Had the prematurely deceased been still alive they would have been placing demands on health care resources, demands which have been avoided as a result of the premature deaths. This paper estimates these health care savings as well as the health care costs.

Table 3 shows the health care costs due to smoking, and the savings in health care costs due to the premature deaths of smokers. The pharmaceutical costs identified here apply to prescribed pharmaceuticals outside the hospital system.

Table 3, Health care costs and savings attributable to smoking, NSW, 1998/9

	Medical $m	Hospitals $m	Nursing homes $m	Pharmaceuticals $m	Total $m
Gross costs	199.5	254.5	259.0	88.2	801.2
Savings from premature deaths	84.0	107.0	112.3	21.1	324.4
Net costs	115.5	147.5	146.7	67.1	476.8

Great care should be taken to interpret correctly this type of information. In no way could it be claimed that, if the health care savings resulting from the premature deaths exceeded the gross health care costs, these deaths would be in the community's interest (as appeared to be the implication of the Arthur D. Little (2001) analysis of the budgetary impact of smoking in the Czech Republic). The community bears other costs as a result

of premature deaths, as is clearly illustrated by later information presented on the other tangible and intangible social costs of smoking.

Table 4 presents estimates of tobacco attributable deaths caused and prevented by smoking. Very few deaths and hospital bed-days are prevented through tobacco consumption. Table 1 shows only three negative attributable fractions, relative to 38 positive attributable fractions, indicating that the protective effects of tobacco are very small relative to the harmful effects.

Table 4, Tobacco-attributable deaths, hospital bed days and hospital costs, caused and prevented, NSW, 1998/9

	Deaths (number)	Hospital bed days (number)	Hospital costs ($m)
Caused	6,951	359,669	257.8
Prevented	91	6,488	3.4
Caused *less* prevented	6,860	353,180	254.5

The following two tables reflect the deaths, bed-days and hospital costs of voluntary and involuntary smoking. Table 5 shows the absolute numbers and Table 6 the relative proportions. These estimates show that the costs of involuntary smoking result largely from involuntary smoking by children and the unborn.

Table 5, Tobacco-attributable deaths, hospital bed days and hospital costs, by age and smoking status, NSW, 1998/9

	Voluntary	Involuntary	Total
Deaths (number)			
0-14	0	35	35
15+	6,782	43	6,825
Total	6,782	78	6,860
Hospital bed days (number)			
0-14	0	24,471	24,471
15+	327,755	954	328,709
Total	327,755	25,425	353,180
Hospital costs ($m)			
0-14	0.0	15.2	15.2
15+	238.4	0.9	239.3
Total	238.4	16.1	254.5

Table 6, Proportions of tobacco-attributable deaths, hospital bed days and hospital costs, by age and smoking status, NSW, 1998/9

	Voluntary	Involuntary	Total
Deaths			
0-14	0.0%	44.3%	0.5%
15+	100.0%	55.7%	99.5%
Total	100.0%	100.0%	100.0%
Hospital bed days			
0-14	0.0%	96.2%	6.9%
15+	100.0%	3.8%	93.1%
Total	100.0%	100.0%	100.0%
Hospital costs			
0-14	0.0%	94.5%	6.0%
15+	100.0%	5.5%	94.0%
Total	100.0%	100.0%	100.0%

94 per cent of all hospital costs arising from involuntary smoking are attributable to patients in the 0-14 age group.

Productivity

Table 7 presents estimates of the loss of productivity in NSW which is caused by smoking. These losses are estimated for the paid workforce and also within the household sector. As with the preceding cost estimates, these are net estimates, and show the amount of resources which would have been available if there had been no tobacco-attributable productivity losses.

Table 7, Paid and unpaid production costs of smoking, NSW, 1998/9

	Male $m	Female $m	Total $m
Labour in the workforce			
Reduction in the workforce	376.8	130.9	507.7
Absenteeism	128.2	22.7	150.9
Total paid production costs	505.0	153.6	658.6
Labour in the household			
Premature death	1,259.8	839.3	2,099.1
Sickness	96.9	30.5	127.4
Total unpaid production costs	1,356.7	869.8	2,226.5
Total paid and unpaid production costs	1,861.7	1,023.4	2,885.1
Consumption resources saved	1,497.0	668.7	2,165.7
Total net production costs	364.7	354.7	719.4

The item "Consumption resources saved" is explained in Section 2 above.

The value of the total gross productivity loss in NSW in 1998/9, in both the workforce and the household sector, is estimated to be almost $2,890m.

Fires

Table 8 provides estimates of the costs of smoking-attributable fires in NSW. Total costs are estimated to be $27.3m. with tangible costs representing about two thirds of total costs.

Table 8, Costs of smoking-attributable fires, NSW, 1998/9

	$m	$m
Health		
Medical	0.224	
Hospital	1.143	
Total health		1.367
Labour		
In the workforce	4.233	
In the household	2.851	
Total labour		7.083
Fire services		7.176
Property damage		1.877
Total tangible costs		17.503
Value of loss of life	9.799	
Total intangible costs		9.799
Total costs		27.303
Total tangible n.e.i.		9.053
Relevant costs as per cent of GSP		0.008%

5. Aggregate results

This section presents a series of tables providing a range of aggregate tobacco-attributable cost estimates, including tangible and intangible costs, avoidable and unavoidable costs, the incidence of total costs, their budgetary impact at both Federal and State levels, and a comparison of selected attributable costs in NSW with NSW state output, as measured by gross state product.

Tangible costs

The tangible social costs of smoking presented in Table 9 are estimated at $1,782m., the largest component of which reflects the reduction in production due to premature deaths.

Table 9, Tangible social costs of smoking, NSW, 1998/9

	$m	**$m**
Labour in the workforce		
Reduction in workforce	507.7	
Absenteeism	150.9	
Total workforce labour		658.6
Labour in the household		
Premature death	2,099.1	
Sickness	127.4	
Total household labour		2,226.5
Total labour		2,885.1
***Less* consumption resources saved**		2,165.7
Total net labour costs		719.4
Health care (net)		
Medical	115.5	
Hospital	147.5	
Nursing homes	146.7	
Pharmaceuticals	67.1	
Total health care		476.8
Fires n.e.i.		9.1
Resources used in abusive consumption		577.0
Total		1,782.2

Intangible costs

Intangible costs arise from loss of life and from pain and suffering. The only intangible cost which it proved possible to estimate in this study was loss of life. The value of loss of life in NSW in 1998/9 is estimated to have been $4,794m.

Total costs

Table 10 combines estimates of tangible and intangible costs, showing that valuation of loss of life is the largest component of total costs. Since it has not been possible to calculate intangible costs associated with morbidity, this estimate is considered to be very conservative.

Table 10, Total social costs of smoking, NSW, 1998/9

	$m	**% of total costs**
Tangible	1,782.2	27.1
Intangible (loss of life)	4,794.0	72.9
Total	6,576.2	100.0

Table 11 compares estimates of smoking-attributable costs in 1998/9 in NSW and at the national level. NSW costs represented 31.2 per cent of aggregate Australian costs.

Table 11, Comparison of smoking-attributable social costs in NSW and Australia, 1998/9

	NSW **$m**	**Australia** **$m**	**NSW as percentage of Australia** **%**
Tangible	1,782.2	7,586.7	23.5
Intangible	4,794.0	13,476.3	35.6
Total	6,576.2	21,063.0	31.2

Source of Australian data: Collins and Lapsley (2002, Table 27).

Avoidable costs

The following two tables present estimates of the proportions of the social costs of smoking in NSW which would be avoidable, given the implementation of effective public policies, As already discussed, it is important to recognise that some of the social costs will necessarily still be incurred, because of the ongoing effects of past smoking, and because not all smoking will stop, no matter what policies are introduced. The method of calculating avoidable costs is described in more detail in Section2 above.

Table 12, Avoidable tangible social costs of smoking, NSW, 1998/9

	$m	$m
Labour in the workforce		
Reduction in workforce	230.9	
Absenteeism	63.0	
Total workforce labour		293.8
Labour in the household		
Premature death	954.6	
Sickness	53.1	
Total household labour		1,007.7
Total labour		1,301.6
***Less* consumption resources saved**		984.9
Total net labour costs		316.7
Health care (net)		
Medical	47.3	
Hospital	63.8	
Nursing homes	60.1	
Pharmaceuticals	33.9	
Total health care		205.1
Fires n.e.i.		5.8
Resources used in abusive consumption		262.4
Total avoidable tangible costs		790.0
Total tangible costs (see Table 9)		1782.2
Avoidable costs as a percentage of total costs		44.3%

Table 13, Avoidable total social costs of smoking, NSW, 1998/9

	$m
Tangible	790.0
Intangible (loss of life)	2,180.1
Total avoidable costs	2,970.1
Total costs (see Table 10)	6,576.2
Avoidable costs as a percentage of total costs	45.2%

Approximately 45 per cent of total smoking costs in NSW in 1998/9 are estimated to have been avoidable.

Who bears the social costs of tobacco?

Table 14 illustrates the distribution of tangible tobacco costs. showing that in NSW in 1998/9, individuals bore about 58% of total tangible costs. In that year, businesses bore about 29% and governments approximately 13%. It is not widely recognised that such a

large proportion of the social costs of smoking are labour costs, most of which are borne by business. By their nature, all intangible costs are borne by individuals.

Table 14, Incidence of the tangible social costs of smoking, NSW, 1998/9

	Individuals $m	Business $m	Government $m	Total $m
Workforce labour	0.0	539.4	119.2	658.6
Household labour	2,226.5	0.0	0.0	2,226.5
Hospitals	3.7	22.2	121.6	147.5
Medical	11.8	8.1	95.6	115.5
Nursing homes	25.9	0.3	120.5	146.7
Pharmaceuticals	12.9	0.0	54.2	67.1
Fires n.e.i.	0.9	6.2	1.9	9.1
Resources used in abusive consumption	0.0	577.0	0.0	577.0
Total quantified tangible costs	2,281.8	1,153.2	513.0	3,948.0
Percentage of total quantified costs	57.8%	29.2%	13.0%	100.0%

Budgetary impact

The following three tables indicate the impact of smoking in NSW on Federal Government and NSW Government budgets.

Table 15, Impact of NSW smoking on the Federal budget, 1998/9

Outlays	$m	$m	Receipts	$m	$m
Health			Excise tax	566.6	
Hospital	58.7		Customs duty	88.4	
Medical	95.6		**Total tobacco revenue**		655.0
Nursing homes	113.5		***Less***		
Pharmaceuticals	54.2		**Revenue forgone**		
Total health		322.0	Income tax	106.9	
Fires n.e.i.		0.0	Indirect taxes	419.9	
			Total revenue forgone		526.7
Total outlays		322.0	**Total net revenue**		128.3
Net revenue minus outlays		-193.7			

Table 16, Impact of NSW smoking on the NSW State budget, 1998/9

Outlays	$m	$m	Receipts	$m
Health			**RRPs**	1013.8
Hospital	62.9			
Medical	0.0		**Total tobacco revenue**	1013.8
Nursing homes	7.0			
Pharmaceuticals	0.0			
Total health		69.9		
Fires n.e.i.		1.9		
Total outlays		71.8	**Total revenue**	1013.8
Revenue minus outlays	942.0			

Table 17, Total impact of NSW smoking on NSW and Federal budgets combined, 1998/9

Outlays	$m	$m	Receipts	$m	$m
Health					
Hospitals	121.6		Excise tax (incl. RRPs)	1,580.4	
Medical	95.6		Customs duty	88.4	
Nursing homes	120.5		**Total tobacco revenue**		1,668.8
Pharmaceuticals	54.2		***Less***		
Total health		391.9	**Revenue forgone**		
Fires n.e.i.		1.9	Income tax	106.9	
			Indirect taxes	419.9	
			Total revenue forgone		526.7
Total outlays		393.8	**Total net revenue**		1,142.1
Net revenue minus outlays		748.3			

RRPs are Revenue Replacement Payments. When the abandonment of State tobacco franchises was forced by High Court decisions in 1997, the Federal Government replaced these franchises with higher levels of tobacco excise, passing on the increased revenue to the States in the form of RRPs.

As a result of NSW smoking, the Federal budget deteriorated in 1998/9 by almost $200m., that is Federal smoking-attributable expenditures exceeded smoking-attributable revenues by that amount. On the other hand, NSW tobacco tax revenues exceed smoking-attributable expenditures in that State by $942m.

As pointed out earlier, while these estimates apply to 1998/9, it should be recognised that the new Federal-State financial arrangements resulting from the introduction of the Goods and Services Tax in July 2000 will have changed these conclusions significantly, since the States no longer have access directly to tobacco tax revenue. The estimated

impact of smoking on the 1998/9 NSW budget presented here represents a historical record of what happened in that year. It does not provide any indication of the current 2005 budgetary impact of smoking.

The above tables exclude State and Federal expenditures on tobacco control activities. It has been argued that these types of expenditures, for example on anti-smoking campaigns and smoking-related research, are the effects of public decisions to reduce smoking rather than the direct effects of cigarette consumption and as such should be excluded from smoking cost estimates. This point has been accepted here for the estimation of smoking-attributable social costs but it is still useful to identify the extent of these types of expenditures. Details of NSW expenditure on tobacco control activities, by both State government and non-government organisations, are presented in Table 18 below.

Table 18, Expenditure on tobacco control activities in NSW, 2002/3

Agency	$
NSW Department of Health Central Budget	3,171,000
NSW Department of Health Area Health Services	2,693,000
Total NSW Department of Health	**5,864,000**
Action on Smoking and Health (ASH)	**130,000**
NSW Cancer Council	**450,000**
National Heart Foundation of Australia	**82,000**
Total	**6,526,000**

Source: information supplied by agencies listed.

Tobacco-attributable costs and Gross State Product

Estimates of aggregate drug-attributable social costs tend to produce numbers which are very large in absolute terms. Commentators often attempt to put these numbers in context by expressing them as a percentage of gross domestic product (GDP), which is a measure of the total value of national production or national income. Similarly, attempts to make international comparisons of the relative sizes of aggregate drug abuse costs in economies of very different sizes (for example, Australia and the USA) tend to be made by comparing aggregate costs expressed as a percentage of GDP.

A problem with this approach is that estimates of drug abuse costs contain certain (sometimes very large) components that are not measured in conventional national account measurements of GDP. In the present study these unmeasured components consist of all intangibles (loss of life) and production losses in the household (unpaid) sector. Thus, when total drug-attributable costs are compared with GDP, like is not being compared with like.

In order to overcome this problem, Table 19 below compares NSW Gross State Product at factor cost (that is, not including taxes and subsidies) with only those components of

drug abuse costs which are conventionally measured in national accounts data. Gross State Product (GSP) is the State equivalent of Gross Domestic Product.

Table 19, Comparison of some smoking-attributable cost categories with NSW Gross State Product, 1998/9

	$m	% of GSP
Labour in the workforce	658.6	0.357
Net health care	476.8	0.258
Fires n.e.i.	9.1	0.005
Resources used in abusive consumption	577.0	0.313
Total	1,721.5	0.932

The relevant components of tobacco-attributable costs represented 0.9 per cent of NSW GSP in 1998/9.

6. Issues in the economic evaluation of reductions in smoking prevalence

It should be emphasised that there is an important distinction between the avoidable and unavoidable costs of tobacco use. Estimates of aggregate social costs exceed the returns potentially available to anti-smoking programs because:

- It would not be feasible to reduce smoking prevalence rates to zero; and
- Even when prevalence rates are reduced, there are significant lead times before the rate reductions fully translate into improved health status for smokers.

Furthermore, as some costs apply to premature mortality, it will not be until many years after the reduction in smoking rates that the population structure fully reflects the prevalence reduction.

Thus, from a public policy viewpoint it is also desirable to know what proportion of aggregate social costs are potentially susceptible to policy interventions. Accordingly, Table 12 and Table 13 above present estimates of avoidable costs of tobacco in NSW. However, the question still arises, from a public policy viewpoint, as to whether the social benefits of a reduction in smoking prevalence would justify the expenditure on the resources necessary to achieve that reduction. To answer that question would require the process of benefit/cost analysis (BCA), which is not attempted in this paper. Theoretical and practical issues of the BCA of anti-smoking programs are discussed in some depth in Collins and Lapsley (1999, Chapter 4) and an economic evaluation of Quit Victoria is presented in Chapter 5 of that publication.

The present study estimates the social benefits (expressed in terms of the reduction of the social costs of smoking) which would arise as a result of a given reduction in smoking prevalence rates in NSW. This study makes no judgment on whether the assumed prevalence reduction is feasible or what mix of public policies would be necessary to achieve such a reduction. It could be used to indicate the extent of public resources which could justifiably be employed on anti-smoking programs, if these programs led to the reduction in prevalence rates considered in this paper.

The results of a possible reduction in smoking prevalence between the financial years 2001/2 and 2006/7 are analysed in this paper. In 2001, smoking prevalence in NSW (as indicated by the percentage of the population aged 14 years and over who smoked on a daily basis) was 18.1 per cent (Australian Institute of Health and Welfare, 2002, Table 2). Benefits are estimated for a reduction in smoking prevalence to 13.1 per cent over the five year period.

Declines in smoking prevalence will lead to reductions in social costs, but the lags involved in this process are complex and difficult to identify. A decline in smoking prevalence may lead to a virtually instant decline in some costs, for example those arising from fire-related deaths, injuries and damage. On the other hand, other types of costs may only be responsive to declines in smoking prevalence with a considerable lag. For

example, reduced smoking prevalence may lead to a decline in lung cancer-related costs only after a period of many years. It appears impossible, on the basis of currently available research, to estimate the relevant average lag period. This study adopts the approach, therefore, of making an educated guess as to the range of values in which the actual lag may lie and to test the sensitivity of the results to the adoption of different lags. All other things being equal, the longer the assumed lag the lower will be the calculated social benefits. Total benefits will be lower and, since they will accrue later in the life of the program, their discounted present value will be less.

The present study, therefore, assumes that a given proportionate reduction in prevalence rates will lead to the same proportionate reduction in social costs after a relevant period. Results are calculated on assumed average lags of six, eight and ten years.

A further complication is that the effects of past tobacco-attributable mortality on the structure of the NSW population will take many years to disappear completely. Thus, the longer the period of study the greater is the proportion of the social costs of tobacco which are potentially avoidable. In this study it is assumed that the population effects of past smoking will only have fully disappeared at the end of a thirty year period.

Estimates of the future benefits of public policy programs could simply be calculated as a time series presenting, on a year-by-year basis, benefits expressed in the values of the relevant years. Such results would have limited significance since it would be virtually impossible to make any comparison between projects which were competing (in the sense that they were alternative ways of achieving the same objective) when the time patterns of benefits differed between the two projects. All other things being equal, the program which yielded its benefits earlier would be the preferable program. This is because program benefits could be reinvested in other projects to yield a further rate of return and the earlier that the benefits accrued the greater would be the reinvestment benefits. If Project A yields comparatively low benefits comparatively early while Project B yields comparatively high benefits comparatively late, simple inspection of the two time series of benefits at current values may not conclusively indicate which project is to be preferred. This type of decision can only be properly made using the technique of discounting.

Discounting reduces the future flow of values to a single figure, the present value expressed in the prices of the chosen year. Present value is calculated by the application of a discount rate to the future value stream. The higher is the discount rate, the lower will be the present value of a given stream of future values. Since there are serious theoretical problems in the choice of an appropriate social discount rate, this study estimates results according to a range of discount rates.

Over what period should the evaluation of reduced smoking prevalence be undertaken? In investment analysis it is usually possible to define the life of the project. However, anti-smoking programs often have no pre-defined lives and it is difficult to predict future public policies towards smoking. Given that the benefits of anti-smoking programs may accrue over many years and that they would certainly continue to accrue for at least some

period of time after the program had ended, the adoption of too short a period of analysis would lead to underestimation of the program benefits. On the other hand, it is extremely difficult to predict future developments in medical technology, and therefore health care costs. Technological improvements may lead to cost reductions, for example as a result of the development of new vaccines, or they may lead to cost increases, for example as a result of the development of more effective but more expensive medical treatments.

The higher is the discount rate, the lower will be the present value of social benefits accruing into the future. For example, one dollar's benefits to be received in thirty years time will have a current value of seventeen cents at a discount rate of six per cent, but only six cents at a discount rate of ten per cent. Given the major uncertainties in forecasting over long periods of time, which have to be balanced against the understatement of benefits implied by the adoption of too short a period of analysis, this paper analyses benefits accruing over twenty and thirty year periods.

In estimating the social benefits of reduced smoking prevalence, comparison must be made with some alternative level of prevalence which is based on the assumption that the maintenance of current policies would lead to the maintenance of current prevalence rates. For the purposes of this study a comparison is made between one situation in which current year 2001/2 prevalence rates are maintained into the future and another in which prevalence is reduced.

An issue arises as to the path which the assumed reduction in the smoking prevalence rate would take in the five year period under analysis. One possibility is that the prevalence rate would fall by an equal absolute amount each year (a linear progression). An alternative assumption would be that suggested by experience in many public health campaigns, that is that the absolute impact on prevalence declines over the life of the campaign. It becomes progressively more difficult to reduce the prevalence rate as a result of delays in reaction by the more resistant sections of the smoking population. This scenario can be represented by a geometric progression. Both scenarios are analysed in this paper, as indicated in
Table 20.

Table 20, Assumed reductions in smoking prevalence rates

Year	Geometric Assumption %	Linear Assumption %
2001/2	18.10	18.10
2002/3	16.97	17.10
2003/4	15.90	16.10
2004/5	14.91	15.10
2005/6	13.98	14.10
2006/7	13.10	13.10

In summary the approach adopted to calculating the benefits of reduced smoking prevalence is as follows:

- Assume that in the absence of anti-smoking campaigns the annual real (that is, adjusted for inflation) social costs of tobacco in NSW in the period of analysis (2001/2-2010/1) would remain the same as in 1998/9, the last year for which actual estimates are available;
- Estimate the proportions of these total costs which are avoidable and unavoidable for each year of the period being analysed;
- Assume that avoidable social costs decline by the same percentage as the percentage decline in smoking prevalence, with assumed lags of six, eight and ten years before the reduction in social costs commences;
- Test the sensitivity of the results to a range of discount rates, assumed lags, periods of analysis and prevalence rate declines.

7. The social benefits of reductions in smoking prevalence in NSW

Section 6 discussed the various methodological issues and problems involved in an economic evaluation of a reduction in smoking prevalence. Given the paucity of relevant research information it is necessary to undertake the evaluation on the basis of the adoption of certain sets of assumptions. Table 21 indicates, for each of the issues identified in Section 6, what we judge to be the "most conservative" approach (in terms of having the effect of reducing the present value of the social benefits of a reduction in smoking prevalence), the "least conservative" approach and the "most plausible" approach (in terms of its approximation, in our judgment, to reality). Thus, in this context, the term "conservative" is used to denote "yielding a comparatively low present value of the benefits of prevalence reduction". "Least conservative" indicates "yielding a comparatively high present value of the benefits of prevalence reduction".

Table 21, Assumptions underlying the evaluation of reduced smoking prevalence

	Reduction in smoking prevalence over nine year period	**Lag between reduction in prevalence and reduction in social costs (years)**	**Period of analysis (years)**	**Discount rate (%)**
Most conservative	Linear	10	20	10
Least conservative	Geometric	6	30	4
Most plausible	Geometric	8	20	6

Table 22 presents estimates of the present value in the financial year 2001/2 of the NSW smoking prevalence reduction of five percentage points over the five year period from 2001/2.These estimates are presented according to the *most conservative, least conservative* and *most plausible* sets of underlying analytical assumptions. The table also presents estimates of the average benefits per smoker.

An assumption of this analysis is that, in the absence of interventions to reduce the rate of smoking prevalence in NSW, the rate would remain at the 2001/2 level of 18.1 per cent. The benefits accruing to effective smoking reduction interventions would result from a reduction of prevalence below the 2001/2 rate. There can be two components in any reduction in prevalence rates:

- Some existing smokers quit smoking; and

- Some smokers who die are not replaced by new non-smokers.

Thus, the term "smoker" here refers both to never-smokers (those who, as a result of the intervention, do not take up smoking) and to ex-smokers (those who, as a result of the intervention, quit smoking).

Table 22, The present value in 2001/2 of the social benefits of the assumed reduction in smoking prevalence in NSW

Assumption set	Present value $m.	Present value per smoker $
Most conservative	2,366.0	9,046
Least conservative	16,221.9	62,023
Most plausible	5,835.5	22,311

These estimates range from $2,366m. to $16,222m. for the five percentage points reduction in the prevalence rate. The present values per smoker, as defined above, range from $9,046 to $62,023. Appendix B presents a testing of the sensitivity of these results to the adoption of a range of estimation assumptions indicated in Table 21 above. In general, we would tend to favour the most conservative analytical basis, and so the most conservative estimates.

These results will be more meaningful if they are placed into a policy context. Assume that public expenditures were required to yield a real social rate of return of at least ten per cent per annum and that the public expenditures were successful in producing the targeted reductions in smoking prevalence. On this basis, and on the most conservative set of assumptions, the achievement of a reduced prevalence rate of 13.1 per cent would justify annual real expenditures of up to $278m. for a 20 year period. Clearly there would be strong economic justification for anti-smoking expenditures, if the funded programs were to be effective, much higher than the actual 2002/3 NSW expenditures of $6.5m. detailed in Table 18.

How do the benefits of anti-smoking programs compare with the benefits available to other public health programs in Australia? The present study was not commissioned to address this question, so it is not possible here to review the costs of effective programs. However, other studies undertaken in Australia (including one undertaken by the present authors) give an indication of the rates of return available to various public health programs, including anti-smoking programs.

Table 23 below provides details of the economic benefits available to a range of programs, including several calculated by Applied Economics for a report published by the Commonwealth Department of Health and Ageing (Applied Economics, 2003). For the purposes of comparison, the best summary indicator in this table of the net program benefits would be the benefit/cost ratio presented in the final column.

Table 23, Comparison of returns on investment in various areas of Public Health

Program to reduce:	Source and period of analysis	Total cost $m	Gross benefit $m	Net benefit $m	Benefit/ cost ratio
Coronary heart disease (Australia)	Applied Economics (2003) 1971-2010 (2000 prices)	810.7	9,289.0	8,478.3	11.5
HIV/AIDS (Australia)	Applied Economics (2003) 1984-2010 (2000 prices)	607.2	3,148.6	2,541.3	5.2
Measles (Australia)	Applied Economics (2003) 1970-2003 (mid 1990s prices)	54.9	9,204.3	9,149.4	167.7
Haemophilus influenzae type B (Hib) disease (Australia)	Applied Economics (2003) 1993-2003 (mid 1990s prices)	155.3	165.2	9.9	1.1
Road trauma (Australia)	Applied Economics (2003) 1970-2010 (2000 prices)	11,304.0	19,967.0	8,663.0	1.8
Tobacco consumption (Victoria)	Collins and Lapsley (1999) 1987-2016 (1999 prices)	61.6	972.6	911.0	15.8
Tobacco consumption (Australia)	Applied Economics (2003) 1971-2010 (2000 prices)	175.7	8,602.5	8,426.8	49.0

There are good reasons for expecting that a benefit/cost analysis of anti-smoking programs in NSW, on the lines of those implemented by Quit Victoria, would yield relatively high rates of return similar to those for Quit Victoria reported in Collins and Lapsley (1999). With NSW and Victoria having similar rates of smoking prevalence, the *per capita* social costs of smoking in the two States are likely also to be similar. Anti-smoking programs which have proved successful in Victoria should prove equally successful in NSW. The high (relative to almost all the other public health programs referred to in Table 23) benefit/cost ratio indicated in the Collins and Lapsley (1999) Victorian study therefore appears to be a good indicator of the potential benefits of higher anti-smoking expenditures in NSW. In fact, the benefit/cost ratio calculated by Applied

Economics (2003) for national anti-smoking programs is very significantly than the conservative Collins and Lapsley (1999) estimates for Victoria.

There have been a number of other studies relating to the cost of tobacco (including Hurley *et al*, 2003, examining smoking-attributable Pharmaceutical Benefits Scheme costs), all indicating that substantial costs are borne by the health care sector.

To summarise, the present study clearly indicates that there are potentially very high social benefits to be gained from effective anti-smoking programs. Other studies indicate that such anti-smoking programs would yield very high rates of return compared with many other public health programs. There are few other areas of public health expenditure, or indeed of public expenditure generally which would be likely to yield such a high rate of return. These rates of return would also be considered high in the private sector.

These calculations in themselves do not indicate whether public expenditure programs of this magnitude would lead to the targeted decline in prevalence, nor do they indicate the form which successful anti-smoking interventions should take. However, the magnitude of the potential cost savings available to successful interventions (as indicated by the avoidable cost estimates) would suggest that high social rates of return should be available to effective policies and programs.

8. Conclusion

This report has estimated the social costs of smoking in NSW in 1998/9, disaggregated to provide comprehensive information on particular areas of costs. The disaggregated tables illustrate where the cost burden falls, and also provide estimates of those costs which are avoidable, given the implementation of effective policies.

Over time the scope of the social costs of smoking which it is possible to estimate has increased substantially. However, there still remain cost areas in which various types of smoking-attributable social costs are known to exist but which the paucity of data makes it difficult to quantify. The major areas relate to the costs of

- Domiciliary care and allied health professional services;
- Reduced on-the-job productivity;
- Litter;
- Ambulances; and
- Pain and suffering experienced by smokers and others.

The implication of these data gaps is that the social cost estimates presented here can be viewed as minimum estimates rather than as a comprehensive evaluation of all smoking-attributable social costs.

The last section of the report addresses the social benefits which would result from reductions in smoking, and quantifies the economic benefits resulting from reduced prevalence.

The approach of the present authors in their work on social cost estimation has always been to decline to estimate individual categories of social cost unless there is a sound basis in theory and in data availability to do so. We are thus very confident in saying that the social cost figures and the rates of return presented in this paper are underestimates of the true figures, although it is not possible to indicate the extent of underestimation. We consider this to be a responsible approach to take in an area of study in which the two sides of the argument – the tobacco industry and the anti-smoking lobby – take such vehemently opposed positions. Because of the conservative nature of the estimates, we argue, they provide a sound basis for the development of public policies in relation to smoking.

Despite the conservative approach adopted here, the estimated costs of smoking in NSW are very high. The benefits of reducing smoking prevalence are also very high, as shown in this report. Ample justification is provided for increasing the levels of expenditure required to reduce smoking prevalence.

However, as indicated above, the results contained in this paper indicate neither which anti-smoking interventions should be undertaken nor what the social rate of return on specific interventions would be. The production of this type of information requires detailed economic evaluation of the range of available options.

Appendix A, Demographic methodology and estimates

This appendix describes the demographic methodology of this research, using aetiological fractions and demographic data to estimate the additional numbers of NSW males and females who would have been alive and enumerated in the NSW population in June 1999 had there been no use of tobacco. It was written by J.H. Pollard, Emeritus Professor of Actuarial Studies, Macquarie University, who undertook the demographic calculations for this study.

The data

The aetiological fractions used in this report are those presented in English, Holman *et al* (1995) and Ridolfo and Stevenson (2001). For the purposes of this projection, the earlier aetiological fractions are assumed to apply prior to 1988 and those of Ridolfo and Stevenson in 1998/9, with intermediate fractions for the period 1989-1997.

The other data used in the calculations are as follows:

- the population of Australia in 1947 by age (in individual years) and sex;
- the Australian life tables 1953-55, 1965-67, 1975-77, 1985-87 and 1995-97:
- the numbers of births in Australia for each calendar year 1947-1999;
- the numbers of net migrants by age (in broad age groups) and sex for representative years in each decade (1950s, 1960s, 1970s, 1980s and 1990s);
- estimates of the Australian and New South Wales populations in 1999 by age and sex.

These demographic data were all available from Australian Bureau of Statistics (ABS) publications.

Method

Using the base 1947 population, the history of births, the above-mentioned life tables and the representative migration numbers, it was possible to project forward the Australian population from 1947 to 1999. The resultant estimates for 1999 were close to those provided by ABS.

The projection program was then re-run with modifications to the assumed rates of mortality to reflect the situation which would have existed had there been (a) no illicit drug use, (b) no illicit drug use nor alcohol use, and (c) no illicit drug use, nor alcohol

use nor tobacco use. The resultant Australian figures were then scaled on a pro-rata basis using the New South Wales and Australian 1999 ABS population estimates in five-year age groups to obtain the New South Wales figures shown in the tables.

All calculations apart from the final scaling were performed using single years of age. The reported results are in five-year age groups.

The scaling approach was adopted to obtain the New South Wales estimates because it was believed that the direct application of the national method to an individual state would produce spurious accuracy due to

- the uncertainties inherent in the age-specific migration numbers into the state from overseas,
- the uncertainties relating to age-specific net interstate migration numbers and their drug usage histories, and
- the possibility that the aetiological fractions, applicable nationally, might not be exactly the same for each individual state.

As in previous reports, no attempt was made to quantify the births which did not take place because of lives lost through drug usage.

Adjustment of the mortality rates

Using the aetiological fractions described above and applying them to the relevant causes of death identified by the same authors, it is possible to estimate the proportions of deaths at each age attributable to illicit drug use, to alcohol use and to tobacco use. These proportions were then applied to the mortality rates in earlier epochs to determine the modified mortality rates for use in the various computer program runs described above. Normal multiple-decrement table formulae were used to calculate the modified rates.

This approach can be criticised on several counts. First, it is doubtful whether exactly the same fractions applied in earlier years, since usage of these drugs has changed over time, and other factors have had major impacts on the numbers dying from the various causes (road accident deaths, for example, have halved in the last decade, as a result of various measures, and circulatory system disease mortality has declined remarkably, presumably as a result of a number of lifestyle and medical changes). Second, the aetiological fractions ought to be applied to the deaths by cause in earlier epochs to derive mortality proportions relevant to those times. This second objection can be addressed, but any improvement in accuracy is likely to be spurious, because of the serious nature of the first limitation.

In the absence of equivalent aetiological fractions for all earlier epochs, the above approach was considered the most reliable.

Table 24 presents the resulting estimates of the additional NSW population in the absence of past and present smoking.

Table 24, Estimated additional NSW population in the absence of smoking, June 1999, classified by age and sex

	Male	Female	Total
0-4	75	13	88
5-9	133	63	196
10-14	233	158	391
15-19	237	170	407
20-24	333	247	580
25-29	384	293	677
30-34	522	386	908
35-39	647	456	1,103
40-44	848	560	1,408
45-49	1,172	650	1,822
50-54	1,690	736	2,426
55-59	2,341	840	3,181
60-64	4,165	1,424	5,589
65-69	7,321	2,434	9,755
70-74	11,370	3,963	15,333
75-79	13,854	5,459	19,313
80-84	11,305	5,299	16,604
85 plus	12,613	7,779	20,392
Total	69,243	30,930	100,173

Appendix B, The sensitivity of the estimates to the assumptions adopted

The tables below indicate the sensitivity of the results to the assumptions adopted. The alternative assumptions relate to:

- The pattern of the reduction in smoking prevalence (linear or geometric);
- The extent of the simulated reduction in smoking prevalence (to 15 per cent or to 10 per cent);
- The lag between the reduction in smoking prevalence and the reduction in the social costs of smoking (six, eight or ten years);
- The period of analysis (twenty or thirty years); and
- The social rate of discount adopted (four per cent, six per cent, eight per cent or ten per cent).

The results presented in Section 8 as the "most conservative", "least conservative" and "most plausible" for the 15 per cent target are highlighted in Table 25,

Linear prevalence reduction to 13.1 per cent by 2006/7

Table 25, Present values (year 2001/2 prices), linear prevalence reduction to 13.1 per cent, twenty year analysis

Interest rate	Lag (in years)		
	6	8	10
4 %	9,509	7,824	6,176
6 %	7,129	5,424	4,449
8 %	5,398	4,262	3,231
10%	4,127	3,188	**2,366**

Table 26, Present values (year 2001/2 prices), linear prevalence reduction to 13.1 per cent, thirty year analysis

Interest rate	Lag (in years)		
	6	8	10
4 %	16,112	14,428	12,780
6 %	11,133	9,753	8,453
8 %	7,856	6,720	5,689
10%	5,653	4,714	3,893

Geometric prevalence reduction to 13.1 per cent by 2006/7

Table 27, Present values (year 2001/2 prices), geometric prevalence reduction to 13.1 per cent, twenty year analysis

Interest rate	Lag (in years)		
	6	8	10
4 %	9,618	7,932	6,281
6 %	7,221	**5,835**	4,530
8 %	5,475	4,332	3,295
10%	4,191	3,244	2,416

Table 28, Present values (year 2001/2 prices), geometric prevalence reduction to 13.1 per cent, thirty year analysis

Interest rate	Lag (in years)		
	6	8	10
4 %	**16,222**	14,536	12,885
6 %	11,225	9,840	8,534
8 %	7,933	6,790	5,753
10%	5,718	4,771	3,942

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