Title

Identifying cost-effective interventions to reduce the burden of harm associated with alcohol misuse in Australia

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TABLE OF CONTENTS

EXECUTIVE SUMMARY

The National Drug Strategy household survey from 1993 to 2004 shows that four in five Australians drank alcohol in the past year and one in ten did so daily. Although the evidence suggests that most Australians consume alcohol with an average pattern of drinking at low risk levels, substantial numbers of both low risk drinkers and higher risk drinkers also drink above the limits for acute harm.

Although the relationship between alcohol consumption and health is complex, the evidence is irrefutable, the misuse of alcohol represents one of the leading causes of preventable death, illness and injury in Australia. Alcohol is the single most important risk factor for both fatal and non-fatal injuries and in 2004-05, the total tangible cost attributed to alcohol consumption (which includes lost productivity, health care costs, road accident-related costs and crime-related costs) was estimated at $10.83 billion.

A number of strategies are available to governments to minimise the harm associated with alcohol misuse. Considerable research has been conducted into understanding whether various interventions for problem drinkers work. While evidence on effectiveness is important, policy makers require additional information on the efficiency of interventions, i.e., an assessment of both costs and consequences. As an aid to priority setting, several studies have examined efficiency using cost-effectiveness analysis.

The purpose of this study is to provide a comprehensive analysis of the cost-effectiveness of interventions to reduce the burden of harm associated with alcohol misuse in Australia. The project has been labelled ACE-Alcohol as it aims to Assess the Cost-Effectiveness (ACE) of interventions to reduce Alcohol related harm. The research contextualises results from a recent World Health Organisation study to the Australian setting using, where possible, Australian data on costs, effectiveness of interventions and health outcomes.

ACE-Alcohol builds on a broader body of priority setting research that explicitly focuses on cost-effectiveness analysis. The ACE-Alcohol model is built in Microsoft Office Excel 2003 and uses the add-in tool @Risk for uncertainty analysis. Intervention cost-effectiveness was evaluated over the lifetime of the Australian population eligible for each intervention in a baseline year of 2003. The modelling strategy adopts two approaches according to whether diseases or injuries related to alcohol misuse are evaluated.

A technical advisory panel comprised of alcohol experts assisted in the identification of interventions modelled in ACE-Alcohol. The interventions evaluated include: volumetric taxation; advertising controls; mass media campaigns; brief intervention by primary care practitioners; provision of residential treatment to individuals with alcohol dependence; licensing controls; increasing the minimum legal drinking age to 21 years; and, random breath testing (RBT).

In the cost-effectiveness analysis, all intervention costs, cost offsets and DALYs were adjusted to the baseline year of 2003 and discounted at a rate of 3% per annum. An incremental cost-effectiveness ratio (ICER) was evaluated for each intervention and compared with a cost-effectiveness threshold of $50,000 per DALY averted. Two comparators were used in ACE-Alcohol: current practice and the partial null. Current practice was considered to comprise predominantly on RBT given its widespread use throughout Australia. Using the partial null, interventions were also assessed using marginal analysis. This enables increasing amounts of investment in the chosen intervention to be compared with the additional benefits conferred. Such an analysis lends itself to identifying an optimal expansion pathway, i.e., the ordering of interventions in the most efficient package.

The findings of ACE-Alcohol suggest the health gains that can be achieved, measured by DALYs, range from 150 (95% uncertainty interval (UI): 79 – 260) for increasing the minimum legal drinking age to 11,000 (95%UI: 6,000 –

16,000) for taxation. With the exception of increasing the minimum legal drinking age to age 21, which benefits only those aged between 18 and 20 years, the interventions that target hazardous and harmful drinkers (brief intervention with / without support) or alcohol dependents (residential treatment with / without naltrexone) avert fewer DALYs than the population-wide interventions. There is also substantial variability in the intervention costs. These range from $0.58 million (95%UI: $0.47 million – $0.69 million) for taxation increases to $71 million (95%UI: $57 million – $85 million) for random breath testing.

Two interventions stand out as being most effective and cost-effective: changes to the way taxes are imposed and advertising bans. Both of these interventions are dominant (i.e., less expensive and more effective than current practice) and have a high probability of being cost-effective. Increasing the minimum legal drinking age to 21 years is also dominant, although the potential health gains are small given the target range is persons aged 18 – 20 years. All other interventions have a high or very high probability of being under the $50,000 per DALY cost-effectiveness threshold. The exception is residential treatment for alcohol dependence (with or without naltrexone) which is not cost-effective.

In terms of the most cost-effective package of interventions, the expansion path includes (in order of incremental cost-effectiveness): volumetric taxation, advertising bans, increase in minimum legal drinking age to 21 years, brief intervention, licensing controls, drink driving mass media campaign, random breath testing and then residential treatment + naltrexone. When combined as a package, the alcohol interventions could avert 26,000 DALYs (95%UI: 19,000 – 34,000 DALYs) at a total intervention cost of $210 million (95%UI: $190 million – $230 million). The costs of intervention would be partly offset by an estimated reduction of $130 million (95%UI: $64 million – $220 million) in the costs of treating alcohol-related diseases and injuries.

The key findings from ACE-Alcohol suggest that all the prevention interventions modelled are more cost-effective in reducing alcohol-related harm than those that treat alcohol dependence. When taken as a package of interventions, all interventions modelled with the exception of residential treatment would result in a cost-effective investment portfolio. Compared to current practice, the optimal package could lead to a substantial improvement in population health at a cost of under $50,000 per DALY. Changes to volumetric taxation and banning of alcohol advertising should be a high priority for investment due to the high probability of cost-savings. Increasing the minimum legal drinking age to 21 years, brief interventions in general practice, increased licensing controls, drink driving campaigns and random breath testing are also likely to be cost-effective when judged against a $50,000 per DALY threshold. Only residential treatment for alcohol dependence (with or without naltrexone) is not cost-effective by this standard.

The results suggest that although random breath testing is cost-effective and is already being implemented in Australia, the same amount of $71 million that is currently spent on random breath testing would, if invested in more cost-effective interventions, achieve over ten times the amount of health gain.

In spite of the shortcomings of ACE-Alcohol, the results provide policy makers with clear evidence on the cost-effectiveness of interventions to curb alcohol misuse. By re-allocating existing resources committed to reducing alcohol-related harm, policy makers could achieve over ten times the health gain for the same level of investment. Given the scarcity of resources and the ever-increasing fiscal restraint imposed by governments, it is hoped that these results may be adopted by policy makers in order to reduce the current burden of harm that alcohol imposes on our society.

INTRODUCTION

Alcohol misuse has two dimensions of exposure: average alcohol consumption for a population (measured in litres of pure alcohol per capita per annum), and high-risk patterns of drinking (measured in standard drinks equivalent to 10 grams of alcohol – per day and per week). The average Australian aged 15 years and over consumed 9.83 litres of pure ethanol in 2004-5(Australian Bureau of Statistics 2006). This population level of consumption has remained stable over the past decade, having declined by two litres since the early 1980s(Chikritzhs et al. 2003). Analysis of the National Drug Strategy Household Survey from 1993 to 2004 shows that four in five Australians drank alcohol in the past year, and one in ten did so daily. In 2004, 84% of Australians aged 14 years or over were current drinkers(Australian Institute of Health and Welfare 2005).

The National Health and Medical Research Council (NHMRC) define Australian guidelines for appropriate levels of drinking according to low, risky and high-risk categories for both short and long-term habits(National Health & Medical Research Council 2001). Low risk levels define a level of drinking at which there is only minimal risk of harm and for some, the likelihood of health benefits. Risky levels are those at which risk of harm is significantly increased beyond any possible benefits. High risk drinking levels are those at which there is substantial risk of serious harm, and above which risk continues to increase rapidly(National Health & Medical Research Council 2001). Short-term risk refers to the risk of harm in the short-term (e.g. accidents and injuries while intoxicated) that is associated with consumption more than six standard drinks per day for men and four for women. Long-term risk refers to the level of risk associated with regular daily patterns of drinking (e.g. liver cirrhosis or cancers). At the time of writing this was defined by the total amount of alcohol typically consumed per week equivalent to more than 4 standard drinks per day for men and 2 for women(National Health & Medical Research Council 2001).

Evidence suggests that most Australians consume alcohol with an average pattern of drinking at low risk levels below these NHMRC recommended guidelines, or abstain (16.4%)(Australian Institute of Health and Welfare 2005). However, substantial numbers of both low risk drinkers and higher risk drinkers also drink above the limits for acute harm annually (14.8%), monthly (12.9%) and weekly (7.7%)(Australian Institute of Health and Welfare 2005). Much of this short-term risky drinking occurs among young adults. These patterns of alcohol misuse have remained stable over the past decade(Australian Institute of Health and Welfare 2005).

Alcohol use has health, social and economic consequences(Room et al. 2005). The relationship between alcohol consumption and health is complex and multidimensional. The evidence suggests that the misuse of alcohol represents one of the leading causes of preventable death, illness and injury in Australia(Begg S et al. 2007). Australian epidemiological researchers have provided a series of comprehensive studies quantifying the causal links between consumption and health-related conditions(Begg S et al. 2007; English 1995; Ridolfo & Stevenson 2001). There are causal relationships between average volume of alcohol consumption and more than 60 types of disease and injury. Most of these relationships are detrimental and include liver cirrhosis, mental illness, several types of cancer, pancreatitis, and damage to the fetus in women who drink hazardously during pregnancy. Evidence also points to a modest beneficial relationships with coronary heart disease, stroke and diabetes mellitus when a low to moderate average volume of alcohol is consumed and binge drinking is avoided(World Health Organisation 2002).

Alcohol is the most important risk factor for both fatal and non-fatal injuries in Australia with about 1,100 injury deaths and 27,000 injury hospitalisations yearly attributed to alcohol for the 10-year period to 2001(Chikritzhs et al. 2003). There are also social costs to the consumption of alcohol. In Australia in 2004-05, the total tangible cost attributed to alcohol consumption (which includes lost productivity, health care costs, road accident-related costs and crime-related costs) was estimated at $10.83 billion(Collins & Lapsley 2008).

A number of strategies are available to governments and communities for both treating and preventing alcohol-related harm. Interventions can generally be categorised into three broad groups: primary; secondary; and tertiary prevention(Beaglehole et al. 1993). Primary prevention initiatives refer to various educational campaigns conducted through the mass media and the secondary school education system, as well as to broader structural and legislative approaches, such as the enforcement of drink driving and liquor licensing laws and modifications in the taxation, advertising and packaging of alcohol. Secondary interventions generally target problem drinkers who are not yet alcohol dependent. They have been implemented in a range of settings including general practice, specialised drug and alcohol clinics within general hospital settings, other general hospital departments, general health screening programs in the community, community-based health centres, workplaces and tertiary education centres. Tertiary interventions target highly dependent drinkers and are more likely to promote abstinence and reductions in alcohol intake as desirable goals.

A number of these interventions have been evaluated and shown to be effective in reducing alcohol use. Indeed, there is no shortage of effective strategies for tackling alcohol-related harm, nor information as to how to implement these(Babor et al. 2003; Shand et al. 2003). Nevertheless, for a number of reasons, few if any of these interventions are being systematically applied and their potential impact on population-level health is poorly understood. By contrast, some interventions without strong evidence for their effectiveness continue to be widely used, including, for example, mass-media public information campaigns and school-based education aiming to reduce alcohol consumption(World Health Organisation 2002).

Considerable research has been conducted into understanding whether various interventions for problem drinkers work. While evidence on effectiveness is important, policy makers require additional information on the efficiency of interventions, i.e., an assessment of both costs and consequences. As an aid to priority setting, several studies have examined efficiency using cost-effectiveness analysis(Ludbrook et al. 2002; Rychlik et al. 2003; Chisholm et al. 2004; Kunz et al. 2004; Ludbrook 2004). In a report to the Scottish Advisory Committee on Alcohol Misuse, Ludbrook et al, (2002) commented that the cost-effectiveness literature is smaller than the effectiveness literature with economic evaluations varying in quality. Nevertheless, the authors did find evidence of the cost-effectiveness (i.e., the intervention represents good value for money) of brief interventions; home and outpatient detoxification; outpatient treatment for relapse prevention; and the use of acamprosate as an adjunct treatment in relapse prevention(Ludbrook et al. 2002).

One of the most comprehensive assessments of the cost-effectiveness of interventions to reduce harm from hazardous alcohol use was conducted by Chisholm et al. (2004) using generalised cost-effectiveness analysis (GCEA)(Chisholm et al. 2004). GCEA is implemented via a World Health Organisation (WHO) program called WHO CHOICE (CHOosing Interventions that are Cost-Effective)(World Health Organization 2003). The GCEA approach compares the costs and benefits stemming from the introduction of a new intervention with the costs and benefits in the absence of all interventions (the null set). Modelling of the null set is an important aspect of this approach and requires back-calculations of disease burden without current policy interventions. While such calculations can be quite complex, the advantage of this method is that it allows for the identification of existing inefficient allocations of resources, as well as opportunities presented by new interventions(World Health Organization 2003).

Chisholm et al. (2004) carried out analyses for 12 epidemiological WHO subregions of the world(Chisholm et al. 2004). A population model was used to estimate the impact of the evidence-based interventions including brief physician advice, taxation, roadside random breath testing (RBT), restricted sales access and advertising bans. The authors concluded that the most efficient public health responses to the burden of alcohol misuse depend on the prevalence of alcohol use which is related to overall consumption. Population wide measures, such as taxation, represented the most cost-effective response in populations with moderate or high levels of drinking, whereas more targeted strategies were indicated in populations with lower rates of hazardous alcohol use(Chisholm et al. 2004).

The purpose of the current study was to provide a comprehensive analysis of the cost-effectiveness of interventions to reduce the burden of harm associated with alcohol misuse in Australia. The study attempts to contextualise results from Chisholm et al, (2004) to the Australian setting using, where possible, Australian data on costs, effectiveness of interventions and health outcomes. It is anticipated that the results may strengthen the use of evidence in health priority setting in Australia by providing guidance to key stakeholders on how to more effectively incorporate cost-effectiveness research findings into policy and program debates while taking into account issues of efficiency, equity, acceptability and feasibility of implementation.

METHODS

Governance structure

ACE-Alcohol was part of a larger project entitled Assessing Cost-Effectiveness in Prevention (ACE-Prevention). ACE-Prevention is a five-year NHMRC funded collaborative research program between the University of Queensland (UQ) and Deakin University. The aim of ACE-Prevention is to assess the cost-effectiveness of 100 preventive and 50 treatment interventions across the range of non-communicable diseases and associated risk factors. ACE-Prevention is overseen by a project steering committee comprised of representatives from government organisations as well as public health experts and representatives from non-governmental health organisations. In addition to the steering committee established for ACE-Prevention, ACE-Alcohol benefited from the contribution of a range of alcohol experts through the establishment of a Technical Advisory Panels (TAP).

The specific role of the TAP for ACE-Alcohol was to:

- Assist in the choice of the interventions to be evaluated;
- Advise on, and facilitate access to, data sets that could contribute to more accurate cost-effectiveness estimates;
- Scrutinise and provide comment and advice on the cost-effectiveness methods and interpretations proposed by ACE-Alcohol UQ researchers; and to
- Formulate policy recommendations based on the evidence and analyses.

Two TAP meetings were held in Brisbane over the course of ACE-Alcohol. The aim of the first meeting, held on Monday April 10 2006, was to select interventions to be evaluated in ACE-Alcohol. The aim of the second TAP meeting, held on Friday September 14 2007, was to consider preliminary results and the relevance of second filter criteria.

The first meeting was attended by: Dr Anthony Shakeshaft (National Drug and Alcohol Research Centre, University of NSW); Ms Donna Bull (Alcohol and Other Drugs Council of Australia); Dr Neil Donnelly (NSW Bureau of Crime and Statistics); Dr Peter d’Abbs (James Cook University) and Professor Robin Room (Turning Point AER Centre for Alcohol Policy). Dr Anthony Shakeshaft, Professor Robin Room and Mr David Templeman (acting Chief Executive Officer of Alcohol and Other Drugs Council of Australia) attended the second meeting.

Selecting the interventions

To assist experts in choosing interventions, a comprehensive review of the literature was undertaken (available upon request). This review identified several good quality reviews of the topic by reputable sources including the World Health Organisation(Babor T et al. 2003), the United Kingdom National Health Service (Waller et al. 2002) and the Scottish Executive(Ludbrook et al. 2002; Ludbrook 2004).

From these reviews the following broad categories of interventions for alcohol misuse were identified:

- Policy, legislative and enforcement interventions to control alcohol availability:
    - Taxation: general or specific e.g. beverage/alcohol content;
    - Licensing controls: hours, outlet type/density, drinking age, public monopoly, community control, server training;
    - Advertising controls: level/content, voluntary versus legislative, local promotions, warning labels;
- Drink-driving legislation: age-specific, blood alcohol concentration level, automatic suspension, ignition locks, random breath testing (RBT);
- Education, communication, training and public awareness interventions:
    - School based: facts based/social skills, interactivity, parent/community involvement;
    - Mass media: social marketing and health promotion message in various forms/intensity/focus;
    - Other: academic detailing with general practitioners (GPs), adolescent wellness centres;
- Screening and brief interventions:
    - Screening (AUDIT, etc);
    - Brief Interventions;
- Withdrawal management and relapse prevention interventions:
    - Withdrawal management: benzodiazepines with psychosocial support for inpatient, outpatient and home detoxification settings;
    - Relapse prevention: psychosocial interventions and/or pharmacotherapy; cognitive behavioural therapy, motivational enhancement, 12-step facilitation, acamprosate

Using this information, the TAP members prioritised interventions according to efficacy and feasibility of adopting an intervention from a policy viewpoint. Due to time constraints, discussion was limited to high priority interventions. The results of this exercise are presented in Table 1 with the following interventions rated as high priority for ACE-Alcohol: taxation, licensing controls, age specific drink driving legislation, alcohol purchase age limit, random breath testing, school-based strategies, primary care brief interventions and residential treatment. Advertising controls and serving the intoxicated were to be further explored. Two interventions specific to the Indigenous population were originally considered by the TAP to be of high priority: public drinking bans and night patrols. However, due to the complex nature and additional data requirements required to model Indigenous interventions, a decision was made to exclude these interventions from ACE-Alcohol.

After a closer review of the literature and an assessment of available information required to model each intervention, the list of interventions was reduced. The interventions modelled in ACE-Alcohol are outlined in Table 2 and include:

- Taxation:
    - Volumetric tax that standardizes taxation across all alcoholic beverages based on alcohol content;
- Licensing controls:
    - Restrictions on the hours of opening;
- Advertising controls:
    - Restrictions on broadcasting time and content of advertisements for media, sponsorship and on products;
- Enforcement:
    - Increasing minimum legal drinking age to 21 years;
    - Random breath testing;
- Prevention of alcohol-related road traffic accidents:

  - A mass media campaigns to educate the population about the dangers of risky drinking and driving;
- Screening / brief interventions:
  - Brief intervention by primary care practitioner;
  - Brief intervention by primary care practitioner plus telemarketing and support to practitioners;
- Treatment and relapse prevention:
  - Provision of inpatient / residential treatment to individuals with alcohol dependence; and,
  - Provision of inpatient / residential treatment to individuals with alcohol dependence plus naltrexone and support

Table 1: Summary of interventions prioritised by ACE-Alcohol TAP

Intervention	Efficacy	Policy Feasibility	Priority for analysis
Taxation			High
Across the board tax increases	High	Moderate	
Tax increases by beverage type	High	Low	
Tax increases by alcohol content	High	Low	
Licensing controls			High
Hours of opening	Moderate	Moderate	
Outlet type / density	Moderate	Low	
Drinking age	High	Low	
Public monopoly	High	Low	
Accords	Low	High	
Server training	Low	Low	
Advertising controls			Explore
Level	Low	Low	
Content	Low	Low	
Self-regulation	Low	High	
Promotions	Low	Moderate	
Warning labels	Low	Moderate	
Drink-driving legislation			
Age specific	High	High	High
BAC level	High	High	
Automatic suspension	Moderate	Moderate	
Ignition interlocks	Low	Unknown	
Enforcement			
Alcohol purchase age limit	High	Low	High
Public intoxication	Uncertain		
Public drinking ban - dry area - indig v nonindig	Low	Moderate	High
Police/community enforcement	High	Moderate	
Decoy sales	Low	Low	
Serving the intoxicated	Moderate	Moderate	Moderate/High
Drink driver offender programs	Moderate	Moderate	
RBT	High	High	High
Mandatory driving license loss	Moderate	Moderate	
Night patrols- indig			High
Ignition interlocks	Moderate	Low	
Prevention			
School based	Low	High	High
Mass media	Low	High	
Community	Moderate	Low	
Adolescent wellness counseling	Low	Moderate	
Thiamine supplement for WK syndrome	Moderate	Moderate	
Screening, brief intervention			
Lab and hospital			High
Primary care brief interventions			High
AUDIT, CAGE, T-ACE / TWEAK	High	Moderate	
Laboratory (GGT, CDT assay)	Low	Low	
Telemarketing to GPs	Moderate	Moderate	
Hospital based by specialist	High	Moderate	
Content - FRAMES*	High	Moderate	
Setting - GP	High	High	
Setting - specialist	High	High	
Setting - hospital, Ward/ED	Moderate	Moderate	
Provider profession	Moderate	High	
Age/Gender	Moderate	Moderate	
Problem severity	Moderate	Moderate	
Follow-up	High	Moderate	
Detoxification			
Benzopiazepines, Beta-blockers, Alpha-agonists, Antiepileptics	High	High	
Outpatient treatment	Moderate	Moderate	
Home detox	Moderate	Moderate	
Sober up shelters	Low/Unknown		
Treatment + Relapse prevention			
Psycho-social interventions (CBT, MET, TSF, Behavioural marital therapy) - inpatient v outpatient	Moderate	High	
Type of Rx by setting + individual v group			
Naltrexone / Acamprosate	Moderate	Moderate	
Disulfiram	Moderate	Low	
Healing centres / outstations - indig			
Residential Rx			High

Levels of evidence rating is an ACE Alcohol consensus derived from a synthesis of reviews of systematic reviews and controlled studies undertaken by Ludbrooke, et al, Babor, et al & Loxley, et al. This rating takes into account limitations in generalising

Policy feasibility is an ACE Alcohol consensus descriptive rating of the likelihood of policy implementation by the relevant level of government in Australia

Table 2: List of interventions modelled in ACE-Alcohol

Intervention	Abbreviation
Taxation	
Volumetric tax that standardises taxation across all alcoholic beverages based on alcohol content	Volumetric Taxation
Licensing controls	
Restrictions on the hours of opening	Licensing conrols
Advertising controls	
Restrictions on broadcasting time and content of advertisements for media, sponsorship and on products	Advertising bans
Enforcement	
Increasing minimum legal drinking age to 21	Min. legal drinking age to 21 years
Random breath testing	RBT
Prevention	
A mass media campaigns to educate the population about the dangers of risky drinking	Drink drive mass media
Screening / brief interventions	
Brief intervention by primary care practitioner	Brief intervention
Brief intervention by primary care practitioner plus telemarketing and support to practitioners	support
Treatment and relapse prevention	
Provision of inpatient / residential treatment to individuals with alcohol dependence	Residential treatment
Provision of inpatient / residential treatment to individuals with alcohol dependence plus naltrexone and support	Residential treatment + naltrexone

Key methodological issues

Both ACE-Alcohol and ACE-Prevention built on earlier studies that were part of a broader body of work on priority setting. This body of work adopts a standardised evaluation method. Key assumptions are summarised below.

Choice of comparator(s)

Traditional economic evaluations evaluate interventions against the status quo or current practice. This is because one of the fundamental questions for economic evaluation is: what difference will the option for change make to current policy? One argument for the use of current practice as the comparator is that the result could be misleading by comparison with a do nothing comparator if current practice was ameliorating the health problem. Sometimes the reverse may be true if, for example, current practice is very inefficient. This would make a new intervention look unduly favourable. It would be more informative in the latter case to model a do nothing comparator.

In reality, in large projects like the Chisholm et al (2004) study and ACE-Prevention, when many interventions addressing a wide range of health problems are evaluated, it is impossible to calculate a true null option of no health service intervention. Instead the pragmatic approach is to define a partial null that is the theoretical level of disease that would be present if none of the interventions under scrutiny were in place.

The approach used in ACE-Alcohol was to bring the two methods together in a consistent manner. The back-calculation from current burden of disease to the partial null was done using the same assumptions on effective coverage, effectiveness and costs of current practice as used to calculate the incremental cost-effectiveness of changing current practice by adding or replacing one or more interventions. In other words, modelling from current practice back to the 'partial null' should mirror the modelling of costs and benefits from the partial null to current practice.

From those interventions identified in Table 2, random breath testing is the only strategy consistently utilised in Australia over the past 20 years(Henstridge et al. 1997). As such it has been used in ACE-Alcohol as a proxy for current practice. Although there have been several other strategies adopted over time such as mass media and licensing, these strategies have generally been of an ad hoc nature. Taxation is also an important strategy used by governments and is included implicitly in any proxy of current practice. Taxation and other ad hoc strategies can be considered as part of the background noise. The partial null is therefore calculated by adjusting the injury burden of disease data (described below) in a way that removes the effect of random breath testing. Removing the effects of RBT enables the researcher to evaluate current practice (i.e., RBT) against a do nothing approach.

Choice of study perspective

A health sector perspective is adopted in ACE-Alcohol. A full health sector perspective includes: the government as health service funder (Commonwealth, States and Territories); together with impacts of the interventions on consumers and their families (including out-of-pocket costs; travel costs; time costs involved in travel, waiting, treatment and recuperation; and carer costs).

Target population

One of the key parameters required for any economic evaluation is an understanding of the target population. The target population refers to the sub-group of the population to which the intervention will apply. As highlighted in the text above and in Table 2, ACE-Alcohol includes a range of general and specific interventions. General interventions target the wider population (i.e., population aged 18+ years) while specific interventions target a particular audience (i.e., hazardous / harmful drinkers, drinkers aged 18-20 years or dependant drinkers). Table 6 provides a more detailed overview of the target group relevant to each intervention.

Estimates of alcohol consumption

Information pertaining to prevalence and patterns of alcohol use were sourced from the 2001 National Health Survey(Australian Institute of Health and Welfare 2002). Alcohol consumption was divided into four levels of alcohol use – abstinence, low, hazardous and harmful – based on number of standard drinks consumed per day (Table 3). Data collected in the National Health Survey in 2001 were used to determine the average consumption of alcohol at each level in Australia (Table 4), and prevalence of the four levels of consumption in the Australian population (Figure 1). Although more recent data on prevalence of alcohol use now exists, a decision was made to use the 2001 National Health Strategy in ACE-Alcohol as these data were used in the 2003 Australian Burden of Disease and Injury study (AusBoD)(Begg S et al. 2007). AusBoD provides the epidemiological parameters for both ACE-Prevention and ACE-Alcohol (discussed below).

Table 3: Categories of alcohol use

Intake level*	Standard drinks per day (1 standard drink = 10 grams alcohol)	
	Males	Females
Abstinence	0.00–0.25	0.00–0.25
Low	0.26–4.00	0.26–2.00
Hazardous	4.01–6.00	2.01–4.00
Harmful	6.01+	4.01+

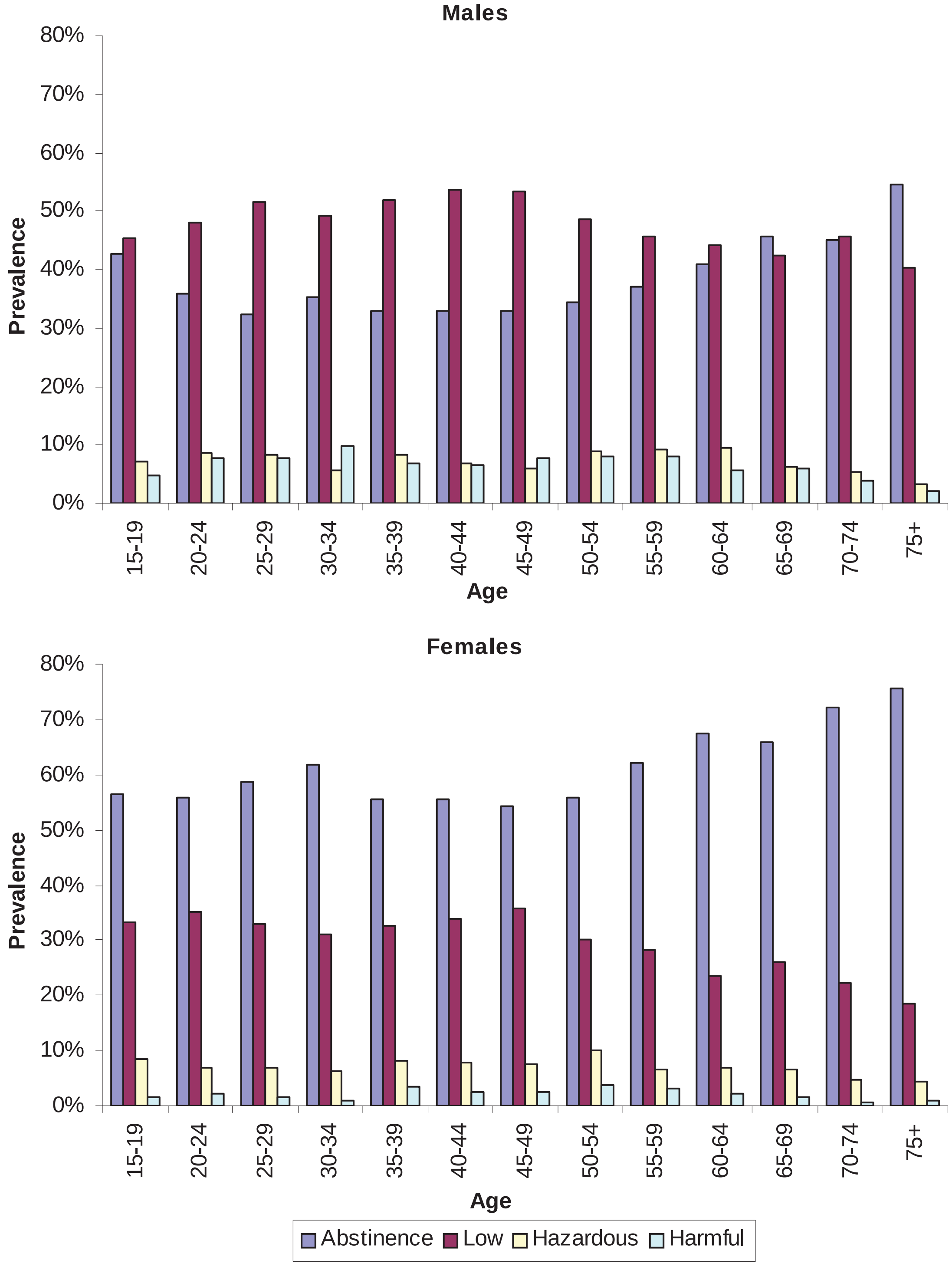
* *Hazardous* and *Harmful* categories previously termed *Medium* and *High*
Source: AIHW(Australian Institute of Health and Welfare 2002)

Table 4: Average consumption of alcohol in grams per day

Intake level*	Average consumption (grams per day)	
	Males	Females
Abstinence	0.2	0.2
Low	16.2	8.9
Hazardous	48.8	27.1
Harmful	98.3	60.8

* *Hazardous* and *Harmful* categories previously termed *Medium* and *High*
Source: AIHW(Australian Institute of Health and Welfare 2002)

Figure 1: Prevalence of alcohol use in Australia(Australian Institute of Health and Welfare 2002)



Modelling approach

The ACE-Alcohol model is built in Microsoft Office Excel 2003 and uses the add-in tool @Risk (Palisade, Version 4.5) for uncertainty analysis(Palisade Corporation 2004). Intervention cost-effectiveness was evaluated over the lifetime of the Australian population eligible for each intervention in a baseline year of 2003. The modelling strategy adopts two approaches according to whether diseases or injuries related to alcohol misuse are evaluated.

Disease models

Excess alcohol consumption increases the risk of ischaemic stroke, hypertensive heart disease, inflammatory heart disease, pancreatitis and cirrhosis, as well as cancer of the breast (in women), mouth and oropharynx, oesophagus, liver and larynx(Corrao et al. 2000). However, alcohol has a protective effect against gallbladder and bile duct disease(English et al. 1995), and ischaemic heart disease at low levels of consumption(Corrao et al. 2000).

Each of the alcohol-related diseases is modelled using a set of differential equations that describe the transition of people between four states (healthy, diseased, dead from the disease, and dead from all other causes). The probability of making a transition between the four states is based on rates of incidence, case fatality and remission. Most epidemiological data inputs to the disease models are derived from AusBoD(Begg S et al. 2007), with additional use of disease modelling software, DISMOD, to derive data that were not explicitly reported(Barendregt et al. 2003). Case fatality and prevalence of ischaemic heart disease, stroke, hypertensive heart disease, inflammatory heart disease, gallbladder and bile duct disease, pancreatitis and all cancers, were estimated from incidence and mortality data using DISMOD, and the prevalence of cirrhosis was estimated from incidence and case fatality rates using DISMOD. For alcohol dependence, incidence and case fatality were estimated by DISMOD using data on the prevalence of alcohol dependence, the rate of remission (a weighted average of the 12 month remission rate observed by

Weisner et al. (2000) and the relative risk of mortality(Harris & Barraclough 1998).

Future changes in disease incidence and case fatality were estimated from a trend analysis of mortality rates by cause between 1979 and 2003 that was carried out as part of the AusBoD study(Begg et al. 2007). Past trends were assumed to continue over the next 20 years with disease rates remaining constant thereafter.

Average disability associated with each disease was derived from DISMOD estimates of disease prevalence and AusBoD calculations of the prevalent years lived with disability from the disease.

For all heart disease, stroke, digestive diseases and cancers, the intervention effect on disease incidence was modelled by the potential impact factor (PIF) (Equation 1).

$$\mathrm{PIF} = \frac{\sum_{i=1}^{n} \mathrm{p}_i \, \mathrm{RR}_i - \sum_{i=1}^{n} \mathrm{p}_i \, \mathrm{RR}'_i}{\sum_{i=1}^{n} \mathrm{p}_i \, \mathrm{RR}_i} \quad (1)$$

Where:

- PIF was the potential impact factor;
- p_i was the prevalence of alcohol consumption at level *i*;
- RR_i was the relative risk of disease associated with alcohol consumption at level *i*; and
- RR'_i was the relative risk of disease associated with alcohol consumption after an intervention was implemented in the population at exposure level i.

The relative risks of disease applied in the alcohol model (Table 5) were derived from existing meta-analyses of data describing the relationship between alcohol consumption and the risk of alcohol related conditions. In the absence of relevant studies for inflammatory heart disease, relative risks were derived from the population attributable fraction (PAF) of inflammatory heart disease due to alcohol use in Australia(Begg et al. 2007). The change in relative risk of each disease was calculated from the change in alcohol consumption due to the intervention, by assuming a linear increase (or decrease) in disease risk with increasing alcohol consumption between each of the four levels of alcohol consumption.

For alcohol dependence, which is wholly attributable to excess alcohol consumption, the intervention effect on disease incidence was modelled, by age and sex, as a proportional change in the incidence of alcohol dependence (Equation 2). Incidence of alcohol dependence was assumed to be negligible below a harmful level of alcohol consumption.

$$\Delta I = \frac{\Delta C}{C_{Harm} - C_{Haz}} \quad (2)$$

Where:

- ΔI is change in incidence of alcohol dependence due to an intervention;
- ΔC is change in alcohol consumption due to an intervention in g/day;
- C_{Haz} is average consumption in g/day at a hazardous level of alcohol consumption; and
- C_{Harm} is average consumption in g/day at a harmful level of alcohol consumption.

For interventions that target people who are alcohol dependent the treatment effect was modelled as an increase in the rate of remission from alcohol dependence in the first year (Equation 3).

$$R' = R \times (100\% - p_{int}) + R_{int} \times p_{int} \quad (3)$$

Where:

- R is the rate of remission from alcohol dependence in the Australian population;

- R' is the rate of remission from alcohol dependence after an intervention is implemented in the population; and
- p_{int} is the proportion of the population receiving the intervention.

In calculating the proportion of the population who received the intervention, we assumed that people who were alcohol dependent and received treatment were consuming alcohol at harmful levels. Relapse to alcohol dependence among those who received the intervention in the first year was modelled as an increase in incidence in subsequent years (Equation 4).

$$I' = I - \Delta P_0 \times r \quad (4)$$

Where:

- I is the incidence of alcohol dependence;
- I' is the incidence of alcohol dependence after an intervention is implemented in the first year;
- ΔP_0 is the change in prevalence of alcohol dependence due to the intervention; and
- r is the annual relapse rate.

Injury models

Excess consumption of alcohol increases the risk of injury(Corrao et al. 2000). Injuries associated with at least 5% risk of death or disability due to alcohol(Begg et al. 2007) consumption in Australia include road traffic accidents (RTAs) falls, fires, burns and scalds, drowning, machinery accidents, suffocation and foreign bodies, suicide and self-inflicted injuries, and homicide and violence(Begg et al. 2007).

In contrast to modelled diseases, injuries are acute. Thus, in AusBoD, disability and mortality due to injury were derived from the incidence of fatal and non-fatal injuries in the population, rather than from prevalence of injuries and their sequelae. For this reason, changes in injury outcomes due to alcohol interventions were modelled by direct changes in injury-related mortality (years of life lost – YLL) and disability (years lived with disability – YLD). All mortality and disability rates in the current practice population were derived from AusBoD(Begg et al. 2007).

The outcomes of alcohol interventions were measured by translating a change in alcohol consumption into a change in RTAs. Where intervention outcomes were measured by a change in consumption, the effects on injuries were quantified using the potential impact factor (Equation 1). The relationship between relative risk of mortality or disability from injury and alcohol consumption was assumed to be exponential (Equation 4). Exponential coefficients were derived for each injury from population attributable fractions(Begg et al. 2007) and prevalence of alcohol use in the Australian population (Figure 2 and 3).

$$RR = \exp\left[\beta \times C\right] \quad (4)$$

Where:

- RR is the relative risk of injury;
- β is a coefficient; and
- C is alcohol consumption in g/day.

For interventions that directly target RTAs (e.g. random breath testing), the effect on PAF_{YLL} and PAF_{YLD} was modelled, by age and sex, from a change in injuries due to RTAs (Equation 5). It was assumed that these interventions impact on drinking patterns around driving, but have a negligible impact on alcohol consumption overall.

$$\Delta PAF = PAF \times \Delta RTA \quad (5)$$

Where:

- ΔRTA is the change in injuries due to road traffic accidents caused by excess alcohol consumption in %.

Figure 2: Relative risk of death and disability from injury due to RTAs

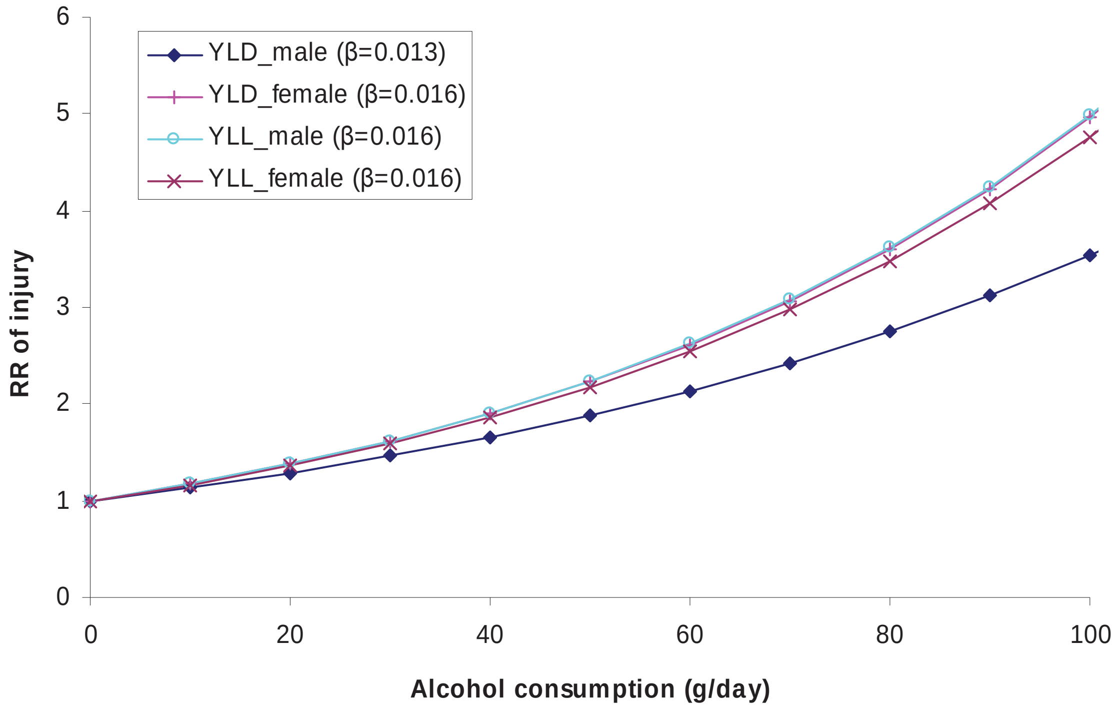


Figure 3: Relative risk of death and disability from injury due to falls, fires, burns and scalds, drowning, machinery accidents, suffocation and foreign bodies, suicide and self-inflicted injuries, and homicide and violence

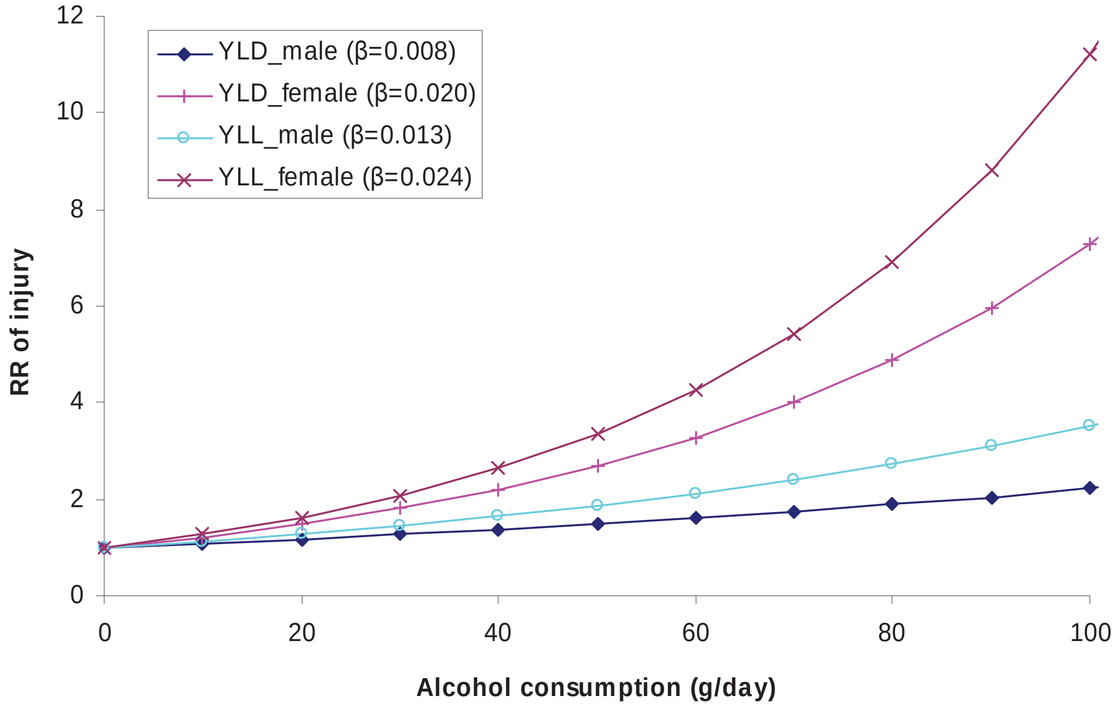


Table 5: Relative risks of disease due to alcohol consumption

		Intake level				
Disease	Sex	Abstinence	Low	Hazardous	Harmful	Source
Ischaemic heart disease	Male	1.00	0.85 (0.82–0.88)	0.84 (0.80–0.87)	1.00 (0.94–1.07)	Correo et al (2000)
	Female	1.00	0.87 (0.84–0.90)	0.92 (0.87–0.96)	1.20 (1.06–1.35)	
Ischaemic stroke	Male	1.00	1.02 (0.84–1.21)	1.44 (1.15–1.79)	1.84 (1.02–3.04)	Ridolfo and Stevenson (2001)*
	Female	1.00	0.62 (0.50–0.77)	0.77 (0.52–1.09)	1.47 (0.41–3.77)	
Breast cancer	Male	–	–	–	–	Ridolfo and Stevenson (2001)
	Female	1.00	1.14 (1.09–1.20)	1.41 (1.32–1.50)	1.59 (1.43–1.78)	
Mouth and oropharynx cancer	Male	1.00	1.58 (1.35–1.87)	2.95 (1.92–4.63)	5.41 (1.78–16.53)	Correo et al. (1999)
	Female	1.00	1.32 (1.11–1.63)	2.01 (1.44–2.85)	3.89 (1.97–10.62)	
Oesophagus cancer	Male	1.00	1.32 (1.19–1.46)	2.17 (1.71–2.75)	4.42 (0.91–2.57)	Correo et al. (1999)
	Female	1.00	1.18 (1.11–1.26)	1.56 (1.38–1.76)	2.05 (1.65–2.57)	
Liver cancer	Male	1.00	1.13 (1.07–1.20)	1.39 (1.21–1.60)	1.79 (1.23–2.57)	Correo et al. (1999)
	Female	1.00	1.07 (1.04–1.11)	1.22 (1.13–1.31)	1.49 (1.29–1.75)	
Larynx cancer	Male	1.00	1.13 (1.07–1.20)	1.49 (1.21–1.81)	2.08 (1.40–3.08)	Correo et al. (1999)
	Female	1.00	1.07 (1.04–1.11)	1.23 (1.14–1.32)	1.63 (1.37–1.97)	
Hypertensive heart disease	Male	1.00	1.26 (1.20–1.32)	1.97 (1.76–2.23)	4.03 (2.93–5.53)	Correo et al. (1999)
	Female	1.00	1.14 (1.11–1.18)	1.45 (1.35–1.55)	2.45 (2.15–2.84)	
Inflammatory heart disease	Male	1.00	1.00 (1.00–1.00)	1.43 (1.33–1.54)	2.24 (1.93–2.55)	Begg et al. (2007) **
	Female	1.00	1.00 (1.00–1.00)	1.87 (1.65–2.09)	3.49 (2.86–4.11)	
Gallbladder and bile duct disease	Male	1.00	0.82 (0.76–0.90)	0.68 (0.55–0.84)	0.50 (0.33–0.75)	English et al. (1995)
	Female	1.00	0.82 (0.76–0.90)	0.68 (0.55–0.84)	0.50 (0.33–0.75)	
Pancreatitis	Male	1.00	1.19 (1.10–1.30)	1.78 (1.35–2.40)	3.15 (1.77–5.47)	Correo et al. (1999)
	Female	1.00	1.11 (1.06–1.16)	1.34 (1.21–1.50)	2.10 (1.61–2.79)	
Cirrhosis	Male	1.00	1.39 (1.17–1.67)	2.36 (1.43–3.91)	4.33 (1.32–13.61)	Correo et al. (1999)
	Female	1.00	1.36 (1.08–1.82)	2.14 (1.39–3.45)	5.21 (2.18–21.39)	

NB. Values are mean relative risk and 95% confidence interval at average alcohol consumption for intake category (Table 4).
* Weighted average of relative risks for ischaemic and haemorrhagic stroke (weighting based on incidence).
** Derived from PAF of 0.10 (Begg et al. 2007) and prevalence of alcohol use (National Health Survey 2001), assuming linearly increasing risk with increasing consumption above low levels of alcohol use.

Costing interventions

There were three steps involved in costing: identification of the appropriate costs to include in the evaluation; measurement of resources used and saved by the program alternatives; and, valuing the resources used and saved by the program alternatives.

In the 'identification' phase of cost analysis, all the important costs and cost offsets were identified and included in the study. From a health sector perspective costs and cost offsets that have an impact on both public providers (Commonwealth Government, State and Territory governments) and the private sector (clients/participants, their family/carers, non-government bodies such as health insurance funds or disease advocacy/patient support groups) were included; but costs to sectors other than health (for example, education and housing) were not.

In ACE-Alcohol we assumed that interventions were operating under steady state conditions. Each intervention was assumed to be working in accordance with its efficacy potential as established by the intervention evidence, that trained personnel were available to deliver the intervention and that the necessary infrastructure was available.

In the measurement phase the frequency of use of each cost component was determined. The cost of each factor of production (or service) was measured by multiplying the quantity of the factor consumed by its relevant price. In the measurement phase we assessed quantity, while in the valuation phase we assessed its price.

Costs were measured in real prices for the reference year (2003). The Australian Institute of Health and Welfare (AIHW) health sector deflators were used to adjust prices to the reference year. Where interventions fell outside of the health sector, adjustments were made using the relevant Consumer Price Index(Australian Bureau of Statistics 2003).

Cost of non-adherence

The non-adherence rate is important to the incremental cost-effectiveness ratio because the participants who do not adhere to the intervention would incur some costs and receive little or no health benefit. Information was sought on the likely subsequent health seeking behaviour and associated costs of non-adherent patients. In the absence of such information, it was assumed that the non-adherers incurred part of the intervention costs, received no benefit and had the same subsequent health seeking behaviour (and associated costs) as those currently not receiving the intervention.

Cost offsets

If an intervention prevents future disease or treats current disease so that future complications are avoided, the projected health care costs are estimated in the intervention and comparator scenarios. The difference in cost offsets between the intervention and comparator may arise from a reduction in incidence, duration and/or severity of disease, or in some cases an improved remission (or cure rate). The cost offsets related to the treatment of disease and injury were estimated, by age and sex, using data from the Disease Costs and Impacts Studies and AusBoD(Australian Institute of Health and Welfare 2004; Begg S et al. 2007). All costs were adjusted to the 2003 reference year using the relevant health cost deflators(Australian Bureau of Statistics 2003).

During simulation of interventions, cost offsets were accrued per prevalent case for the cardiovascular diseases, cirrhosis and alcohol dependence, and per incident case for gallbladder and bile duct disease, pancreatitis and all cancers, which have a shorter duration of illness. For all injuries, where incident or prevalent cases were not explicitly evaluated, the cost offsets were accrued per YLD averted.

Discounting

Discounting was applied to both costs and benefits. This reflected the fact that, individually and as a society, we prefer to have dollars or resources now rather than later, because we can benefit from them in the interim. Similarly, we prefer to have benefits now rather than later. A 3% per annum discount rate was applied to match the rate chosen in AusBoD. It is also the rate of discounting recommended by a consensus panel of health economists in the United States(Gold et al. 1996).

Measurement of health benefits

In ACE-Alcohol we measured health gain in health-adjusted life years where the loss of health due to non-fatal health states was valued with the appropriate disability weight(s) used to estimate Disability-Adjusted Life Years (DALYs) in burden of disease studies. When we present our results we equate these health-adjusted life years gained to DALYs averted by the intervention. However, it is important to realise that there are philosophical differences between the two. First, in a burden of disease study we estimate the health status of a population in a particular year. It is therefore, a cross-sectional measure even if the non-fatal component is measured as the loss of health that is estimated to arise from incident events. Economic evaluation methods, by contrast, always have a time dimension: what happens over time if a target population is exposed to an intervention of interest or a comparator? Health gain is calculated as the difference in mortality and morbidity outcomes between a comparator and the intervention option over a defined period of time (the horizon).

Second, in burden of disease the DALY is constructed as a health gap measure, i.e. we set an ideal (everyone ought to live into old age free of disease) and contrast the current health status of a population with that ideal. Thus, Years of Life Lost (YLL), the mortality component of DALYs, are calculated as the difference between age at death and a standard life expectancy at that age for each death. It is best to view these conversions of counts of deaths into YLL as weighting deaths by age. Young deaths accrue more YLL than old deaths. In economic analyses, we do not use the standard life table to give a value to loss of life. Instead, we keep track of a target population over time and count the years of life lived in intervention and comparator scenarios assuming realistic mortality risks as people age. If we assume no trends in mortality this would equate to giving a death the value of the equivalent life expectancy for the age at death from the population's period life table. If we apply mortality trends in our models, it is equivalent to awarding remaining life expectancy from a cohort life table to each death.

Cost-effectiveness ratios

In the cost-effectiveness analysis of each intervention, all intervention costs, cost offsets and DALYs were adjusted to the baseline year of 2003 and discounted at a rate of 3% per annum. An incremental cost-effectiveness ratio (ICER) was evaluated for each intervention (Equation 6) and compared with a cost-effectiveness threshold of $50,000 per DALY averted.

$$\text{ICER} = \frac{\Delta C}{\Delta E} \quad (6)$$

Where:

- ΔC is the incremental net cost in Australian dollars of delivering the intervention over the comparator; and
- ΔE is the incremental net health benefit in DALYs averted.

Two comparators were used in ACE-Alcohol: current practice and the partial null. As discussed previously, current practice was considered to comprise RBT given its widespread use throughout Australia together with current taxation and ad hoc media campaigns. The most rigorous analysis of cost-effectiveness analysis uses the partial null as the comparator (presented below). This is consistent with the WHO CHOICE approach used in Chisholm et al. (2004) and enables the researcher to investigate the cost-effectiveness of current practice as a separate intervention.

Using the partial null, interventions were also assessed using marginal analysis. This enabled increasing amounts of investment in the chosen intervention to be compared with the additional benefits conferred. In a marginal analysis the difference in costs and outcomes was calculated between the scenario with the initial target population/intensity and that of the expanded target population/intervention effort. Such an analysis lends itself to identifying an optimal expansion pathway, i.e., the ordering of interventions in the most efficient package.

Uncertainty analysis

There is always a level of uncertainty associated with epidemiological parameters and intervention cost and effect estimates. For example, data from randomised controlled trials may not be easily transferred to the Australian setting or to the proposed intervention. In ACE-Alcohol, the uncertainty in all cost and health outcome measures was evaluated by Monte Carlo simulation (2000 iterations) using @Risk(Palisade Corporation 2004). From the values generated by the iterations of the simulation, a 95% uncertainty interval was calculated by taking the 2.5 and 97.5 percentiles to mark the lower and upper bounds. This uncertainty interval can be interpreted as the range within which the true result lies with 95% certainty. An uncertainty interval differs from a confidence interval in that it includes both type I and type II errors. The uncertainty is also presented graphically in cost-effectiveness planes and acceptability curves(Briggs 2001; Briggs et al. 2002).

Probability distributions around the input variables are derived from statistics, such as standard errors, quoted in the literature, and from expert advice on the likely scenarios under Australian conditions. All cost offsets were assumed to vary uniformly by ±25%. Uncertainty in each relative risk of disease was assumed to be normally distributed around the logarithm of the relative risk. Uncertainty assumptions relating to each intervention are further discussed under each specific intervention but a general rule was to assume parameter uncertainty of ±25% in the absence of additional information.

Second stage filter criteria

There is an increasing awareness in the literature on priority setting of the need to combine technical approaches such as economic evaluation with approaches that facilitate due process(Carter 2000). While evidence on cost-effectiveness is the main focus of ACE-Alcohol, there are other criteria that can influence the priority ranking of the selected interventions. These additional criteria can function as a second filter by which each of the interventions are judged before recommending allocation of more or less resources. The criteria considered in ACE-Alcohol include:

- Strength of evidence;
- Capacity of the intervention to reduce inequity;
- Acceptability to stakeholders;
- Feasibility;
- Sustainability; and,
- Potential for other consequences

Interventions modelled in ACE-Alcohol

Volumetric taxation

The effect of alcohol prices is included in the comprehensive policy review by Babor et al, (2003). This review suggests that variations in estimates may be explained by prevailing social, cultural and economic circumstances. In particular, the relatively low elasticity for beer, compared with wine and spirits, may result from studies in beer preferring countries, such as the United Kingdom and the United States. The existence of other policy measures to make alcohol less accessible may reduce the impact of price changes.

A review of econometric studies by Chaloupka et al. (2002) suggests that long-term effects of price may be higher, due to the addictive nature of alcohol consumption but there remains conflicting evidence concerning the relative effects of price on heavy drinkers. Studies relating prices to alcohol consumption for heavy drinkers provide less convincing evidence than studies relating tax changes to changes in the incidence of alcohol related problems, such as mortality, morbidity, accidents and crime, which show reductions in problems resulting from price rises(Babor et al. 2003). These studies provide indirect evidence that price increases are reducing the incidence of problem drinking.

The intervention modelled in ACE-Alcohol simulated a change to the current excise tax approach so that alcohol excise duty is equalized across all alcoholic beverage categories. Currently, excise rates are applied to all alcoholic beverages, except wine, based on their respective alcohol content. Separate excise rates apply to each type of alcoholic beverage, with wine being charged a value added tax (VAT) in place of an excise. The ACE-Alcohol intervention involves removal of the VAT charged on wine, and equalisation of the excise rate charged per litre of alcohol across all drink types, including wine, such that the percentage impact on final prices is consistent across all beverage categories. The intervention impacts on alcohol consumed from mainstream outlets, including hotels. Alcohol that is brewed or distilled at home was not included in the analysis because it was assumed to represent a minor proportion of total alcohol consumption in Australia. Impact upon consumption levels for all ages and drinker risk levels was taken into account.

Estimates of price-elasticity for beer, wine, ready to drink pre-mixed spirits (RTDs) and spirits were taken from a recent Australian report conducted by EconTech (2004). The intervention effect was estimated as follows. First, the price change required to equalise the tax rate to each category of alcohol was determined. Second, using elasticities, the change in consumption for each beverage was then estimated by summing the change in quantity derived from the change in its own price and the changes in price of the other alcohol drinks. The results suggest that equalising the taxation rate per litre of alcohol to $25.25, leads to a 1.4% reduction in consumption. Uncertainty in the effect was assumed to be normally distributed with a standard error of 20% of the point estimate. A 3% per annum decay rate was assumed given the potential effect of inflation.

For consistency with the WHO CHOICE analysis, costs for this intervention were based on assumptions made by Chisholm et al. (2004). Total costs of the intervention were estimated at $18 million. A triangular distribution was fitted around this cost to capture uncertainty.

Licensing controls

Licensing controls can affect a range of issues, such as hours of operation for outlets selling alcohol, types of outlet permitted to sell alcohol, the density of outlets within an area and the age at which alcohol can be legally purchased or consumed. In some countries, such as the United States, sales of alcohol may be controlled through public monopoly. These controls may increase or reduce the ease of access to alcohol, which is part of the cost. Promoting lower alcohol content in beverages and the promotion of alcohol free events and alternative activities may have also lower consumption(Babor et al. 2003).

Overall, the evidence relating to the impact of licensing hours remains unclear. Outlet density is one factor in the cost of access to alcohol and, in general, an increase in the number and type of outlets will increase consumption. Accidents and violence are more likely in areas with high density of outlets but there is no evidence that changing density over time changes the total of problem outcomes(Babor et al. 2003). There may be other factors associated with high-density areas that contribute to accidents and violence. Babor et al (2003) suggest that off-premise monopoly systems limit consumption and alcohol related problems and are less likely to sell to minors. Such systems result in fewer stores with limited opening hours.

The ACE-Alcohol intervention modelled was a limit in the availability of alcohol reducing trading hours on a Sunday. Chisholm et al, (2004) evaluated a similar intervention and estimated a reduction in alcohol consumption based on a number of studies ranging from 1.5% to 3%. This effect was applied to all diseases and injuries in the model with a 50% per annum decay rate assumed. Uncertainty in the effect was assumed to vary uniformly between the estimated minimum and maximum.

For consistency with the WHO CHOICE analysis, costs for this intervention were based on assumptions made by Chisholm et al (2004). Total costs of the intervention were estimated at $20 million. A triangular distribution was fitted around this cost to capture uncertainty.

Advertising bans

Alcohol advertising has the potential of portraying drinking as socially desirable, of promoting pro-alcohol attitudes, of recruiting new drinkers and of increasing drinking among current drinkers(World Health Organisation 2002) and thereby having an affect on total alcohol consumption(Saffer & Dave 2002). Advertising plays a role in two ways, by increasing market share or by increasing market size. New sales that come from consumers who purchased from rival firms increases the market share whilst new sales that come from consumers who have never purchased the product increases the market size(Saffer & Dave 2002).

The types of restrictions on advertising can vary from complete bans and partial legal restrictions to voluntary advertising agreements or no restrictions(World Health Organisation 2002). In Australia there are voluntary agreements on advertising for national television, national radio, print media and billboards for both beer, wine and spirits. An advertising ban may not necessarily reduce the total level of advertising, but may reduce the effectiveness of the other non-banned media. This results in a substitution to the remaining non-banned media, however a more comprehensive bans will not have a significant effect on market wide demand for all beverages(Saffer & Dave 2002). If advertising increases consumption, and if a set of bans on certain media reduces total advertising, then advertising bans will have a negative effect on alcohol consumption.

Governments can potentially restrict the level of advertising and the content of advertising, either by legislative action or through voluntary agreements with the alcohol industry. There may also be controls on other promotional activities. The evidence relating to advertising bans remains mixed, with the most recent study showing bans decreasing consumption(Saffer & Dave 2002).

The intervention modelled in ACE-Alcohol involves nation-wide implementation of restrictions on all types of alcohol promotion and advertising. Restrictions on alcohol advertising include any policies that limit advertising of alcoholic beverages, particularly advertising that exposes young people to alcohol messages. Based on work conducted by Saffer and Dave (2002), a 5% to 8% reduction in consumption was applied to all diseases and injuries in the model in the first year, with a subsequent 50% per annum decay in effectiveness assumed. The effect was assumed to vary uniformly between 5% and 8%.

For consistency with the WHO CHOICE analysis, costs for this intervention were based on assumptions made by Chisholm et al (2004). Total costs of the intervention were estimated at $20 million. A triangular distribution was fitted around this cost to capture uncertainty.

Minimum legal drinking age to 21 years

The minimum legal drinking or purchasing age is the age at which a person can legally purchase alcohol from a licensed premises or dealer or consume alcohol in public. Wagenaar and Toomey (2002) provide a systematic review of minimum drinking age laws (MDAL) on alcohol consumption, drink driving and traffic crashes and other health and social outcomes, and also review the literature around underage access. They conclude that the balance of evidence supports the effectiveness of MDAL in reducing alcohol consumption, drink driving and adverse traffic related outcomes(Wagenaar & Toomey 2002)..

The intervention modelled in ACE-Alcohol involves an increase in the minimum legal drinking age from 18 to 21 years. In a systematic review of nine regression-based studies by Shults et al (2001) the median decrease in alcohol-related single vehicle night-time crashes resulting from an increase in the minimum legal drinking age was 12% (Inter-quartile range (IQR): 8% – 17%)(Shults et al. 2001). The effect was applied only to injuries due to road traffic accidents in the cost-effectiveness analysis. It is assumed that the intervention effectiveness remains stable once implemented, i.e., no decay rate is assumed.

No costs for this intervention were available in the literature, so estimates were derived from WHO CHOICE interventions of a similar nature. Total costs of the intervention were estimated at $20 million. A triangular distribution was fitted around this cost to capture uncertainty.

<u>Random breath testing (RBT)</u>

RBT was first introduced in New South Wales on December 17 1982 and spread to most states shortly thereafter(Homel 1990). Henstridge et al. (1997) estimated the long-term effectiveness of RBT using time series analyses of statistical data on accidents and police enforcement in New South Wales, Queensland, Western Australia and Tasmania. Results from this study suggest that RBT had an immediate, substantial and permanent impact on accidents in all states except Tasmania, where reductions in fatalities were not sustained beyond about three months(Henstridge et al. 1997). The authors comment that the results were most clear for New South Wales with RBT reducing fatal accidents initially by 48% and by 15% on a permanent basis(Henstridge et al. 1997).

There is good Australian evidence on the characteristics and effectiveness of RBT. Homel et al (1990) suggests that RBT needs to be random, enforced, highly visible and advertised through print and television(Homel 1990). In accordance with Homel's suggested guidelines for a RBT, the RBT intervention modelled in ACE-Alcohol involves RBT stations (e.g. 'booze buses') to detect and prevent driving with a blood alcohol concentration of more than 0.05g/100mL, with coverage to achieve an average of one test per driver per year.

The effect is modelled as a decrease in injuries due to road traffic accidents. Costs of RBT intervention were derived from personal communication with a Queensland police officer and the alcohol literature. Total annual cost of the intervention was estimated at $71 million, which comprised program costs ($37 million), costs for under-the-limit drivers ($26 million) and costs for over-the-limit drivers ($8.9 million). Program costs included the annuitized costs of booze buses, roadside breath testing devices, breath analysis instruments on the bus, police cars, police motorcycles, traffic management equipment and the calibration laboratory. Program costs also included the cost of a coordinator and a media campaign. Costs associated with each under-the-limit driver tested include cost of police officer testing time (Constable), police officer set-up time, driver's time (stopping for test) and mouthpiece cost. Costs associated with each over-the-limit driver tested (around 1% of all drivers tested)(Queensland Police 2003) included police officer testing and set-up time, driver's time (stopping for test), mouthpiece cost, breath analysis officer time, police officer booking and further administrative time, police officer court materials preparation and the driver's time waiting for breath analysis reading. Court costs and economic costs of license suspension for over-the-limit drivers were not included.

Drink drive mass media campaign

Mass media campaigns are generally put in place to persuade people to take individual steps to avoid and/or prevent others from drinking alcohol or dangerous activities associated with drinking such as drinking and driving. Methods used include television, radio, magazines, billboards, and newspapers. Campaigns are most likely to be effective when combined with another intervention such as law enforcement or other media messages. Message content and delivery are specific aspects that can affect the effectiveness of mass media campaigns(Elder et al. 2004).

In a systematic review of eight studies by Elder et al, (2004) the median decrease in alcohol-related crashes resulting from alcohol campaigns was 10% (Inter quartile range: 6% – 14%). In his review Elder et al (2004) stated several reasons as to why media content is important in reducing drink and driving alcohol-involved crashes and includes: fear and legal consequences of arrest; promotion of positive social norms; fear of harm to self, others, or property; and, stigmatizing drink drivers as irresponsible and dangerous. Message delivery needs to ensure that it is frequent enough that the intended audience receives the information frequently enough to exceed a threshold for effectiveness(Elder et al. 2004).

The intervention modelled in ACE-Alcohol was specifically looking at a nation-wide implementation of a mass media campaign around responsible driving. The effect reported by Elder et al. (2004) was modelled as a reduction in alcohol-related crashes with a 50% per annum decay in effectiveness. Although the systematic review by Elder does not provide a summary of costs, an Australian study by Cameron included in the review provides a monthly estimate of $3.3 million(Cameron et al. 1993). This monthly estimate is converted to an annual estimate and adjusted to $AUD 2003 equivalent to almost $40 million. A triangular distribution was fitted around this cost to capture uncertainty.

<u>Brief intervention</u>

An initial literature search identified a paper by Bertholet et al. (2005) that reported results of a systematic review and meta-analysis of the literature on brief interventions conducted in non alcohol-dependant, non alcohol-treatment-seeking patients where care was delivered in a primary care setting(Bertholet et al. 2005). This study reported an adjusted intention-to-treat analysis with a mean pooled difference of -38 grams of alcohol per week (95% CI -51g/wk to -24g/wk). ACE-Alcohol staff conducted a subsequent literature review and located three other studies to include in an updated meta-analysis(Altisent et al. 1997; Anderson & Scott 1992; Mundt et al. 2005). We inspected the original studies identified and used by Bertholet et al, (2005) and extracted data from those studies, together with the data from the three additional studies previously mentioned. Results of the meta-analysis, using a random effects method resulted in a pooled estimate of decrease in self-reported alcohol consumption of -44 grams of alcohol consumed per week (p<0.001). This is in addition to any decrease in consumption reported by the control groups in each study. We interpreted this to mean that when brief interventions are implemented with the guidelines there is potential to significantly reduce self-reported alcohol consumption by up to four standard drinks per week more than controls.

While there was no significant heterogeneity found between studies, closer inspection of the effect sizes of the various studies revealed that some studies produced large decreases in self-reported alcohol consumption, while others reported small decreases, or even increases in alcohol consumption. Even though the Q-statistic was not significant, it was decided to further investigate the different variables in each study to determine if variations in the presence, frequency, duration or quality of the variable were related to changes in self-reported alcohol consumption. Predictor variables that were investigated (chosen because these were the most obvious factors that varied across studies that were eventually included in our analyses) were: length of initial consultation; number of follow-up visits; number of follow-up phone calls; bibliotherapy / written materials; baseline alcohol consumption; and, screening tool type used (e.g. AUDIT score, CAGE responses etc…).

The above variables were then entered into a meta-regression (using STATA), but none were found to have a significant moderating effect on effect size (all p-values for the various beta-coefficients were > 0.3). Using the above results, it was determined that an effective brief intervention would consist of the following components:

- Screening by GP for alcohol consumption. In this instance the use of the Alcohol Use Disorders Identification Test (AUDIT) is recommended due to the consistent findings regarding its superior sensitivity and specificity in detecting hazardous and harmful alcohol consumption in non-alcoholic, non-clinical populations(Reinert & Allen 2002)
- Counselling, provided by the GP, on the level of consumption and advice to decrease consumption to safer level; the provision of written materials to reinforce the GP message to cut down and provide a reference regarding what is considered to be "safe" drinking levels; and
- The provision of a follow-up consultation to monitor and allow further advice on, if necessary, alcohol consumption

The brief intervention modelled in ACE-Alcohol contains the above characteristics. The effect derived from the meta-analyses was applied to all diseases and injuries with an assumption of 50% decay in effect per annum. The cost of the intervention was calculated by combining the value of resources outlined by the meta-regression together with the number of drinkers receiving the intervention. The cost per non-adherer was estimated at $28.95 with the cost per adherer estimated at $105.50. Triangular distributions were fitted around the mean costs to capture uncertainty.

<u>Brief intervention + telemarketing + support</u>

This intervention was the same as the brief intervention with the addition of resources to recruit and support GPs. Effect parameters were identical to brief intervention, but with more GPs recruited to the program and more GPs delivering the program, a larger number of hazardous and harmful drinkers receive the intervention. An article by Funk et al. (2005) suggests that telemarketing increases uptake of GPs screening for drinking behaviour to 26%, 84% can detect drinking behaviour (using AUDIT), the addition of a support package increases the proportion of GPs offering the intervention (i.e., advice) to 18%, and 70% of patients return for follow-up consult(Funk et al. 2005). The cost of the intervention was calculated by combining the value of resources outlined for the brief intervention ($105.50 per adherer and $28.95 per non-adherer) with resources required to recruit GPs ($13.34 per GP) and support GPs ($222.98 per GP)(Funk et al. 2005). Triangular distributions were fitted around the costs to capture uncertainty.

Residential treatment

The literature on the effectiveness of residential treatment as a stand-alone treatment is limited; it is most often part of the alcohol treatment continuum. Management of alcohol withdrawal can occur in a variety of settings; treatment may be residential, out-patient or home-based. Efficacy, safety and acceptability of withdrawal management is equivalent in these settings(Miller et al. 1995). The intervention modelled in ACE-Alcohol involved provision of residential treatment to individuals with alcohol dependence

Six studies were found to report data on alcohol reduction in grams per day(Allan et al. 2000; Hayashida et al. 1989; Klijnsma et al. 1995; Parrott et al. 2006; Shaw GK et al. 1998; Stockwell et al. 1990). These results were pooled in a meta-analysis using a random effects inverse variance method with STATA (release 8). The studies were uncontrolled or used controls of alternative residential treatment settings that were equivalent in efficacy. This lack of a do nothing control was accounted for by inclusion of a non-treatment community remission rate in alcohol dependents of 28.17%(Booth et al. 2001). Two intervention effects were adopted: a reduction in alcohol consumption of 13.31 grams per day (95% CI: 10.7 – 15.92), which is applied to all diseases and injuries in the model; and an increase in remission from alcohol dependence in the first year with 50% relapse thereafter. The rate of remission in the first year due to residential treatment was 0.172.

Costs of residential treatment were obtained from Victorian Government data(Department of Human Services 2007). A purchaser provider model was implemented which included all costs and involved three year funding at agreed pricing for services. The costing included five service types: home-based withdrawal, out-patient withdrawal, rural withdrawal, community-based residential withdrawal and youth residential(Department of Human Services 2007). The detailed cost data for drug and alcohol detoxification service purchasing was based on a service mix of home-based (9%), out-patient (18%), rural (9%), community-based residential (53%) and youth-residential (10%) withdrawal. Average cost per detoxification treatment was estimated at $1708(Department of Human Services 2007). A triangular distribution was fitted around the mean cost to capture uncertainty around costs.

Residential treatment + naltrexone

This intervention was the same as residential treatment with the addition of naltrexone. Naltrexone is a pharmacotherapy given to patients after detoxification from alcohol. Naltrexone is provided for a 12-week period in conjunction with a comprehensive support program. The target population was those dependent drinkers successfully completing detoxification.

Naltrexone with counselling decreases alcohol consumption by 3.4 standard drinks per day(Srisurapanont & Jarusuraisin 2005). This effect is applied to all diseases and injuries in the model after conversion into grams per day of alcohol consumption. The cost of the intervention per dependant patient was estimated at $2,358 and was calculated by combining the cost of residential treatment ($1,708) with the costs of a 12 week script for naltrexone ($468) and six visits to the patient’s primary care practitioner ($181)(Health Insurance Commission 2003).

Intervention parameters for cost-effectiveness analysis

A summary of the key intervention parameters used in the cost-effectiveness analysis are outlined in Table 6. These include a definition of the target group, the magnitude of intervention effect and the total costs of intervention. This table provides a key source of data underlying the evaluation of each intervention. As can be seen in the table, cost estimates have been separated into intervention costs and time and travel costs. This separation provides an indication of who bears the costs, predominantly the health care provider. These costs are summed in further analyses.

Table 6: Definition of intervention target groups, effects and costs in the cost-effectiveness analysis.

Intervention	Target group	Effect in target group	Cost ($million)*	Sources
Taxation	100% of population aged 18+ years	-1.4% g/day consumption	$0.58 intervention $0 time & travel	Effect modelled using price elasticities and cross-price elasticities(Econtech 2004). Costs, including basic administration, media and law enforcement, are derived from Chisholm et al. (2004)(Chisholm et al. 2004).
Advertising bans	100% of population aged 18+ years	-6.5% g/day consumption	$20 intervention $0 time & travel	Effect from pooled time series data from 20 countries over the period 1970-1995(Saffer, and Dave 2002). Costs, including basic administration, media and enforcement, are derived from Chisholm et al. (2004)(Chisholm et al. 2004).
Licensing controls	100% of population aged 18+ years	-2.3% g/day consumption	$20 intervention $0 time & travel	Effect derived from Chisholm (2004). Costs, including basic administration, media and enforcement, are derived from Chisholm et al. (2004)(Chisholm et al. 2004).
Brief intervention	2% of hazardous/harmful drinkers aged 18-79 years	-6.3 g/day consumption	$1.4 intervention $0.91 time & travel	Effect derived from meta-analysis of RCTs. Costs derived from resource use (e.g. GP screening, delivery and follow-up, written information, etc.).
Brief intervention + telemarket. + support	3% of hazardous/harmful drinkers aged 18-79 years	-6.3 g/day consumption	$4.2 intervention $1.9 time & travel	As for Brief Intervention, with additional costs for increased GP recruitment, intervention delivery, telemarketing and support (phone calls, staff, etc.)
Residential treatment	4% of alcohol dependents aged 18-79 years	-13 g/day consumption; +0.056 remission with 50% relapse/year	$24 intervention $13 time & travel	Effect on consumption derived from meta-analysis of 6 studies. Effect on remission derived from Shaw (1998). Costs derived from Victorian Government purchase price for detoxification services.
Residential treatment + naltrexone	4% of alcohol dependents aged 18-79 years	-34 g/day consumption; +0.056 remission with 18% relapse/year	$41 intervention $18 time & travel	Reduction in relapse rate with naltrexone from Cochrane review(Srisurapanont, and Jarusuraisin 2005a). Additional pharmacotherapy costs from Medicare Australia.
Random breath testing	100% of population (drivers) aged 18+ years	-15% road traffic accidents	$71 intervention $0 time & travel	Effect derived from NSW time series data for the period 1976-1992 (Henstridge et al., 1997) Costs based on Australian costs of RBT consumables, staff, etc.
Minimum legal drinking age to 21 yrs	100% of population (drivers) aged 18-20 years	-13% road traffic accidents	$0.64 intervention $0 time & travel	Effect on alcohol-related road traffic accidents from a systematic review (Schults et al., 2001). Costs include basic administration, media and enforcement, and are derived from Chisholm et al. (2004).
Drink driving mass media	100% of population (drivers) aged 18+ years	-10% road traffic accidents	$40 intervention $0 time & travel	Effect derived from systematic review of 8 studies by (Elder et al., 2004). Cost derived from Victorian campaign costs (Cameron et al., 1993; Newstead et al., 1995)

***** All costs are adjusted to real prices in the 2003 reference year using the relevant Health Price Index from the Australian Institute of Health and Welfare (AIHW), or relevant Consumer Price Index from the Australian Bureau of Statistics (ABS) where the costs would occur outside of the health sector.

RESULTS

Results for volumetric taxation

Volumetric taxation is a dominant strategy (Table 15). The intervention is estimated to cost $0.58 million (discounted to 2003 figures), but the potential cost offsets arising from a change in drinking behaviour are estimated at $57 million leading to a net cost saving of $56 million (95% UI: -$110 million to -$18 million). The health gain achieved from volumetric taxation is estimated at an additional 11,000 DALYs averted (95% UI: 6,000 – 16,000). Figure 4 provides the cost-effectiveness plane for volumetric taxation and demonstrates that all the results fall in the south-east quadrant, indicating dominance. Figure 5 outlines the acceptability curve of the intervention demonstrating that it is cost-effective in 100% of cases.

Table 7 considers some of the key second filter criteria of implementing a change to the taxation structure. Given the fact that everyone who uses alcohol irrespective of socio-economical status, ethnicity, locality or gender will be affected by this intervention, its equity implications are favourable. The impact of intervention (taxation) will be proportional to amount of alcohol consumed. The intervention has been modelled as a low cost, relatively easy to implement strategy that will generate significant savings to the health care system. This fact is likely to be acceptable to key stakeholders. However, acceptance by voters may be an important determinant. The feasibility of this intervention is dependent upon government motivation and commitment but it is important to note that existing systems are in place to implement and monitor the intervention and once implemented it would need minimal resources to ensure its sustainability. Evidence for this intervention is moderate and more Australian empirical work is required to strengthen elasticity estimates. Taking these issues into consideration volumetric taxation appears to be a feasible intervention in the Australian context.

Figure 4: Cost-effectiveness plane of volumetric taxation

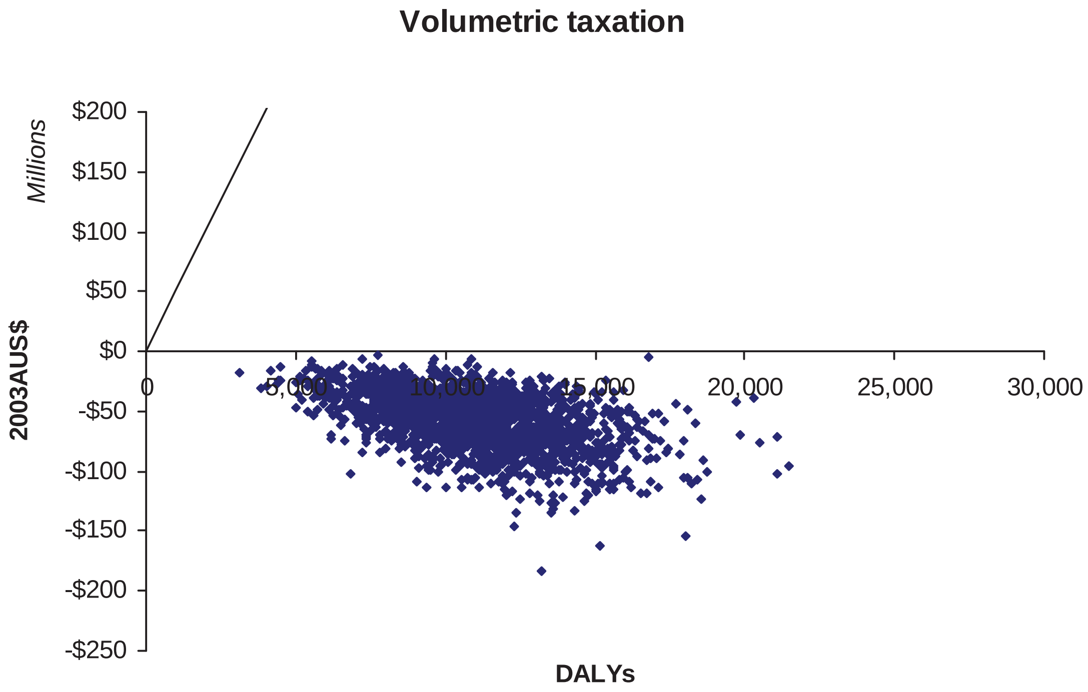


Figure 5: Acceptability curve of volumetric taxation

Table 7: Second filter criteria: implementing volumetric taxation

Discussion of ICER	Equity filter	Acceptability to stakeholders filter	Feasibility & Sustainability filters	Potential for side effects filter	General comments
• All of the ICER results are located in south-east quadrant (dominant quadrant) of cost effective plane suggesting the intervention is more effective and less costly (cost saving). • Acceptability curve shows 100% probability of intervention to be to be below $50,000 cost-effectiveness threshold.	• This intervention equalises tax rate per litre of alcohol across all alcoholic beverages • Everyone who uses alcohol irrespective of socio-economical status, ethnicity, locality or gender will be subjected to this intervention. • The burden of intervention (i.e., amount of paid) will be proportional to amount of alcohol consumed	• The intervention is low cost and will generate significant offsets • Alcohol lobby group (or companies) are likely to oppose the decision (as they may loose revenue) which may influence the government policy decisions. • Political scenario and perceived acceptance by voters will be other determinants for the acceptability among politicians. • A section of health conscious population may accept the volumetric taxation whereas alcohol consumption group in the population may not like to pay more for the alcohol.	• Existing systems are in place to implement and monitor the intervention • Once implemented it would need minimal resources to ensure sustainability.	• There are no negative side effects related to health or economy. • There can be positive side effects like productivity gains due to decreased alcohol consumption, decreased road crashes (so called ? accidents), violence, crime and alcohol related health problems	• This seems to be the best intervention based on cost-effectiveness results and second filter criteria. • However, convincing the government will be the key challenge. • Evidence for this intervention is moderate with more empirical work required to strengthen elasticity estimates

Results for licensing controls

Licensing controls are a cost-effective intervention with an ICER of $3,300 (95% UI: dominant to $8,300) (Table 15). This intervention is estimated to cost around $20 million (discounted to 2003 figures) to implement and enforce, with potential cost offsets estimated at $11 million. This provides a net incremental cost of $8.7 million (95% UI: -$1-6 million to $17 million). The health gain achieved from licensing controls is estimated at an additional 2,700 DALYs averted (95% UI: 1,700 – 4,000). Figure 6 provides the cost-effectiveness plane for licensing controls and demonstrates that all the results fall below the $50,000 per DALY threshold. The acceptability curve in Figure 7 further shows that there is a 100% probability of cost-effectiveness at under $50,000 per DALY.

Table 8 considers some of the key second filter criteria of implementing a change to licensing hours. The equity aspects for this intervention tend to be minimal given the restrictions would impact on a relatively small proportion of the drinking population. Governments would benefit from minimising social disturbances; industry is receptive to strategies that encourage responsible drinking, but will resist proposals to restrict operating hours. Intervention is feasible given infrastructure is in place to change legislation. Additional resources would be required to monitor and enforce the intervention. The Australian evidence base for this intervention is reasonably weak and there are numerous ways of implementing this policy that include restricting operating hours to reducing number of outlets. A feasibility study may be required to identify the most appropriate strategy for each region. Overall, based on cost-effectiveness results and second filter criteria effectiveness analysis the intervention appears to be a good buy.

Figure 6: Cost-effectiveness plane of licensing controls

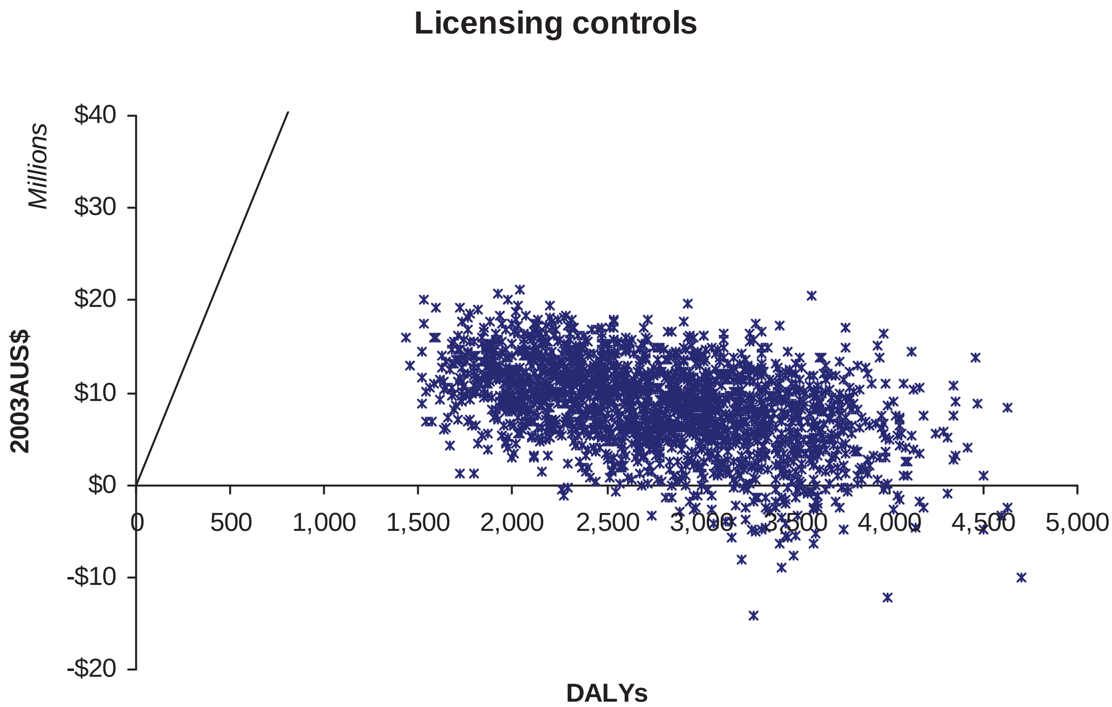


Figure 7: Acceptability curve of licensing controls

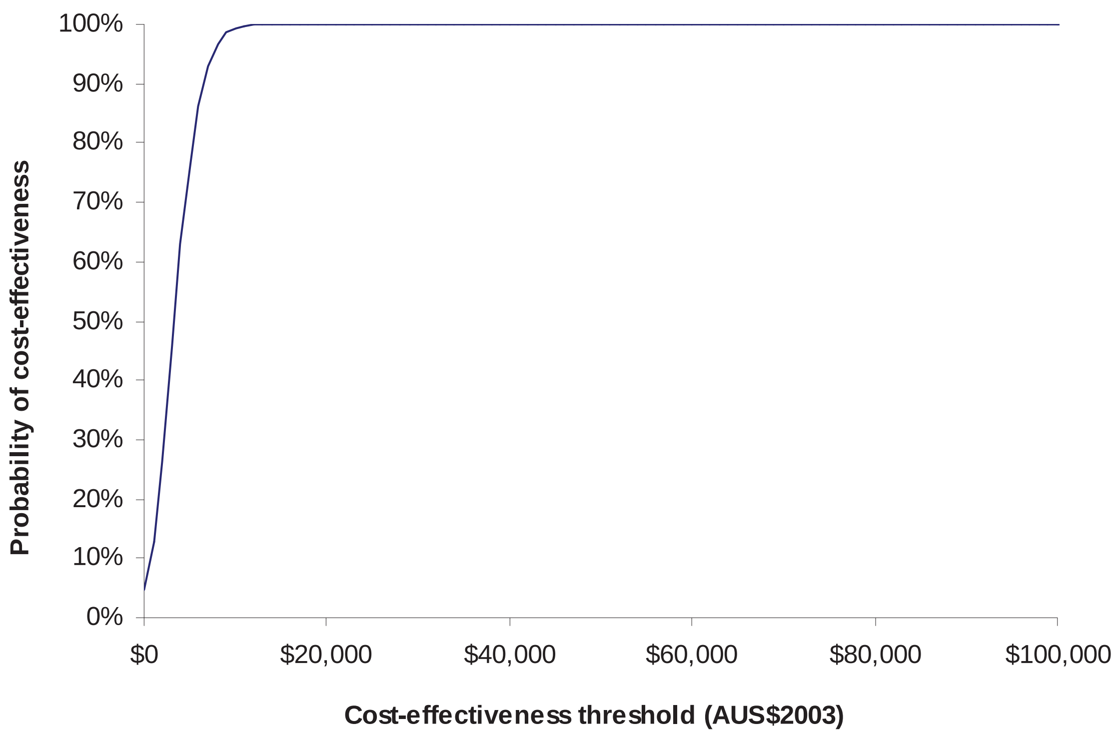


Table 8: Second filter criteria: licensing controls

Discussion of ICER	Equity filter	Acceptability to stakeholders filter	Feasibility & Sustainability filters	Potential for side effects filter	General comments
• ICER results are located in north east and south-east quadrant (dominant quadrant) of the cost effective plane. • Acceptability curve shows 100% probability of intervention to be below $50,000 per DALY cost-effectiveness threshold.	• Equity issues are minimal given the restrictions would impact on a relatively small proportion of the drinking population	• It is envisaged that there may be widespread acceptability of this interventions by all stakeholders. • Governments would benefit from minimising social disturbances; industry are receptive to strategies that encourage responsible drinking but may resist the call to restrict operating hours	• Intervention is feasible given infrastructure is in place to change legislation • Additional resources would be required to monitor and enforce the intervention.	• Minimal negative side effects	• The evidence base for this intervention is reasonably weak • There are numerous options available from restricting operating hours to reducing number of outlets. A feasibility study may be required to identify the most appropriate strategy for each region. • Based on the cost-effectiveness analysis the intervention appears to be a good buy.

Results for advertising bans

Advertising bans are a dominant strategy with an uncertainty interval of dominant to $1,100) (Table 15). (Table 15). Although the intervention is estimated to cost $20 million (discounted to 2003 figures), the potential cost offsets arising from a change in drinking behaviour are estimated at $31 million. This provides a net incremental cost saving of $12 million (95% UI: -$37 million to $7.4 million). The health gain achieved from advertising bans is estimated at an additional 7,800 DALYs averted (95% UI: 5,500 – 11,000). Figure 8 provides the cost-effectiveness plane for advertising bans and demonstrates that all the results fall predominantly in the south-east quadrant, indicating dominance. These results are reinforced by the acceptability curve in Figure 9, which shows a 100% probability of cost-effectiveness at less than $50,000 per DALY.

Table 9 considers some of the key second filter criteria of implementing a ban to the promotion/advertising of alcohol products. The intervention is equitable given it will be applied across the board with no exception – smoking control is a good example of how advertising bans can achieve universal support and encourage reduction in risky behaviour, particularly in vulnerable sub-groups of the population that advertising predominantly targets. The ban may be more acceptable to policy makers and politicians as it can address the issue of harm from alcohol misuse with limited additional efforts. However, the media, advertising industry and alcohol lobby groups would probably oppose the ban given alcohol is a legal commodity and consumers have a right to be informed about it.

The intervention appears feasible given that the infrastructure is currently in place to enact change but it is important to note that the effectiveness of the bans require ongoing resource inputs and monitoring. Although the evidence base for this intervention is reasonably weak, the strategy itself is widely promoted by the WHO and leading alcohol researchers as an important component of any strategy to minimise alcohol abuse. This appears to be a good buy in terms of potential cost-effectiveness.

Figure 8: Uncertainty analysis of advertising bans

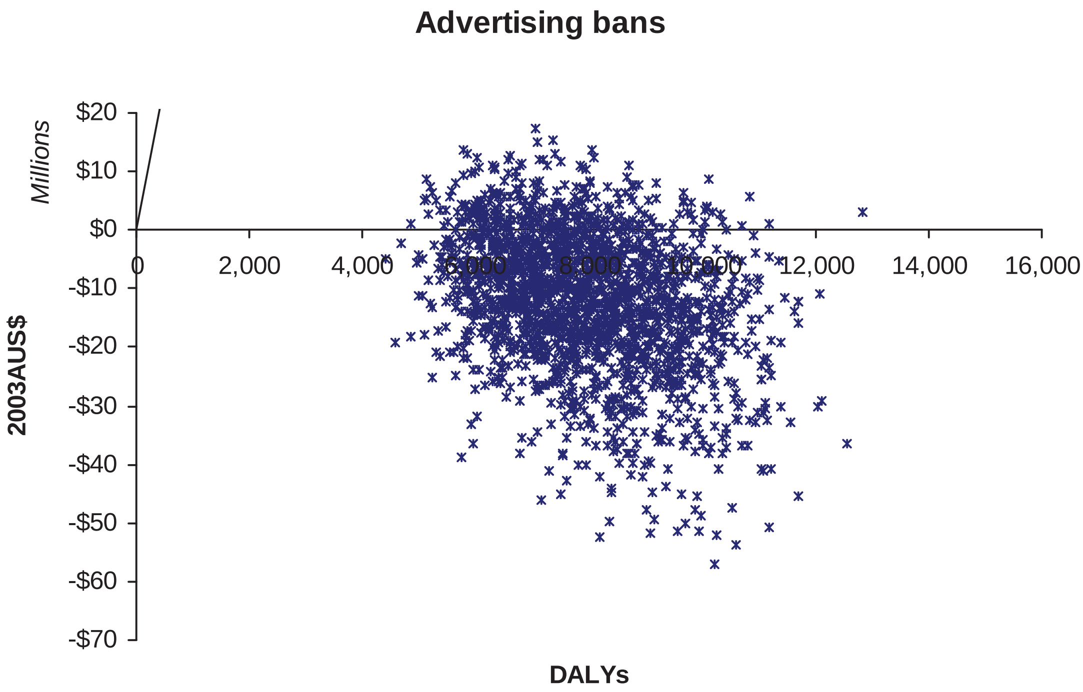


Figure 9: Acceptability curve of advertising bans

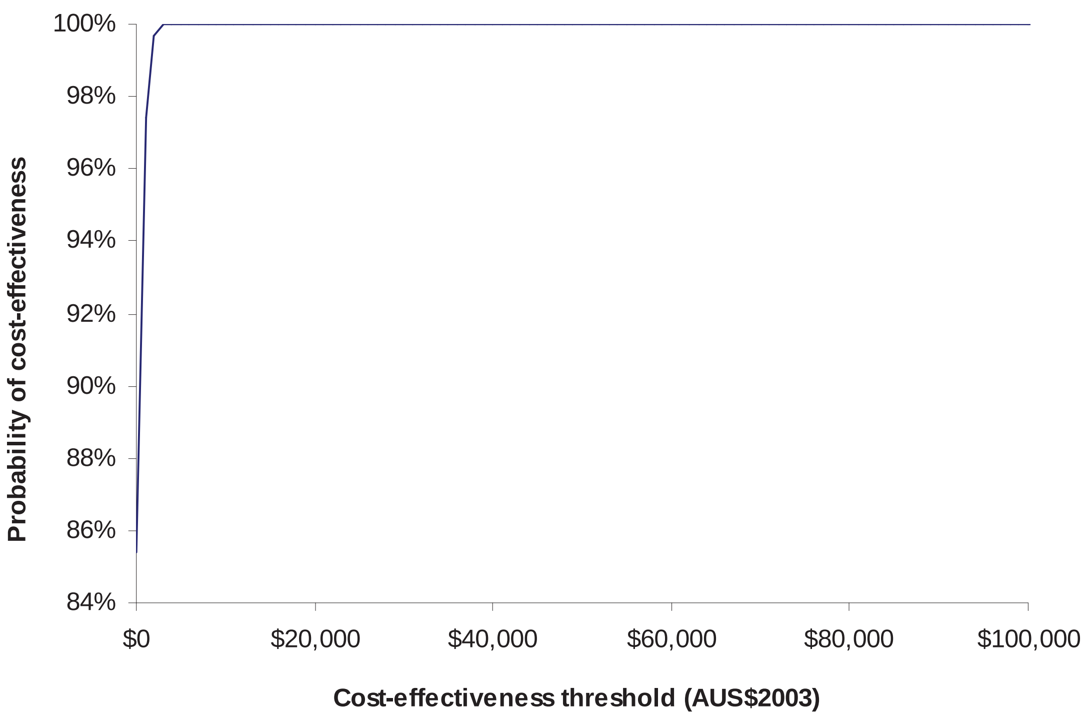


Table 9: Second filter criteria Intervention: Advertising bans

Discussion of ICER	Equity filter	Acceptability to stakeholders filter	Feasibility & Sustainability filters	Potential for side effects filter	General comments
• Results of the ICER results are located in both north –east and south-east quadrant (dominant quadrant) of cost effective plane. • Acceptability curve shows 100% probability of intervention to be cost-effectiveness below $50,000 threshold.	• The intervention is equitable given it will be applied across the board with no exception – smoking control is a good example of how advertising bans can promote universal support and encourage reduction in risky behaviour, particularly in vulnerable sub groups of the population that advertising predominantly targets	• It may be more acceptable to policy makers and politicians as it can address the issue with limited additional efforts with in the health care context. • Industry and lobby groups would oppose the ban on the grounds that alcohol is a legal commodity and consumers have a right to be informed about products	• A hypothecated tax could fund this intervention • Intervention is feasible given infrastructure is in place and precedent has been set by tobacco control • Sustainability of the program is possible only with ongoing additional resource inputs and monitoring.	• There are limited scope for negative side effects related to health or economy • There can be positive side effects like productivity gains due to decreased alcohol consumption, decreased road crashes (so called accidents), violence, crime and alcohol related health problems	• Although the evidence base for this intervention is reasonably weak, the strategy itself is widely promoted by the WHO and leading academics as an important component of any strategy to minimise alcohol abuse • This appears to be a good buy in terms of potential cost-effectiveness

Results for raising the minimum legal drinking age to 21 years

Raising the minimum legal drinking age to 21 years is a dominant strategy compared to current practice (Table 15). Although the intervention is estimated to cost $0.64 million (discounted to 2003 figures), the potential cost offsets arising from a change in drinking behaviour are estimated at $0.8 million provided a net incremental cost saving of $0.16 million (95% UI: -$0.93 million to $0.31 million). The health gain achieved from raising the minimum legal drinking age to 21 years is estimated at an additional 150 DALYs averted (95% UI: 79 – 260). Figure 10 provides the cost-effectiveness plane for raising the minimum legal drinking age to 21 years and demonstrates that all the results fall predominantly in the south-east quadrant, indicating dominance. These results are reinforced by the acceptability curve in Figure 11, which shows a 100% probability of cost-effectiveness at less than $50,000 per DALY.

Table 10 considers some of the key second filter criteria of increasing the minimum legal drinking age to 21 years. The major equity concern with this intervention is that it reduces access of alcohol by those aged 18 to 20 years of age, the age group that is most at risk for harm from alcohol related road traffic injury. The intervention may be more acceptable to policy makers and politicians as it can address the issue with limited additional legislative effort. It is important to note, however, that there will be voter opposition to legislation changing the MLDA because the voting 18 years of age. Industry and lobby groups will also oppose the because of the potential for lost patronage. The intervention is feasible given that the infrastructure is currently in place to change legislation but additional resources would be required to monitor the intervention to ensure compliance and the sustainability of its benefits.

The evidence base in the USA is moderate. Adolescents and young adults consume alcohol at risky levels and are prone to alcohol related injury and death. A major issue for its application in Australia is that it is over 30 years since any Australian state reduced the drinking age to 18 the increase in MLDA would therefore be a major change rather than (as it was the USA) a return to a

MLDA changed within the recent memory of the electorate. If the Australian government can change the culture of drinking through this intervention, it would influence alcohol related harm. Overall, this appears to be an intervention that deserves more attention.

Figure 10: Uncertainty analysis of raising minimum legal drinking age to 21 years

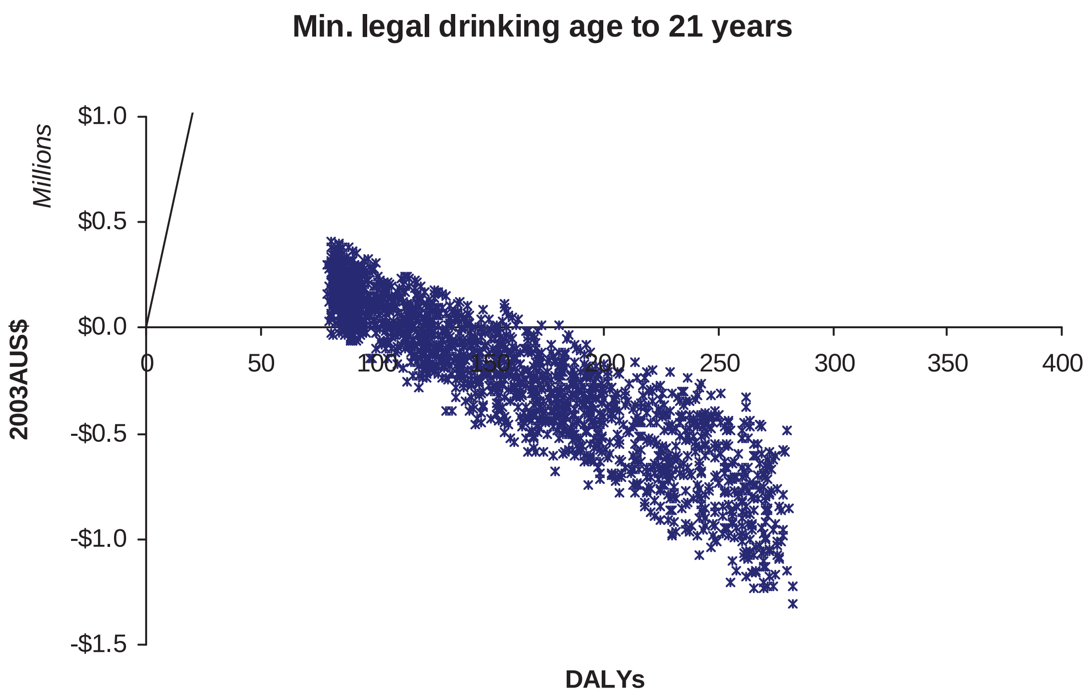


Figure 11: Acceptability curve of raising minimum legal drinking age to 21 years

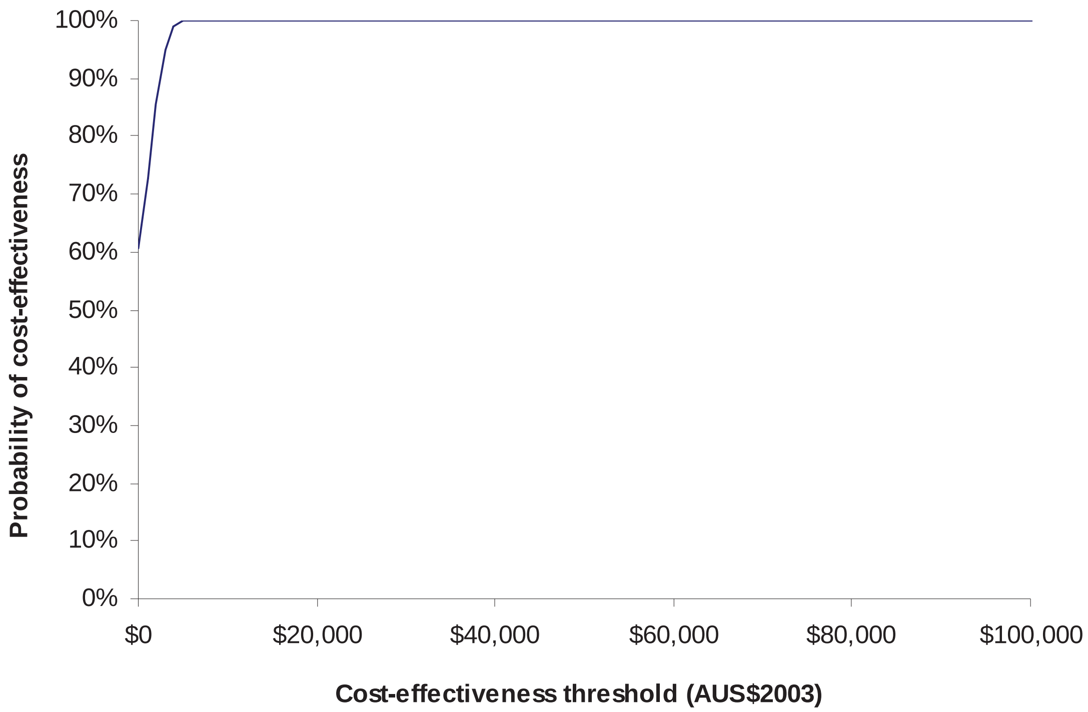


Table 10: Second filter criteria: Raising minimum legal drinking age to 21 years

Discussion of ICER	Equity filter	Acceptability to stakeholders filter	Feasibility & Sustainability filters	Potential for side effects filter	General comments
• Majority of the ICER results are located in south-east quadrant (dominant quadrant) of cost effective plane suggesting the intervention is more effective and less costly (cost saving). • Acceptability curve shows 100% probability of intervention to be to be below $50,000 per DALY cost-effectiveness threshold.	• The only equity concern is reductions in access of alcohol to those aged 18-20 years of age. However, this is exactly the age group that is most at risk	• Acceptability issues are important given legal age to vote is 18 years of age. • The intervention may be more acceptable to policy makers and politicians as it can address the issue with limited additional efforts. • Industry and lobby groups would oppose the ban given the potential lost patronage	• Other developed countries enact this law so a precedent is set • Intervention is feasible given infrastructure is in place to change legislation • Additional resources would be required to monitor the intervention to ensure sustainability	• There is limited scope for negative side effects related to health or economy. • There can be positive side effects like productivity gains due to decreased alcohol consumption, decreased road crashes (so called accidents), violence, crime and alcohol related health problems • The industry may cite loss of revenue and/or employment opportunities within the hospitality industry	• The evidence base, albeit not from Australia, is moderate. Evidence suggests adolescents and young adults consume alcohol at risky levels and are prone to alcohol related injury and death. If the government can change the culture of drinking through this intervention, it would influence alcohol related harm. • This appears to be a good buy in terms of potential cost-effectiveness

Results for random breath testing

Random breath testing is cost-effective with an ICER of $24,000 (95% UI: $10,000 - $76,000) (Table 15) This intervention is the most expensive of the strategies modelled, with an estimated cost of $71 million (discounted to 2003 figures). The potential cost offsets are estimated at $17 million, providing a net incremental cost of $54 million (95% UI: $35 million to $72 million). The health gain achieved from random breath testing is estimated at 2,300 DALYs averted (95% UI: 870 – 3,800). Figure 12 provides the cost-effectiveness plane for random breath testing and demonstrates that all results fall in the north-east quadrant. The acceptability curve in Figure 13 illustrates that there is a 90% probability that the intervention will be below the $50,000 per DALY threshold.

Table 11 considers a continuation of RBT against the key second filter criteria. The intervention is equitable given that all drivers have a chance of being stopped for a random breath test. The intervention does not however apply to those people drinking at harmful and hazardous levels who may not drive. Acceptability for this strategy is high given it is an existing policy instrument that has been used to address drink driving. Infrastructure is currently in place and workforce issues have been addressed. However, the intervention is very expensive and requires an ongoing commitment by government to provide funding and police to conduct the tests to ensure sustainability. The evidence base for this intervention is reasonably solid with CEA results suggesting good value for money in the majority of cases. The intervention is, however, very expensive and requires enforcement and continued education campaigns.

Figure 12: Uncertainty analysis of random breath testing

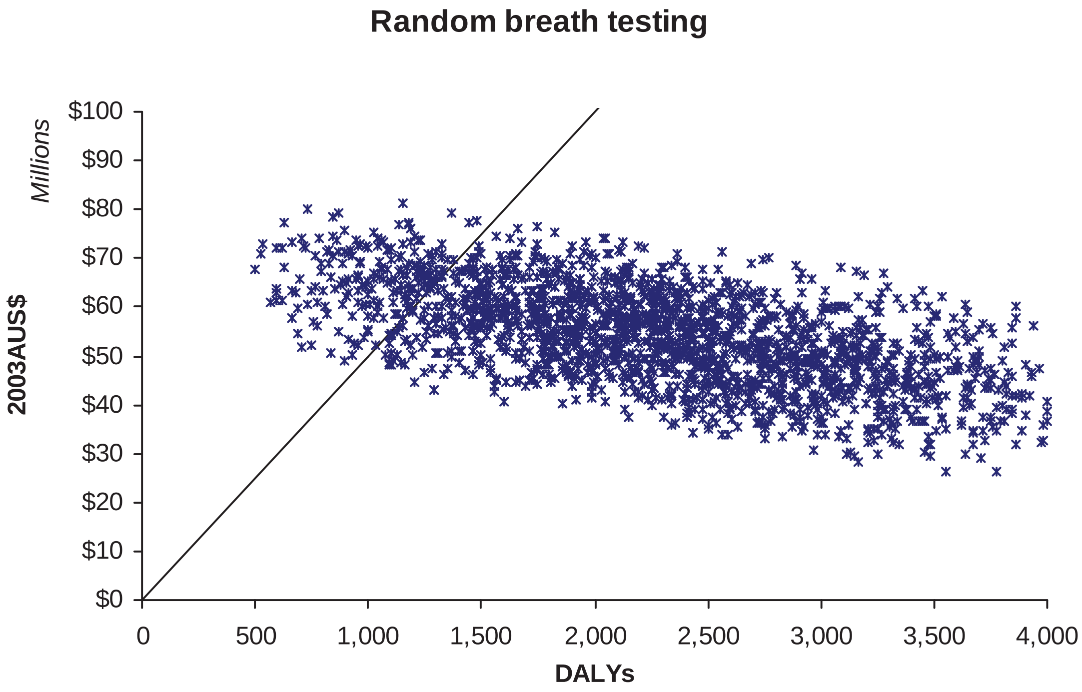


Figure 13: Acceptability curve of random breath testing

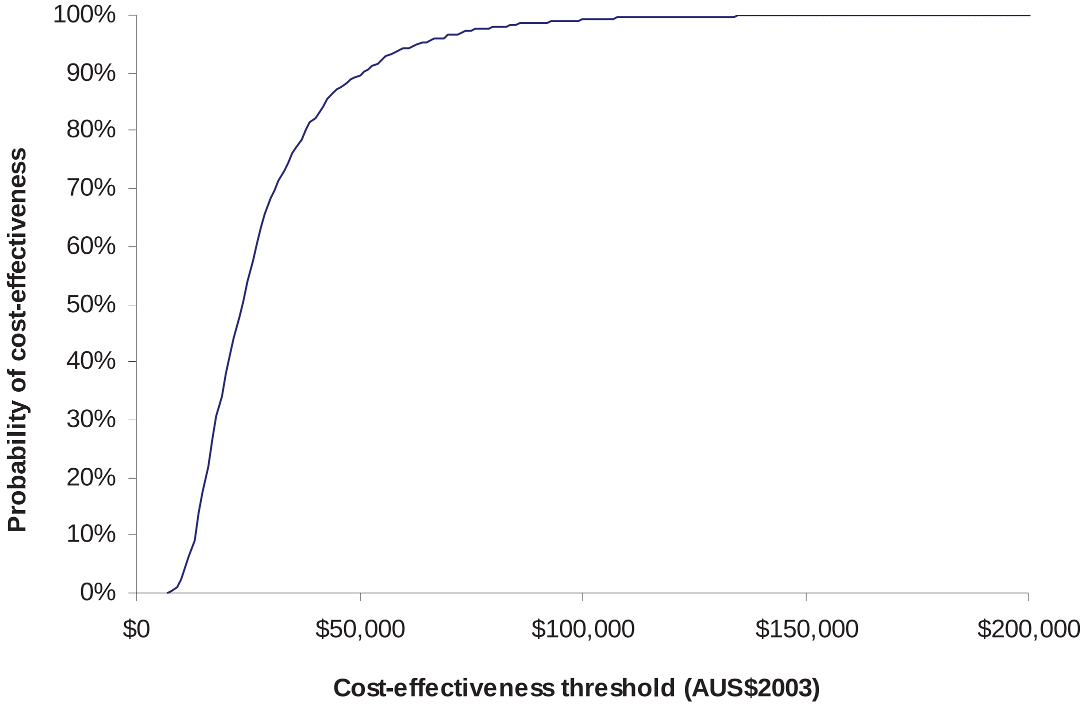


Table 11: Second filter criteria: Random breath testing

Discussion of ICER	Equity filter	Acceptability to stakeholders filter	Feasibility & Sustainability filters	Potential for side effects filter	General comments
• The majority of the ICER results are located in north - east quadrant of the cost effective plane • Acceptability curve shows 90% probability of intervention to be below $50,000 per DALY cost-effectiveness threshold.	• The intervention is equitable given that drivers have an equally random chance of being stopped for a RBT. • The intervention does not apply to those people drinking at harmful and hazardous levels who may not drive.	• Acceptability is high given it is an existing strategy	• Infrastructure is currently in place and workforce issues have been addressed. • The intervention is very expensive and requires an ongoing commitment by government to provide funding and police to conduct the tests to ensure sustainability. • Police are very busy so the opportunity cost of their time has to be considered.	• There are limited scope for negative side effects related to health or economy • There can be positive side effects like productivity gains due to decreased alcohol consumption, decreased road crashes (so called accidents), violence, crime and alcohol related health problems	• The evidence base for this intervention appears reasonably solid with CEA results suggesting good value for money in the majority of cases. • The intervention is, however, very expensive and may reach saturation point once drivers are properly educated about dangers of drinking and driving.

Results for drink driving mass media campaign

The drink driving mass media campaign intervention is cost-effective with an ICER of $14,000 (95% UI: $7,200 - $460,000) (Table 15). It is estimated to cost around $39 million (discounted to 2003 figures) to implement and enforce, with potential cost offsets estimated at $11 million, providing a net incremental cost of $28 million (95% UI: $16 million - $42 million). The health gain achieved from drink driving mass media campaign is estimated at an additional 1,500 DALYs averted (95% UI: 80 – 2,300). Figure 14 provides the cost-effectiveness plane for drink driving mass media campaign and demonstrates that all the results fall in the north-east quadrant. The acceptability curve in Figure 15 shows that the intervention has an 80% probability of being below the $50,000 per DALY cost-effectiveness threshold.

Table 12 considers some of the key second filter criteria of implementing mass media campaign targeting drink driving. The equity aspects for this intervention tend to be minimal given the restrictions would affect the population as a whole. It is envisaged that there may be widespread acceptability of this interventions by all stakeholders. The intervention is feasible given infrastructure is in place and a precedent has been set by tobacco control restrictions. Sustainability of the program is possible only with on-going additional resource inputs and monitoring. Although the evidence base for this intervention is reasonably weak, the strategy itself is widely promoted as an important component of any strategy to minimise alcohol abuse and one that fits well with RBT. This appears to be generally a reasonable buy in terms of potential cost-effectiveness.

Figure 14: Uncertainty analysis of drink driving mass media campaign

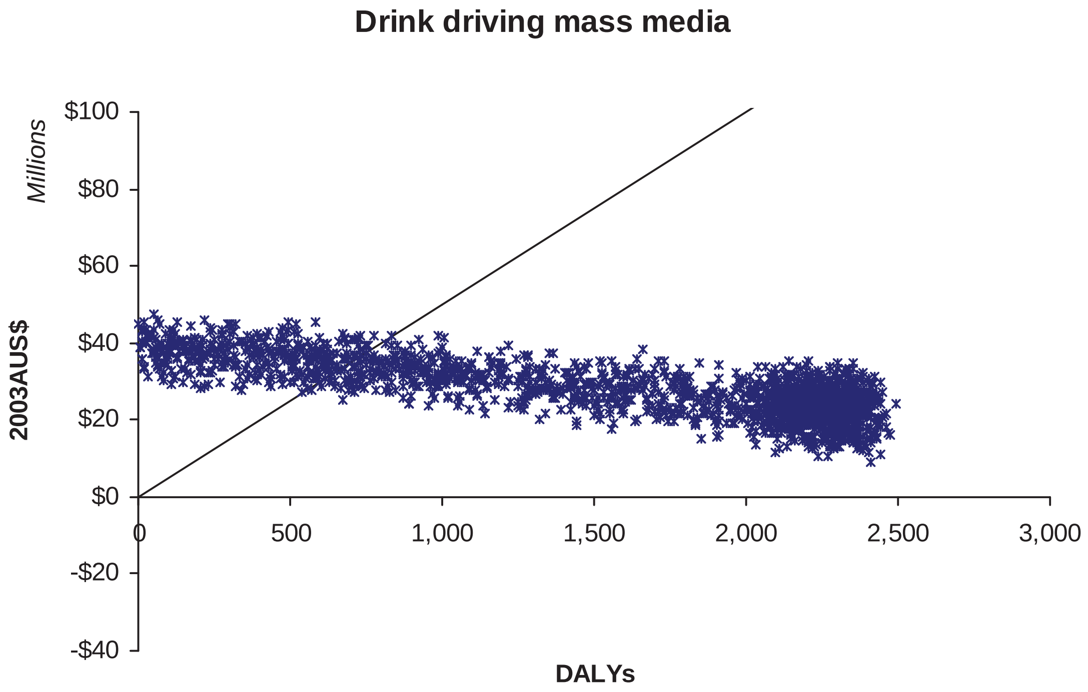


Figure 15: Acceptability curve of drink driving mass media campaign

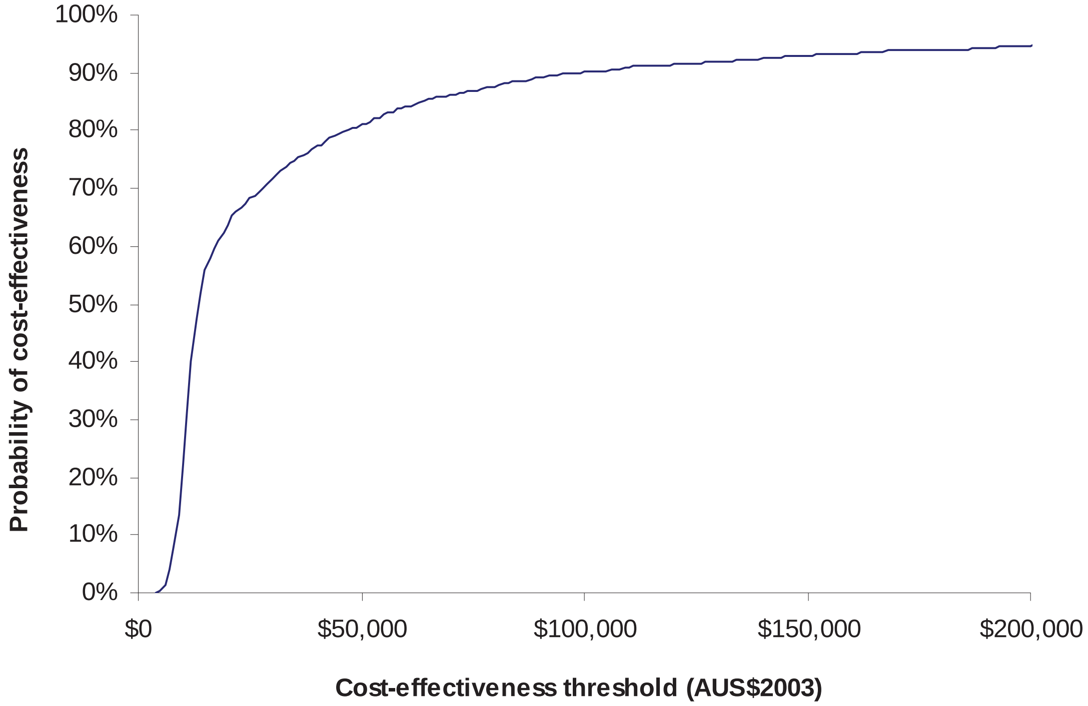


Table 12: Second filter criteria: drink driving mass media campaign

Discussion of ICER	Equity filter	Acceptability to stakeholders filter	Feasibility & Sustainability filters	Potential for side effects filter	General comments
• All of the ICER results are located in north-east quadrant of the cost effective plane • Acceptability curve shows 80% probability of intervention to be below $50,000 per DALY cost-effectiveness threshold.	• The intervention is equitable given it will be applied across the board with no exception – smoking control is a good example of how media campaigns can promote universal support and encourage reduction in risky behaviour	• It may be more acceptable to policy makers and politicians as it can address the issue with limited additional efforts with in the health care context. • Industry and lobby groups should support a media campaign to encourage responsible drinking	• A hypothecated tax could fund this intervention • Intervention is feasible given infrastructure is in place and precedent has been set by tobacco control • Sustainability of the program is possible only with ongoing additional resource inputs and monitoring.	• There are limited scope for negative side effects related to health or economy • There can be positive side effects like productivity gains due to decreased alcohol consumption, decreased road crashes (so called accidents), violence, crime and alcohol related health problems	• Although the evidence base for this intervention is reasonably weak, the strategy itself is widely promoted by the WHO and leading academics as an important component of any strategy to minimise alcohol abuse • This appears to be a reasonable buy most of the time in terms of potential cost-effectiveness. • The wide confidence interval suggest better data may be required to confirm results

Results for brief intervention with / without support

Brief intervention by a general practitioner is cost-effective with an ICER of $6,800 (95% UI: $1,200 - $17,000) (Table 15). This intervention is estimated to cost around $2.3 million (discounted to 2003 figures) to implement, with potential cost offsets estimated at $1.2 million, providing a net incremental cost of $1.1 million (95% UI: $0.2 million to $1.9 million). The health gain achieved from brief intervention is estimated at an additional 160 DALYs averted (95% UI: 92 – 250). Figure 16 provides the cost-effectiveness plane for brief intervention and demonstrates that all the results fall across both the north-east and south-east quadrants. The acceptability curve in Figure 17 demonstrates that the intervention has a 100% probability of being below the $50,000 per DALY cost-effectiveness threshold.

Brief intervention by a general practitioner with support is also cost-effective with an ICER of $10,000 (95% UI: $3,900 - $22,000) (Table 15). This intervention is estimated to cost around $6.1 million (discounted to 2003 figures) to implement, with potential cost offsets estimated at $2.6 million, providing a net incremental cost of $3.5 million (95% UI: $1.6 million to $5.5 million). The health gain achieved from brief intervention with support is estimated at an additional 340 DALYs averted (95% UI: 190 – 530). Figure 16 provides the cost-effectiveness plane for brief intervention and demonstrates that all the results fall across both the north-east and south-east quadrants. The acceptability curve in Figure 17 demonstrates that the intervention has a 100% probability of being below the $50,000 per DALY cost-effectiveness threshold.

Table 13 considers some of the key second filter criteria of a nation-wide expansion of brief interventions by general practitioners. This intervention applies to those people who visit their GP. A proportion of young and healthy people who consume alcohol at harmful and hazardous levels may not visit their GP. Similarly, people who do not have easy access to a GP due to social, geographical, ethnic, health or economic constraints may be excluded from receiving the intervention. The intervention is acceptable to policy makers and politicians because it can address risky alcohol use with limited additional efforts within the health care setting. However, the intervention needs time, motivation and commitment from GP which is one reason why we have modelled a modest uptake by GPs. This may require additional training to ensure interest and motivation among the GPs. Feasibility is not an issue given training and orientation of GPs currently exist. With additional effort training can be more widely offered and promoted within the existing systems and structure of health care delivery.

Sustainability of the program is possible only with ongoing additional resource inputs and monitoring. This will need institutional mechanism to keep up the motivation of GPs, regular monitoring and feedback and refresher training. Methods can be developed to deliver these interventions within the existing primary care system. The evidence base for this intervention is strong and, based on the results of the cost-effectiveness analysis and second filter criteria, the intervention represents a good use of scarce health care resources.

Figure 16: Uncertainty analysis of brief intervention with / without support

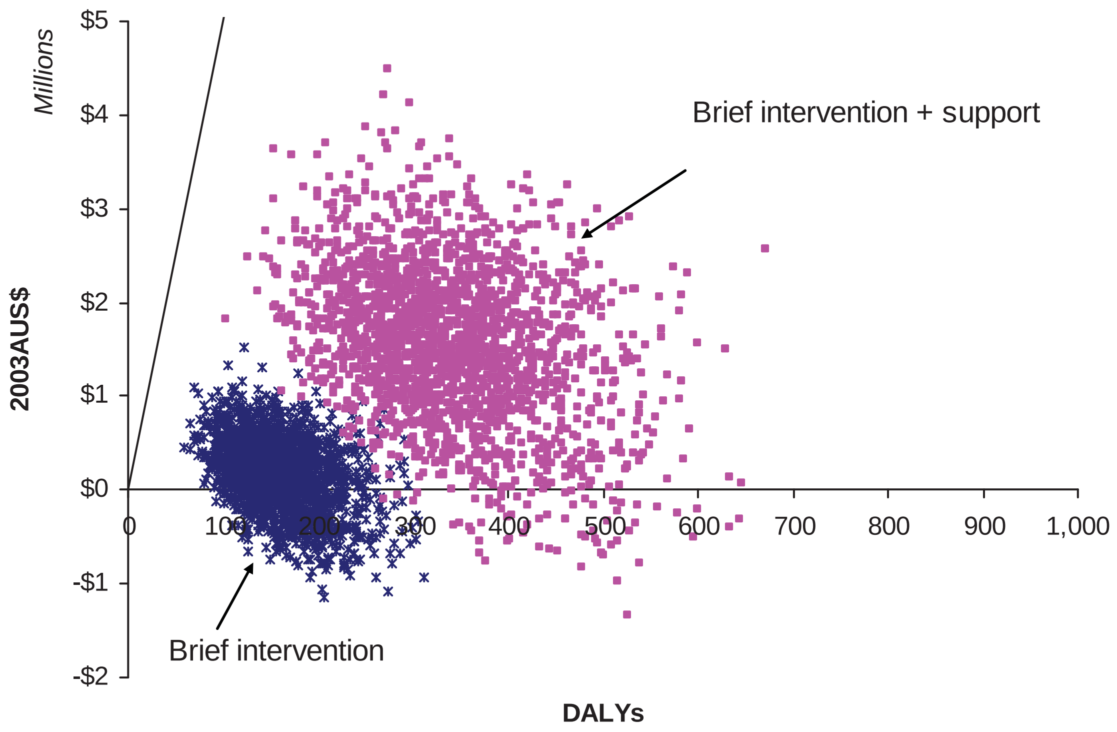


Figure 17: Acceptability curve of brief intervention with / without support

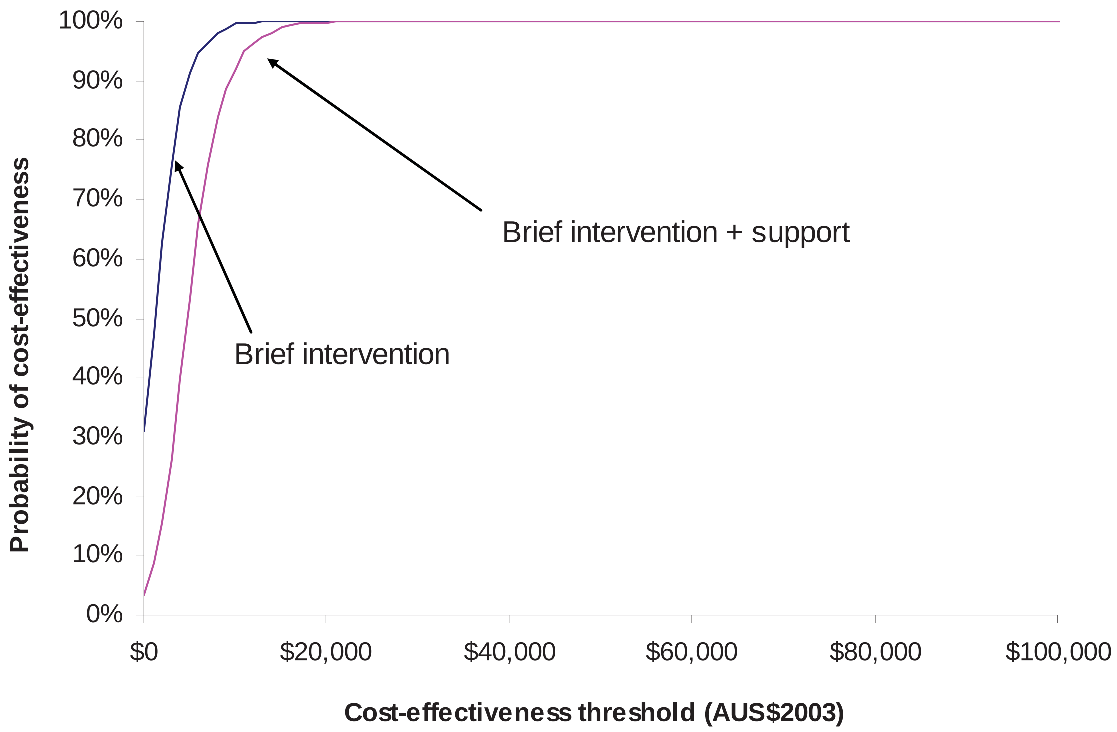


Table 13: Second filter criteria: Brief intervention

Discussion of ICER	Equity filter	Acceptability to stakeholders filter	Feasibility & Sustainability filters	Potential for side effects	General comments
• ICER results are located in both the north-east and south-east quadrant (dominant quadrant) of cost effective plane suggesting the intervention is more effective and less costly (cost saving). • Acceptability curve shows 100% probability of intervention to be below $50,000 per DALY cost-effectiveness threshold.	• Only those people who visit GP will be subjected to this intervention. • A proportion of young and healthy people who consume alcohol at harmful and hazardous levels may not visit their GP. • Similarly, people who do not have easy access to GP due to social, geographical, ethnic, health or economic constraints may be excluded by the intervention. • If reporting the quantity of alcohol intake is considered a taboo in the society (especially if it is not accepted social norm) there may be under reporting and thus some people may be excluded from intervention.	• Acceptable to policy makers and politicians as it can address the issue with limited additional efforts • This intervention would need time, motivation and commitment from the GP. • GPs may need additional training for which interest and motivation among the GPs is essential. • In general, people are likely to be open for health advice from the GPs. • Some people who do not perceive their alcohol consumption is hazardous to health may not be open to the GP briefing. On extreme cases some of them may avoid visiting GPs to avoid discussing about alcohol during each visit (especially if they perceive GP as "preaching GP")	• It is feasible intervention as the training and orientation of GPs would be possible with some resource inputs. One can instil a reasonable motivation by GPs to perform this intervention by conducting training and performing regular monitoring and enforcing the reporting. • Thus with some additional resource and efforts this can be implemented with in the existing systems and structure of health care delivery. • Sustainability of the program is possible only with ongoing additional resource inputs and monitoring. This will need institutional mechanism to keep up the motivation of GPs, regular monitoring and feed back and refresher training. A mechanism can be worked out to deliver these with in the existing systems and service delivery context.	• There are limited scope for negative side effects related to health or economy • There can be positive side effects like productivity gains due to decreased alcohol consumption, decreased road crashes (so called accidents), violence, crime and alcohol related health problems	• The evidence base for this intervention is strong • This is a reasonable intervention based on the cost-effectivenes s and other second filter criteria. • It will, however, require good planning and systematic efforts for implementat ion.

Results for residential treatment with / without naltrexone

Residential treatment for alcohol dependence is cost-ineffective compared to current practice, with an ICER of $190,000 (95% UI: $134,000 - $270,000) (Table 15). This intervention is estimated to cost around $37 million (discounted to 2003 figures) to implement, with potential cost offsets estimated at $1.7 million, providing a net incremental cost of $35 million (95% UI: $33 million - $37 million). The health gain achieved from residential treatment is estimated at an additional 190 DALYs averted (95% UI: 130 – 640). Figure 18 provides the cost-effectiveness plane for residential treatment. All the results fall in the north-east quadrant, the majority to the left of the cost-effectiveness threshold. These results are further demonstrated by the acceptability curve in Figure 19, which demonstrates that the intervention is 100% likely to be cost-ineffective (i.e., above the $50,000 per DALY cost-effectiveness threshold).

Residential treatment for alcohol dependence with a 12 week period of Naltrexone (with a comprehensive support program) is also cost-ineffective compared to current practice, with an ICER of $120,000 (95% UI: $84,000 - $170,000) (Table 15). This intervention is estimated to cost around $59 million (discounted to 2003 figures) to implement, with potential cost offsets estimated at $4.4 million, providing a net incremental cost of $55 million (95% UI: $52 million to $57 million). The health gain achieved from residential treatment + naltrexone is estimated at an additional 460 DALYs averted (95% UI: 320 – 640). Figure 18 provides the cost-effectiveness plane for residential treatment + naltrexone. All the results fall in the north-east quadrant, the majority to the left of the cost-effectiveness threshold. These results are further demonstrated by the acceptability curve in Figure 19, which demonstrates that the intervention is 100% likely to be cost-ineffective (i.e., above the $50,000 per DALY cost-effectiveness threshold).

Table 14 shows the second filter criteria for this intervention. This intervention may not fulfil equity criteria because it only includes those drinkers who are willing to stop or reduce their alcohol consumption and have expressed a commitment to do so. This would probably happen in only small proportion of people who have health problems related to alcohol consumption. This intervention is also less likely to include people who have limited access to knowledge and services because of social, economical and geographical reasons. On the other hand, one can argue that the intervention is more equitable than population wide strategies because it reaches the people who need the intervention most; those who are alcohol dependent and facing social and health problems. Residential treatment is likely to be more acceptable to both service providers and receivers. The intervention is feasible with more effort from both service provider and receiver.

Given this type of intervention is resource intensive, it requires a team of professionals to perform the intervention. It would therefore require additional resources and individual level planning for services provision. It is sustainable as long as the team of professionals and resources are available. Overall, however, this is the least preferred intervention based on cost-effectiveness and second filter criteria.

Figure 18: Uncertainty analysis of residential treatment with/without naltrexone

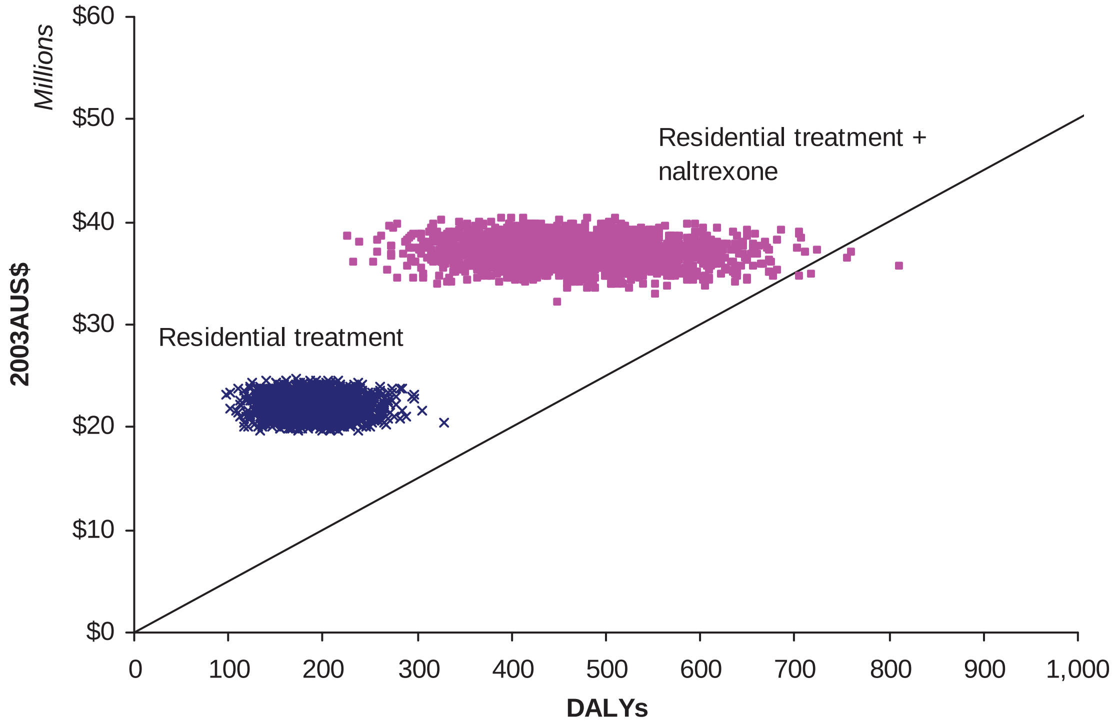


Figure 19: Acceptability curve of residential treatment with / without naltrexone

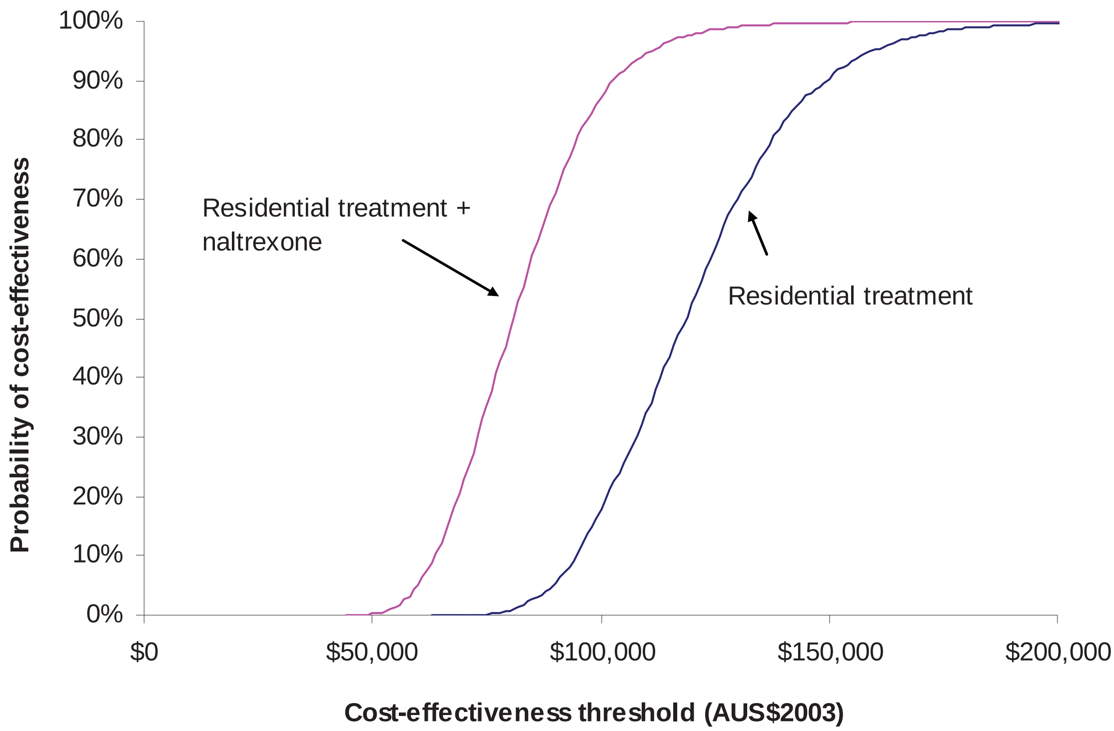


Table 14: Second filter criteria: Residential treatment with / without naltrexone

Discussion of ICER	Equity filter	Acceptability to stakeholders filter	Feasibility & Sustainability filters	Potential for side effects filter	General comments
• Most of the results are above the threshold of $50,000 limit suggesting the intervention is not cost-effective. • Acceptability curve shows nearly 0% probability of intervention to be below $50,000 per DALY cost-effectiveness threshold.	• Intervention applies to those who are willing to stop alcohol consumption and have taken definitive steps to do so. Thus others who consume lot of alcohol may not get the intervention • This intervention is less likely to include people who have limited access to knowledge and services due to social, economical and geographical reasons or those who are not willing to change their practice as they may not be in a position to initiate necessary steps to avail this service. • The intervention is more equitable as this reaches to the people who need the intervention most; who are alcohol dependent and facing social and health problems.	• Residential treatment is likely to be more acceptable to both service providers and receivers. • As service provider can visualize the alcohol dependence related health condition (also social condition) is likely to be more motivated in providing the services. • As this program has some visibility it is likely to appeal policy makers/politicians too. • It may be less acceptable to third party funders as they may have to partially cover the expenses of the intervention. • It may be more acceptable to private health care providers as they may earn more revenue.	• This is feasible with more effort from both service provider and receiver. Since this is approach that is more comprehensive, it will need a team of professionals to perform the intervention. It would need more resources, and individual level planning for services provision. • It is sustainable as long as the team of professionals and resources are available.	• There can be some side effects due to medications provided which is unlikely to be very serious. • There can be some economic consequences (burden) related to health care spending by the health care delivery systems and service receivers. • There can be some stigmatization like "branding as alcoholics" for those who receive the services • May be some positive side effects of productivity gains	• This is least preferred intervention based on the cost-effectiveness (not recommended) and second filters criteria. • However this intervention may capture some interest among the government and policy makers

Results of interventions against current practice

Table 15 provides results for all interventions modelled in ACE-Alcohol. All interventions are compared against current practice with the exception of RBT which is evaluated against a partial null. This provides an opportunity to evaluate how cost-effective current practice is compared to other interventions. Although the results for interventions have been individually discussed above, presenting results for all the interventions provides an opportunity to highlight key differences between the strategies. For example, the health gains that can be achieved, measured by DALYs, ranges from 150 (95% uncertainty interval (UI): 79 – 260) for increasing the minimum legal drinking age to 11,000 (95%UI: 6,000 – 16,000) for taxation. With the exception of increasing the minimum legal drinking age to age 21, which benefits only those aged between 18 and 20 years, the interventions that target hazardous and harmful drinkers (brief intervention with / without support) or alcohol dependents (residential treatment with / without naltrexone) avert fewer DALYs than the population-wide interventions. There is also substantial variability in the intervention costs. These range from $0.58 million (95%UI: $0.47 million – $0.69 million) for taxation increases to $71 million (95%UI: $57 million – $85 million) for random breath testing.

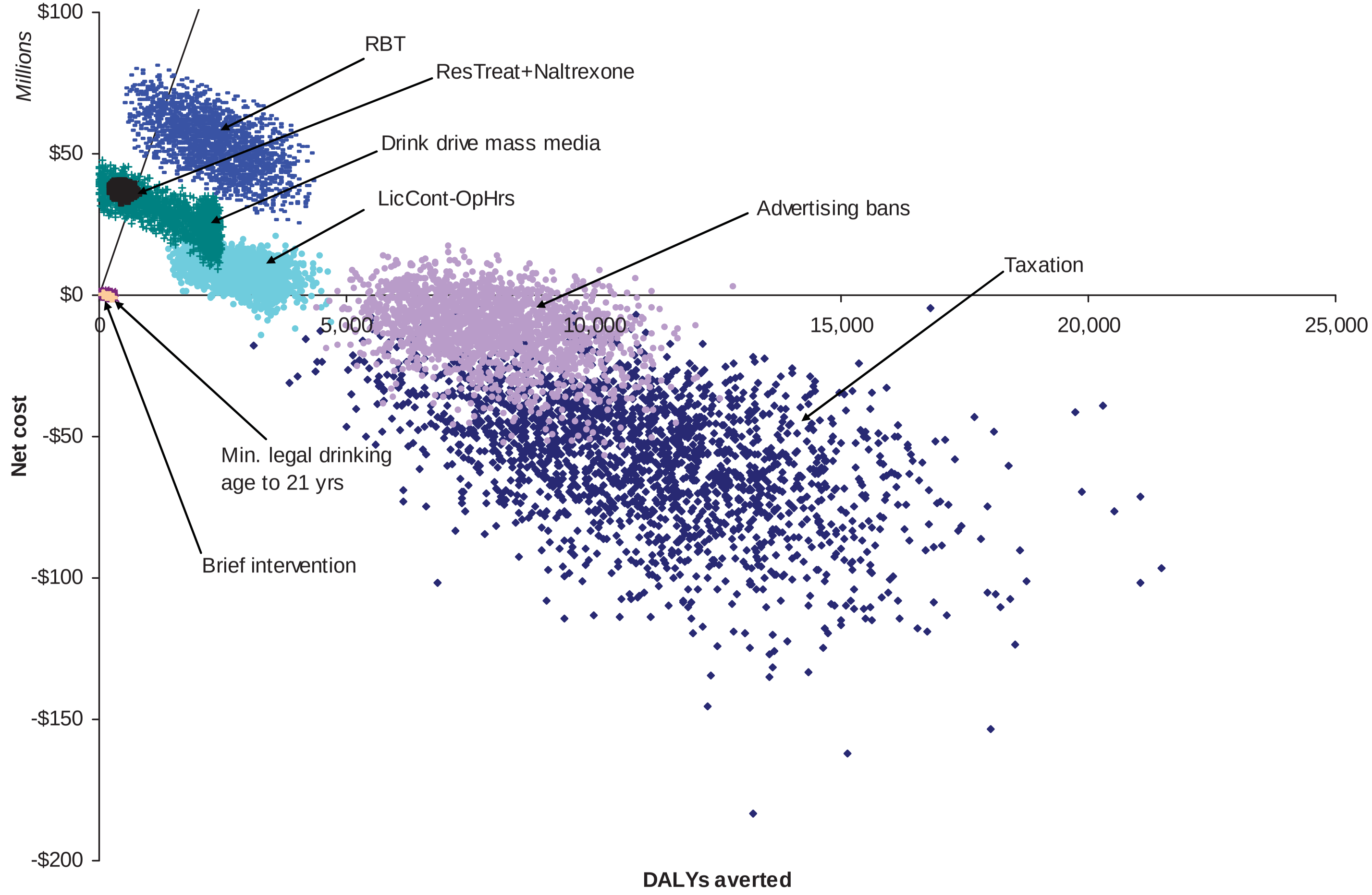
Figure 20 provides the results of the uncertainty analysis, plotted on a cost-effectiveness plane, for all interventions. Consistent with the presentation of uncertainty analysis for individual interventions, the straight line located in the northeast quadrant represents the threshold of cost-effectiveness set as $50,000 per DALY averted. When compared with current practice, the interventions predominantly fall in the northeast and southeast quadrants of the cost-effectiveness plane. This indicates that they have a high probability of improving population health while either increasing expenditure on alcohol interventions or, in some cases, the intervention produces a net cost saving. Two interventions stand out as being most effective and cost-effective: volumetric taxation and advertising bans. Both of these interventions are dominant and have a high probability of being cost-effective. Increasing the minimum legal drinking age to 21 years is also dominant, although less effective overall because it affects drinkers in a narrow age range. All other interventions have a high or very high probability of being under the $50,000 per DALY cost-effectiveness threshold. The exception is residential treatment for alcohol dependence (with or without naltrexone) which is not cost-effective.

Table 15: Results of interventions against current practice

Intervention	DALYs averted	Cost Offsets ($million)	Intervention Cost ($million)	Net Cost ($million)	Median ICER ($/DALY)
Taxation	11,000 (6,000 – 16,000)	-$57 (-$108 – -$20)	$0.58 ($0.47 – $0.69)	-$56 (-$110 – -$18)	Dominant (Dominant – Dominant)
Advertising bans	7,800 (5,500 – 11,000)	-$31 (-$57 – -$12)	$20 ($16–$24)	-$12 (-$37–$7.4)	Dominant (Dominant – $1,100)
Licensing controls	2,700 (1,700 – 4,000)	-$11 (-$21 – -$4.0)	$20 ($16–$24)	$8.7 (-$1.6–$17)	$3,300 (Dominant – $8,300)
Brief intervention	160 (92 – 250)	-$1.2 (-$2.1 – -$0.6)	$2.3 ($1.6–$3.2)	$1.1 ($0.25–$1.9)	$6,800 ($1,200 – $17,000)
Brief intervention + telemarket. + suppo	340 (190 – 530)	-$2.6 (-$4.6 – -$1.3)	$6.1 ($4.4–$8.1)	$3.5 ($1.6–$5.5)	$10,000 ($3,900 – $22,000)
Residential treatment	190 (130 – 260)	-$1.7 (-$2.5 – -$1.2)	$37 ($35–$38)	$35 ($33–$37)	$190,000 ($134,000 – $270,000)
Residential treatment + naltrexone	460 (320 – 640)	-$4.4 (-$6.3 – -$2.8)	$59 ($57–$61)	$55 ($52–$57)	$120,000 ($84,000 – $170,000)
Random breath testing	2,300 (870 – 3,800)	-$17 (-$31 – -$5.8)	$71 ($57–$85)	$54 ($35–$72)	$24,000 ($10,000 – $76,000)
Minimum legal drinking age to 21 yrs	150 (79 – 260)	-$0.8 (-$1.6 – -$0.4)	$0.64 ($0.51 – $0.76)	-$0.16 (-$0.93–$0.31)	Dominant (Dominant – $3,700)
Drink driving mass media	1,500 (80 – 2,300)	-$11 (-$20 – -$0.6)	$39 ($32–$47)	$28 ($16–$42)	$14,000 ($7,200 – $460,000)

NB: Random breath testing results against partial null

Figure 20: Results of the uncertainty analysis for interventions



Results of optimal cost-effective expansion path: intervention pathway

From a policy point of view, a key strength of cost-effectiveness analysis is as an input into the allocation of resources. The data generated from ACE-Alcohol, using RBT as a proxy for current practice, suggest that current expenditure on RBT is around $71 million and results in an ICER of $24,000 per DALY averted. As highlighted from the preceding section, there are, however, most cost-effective options than RBT. Table 16 provides policy makers with the most efficient package of interventions, i.e., the optimal expansion path. The results suggest that the first intervention that should be adopted by the government is: volumetric taxation, followed by advertising bans, increase in minimum legal drinking age to 21 years, brief intervention, licensing controls, drink driving mass media campaign, random breath testing and then residential treatment with naltrexone. The expansion path looks at the most cost-effective package and in this regard brief intervention by a general practitioner with support and residential treatment alone are omitted given that they are less efficient (i.e., less cost-effective) than brief intervention alone and residential treatment, respectively.

When combined as a package, the results suggest that the alcohol interventions could avert 26,000 DALYs (95%UI: 19,000 – 34,000 DALYs) at a total intervention cost of $210 million (95%UI: $190 million – $230 million). The costs of intervention would be partly offset by an estimated reduction of $130 million (95%UI: $64 million – $220 million) in the costs of treating alcohol-related diseases and injuries.

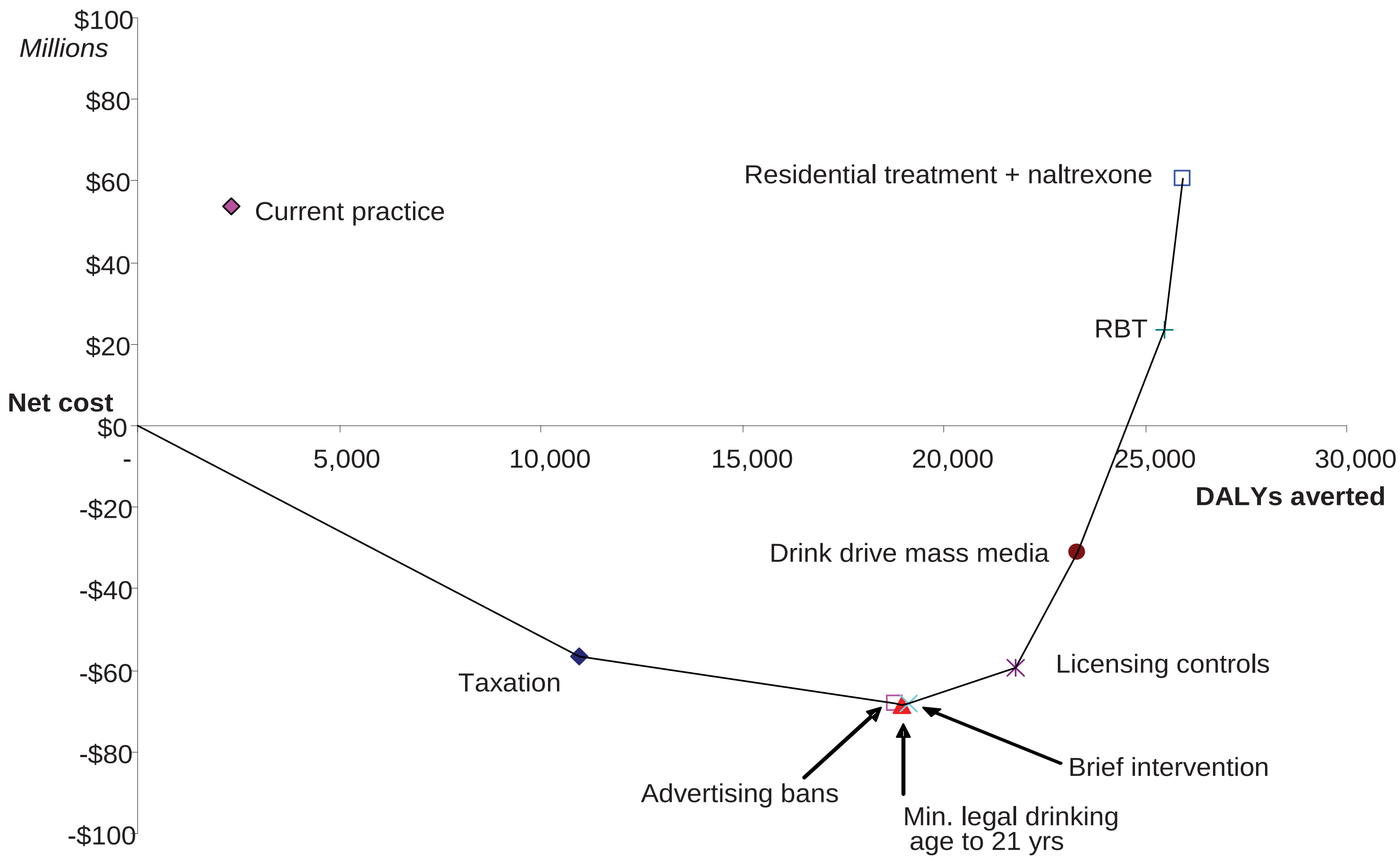
Figure 21 provides a graphical illustration of the expansion pathway using the cost-effectiveness plane. As can be seen the first six interventions on the pathway are located in the cost-saving south-east quadrant of the cost-effectiveness plane, suggesting that the package of these interventions would result in net savings to the government. The addition of RBT and residential treatment with naltrexone pushes the plane into the north-east quadrant as the interventions become incrementally less cost-effective. Current practice (i.e., RBT) is located in the north-east quadrant compared to the intervention pathway. This highlights the substantial improvement in population health that could be gained with more effective investment of the health dollars that are currently spent on alcohol interventions.

Taxation, at the start of the pathway, is clearly the best option, followed by advertising bans. At the other end of the pathway, residential treatment with naltrexone is clearly the least desirable option from a cost-effectiveness perspective. The order of the five interventions in the middle of the pathway is less clear. The pathway reflects the intervention order based on median cost-effectiveness, but there is considerable overlap in the distribution of points for each intervention from the Monte Carlo simulation. The first three of the five interventions (increases to the minimum legal drinking age, brief intervention and licensing controls) have a very high probability of being under the $50,000 per DALY threshold. They should probably be implemented ahead of the other two interventions (drink driving campaign and RBT) that have a lower probability of being under the $50,000 per DALY threshold and zero probability of being cost-saving (Table 18).

Table 16: Results of expansion path against partial null

Intervention	Median ICER ($/DALY)	Probability of being cost-saving	Probability of being < $50,000/DALY
Taxation	Dominant	100%	100%
Advertising bans	Dominant	85%	100%
Min. legal drink age to 21	Dominant	59%	100%
Brief int.	$7,000	0%	100%
Licensing controls	$3,500	4%	100%
Drink driving mass media	$14,000	0%	80%
Random breath testing	$26,000	0%	88%
Res. treat. + naltrexone	$120,000	0%	0%

Figure 21: Optimal expansion path for alcohol interventions



DISCUSSION

The purpose of ACE-Alcohol was to provide a comprehensive analysis of the cost-effectiveness of interventions to reduce the burden of harm associated with alcohol misuse in Australia. Using a consistent method it is envisaged that the results of this study may be compared with results from the wider ACE-Prevention project and the earlier WHO-CHOICE project.

The key findings from ACE-Alcohol suggest that all the prevention interventions modelled are more cost-effective in reducing alcohol-related harm than those that treat alcohol dependence. When taken as a package of interventions, all interventions modelled with the exception of residential treatment would result in a cost-effective investment portfolio. Compared to current practice, the optimal package could lead to a substantial improvement in population health at a cost of under $50,000 per DALY. Changes to volumetric taxation and banning of alcohol advertising should be a high priority for investment due to the high probability of cost-savings. Increasing the minimum legal drinking age to 21 years, brief interventions in general practice, increased licensing controls, drink driving campaigns and random breath testing are also likely to be cost-effective when judged against a $50,000 per DALY threshold. Only residential treatment for alcohol dependence (with or without naltrexone) is not cost-effective by this standard.

The results suggest that although random breath testing is cost-effective and is already being implemented in Australia, the same amount of $71 million that is currently spent on random breath testing would, if invested in more cost-effective interventions, achieve over ten times the amount of health gain.

In spite of these promising efficiency gains, the results of ACE-Alcohol need to be considered in terms of the second filter criteria. First, the strength of evidence underpinning the interventions is at best modest and the strength of evidence varies between interventions. The type of evidence ranges from modelling the effects of increased taxation on consumption, to analyses of pooled time series data (e.g. advertising bans, minimum legal drinking age) and the meta-analyses of randomised controlled trials (e.g. brief intervention).

Second, population-wide interventions, such as changes to taxation and advertising bans, may be more equitable than targeted interventions, such as residential treatment or brief interventions, which rely on access to a GP with the time to screen and deliver the intervention. This may disadvantage those in regional areas where GPs are in short supply and residential detoxification facilities are limited.

Third, alcohol manufacturers and retailers will oppose policies that reduce demand for alcohol and aim to reduce alcohol consumption. Further, consumers may not welcome increased alcohol prices or restrictions on access to alcohol products. Increasing the minimum legal drinking age will probably be unacceptable to most consumers under the age of 21 years.

Fourth, those interventions that are based on one-off legislative changes (e.g. changes to taxation and the minimum legal drinking age) may be most feasible and sustainable because the systems and infrastructure to implement and monitor the changes are already in place. The feasibility and sustainability of brief intervention and residential treatment are less certain because they depend on an adequate workforce of motivated GPs and other staff to provide counselling and treatment. The feasibility of interventions may also be affected by broader social cost implications that are not captured by taking a health sector perspective in the analyses. For example, including dead weight loss (i.e. loss of consumer surplus) associated with changes to taxation may affect the cost-effectiveness and feasibility of the taxation intervention from a broader social viewpoint.

The sustainability of intervention effectiveness is an important unknown in the cost-effectiveness analysis. Some interventions, such as random breath testing, are supported by more than 20 years of time series data. This suggests that they have a sustained effect, but for other interventions, such as residential treatment, the trials only include relatively short-term follow up and the sustainability of intervention effects is uncertain. Differences in intervention sustainability could affect the order of interventions in the expansion pathway but would not substantially alter the cost-effectiveness of the intervention package.

Fifth, there is little chance that alcohol interventions will reduce population health. Although there may be some loss of the putative protective effects of moderate alcohol use for ischaemic heart disease, gallbladder and bile duct disease, these small losses would be more than out-weighed by the population health gains from reducing all other alcohol-related diseases and injuries. There are also potentially positive effects of the interventions that we have not included in our analyses, such as productivity gains generated by decreases in alcohol-related disease and injury, reduced road traffic accidents, violence and crime.

ACE-Alcohol considers the ideal mix of interventions to alleviate the burden of harm from alcohol misuse in the adult Australian population. The analysis does not address issues relevant to the Indigenous population or vulnerable sub-groups of the population, other than dependent drinkers. These sub-studies are urgently required. Although the ACE-Alcohol methodology lends itself to these types of analyses, the resources available in the current project were insufficient to expand the analyses to these groups. Additional funding is being sought for these analyses. Further, ACE-Alcohol has attempted to use, where possible, local data. In some areas, such as cost of changing legislation, cost of raising the legal drinking age and cost of advertising campaigns, additional data sources were utilised. .

In spite of the shortcomings of ACE-Alcohol, the results provide policy makers with clear evidence on the cost-effectiveness of interventions to curb alcohol misuse. By re-allocating existing resources committed to reducing alcohol-related harm, policy makers could achieve over ten times the health gain for the same level of investment. Given the scarcity of resources and the ever increasing fiscal restraint imposed by governments, it is hoped that these results may be adopted by policy makers in order to reduce the current burden of harm that alcohol imposes on our society.

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