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Cost Savings of Brief Alcohol Interventions in Primary Health Care

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Disclaimer

The analysis and conclusions of this report remain the work of Sapere Research Group, and do not necessarily represent the views of members of the expert reference group or of the Alcohol Advisory Council of New Zealand (ALAC) who commissioned the report.

Executive summary

Sapere Research Group was commissioned by ALAC to estimate the short-term health care cost savings from the use of alcohol brief interventions (BIs) in general practice and emergency departments (EDs). The study had two main components: a literature review of existing research; and the development of a model to estimate the short-term cost savings. The literature review was used to inform the development of the model for a New Zealand setting. An expert reference group also provided guidance on the literature review and model development.

BIs for the reduction of hazardous use of alcohol are highly likely to produce positive fiscal returns for the New Zealand health system, if implemented widely in general practice and ED settings. A decision tree model, based on parameter values derived from the international research literature and from expert advisors in New Zealand, estimates a positive return on investment of implementing BIs. An investment of $1 in BIs in general practice is estimated to produce a return of $1.74 over three years, while in an ED setting the return for $1 is $2.48 over three years.

This finding represents an opportunity to achieve improved health status for a substantial population of people, while reducing cost pressures on health services.

If applied to the New Zealand population as a whole, the magnitude of cost saving from a single year of investment in the programme, once the direct costs of providing the programme are covered, is estimated to be approximately $4 million over three years, from a single year of investment in the programme. Absolute cost savings are likely to be smaller initially and to increase over time, as the benefit of reduced alcohol use on short-term injuries is accompanied by longer-term effects on chronic disease prevalence and severity.

Where there was uncertainty in the model parameters, values were chosen from the conservative end of the range. The results estimated in this study have been tested for sensitivity to key parameters. The fundamental conclusion of positive fiscal gain from BIs is robust to considerable variation in the parameters used in the decision tree model.

Implementation issues were not within the scope of this study, but some key considerations arose from the analysis. In particular, the implementation of BI within the context of an effective screening mechanism will be an important factor in creating an effective programme that realises the potential gains identified in this analysis.

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1 Introduction

ALAC commissioned Sapere Research Group to estimate the potential cost savings to the health system through brief interventions (BIs) in primary health care to reduce the hazardous use of alcohol. The project aimed to estimate the short-term savings in health care costs that could be realised in a New Zealand setting, the scope specifically limited to the fiscal cost of alcohol to the health system.

The study has two components: a literature review of existing research on the effectiveness of BIs; and the development of a model to apply the literature review findings to a New Zealand setting. The scope of the project did not cover new primary analysis or data collection, but was intended to cover the collation and application of existing information to a cost consequences model. The specific design and implementation of a BI is not a part of this project, although of necessity the general properties, and particularly the cost, of providing such an intervention were considered.

The wider project goal is to inform ALAC's development of strategies to encourage generalist health services to respond to harmful alcohol use. The findings are intended to contribute to decision-making on the implementation of BIs in primary health care settings. In particular, the settings of general practice and emergency departments (EDs) have been considered explicitly, although many of the issues and results discussed here may be applicable to other health care settings such as sexual health clinics and mental health services.

1.1 Approach

While there has been a considerable amount of published research on the subject of BIs for the hazardous use of alcohol, specific research in a New Zealand setting is less commonly found. Therefore the parameters of the model to be developed as part of this project are, of necessity, a combination of carefully assessed published data with judgements made on the basis of experience. To this end an expert reference group was convened in order to provide advice on, and in particular to inform decisions about, the application of evidence in a New Zealand setting and to make judgements informed by experience where the published literature does not provide the necessary parameters, or is not easily applicable in New Zealand.

The expert reference group comprised:

- Dr Paul Quigley, Emergency Department at Wellington Hospital
- Dr Helen Moriarty, Department of Primary Health Care and General Practice, University of Otago Wellington

- Ms Eileen McKinlay, Department of Primary Health Care and General Practice, University of Otago Wellington
- Dr Barry Jackson, University of Bloomsburg, Pennsylvania.

The expert reference group members' expertise covers New Zealand ED and general practice services, medical and nursing perspectives, and specialist research in the management of alcohol use. Sapere Research Group remains the author of this report, and is responsible for any errors and omissions.

An early meeting was held with the expert reference group. This addressed published literature on BIs, and set some of the broader parameters for designing the model. Further comment from the reference group was sought on an individual basis, in order to identify aspects of the preliminary results that required further analysis and investigation.

The literature review was completed by Sapere staff, using the Medline and CINAHL databases. The results are summarised in this document, and a more complete discussion of the material found in the literature is included in Appendix One.

On the basis of the reviewed literature, a preliminary set of models was prepared to cover ED and general practice settings. The early results were then discussed with individual members of the expert reference group and fed back to ALAC for initial comment before further model development and sensitivity testing.

Inevitably there are elements of these findings that rely on assumptions. Assumptions have been clearly explained wherever possible, and should stimulate informed discussion about the final design of a BI programme.

2 Literature review: main findings

Appendix One provides more detail on the literature review. This section highlights the main findings that are relevant to the present study.

2.1 Screening

Implementing a BI raises the issue of how to identify who would benefit from receiving it. The starting point for a BI programme is therefore to establish the kind of screening that will take place in order to identify suitable individuals who will benefit most from the BI. The main points arising in the literature relevant to screening are:

- A range of health workers can effectively screen patients.
- Self-completed questionnaires can be effective.
- General practitioners (GPs) can be reluctant to raise alcohol issues in a consultation.
- Multiple screening of risk factors other than alcohol can be effective.
- New Zealand research has demonstrated the effective implementation of pre-screening for a number of lifestyle risks, including alcohol, in a general practice setting.
- Formally published evidence for the effective implementation of screening is available from EDs in other countries, but not as yet from New Zealand.
- A number of specific alcohol risk tools are available, but the Alcohol Use Disorders Identification Test (AUDIT) questionnaire tool is widely considered to be the gold standard in primary health care settings [1].
- Some other screening tools may be faster and less costly to implement than AUDIT, with some loss of sensitivity and specificity.

2.2 Nature of brief intervention

In delivering a BI, the issues that need to be addressed include where it should be delivered, how intensively it should be delivered, and who should deliver it. Key points from the literature are:

- A BI is usually defined as consisting of one to four sessions.
- As little as three to five minutes of simple advice from health care professionals can help patients to reduce their drinking.
- For many patients BI is as effective as more extended interventions.

- BI can be delivered equally effectively by a range of health care workers, including medical, nursing and social work professionals.
- A combination of physicians and other professionals is a common approach to delivering a BI.
- A follow-up contact, whether by telephone or in person, is often an element of BI.
- The literature is unclear on whether BIs can be delivered as effectively via web-based interfaces as in person. In some circumstances impersonal computer-based procedures may be more successful in addressing sensitive subjects such as an individual's alcohol use.

2.3 Effectiveness of brief intervention

BIs may be differentially effective for different people, in different settings, and when applied in different ways. The key results of reviews of the effectiveness of BIs are:

- BI has been found to be cost effective in both general primary care and emergency settings in international research.
- The effectiveness of BIs is reported in many different ways by different researchers, which makes comparisons of effectiveness between studies problematic.
- BI has been demonstrated to be effective in populations of adolescents, older adults, women, pregnant women and general populations.
- BI has been found to be effective in reducing alcohol consumption, and in avoiding health care activity.
- The continued effectiveness of BI has been found up to a period of four years from the initial intervention, although many studies follow up for only one year.
- The effectiveness of screening has a major impact on the overall population effectiveness (and implicitly the cost effectiveness) of BI.

2.4 Discussion

The literature on BI generally supports the view that implementing BI in a New Zealand primary health care setting is likely to bring benefits, both in terms of health status and quality of life, and in reducing the costs of alcohol-related health care. However, the literature does not provide definitive guidance on the preferred form of BI, leaving the specific design and therefore the implementation cost of an intervention an open issue.

The effectiveness of interventions is often reported in measures that do not directly map to measurable reductions in health care activity. For example, it is common to report a reduced average intake of grams of alcohol per person in an experimental group, compared with control. While reduced alcohol consumption is clearly associated with a reduced risk of requiring a variety of specific health care services, estimating the precise relationship between the number of reduced grams on average and reduced health care costs would require more detailed research than is presently available in a New Zealand setting, and would be a major exercise. Assumptions have therefore been made at the modelling stage, which reflect the tenor of research findings and the range of realistic possibilities in a New Zealand setting.

3 Modelling cost impacts in New Zealand

3.1 Nature of brief intervention

Without specifying the details of a BI, it is necessary to consider the general structure and approach so that enough parameters can be specified to produce a meaningful model. While it is explicitly not the purpose of this project to advise on the implementation of BI, enough detail is needed to be able to populate a model. Where aspects of the approach we have used raise further questions about implementation, we have aimed to identify and highlight those issues for discussion in a future implementation process.

The expert reference group advised using a three-stage structure, beginning with pre-screening, then using a specific alcohol screening tool, and finally proceeding to BIs for those who use alcohol hazardously. Without prescribing the implementation, it is envisaged that in practice this would work differently in the two settings being modelled.

3.1.1 General practice

A pre-screen could take the form of a single oral question, or a written or computer-based questionnaire that is completed by a patient, then coded or recorded by administration staff. For the purpose of this project we have implicitly assumed that the pre-screen would resemble the Case-Finding and Help Assessment Tool (CHAT) developed by Goodyear-Smith and colleagues [2], which asks a number of lifestyle questions and invites the patient to decide whether they would like to receive help in any of the identified areas. The implementation of CHAT might be considered problematic in some quarters – general practice staff might perceive the CHAT tool as time consuming and burdensome, and it is clearly the case that some GPs are reluctant to raise alcohol, and probably other lifestyle issues unprompted by a patient [3]. But Goodyear-Smith et al found a high level of acceptance among a large group of general practices, suggesting that the widespread implementation of the CHAT tool or something like it is probably feasible in a New Zealand general practice setting [2].

A further benefit of the CHAT approach is that patients are asked a number of lifestyle questions at once, as part of a routine contact. This minimises the intrusiveness of any one question, and helps to reduce any potential adverse responses to a specific query about alcohol, which patients may regard as intrusive and unwelcome. This is an important issue for patients, but also for general practice doctors and nursing staff, who need to maintain their individual relationships with the patients and are often concerned about alienating individual patients with unwelcome questions.

CHAT, or a similar pre-screening tool, can be conducted by practice administration staff, or even electronically, rather than by clinicians. This means that it need not be costly to implement universally.

We envisage that pre-screening could take place once a year, or where a patient has changed to a new practice. Practice electronic recall systems are easily able to provide reminders to practice staff, asking them to check patient information at specified time periods, and it would be possible for a practice receptionist to be electronically reminded to use the tool at the time they book a patient into the system on arrival at the waiting room.

After pre-screening, a more definitive tool should be used to assess hazardous drinking activity when indicated by answers to the pre-screen tool. AUDIT is considered the gold standard for these purposes, but a number of similar tools could also be used, such as the Paddington Alcohol Test (PAT).

The CHAT tool has a 44 percent positive predictive value relative to AUDIT [7]. The key difference is that AUDIT includes more detail on drinking patterns. The AUDIT tool is useful, firstly, in that the use of AUDIT has some element of BI itself and helps to reinforce the beneficial effect of the exercise. Secondly, AUDIT provides more information on the nature of the individual's drinking patterns than arises from a single pre-screening question, and this will be helpful in providing the BI itself. Finally, individuals with exceptionally high levels of alcohol use will need to be differentiated from lower-level users, so that suitable referrals can be made to specialist services.

We envisage that the actual BI would be provided in the general practice, and would last approximately five minutes. It could be provided by either a nurse or a doctor, and some proportion of people could be referred to the Alcohol Drug Helpline for a more extended intervention.[1] The BI for most people would involve being informed by the health professional that their drinking is potentially harmful and given some information and guidance on appropriate levels of drinking. Some studies would characterise this as a very brief intervention.

3.1.2 Emergency department

The ED setting is different from that of general practice, but BI can be developed in a broadly similar approach. Taking advice from the expert reference group, we modelled a conceptually similar three-stage process of: pre-screening; applying the

[1] The Alcohol Drug Helpline is an information, referral and intervention service, offering free confidential information, insight and support on problems to do with drinking and drug taking.

AUDIT tool; and BI. But the implementation of these would be somewhat different from the process in general practice.

The pre-screening component is probably the easiest element to incorporate into standard ED procedure, since people who present at ED are, if they are able, currently requested to complete a certain amount of paperwork for identification, ACC and other administrative purposes. Integrating a written question into existing systems would be straightforward, and the marginal addition of time would be negligible. It would be important to make sure that information elicited from the pre-screen is transmitted to the correct ED personnel who then manage the patient. The particular form of the pre-screen could once again be either a multiple element lifestyle questionnaire such as CHAT, or a single, direct question. Both approaches have merits, and this is one of the issues that will need to be addressed with experts in ED settings during any future implementation process.

Patients who scored positively on pre-screening would be asked to participate in a more complete screen, such as AUDIT, and then be offered BI. In the case of the ED setting we assume that a BI is somewhat shorter than the intervention that would be provided in the general practice setting, at three minutes on average. This assumption is based on expert advice that ED staff have more time constraints than staff in a general practice setting. We maintain the assumptions that it could be provided by either medical or nursing staff, and that some proportion of patients could be referred to the Alcohol Drug Helpline for more intensive counselling.

The precise nature of the BI programme as it would be implemented in the real world will require expert advice from health professionals, and an extensive process of design and development will be needed if there is to be the necessary buy-in and support from the clinicians who would be asked to do it. We believe that the outline of the screening and intervention approach described here could be workable, but have taken the process only as far as was necessary to provide reasonably realistic parameters for cost modelling. In comparison with international studies, we have assumed a very brief intervention in both the general practice and ED settings. This reflects both the expert reference group's advice about fitting BI into existing workflow processes, and a desire to use the least costly intervention available that is likely to deliver benefits.

3.2 Modelling methodology

We modelled the cost consequences of BI in primary health care by adopting a decision tree model with a probabilistic sensitivity analysis. This methodology involves simulating a cohort of patients passing through a series of different health states according to the underlying model. In this analysis, we develop a simulation in which patients move from a state of hazardous drinking to a state of not hazardous drinking with a probability derived from literature on the effectiveness of a BI.

The model makes a number of simplifying assumptions. Some of these are tested in our results by varying parameters in order to investigate effects, while others remain to be investigated further. The methodology follows a number of procedures recommended by Briggs et al [4].

The model was implemented in R, a statistical programming language that has rich facilities for simulation and data analysis [5].

For the purpose of this model we adopted a short-term perspective of cost impacts. This reflects the intention to consider the issue from the point of view of health care funders and providers, who have immediate imperatives to manage budgets. We calculated results based on one-year and three-year durations, reflecting common planning horizons for health service planning and funding. The time dependency of outcomes was not modelled.

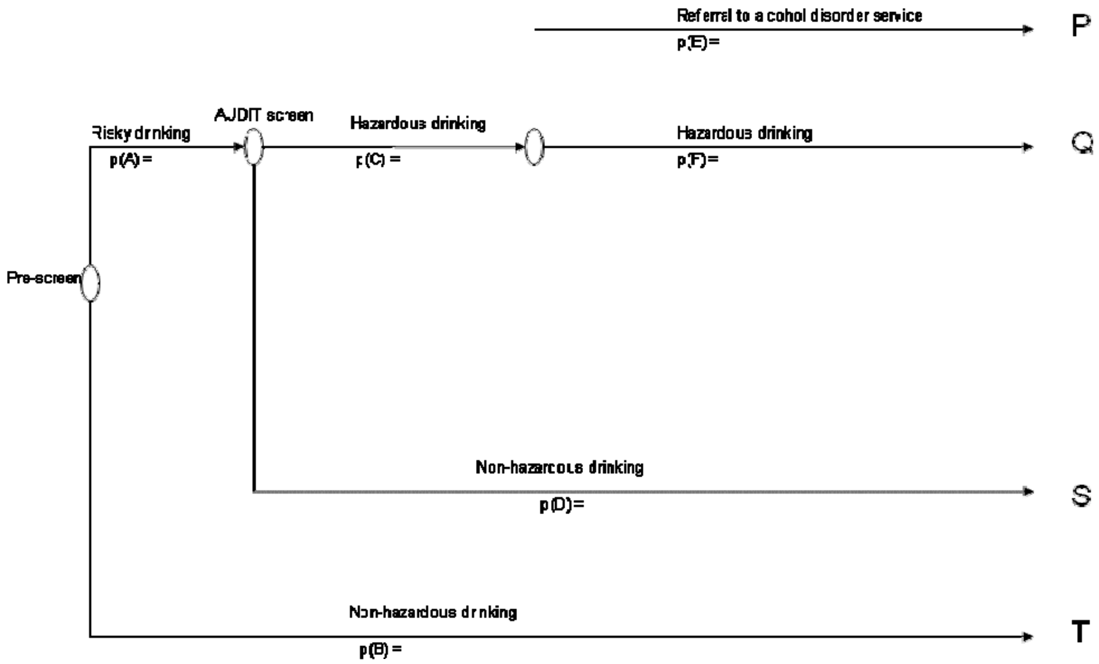
The structure of our model reflects the approach we have agreed upon for implementing a BI for alcohol screening in New Zealand outlined in Section 3.1. This is a three-stage model, with a universal pre-screening stage followed by specific assessments for the hazardous use of alcohol, and BI offered to those who are identified as appropriate.

Where heavy drinkers who abuse alcohol are identified, it is assumed that there will be referrals to specialist alcohol services.

There are two versions of the model, one for a world with no BI (Figure 1) and one in which BI is implemented (Figure 2). The difference between the two models represents the potential for fiscal cost savings to the health sector from implementing the BI. Including some common structure between the models means that assumptions can be tested by simultaneously varying parameters, both in the base model and in the counterfactual version with the potential BI.

The no-BI decision tree model is presented in Figure 1. The model is implemented by assigning a probability to each branch of the decision tree. Probabilities on each branch separating from a node or decision point must sum to 1.0. Probabilities are multiplied for each pathway along the branches of the tree in order to arrive at a probability of achieving the end state of each branch. A cost is assigned to each branch end state (labelled P to T), which can be multiplied by each branch probability and then summed across all branches. This produces an estimate of the expected cost value of the whole system, as depicted by the branch structure. Branches are labelled A to G, and the probability for each branch is depicted, for example, as p(A) (for the probability of branch A).

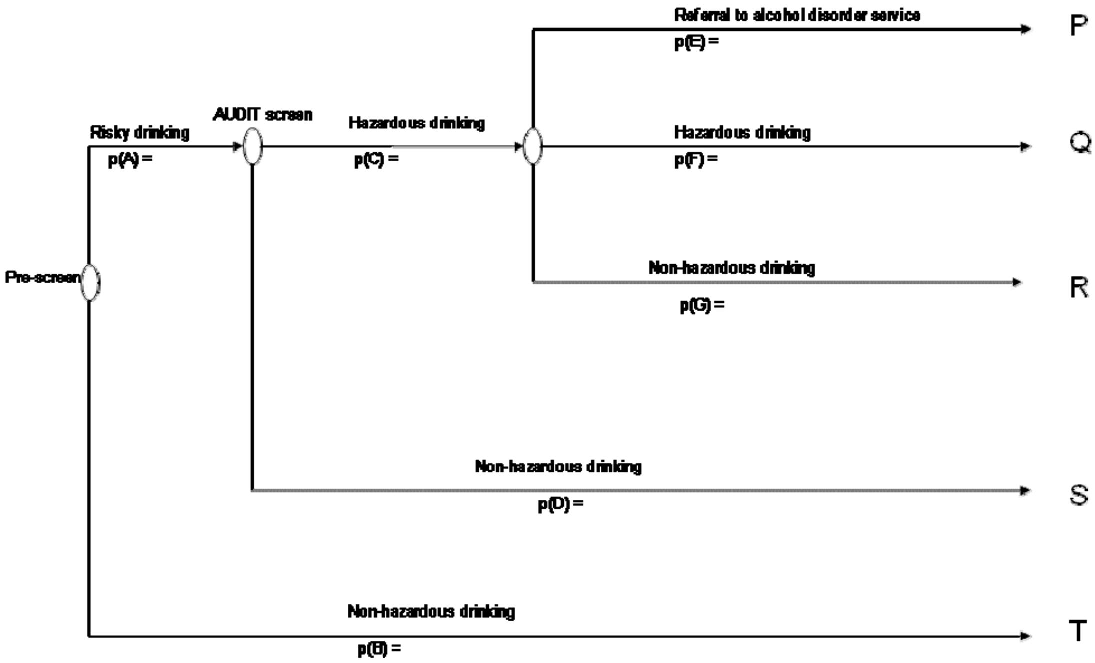
Figure 1: Decision tree – no brief intervention



The version of the model that includes BI (Figure 2) has the same structure, with the important difference that once a patient has been identified as a hazardous drinker by a screening tool such as AUDIT, after the BI they will, with some probability, change state to become a non-hazardous drinker. This in turn is associated with a lower cost to the health system (i.e. a person in state R will have a lower cost of alcohol-related health care than someone in state Q). The costs of actually providing each stage of screening and BI are added to the relevant arms of the model.

Where the information from the literature permits, each probability entered into the model is recalculated a large number of times for different possible values across a distribution. This approach allows an estimation of the sensitivity of the result on the specific value of the probabilities used in the model, and therefore an understanding of how much the result might change if the original probability estimates were not accurate.[2]

Figure 2: Decision tree – brief intervention



In practice the code for each of the two models, with and without BI, is nearly identical. In the base model with no BI a probability of zero is assigned to the branch that ends in state R (i.e. p (G) = 0), so that all patients remain in a hazardous drinking state. In the model with BI p(G) is assigned a positive probability, meaning that some people are moved to a less hazardous drinking state, with an associated cost reduction. The non-BI model includes no costs associated with pre-screening or screening.

We have provided for a proportion of individuals who are heavy abusers of alcohol to be referred to specialist alcohol services. For the purpose of this model we assume that the cost of providing the specialist services equals any avoided cost reduction in alcohol-related care for those individuals. It would be possible to

[2] The specific forms of the random distributions from which variables are drawn should be appropriate to the parameter being modelled. We used the beta distribution for each of the nodes where there are two possibilities, since the beta is the conjugate of the binomial distribution, and has the property of being bounded by 0 and 1, as is the case with a probability. We used a Dirichlet distribution to represent variability from the BI node in the intervention model, since there are three options that require a multinomial probability for the three possibilities.

estimate the effects of differing costs and benefits of such specialist services in future versions of the model.

Each of the two models is constructed twice, once for an ED setting and once for a general practice setting. The structure of the screening and BI is the same in both settings, but there are differences in the assumptions about screening probabilities and costs.

3.3 Sources and assumptions

The model relies on two types of assumption. The first are simplifying structural assumptions that inform the model structure. These allow a tractable model to be constructed with a limited number of parameters that can be readily understood and interpreted. All models are an abstraction of the real world – the key property of a successful model is that it should represent the relevant and important properties of the system being investigated.

The second class of assumptions informs the specific parameters that are used in the model. Wherever possible we have used parameters from published literature on alcohol screening and BI. But research reports do not always identify the precise parameter that is needed for the model, or report the details in a way that is useful for further analysis. In some cases the applicability of a published parameter to a New Zealand setting might be questionable. We therefore had to make assumptions about the parameters.

3.3.1 Structural assumptions

The model adopts the three-stage structure we have developed for implementing BI, with a pre-screen, a specific screen for drinking behaviour, and the provision of a BI. For the purpose of this model we have not explicitly allowed scope for a patient to decline a BI, although this issue can to some extent be allowed for by choosing a parameter for p(C) that allows for a smaller probability of being positive after the screening process.

The model in its raw state produces an average estimated cost saving in alcohol-related health care for an individual patient drawn from the population of general practice or ED attendees over one year. We have extended the model results to a three-year horizon, which in turn requires two further assumptions. The first is the number of people who, having ceased the hazardous use of alcohol, will return to hazardous use. Since the BI literature is largely focused on short-term studies, we have chosen to make a harsh assumption, which is likely to overestimate the number of people returning to alcohol use. We have used a figure of 50 percent recidivism each year. This conservative estimate makes it likely that the final result will be an underestimate of the return on investment.

The second assumption is a discount rate, reflecting the greater value of benefits realised in the near future. This standard economic approach deflates future values of benefit and cost in today's terms. We have adopted a rate of 6 percent to deflate future values.[3]

Table 1: General assumptions

Assumption	Comment
81% of the population visit a GP each year, and 9% an ED	New Zealand Health Survey data [52]
The average cost of hazardous drinking to the health sector is $371.21 per hazardous drinker	BERL report [10]
50% of the cost per hazardous drinker can be avoided when an individual stops drinking hazardously	Assuming that a portion of costs are fixed over a 3-year period.
No distinction on effectiveness of BI in ED and general practice	Current literature review does not show clear difference in effectiveness of BI depending on site
% of patients identified as positive through CHAT screening tool= % of patients willing to engage in BI	The AUDIT test (and BI if indicated) is automatically provided to those who screen positive on CHAT
Implementation costs are excluded	Out of scope for this study
Very brief intervention	Literature review shows little increased benefit from longer BIs [39] – however, shorter BIs cost less, therefore increasing cost effectiveness. They can also be accommodated more easily in current workflow
ED BI is shorter than general practice BI (3 min vs 5 min)	Expert reference group and ED consultant advice
50% of the benefit erodes each year, as a consequence of individuals returning to hazardous drinking behaviours	Based on expert advisory group (EAG) advice and literature review findings, particularly Fleming et al's randomised control trial (RCT) [37], which found a continuing positive effect of BI at a 48-month follow-up, but eroding differences between the control and BI groups
50% general practice uptake	The model estimates on a per person basis, so this assumption is merely for illustrative purposes

3.3.2 Probability parameter assumptions

Table 2 lists the probabilities used in each node of the model for both general practice and ED settings.

[3] The New Zealand Treasury recommends a discount rate of 6.7 percent for non-infrastructure investment, whereas 6.0 percent is more conventionally used in a health care setting, e.g. in Briggs et al [4]. The Treasury advice is available at: http://www.treasury.govt.nz/publications/guidance/planning/costbenefitanalysis/discountrates.

Table 2: Probability parameters

Setting	Parameter	Mean	Standard error	Source
ED	p(A) % indicated as risky drinking on screen	0.146	0.00487	Crawford et al [6], proportion of people willing to accept BI. Comparable with anecdotal New Zealand ED estimate of 16%
	p(B) % indicated as not risky drinkers on screen	1-p(A)		By definition
	p(C) % positive on screen also positive on AUDIT	0.44	0.024	Assume same specificity against AUDIT as the CHAT result (Goodyear-Smith et al [7])
	p(D) % positive on screen not positive on AUDIT	1-p(C)		By definition
	p(E) % referred to alcohol disorder service	0.0583		Data from Wellington ED on referrals to alcohol disorder service
	p(F) baseline % hazardous drinking	1-p(E)		By definition
	p(F) with BI % hazardous drinking	1-(p (E)+p(G))		By definition
	p(G) with BI % ceasing hazardous drinking after BI	0.30		Assumption: 30% people cease risky alcohol consumption for a period
General practice	p(A) % indicated as risky drinking on screen	0.1375	0.01107	Goodyear-Smith et al 2008, CHAT validation (Goodyear-Smith et al[7])
	p(B) % indicated as not risky drinkers on screen	1-p(A)		By definition
	p(C) % positive on screen also positive on AUDIT	0.44	0.024	Goodyear-Smith et al 2008, CHAT validation (Goodyear-Smith et al [7])
	p(D) % positive on screen not positive on AUDIT	1-p(C)		By definition
	p(E) % referred to alcohol disorder service	0.01		Anecdotal report from New Zealand general practice
	p(F) baseline % hazardous drinking	1-p(E)		By definition
	p(F) with BI % hazardous drinking	1-(p(E)+p(G))		By definition
	p(G) with BI % ceasing hazardous drinking after BI	0.30		Assumption that 30% people cease risky alcohol consumption for a period of time is derived from Fleming's RCT [37] that found a 57% reduction of heavy drinkers, approximately 33% reduction in weekly alcohol consumption, and 33% reduction in self-reported binge-drinking episodes 1 year after receiving the BI

The p(A) parameters for the ED setting are taken from United Kingdom ED research, which is assumed to be broadly consistent with the spectrum of presentations to a New Zealand ED. The tool used in these studies was PAT [24], which is generally considered to be comparable in performance with the AUDIT tool, but faster to apply to a patient.

The most difficult parameters to estimate are p(A) and p(C) for the general practice setting. The pre-screening we envisage in general practice would be similar to the multi-risk screening tools that have been developed and validated in a New Zealand setting by Goodyear-Smith et al, such as the Multi-Item Screening Tool (MIST) and CHAT. These tools tend to find that approximately 10-12 percent of presenting patients may have alcohol issues and are willing to receive help and advice. These results do not square with the studies by McMenamin [50] and Paton-Simpson et al [51], which identify 22 percent and 16 percent respectively of patients as being risky drinkers. It may be the case that there was some degree of implicit pre-screening, particularly in the McMenamin study. If so, this would help to explain the higher observed rate in the McMenamin results compared with those in the later Paton-Simpson study, which used the AUDIT tool.

It is not clear how these general practice numbers relate to each other, but the recent, rigorous and widely published results of Goodyear-Smith et al [2,7] probably reflect a more pragmatically useful scenario for the purpose of the present study. The specific identification of people who are willing to receive help is a useful one, and reflects a more realistic probability of the number of people to whom an intervention might actually be delivered than the Paton-Simpson et al result, which is a more research- and prevalence-oriented study than a permanent implementation of AUDIT into routine care.

Therefore, we assume that the CHAT combined prevalence for identifying people with problematic drinking or alcohol dependency will be the p(A) for pre-screening. Since the CHAT questions are reported to have a 44 percent positive predictive value compared with AUDIT for identifying problematic drinking [7], we use a probability of 0.44 for p(C): the AUDIT screening stage, on a total population of 967 in the study. We have assumed that ED pre-screening would have a similar level of specificity to AUDIT.

Members of the expert reference group advised that very few referrals to specialist alcohol disorder services are made from general practice, so we have started the model with an arbitrary figure of one percent. We would be interested in incorporating further information on this into the model, should it become available.

The effectiveness of BI in reducing the hazardous use of alcohol is a key parameter of the model, captured as p(G) in our list of parameters. While there have been a number of studies of the effectiveness of BI, the only well designed study that reported data in a way that could inform our model was Fleming et al, 2002, an American RCT, which found in a general population presenting to primary care that

57 percent of the intervention subjects had reduced their alcohol intake from hazardous to non-hazardous levels, approximately 33 percent had reduced their weekly alcohol consumption, and 33 percent had reduced their self-reported binge-drinking episodes one year after receiving a BI [37]. The specific intervention in the case of this study was at the more intensive end of the range of BIs, consisting of two physician contacts and two nurse follow-up telephone calls. The intervention was found to be effective after a follow-up of 48 months.

3.3.3 Cost of alcohol-related health care

Costs were the most difficult parameter to assess for this model. The direct costs of health care as a consequence of alcohol consumption have been estimated in New Zealand, but are usually reported as national figures, based on applying proportionate scaling factors to gross expenditure on different types of health care. For the purpose of the present study, the model is based on a patient perspective, calculating an expected value of health care cost for an individual.

As a starting point we take the estimate from a BERL report [10] of the total cost of health care to the government caused by alcohol at $299.6 million in 2005/06 (p157). BERL used the New Zealand health survey to report that a total of 18.4 percent of the population drank hazardously or with high risk. This is similar to the 20 percent of the population reported by the New Zealand Mental Health Survey [8]. For the purpose of assigning an average cost, we assume that alcohol-related health care costs are attributable to those 20 percent of the population who drink hazardously, taking 20 percent of the 2005/06 population to be 807,092 people. This produces an average alcohol-related health care cost per person drinking hazardously of $371.21 per year.

Even if direct contacts with the health system are avoided through reductions in hazardous drinking, true cost savings are unlikely to be made at the level of average cost. Avoided costs to existing health care services will be made marginally, with larger proportional cost reductions only realised when savings reach the point-of-change economies of scale. For instance, a small reduction in ED attendances will remove some costs, but many fixed costs will remain. As a starting point we assume that 50 percent of health care costs will be directly recoverable. This proportion may increase in future years. The model pathway for people for whom BI has had a positive effect therefore has an attributed cost of 50 percent of the pathway those people would have followed without the intervention: a value of $185.60.

It should be noted that the structure of our model places relatively little emphasis on the absolute cost of alcohol-related health care. The key parameter is the proportion of the reduction in cost that is attributable to ceasing the hazardous use of alcohol. Changes in the absolute average cost of alcohol-related health care will feed in to the final result in a directly linear, proportional fashion. It should be noted that the values for cost derived from the BERL report are 2005/06 levels, and will have increased in line with health care inflation since that time.

3.3.4 Cost of intervention assumptions

The estimated costs of intervention are summarised in Table 3. The cost of intervention is added as a fixed quantity to each branch of the model. The cost reflects the activities of a patient who has followed each path, including pre-screening, screening such as AUDIT and the BI itself. We have used estimates based on costs per minute of clinical and administrative time derived from primary care diary and activity data, including organisational overheads.

The follow-up calls to the Alcohol Drug Helpline were costed with information provided by Helpline management, on the basis of the marginal additional cost of a 20-minute call, including direct staff and information technology (IT) inputs to a call.

These costs are based on plausible assumptions about what screening and intervention would look like, but could be altered as a consequence of decisions about implementation – for instance, by the use of online screening and BI tools, or by using non-medical staff time only. Equally, longer and more intensive interventions could result in much greater costs of actually providing BI.

Table 3: Cost of providing a BI

Element	Assumed activity	Assumed cost	Cost applies to
Pre-screening **General practice and ED**	Self-completed paper or computer form, as described in CHAT questionnaire: 2 minutes per patient of practice admin time (@ $20/hour), to print forms and collect results	$0.67	Entire population using general practice/ED services annually
AUDIT screening **General practice and ED**	AUDIT questionnaire: 2 minutes of clinical time – 50% of time a nurse, 50% of time a doctor	$3.94	Those with a positive CHAT screen result
BI **General practice**	5 minutes of clinical time – 50% of time a nurse, 50% of time a doctor. 33% uptake of Helpline	$13.78	Those with a positive AUDIT result
BI **ED**	3 minutes of clinical time – 50% of time a nurse, 50% of time a doctor. 33% uptake of Helpline	$9.84	Those with a positive AUDIT result

4 Results

4.1 Raw results

Table 4 summarises the expected cost of alcohol-related health care for a random individual presenting to general practice and to an ED, predicted from our model with the parameters described previously. Costs incorporate the additional cost of providing the BI, as well as the decreased cost of future alcohol-related health care for individuals who respond to the BI.

Table 4: Cost impact of BI at individual level

	General practice	ED
No BI	$22.45	$23.82
BI	$21.16	$22.18
Difference	$1.29	$1.64
3-year difference	$2.18	$2.77

With our assumptions, BI appears to show substantial net cost reductions in both general practice and EDs. As might be expected, the average difference as a consequence of implementing BI is greater in an ED setting than in general practice, since the population presenting to ED displays a higher level of hazardous alcohol drinking behaviour.

The difference in alcohol-related health care cost for a single year has been extended to a three-year horizon, indicating the longer-term benefits of BI over a timeframe often used for health care planning. It has been assumed that half of the difference erodes each year as a consequence of individuals returning to hazardous drinking behaviours. The eroded difference has also been discounted at 6 percent per annum (see Section 3.3.1) to provide a real cost impact in year one values.

The cost impact is calculated on the basis of average health care cost to the government of alcohol-related care, across the entire population of hazardous alcohol users. This is a blanket cost for all forms of alcohol-related health care, derived from previous New Zealand work, particularly BERL [10]. The time lag between the change of behaviour of a formerly hazardous alcohol user and the consequent avoidance of alcohol-related health care will vary considerably according to the different kinds of care. If approximately one-third of alcohol-related health care is accident related, it might be expected that at least one-third of the cost difference would be recovered in a very short timeframe. From the perspective of a health planner, it could therefore be expected that one-third of the cost savings would be achieved within the first year of implementing a BI programme, while it would take some time for the programme to realise the fuller cost savings.

4.2 Sensitivity analysis

This analysis has been based on a number of assumptions, which may be open to debate and discussion. The key parameters that have large elements of uncertainty or potential debate are: the actual cost of providing a BI; the proportion of people who, having received BI, cease to use alcohol hazardously; and the cost reduction in alcohol-related health care that arises from ceasing to drink hazardously. To some extent we have been able to base our model parameters on published literature, but uncertainty in these areas has the potential to throw doubt on our results.

Probabilistic sensitivity analysis allows a quantification of the impact of uncertainty in the model parameters. Because our model was probabilistic and we specified a distribution of probabilities rather than a single average value, we are able to investigate the relationship between various points on the distributions of the parameters, and the final cost result.

The raw output of the model is the average health care-related cost for every member of the population seen in either an ED or a general practice setting. The BI results show a lower average cost than the baseline result. But if the BI results actually produce a higher cost value, some of the saving that has been calculated would no longer apply. We looked at the relationship in the BI arm of the model between key parameters and the average cost of alcohol-related health care in the population. We calculated the strength of the relationship between the parameter value and the overall average cost. We identified thresholds beyond which the programme would still be cost effective.

As an example, one of the assumed parameters is that when a person moves from a state of hazardous to non-hazardous drinking, there will be a reduction in alcohol-related health care for that person of 50 percent – i.e. costs will be at 0.5 of their baseline level. But if costs drop much more, to 10 percent (i.e. 0.1 of the baseline level), the cost saving of the BI would be much greater. If costs dropped by a lesser amount, to, say, 80 percent of the original level, the potential fiscal saving of the BI would be lower, and it might not be cost effective.

Figure 3 shows the relationship between the average alcohol-related health care cost after intervention (as a proportion of what it is before the intervention) and the overall cost of alcohol-related health care. Knowing, from our base result, that if there is no BI the cost of alcohol-related health care will be $22.45 in the general practice population and $23.82 in the ED population, we can identify a cut-off of about 85 percent (0.80) as the point at which the drop in alcohol-related health care costs is enough to make the BI cost effective. The intervention must result in a drop to 80 percent or less of the base cost of alcohol per person.

Tables 5 and 6 summarise and interpret sensitivity results for the three key parameters in the two different settings. The main finding is that the parameters are all quite robust to uncertainty. There could be substantial changes in the base values without nullifying the basic result that BIs produce cost savings in health care.

Figure 3: Sensitivity to reduction in cost assumption

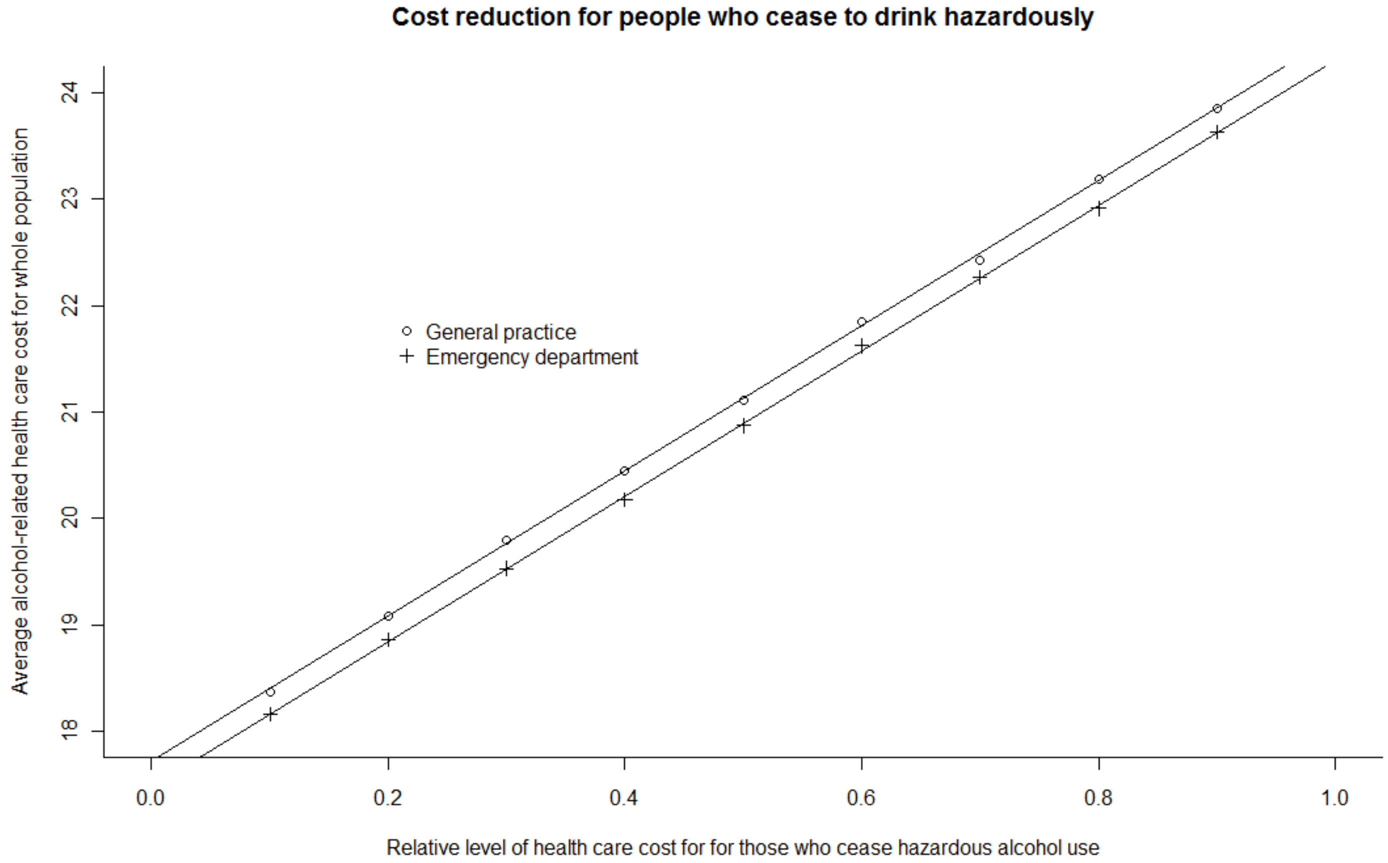


Table 5: Sensitivity in ED parameters

Parameter	Value	Sensitivity	Interpretation
Cost of BI	$9.84	0.066	For every increase of $1 in the cost of BI, the average cost of alcohol-related care for the whole population under BI increases by $0.066. The cost of the BI could increase by $24.85 before losing cost effectiveness
Probability stop hazardous alcohol consumption	30%	-0.1703	Every increase of 1% in the probability that a patient changes from hazardous to non-hazardous drinking after BI reduces the cost to the health care system across the whole population by a further $0.17. The model assumes a 30% cost reduction, but as long as a BI is effective for more than 22.4% of people who receive it, it will be cost effective overall
Level of cost reduction after BI	50%	7.02	For every increase of 1% in the reduction of alcohol-related health care costs when people move from hazardous to non-hazardous alcohol consumption after BI, the cost to the health care system reduces by $0.0702. The model assumes a 50% cost reduction. As long as the cost reduction is greater than 23.4%, the BI will still be cost effective

Table 6: Sensitivity in general practice parameters

Parameter	Value	Sensitivity	Interpretation
Cost of BI	$13.78	0.070	For every increase of $1 in the cost of BI, the average cost of alcohol-related health care for the whole population under BIs increases by $0.07. The cost of the BI could increase by $18.43 before losing cost effectiveness
Probability stop hazardous alcohol consumption	30%	-0.314	Every increase of 1% in the probability that a patient changes from hazardous to non-hazardous drinking after BI reduces the cost to the health care system across the whole population by $0.31. The model assumes a 30% cost reduction, but as long as a BI is effective for more than 24.7% of people who receive it, it will be cost effective overall
Level of cost reduction after BI	50%	6.7	For every increase of 1% in the reduction of alcohol-related health care costs when people move from hazardous to non-hazardous alcohol consumption after BI, the cost to the health care system reduces by $0.067. The model assumes a 50% cost reduction. As long as the cost reduction is greater than 19.2%, the BI will still be cost effective

Overall, the sensitivity analysis shows that the result of producing cost savings as a consequence of BI is not very sensitive to the assumptions that have been made about the cost of the BI, or to the magnitude of the cost reductions for those who have received the BIs. It is, however, sensitive to the assumption of the proportion of population who will cease to use alcohol hazardously after BI. If this parameter is substantially lower than the level we have assumed in the analysis, BI will no longer show direct cost savings.

4.3 Aggregate results

The raw results from our model are in the form of an average cost reduction of alcohol-related health care for an individual drawn from the population who attends either ED or general practice. If these results are aggregated to reflect whole populations, an estimate can be derived of the overall amount of saved resources that BI could provide for the health system. Tables 7 and 8 present the aggregate results from implementing BI across New Zealand for general practice and ED settings respectively.

4.3.1 General practice

The New Zealand Health Survey 2006/07 reported that 81.3 percent of people older than 14 years of age had seen GPs in the previous 12 months [52]. Statistics New Zealand estimates the total New Zealand population aged over 14 in 2009 by district health board (DHB) at 3,421,415[4], which at a rate of 0.813 implies that 2,781,610 have visited general practices in any one year. For the purpose of extrapolation, we assume that lifestyle screening and a BI would only be offered to an individual once per year.

If there were a 50 percent take-up rate of screening and BI across general practices, this implies that, with the model assumptions about the cost and probability of pre-screening, sensitivity and specificity of AUDIT and BI costs, approximately $2.8 million would need to be spent in order to implement the programme. But this investment would give an annual net return of $1.8 million in reductions in alcohol-related health care, or $3 million over three years, over and above the cost of the BI programme. This represents a direct fiscal return on investment of $1.63. For every dollar spent, a total of $1.63 in alcohol-related health care costs would be avoided, even on the generally conservative assumptions in the model. The return on

[4] The Ministry of Health supplied Sapere with unpublished projections by DHB that it had commissioned from Statistics New Zealand.

investment over the three-year period would be $1.74, even with the assumption that a large proportion of people return to the hazardous use of alcohol each year.

4.3.2 Emergency department

The New Zealand Health Survey 2006/07 [52] reported marked regional differences in the prevalence of ED attendance, but reported actual prevalence in groups of DHBs, rather than by individual DHB area. Assuming that all EDs implemented screening and intervention once per annum for everybody who attended, approximately $538,000 per annum would be needed for the ongoing implementation of the programme. This would produce a net reduction in the cost of alcohol-related health care of $470,000 on an annual basis, or $793,000 over three years, with a return on investment for each $1 spent of $1.87 and $2.48 respectively.

Overall, both general practice and ED settings exhibit a strong positive return on investment in direct fiscal terms for the implementation of BIs for the hazardous use of alcohol. BIs are likely to produce positive fiscal benefits, as well as contributing to increased health status and quality of life for individuals.

It should be noted that the return on implementation is proportionately greater in the ED setting, but that the absolute gains are potentially greater from implementation in general practice. This reflects the higher level of alcohol-related care provided in EDs, but the much greater level of contact across the population in general practice. On average 9 percent of the population visit EDs each year, compared with 81 percent for general practice [52]. These relative returns in both proportional and absolute terms will be important factors for planners to consider when considering the general implementation of BI.

Table 7: Cost savings from BI in general practice by DHB						
DHB name	**2009 population 15+**	**Visited general practice**	**50% take-up**	**1-year cost of BI**	**3-year health care savings from BI**	**Net 3 years' savings (health care savings from BI less cost)**
Auckland	366,640	298,078	149,039	$304,850	$629,755	$324,905
Bay of Plenty	163,710	133,096	66,548	$136,120	$281,195	$145,075
Canterbury	405,150	329,387	164,693	$336,870	$695,900	$359,031
Capital and Coast	233,060	189,478	94,739	$193,783	$400,314	$206,531
Counties Manukau	362,130	294,412	147,206	$301,101	$622,010	$320,909
Hawke's Bay	119,790	97,389	48,695	$99,603	$205,758	$106,155
Hutt	111,150	90,365	45,182	$92,417	$190,914	$98,497
Lakes	78,380	63,723	31,861	$65,170	$134,627	$69,457
MidCentral	131,650	107,031	53,516	$109,464	$226,129	$116,665
Nelson Marlborough	110,960	90,210	45,105	$92,260	$190,588	$98,329
Northland	121,190	98,527	49,264	$100,767	$208,162	$107,396
Otago	155,830	126,690	63,345	$129,568	$267,660	$138,092
South Canterbury	45,175	36,727	18,364	$37,562	$77,596	$40,034
Southland	89,120	72,455	36,227	$74,100	$153,075	$78,975
Tairawhiti	34,535	28,077	14,038	$28,714	$59,317	$30,603
Taranaki	85,195	69,264	34,632	$70,838	$146,335	$75,498
Waikato	280,620	228,144	114,072	$233,327	$482,004	$248,677
Wairarapa	31,760	25,821	12,910	$26,407	$54,550	$28,144
Waitemata	419,170	340,785	170,393	$348,529	$719,985	$371,457
West Coast	26,235	21,329	10,665	$21,815	$45,064	$23,250
Whanganui	49,965	40,622	20,311	$41,545	$85,823	$44,278
New Zealand	**3,421,415**	**2,781,610**	**1,390,805**	**$2,844,808**	**$5,876,763**	**$3,031,955**

Table 8: Cost savings from BI in EDs by DHB group						
DHB group	**2009 population 15+**	**% attend ED**	**People attend ED**	**1-year cost of implementation**	**3-year health care savings from BI**	**Net 3 years' savings (health care savings from BI less cost)**
Northland/ Tairawhiti/ Hawke's Bay/ Lakes/ Whanganui	403,860	9.50%	38,367	$72,029	$178,305	$106,277
Waitemata	419,170	6.90%	28,923	$54,299	$134,416	$80,117
Auckland	366,640	4.90%	17,965	$33,727	$83,490	$49,763
Counties Manukau	362,130	4.10%	14,847	$27,873	$68,999	$41,126
Waikato	280,620	8.90%	24,975	$46,887	$116,068	$69,181
Bay of Plenty/Taranaki/ MidCentral	380,555	9.90%	37,675	$70,730	$175,089	$104,360
Wairarapa/Hutt Valley/Capital and Coast	375,970	11.10%	41,733	$78,348	$193,948	$115,600
Canterbury	405,150	6.50%	26,335	$49,440	$122,388	$72,948
Nelson Marlborough/ West Coast/ South Canterbury/ Southern	427,320	13.00%	55,552	$104,291	$258,170	$153,879
New Zealand	**3,421,415**	**8.40%**	**287,399**	**$537,624**	**$1,330,874**	**$793,250**

5 Discussion

This project has a specific and relatively narrow aim: to establish the fiscal cost consequences of BIs for the hazardous use of alcohol in primary care settings, from the perspectives of health care funders and planners. It is not within the scope of this project to consider the health gains that would arise from implementing BIs, although such benefits to patients would clearly be a valuable consequence of such programmes.

The overall finding of this study is that BIs can be directly cost saving to health services. This situation, in which achieving health gains from an intervention is likely to result in a direct fiscal cost saving, is not commonly seen in health services, and represents an unusual opportunity to achieve health gains while reducing pressure on health service budgets. Moreover, while the scope of this analysis is purely the fiscal impacts on health services, BIs would be likely to have wider impacts on expenditure reductions in other sectors, particularly justice, representing further gains to society. The relatively narrow scope of this project has found clear benefits from BIs, but these should be regarded as a minimal estimate, since wider fiscal benefits in other sectors, and gains in health and social measures, would also be produced.

Epidemiological literature distinguishes between the efficacy of an intervention under ideal controlled conditions, often observed in clinical trials, and the effectiveness of an intervention under the field conditions of usual care. This classic distinction is an issue in the research on BI, which frequently reports the effectiveness of controlled groups but does not often consider the wider issue of implementation in the context of population screening, a point underlying the critique by Beich and colleagues [9]. The challenge for this project has therefore been to develop a model of BI within a whole-population context, and to apply the results of trials to actual alcohol-related health care costs. It is important to emphasise that the effectiveness of pre-screening and AUDIT assessments is key to the overall cost effectiveness of BI. Indeed, the actual direct cost of an intervention is only one influence on the overall cost effectiveness of the programme.

The model developed here is based throughout on conservative assumptions about the nature and effectiveness of BI. Individually, the cost of a BI, the proportion of people who cease hazardous alcohol use, and the level of health care cost reduction associated with ceasing hazardous use all have an impact on whether the BI will be cost effective. But the values used in this study, although conservative, are in each case well beyond the minimum required for BI to create cost savings. Even if the assumptions and the values used in this model are debated, there is still a very high likelihood that BI would produce direct cost savings to the health sector.

The one area in which our assumptions have not been conservative is the time period in which direct savings would be realised. We have assumed that the average cost saving from all alcohol-related health care would be realised at once, but in reality there would be a time lag for savings to appear from different kinds of health care. Alcohol-related injuries, given their nature, would show an almost immediate cost reduction, whereas the cost savings from avoided long-term conditions would take longer to realise. To some extent this issue has been acknowledged by assuming that in the short term only 50 percent of alcohol-related health care costs would be avoided by people ceasing hazardous alcohol use, but it should be noted that the level of cost reduction would likely be somewhat lower in the initial few years of implementation, and somewhat higher in later years.

Given that injury is associated with approximately one-third of alcohol-related health care costs, this represents the lower limit of the level of cost reduction that would be realised immediately. The worst-case scenario would therefore be that cost reductions would be one-third of the level we have estimated. This level would still leave room for positive cost savings and for some level of investment to fund the initial implementation. ACC advises that early results from a current research project suggest that alcohol-related injuries are, like for like, 30 percent more costly than other injuries. If this finding holds across New Zealand EDs, it would increase the level at which short-term cost gains could be realised.

This study has largely avoided addressing implementation matters beyond the fairly general level required for the construction of the cost model. But considerations of implementation do arise from the work reported here, and it is worth noting some of these issues for future discussion.

The use of pre-screening for lifestyle health risks is likely to be controversial among some groups of health care providers, particularly in general practice settings. The reality of implementation would probably require a comprehensive approach, providing performance measures and incentives that would reward practices for participating and for achieving high levels of screening coverage and BI delivery. Goodyear-Smith et al reported widespread use of the CHAT tool among a large number of practices for the purpose of evaluation [2], which suggests a hopeful prognosis for larger-scale implementation if the right environment can be achieved. They reported that the fears of GPs before participating – that they would be overwhelmed by the discovery of an array of lifestyle issues for patients with which they were not equipped to cope – were not realised in the actual event.

This study has estimated the cost gains that BI would provide for the health system overall, if it were implemented in general practice and ED settings. There is, however, a disconnection between the investment in providing the BI in these settings and the parts of the health system where the gains would be realised.

In the short term, gains are likely to be experienced in ED and inpatient settings, where injuries are avoided. Longer-term gains would be realised in hospital inpatient and outpatient settings, and to some extent in primary care, as long-term conditions arising from alcohol were avoided or their severity reduced. This means that implementing a BI in an ED has a clear rationale: this is the same setting where a substantial element of the gain will be directly seen in the short term.

The situation is rather different in general practice. Implementing BIs in general practice would realise cost gains for the wider health system, but would be unlikely to provide direct cost savings for general practice itself. While the system-wide magnitude of gain from BI in general practice is larger than the gain from EDs (because many more people attend general practice each year than attend EDs), there would probably need to be some form of redistribution of funding and investment in order to deliver BI and to realise the wider gains. General practice would be unlikely to be able to realise enough short-term gains in its own setting from BI to cover the costs of delivery.

For the purpose of this model we have assumed that a BI takes the form of a short contact with a health professional in the relevant setting, and that one-third of people who receive BI go on to receive more extended sessions by telephone from the Alcohol Drug Helpline. This approach is in line with the range of BI models described in the literature, but could be subject to some variation, particularly with specific population groups such as students and particular ethnic populations. Alternative forms of delivery, including via electronic media, may have some attraction in terms of the cost of delivery and may also prove well suited to some population groups, particularly younger users of alcohol. Such mechanisms also provide means to tailor interventions to be culturally appropriate, or to cater for a range of languages.

In order to achieve the maximum gains from BI, it will be necessary to implement the approach as widely as possible, across EDs and general practice. But as is the case with most implementations of new interventions, a staged approach with a defined pilot and careful evaluation would be appropriate in order to establish those elements of the programme that are more or less effective, and address implementation issues before attempting to spread the programme across the health sector.

The results of this study provide a strong indication that BI is likely to realise fiscal cost savings to the health sector, while simultaneously producing health gains. The key results are that there is likely to be a $1.74 return for every dollar spent on BI in general practice over a three-year period, and a $2.48 return over three years for every dollar spent in an ED setting.

The overall conclusion that there will be positive fiscal savings from implementing BI is robust to uncertainty in some of the key parameters of our model. If the implementation of BI can be achieved in a comprehensive and effective fashion, this programme has considerable potential to bring benefit to the New Zealand health system, and to New Zealanders.

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7 Appendix One: Literature review

This review covers aspects of the burden of alcohol to the health system in New Zealand, and the nature and effectiveness of brief interventions (BIs) for the reduction of harm from alcohol consumption. The review used Medline and CINAHL, focusing on primary studies and meta-analyses rather than on commentary. The main initial search terms used were:

- Brief intervention;
- Alcohol;
- Screening; and
- Effectiveness.

For more specific material relevant to aspects of the model design and analysis, we conducted specific searches on:

- Alcohol;
- General practice;
- New Zealand;
- ED;
- Alcohol Use Disorders Identification Test (AUDIT);
- Paddington Alcohol Test (PAT); and
- Sensitivity and specificity.

Grey literature with specific New Zealand relevance was searched for on the internet, using internet search resources and recommendations from the expert reference group. The expert reference group reviewed an early draft of the review, and was invited to make suggestions for additional references and material that had not yet been included. Key articles referenced in literature that we had extracted were followed up individually if they had not already been identified.

7.1 Burden of alcohol to the health care system in New Zealand

A number of New Zealand studies have recently considered elements of the cost of alcohol. The direct cost of alcohol to the health care system is only one of the elements of the wider cost of health care to society, but this has been the subject of a number of analyses.

There are three major reports in this area. The most relevant to this project is the 2009 report from BERL, commissioned by ALAC, which estimated the wider cost of alcohol to New Zealand society [10]. This report made several estimates of the cost of alcohol to the health care system, and more specifically the cost of health care to the government. The authors' estimate of the cost of alcohol to the government within different categories, in 2005/06 millions of dollars, is summarised in Table A1:

Table A1: Cost of alcohol to government in New Zealand (millions)

Health care	Alcohol	Other drugs	Joint alcohol and other drugs	Total
Pharmaceuticals	0.3	11.8	0.0	12.1
Hospital	121.0	9.2	0.0	130.3
Medical	66.8	1.0	-3.3	64.5
Treatment for victims of crime	97.8	9.0	16.8	123.7
Total	286.0	31.0	31.6	330.6

BERL recommended using a combined figure from the columns for a) alcohol and b) joint alcohol and other drugs when considering the total costs of alcohol to the health system. For total costs of health care to the government, this gave a cost of $317.6 million.[5]

BERL provided considerable detail of its methodology, which involved extensive data analysis from a variety of government agency sources as well as primary data from general practice databases. Of note is that the rate of increases in the cost of inpatient care, including increases in case weight prices, was 3.6 percent ([10] p120). This may serve as an indicative inflator for increases in health care costs since 2005/06.

The second major piece of work that addresses this issue was the report by the Law Commission: Alcohol in our lives: An issues paper on the reform of New Zealand's liquor laws. Chapter six of this report focused specifically on the health issues associated with alcohol [11]. This report emphasised a number of key aspects of alcohol's contribution to disease and disability, including the substantial element of injury in alcohol-related health care, and the consequences of alcohol consumption for suicide.

[5] 286.0 + 31.6 = $317.6m.

The third important New Zealand study in this area was Te Rau Hinengaro – The New Zealand Mental Health Survey, a study commissioned by the Ministry of Health to examine alcohol and other drugs in the context of mental health [12]. While this study did not report on the broader use of health care services by people who consume alcohol hazardously, it did describe the substantial burden of mental health-related health care that is associated with hazardous levels of alcohol use. It found that for people with alcohol abuse or alcohol dependency, the higher end of the hazardous drinking range, service contact for mental health care was relatively low, with 25.8 percent and 36.9 percent respectively of people reporting contact with health services for mental health visits.

A number of other specific studies from peer-reviewed journals and reports addressed the impact of alcohol on health services in New Zealand. These are summarised in Table A2.

The general message of these studies was that the direct impact of alcohol on the health system is high. Not only are injuries a major element, as noted by the Law Commission and in a number of specific studies, including those by Humphrey et al [13] of the contribution of alcohol to the volume of ED presentations, but Connor et al's [14] assessment of the burden of disease estimates that 70 percent of the total 33,543 disability-adjusted life years (DALYs) lost as a consequence of alcohol consumption are not injury related. The single greatest loss is directly attributable to alcohol abuse disorder, but chronic disease arising from alcohol is also an important part of the health impacts of alcohol.

The New Zealand health system is responding to a substantial health need that arises from alcohol consumption. It is not clear from existing research how much unmet need exists for further health services, although the findings of Te Rau Hinengaro imply that this is probably considerable.

Table A2: Impact of alcohol on health services in New Zealand

Study	Population	Health category or service	Estimated proportion or amount
Craig et al [15]	National hospital admission data for 15- to 24-year-olds from 2002 to 2006: 5,413 young people	Alcohol-related hospital admissions	**5,413 young people**
		Injuries	**34.7%**
		Self-harm	**20%**
		Assault	**20%**
		Falls/Motor accidents/glass injuries	**60%**
		Mental health problems	**28%**
		Intoxication	**11%**
Humphrey et al [13]	Auckland hospital injury admissions	Alcohol-related injury admissions	**35%**
Kirkwood [16]	972 patrons arriving at bars on Auckland's North Shore who were asked about their drinking behaviours	(Had experienced) alcohol-related injury	**30%**
		(If gone out with intention to get drunk) alcohol-related injury	**41%**
Lee and Snape [17]	Christchurch Hospital	Alcohol-related facial fractures	**49% (of which 65% required hospital admission and 58% required surgery)**
Buchanan et al [18]	Waikato Hospital	Alcohol-related facial fractures	**34%**
Murphy and Wetzel [19]	General	Lifetime risk of suicide in alcohol-dependent people	**60-120 times greater suicide risk than the non-psychiatrically-ill population** **2.2% (outpatient) and 3.4% (inpatient)**
Connor et al [14]	New Zealand	Burden of disease estimate	**25,971 DALYs lost in 2002**

7.2 Nature of brief interventions

The overall goal of a BI is to identify and provide early help (early intervention)for people to lower their risk of alcohol-related harm. ALAC has defined early intervention in a formal policy statement [20]:

An approach that aims to reduce alcohol-related harm through timely identification and tailored advice and support for those at risk of harm due to their hazardous use of alcohol. A programme, service or resource is early intervention if it:

- is aimed at reducing alcohol-related harm and encouraging moderation;
- is available for groups/individuals that are drinking in a hazardous manner;
- is easily accessible;
- has the capacity to identify those at high risk due to their hazardous drinking;
- is a form of secondary prevention; and
- is tailored for the groups/individuals that are drinking in a hazardous manner and are therefore at risk.

7.3 Screening

A BI strategy begins with introducing systematic screening to the normal routine at medical facilities and other community settings where people with substance use disorders are likely to be found. Key tools for screening are summarised in the table below. They are largely questionnaire instruments, and are administered either by interview or by self-administration by the patient.

Of these tools, AUDIT is widely considered to be the gold standard of alcohol screening tools, and is often used as the comparator in validations of other tools.

Table A3 summarises the characteristics of the key tools for alcohol screening that are identified in the literature.

Table A3: Tools for screening for alcohol misuse			
Test	**Administration time**	**Scoring time**	**Number of questions and description**
AUDIT [22]	3 min	Seconds	10 questions Developed by the World Health Organization, it focuses on both hazardous drinking and alcohol use disorders. AUDIT has been well validated across different cultural groups in a variety of countries
AUDIT-C [23]	1 min	Seconds	3 questions A shorter version of AUDIT, focusing mainly on the quantity, frequency and pattern of drinking
PAT [24]	1 min		Specifically developed for use in ED settings
SMAST (Short Michigan Alcoholism Screening Test) [25]	5 min	2 min	24 questions Yes-no questions that list signs and symptoms of chronic alcoholism. It is criticised for being too long and for focusing on dependence rather than early diagnosis. There is also a 12-question version
CAGE (cut down, annoyed, guilty, eye-opener) [26]	1 min	1 min	4 questions Focuses on identifying dependence and may produce false positives due to the use of questions measuring "lifetime" symptoms ("have you ever…")
CRAFFT (car, relax, alone, forget, friends, trouble) [27]	2 min	1 min	6 questions Has been validated with adolescents in primary care settings
FAST (fast alcohol screen test) [21]	1 min		4 questions Specifically developed for rapid screening in primary care, based on 4 AUDIT questions. Better sensitivity and specificity compared with AUDIT than achieved with PAT

Hodgson et al's validation of FAST provides a useful summary of the time taken to perform PAT, CAGE, AUDIT and FAST in an ED setting [21]. These findings are presented in Table A4.

Table A4: Time to perform alcohol use tools in ED

Test	N	Mean (seconds)	Standard deviation
FAST	67	13	14.2
CAGE	64	14	7.2
PAT	48	42	31.9
AUDIT	191	78	35.5

The times reported by Hodgson et al [21] are faster than those claimed in the original AUDIT validations, but highlight the extreme rapidity with which FAST and CAGE can be administered.

The PAT tool appears to have been used mostly in a United Kingdom setting, with three studies assessing the usefulness of the tool, including an RCT [6,28,29]. The Crawford study [6] in particular provides useful information about the proportion of patients who screen as positive on PAT, before proceeding to BI (22.2 percent).

In the New Zealand context, there has been specific research on the use of pre-screening in a primary care setting. This tool is not comparable with the specific alcohol tools, as it addresses a number of lifestyle factors in a single approach. The intention is to proceed to the specific tools described in Table A3 should an individual have alcohol issues detected at the pre-screening stage [2,7,30]. The CHAT tool, a self-administered paper- or computer-based questionnaire, has been validated against AUDIT and has been successfully implemented on a trial basis in general practice. The value of this tool lies in its ability to identify a number of lifestyle risks other than alcohol consumption, widening its utility for primary care patients and clinicians. As a pre-screen for alcohol, it may have the potential to improve the yield rate of a second, longer and more expensively implemented screening tool, such as AUDIT.

Some authors have identified potential barriers to screening, particularly in a general practice setting. Moriarty et al [3] described recorded consultations between general practitioners (GPs) and patients, and found that GPs were reluctant to raise questions about patients' alcohol consumption, probably as a consequence of time pressure and perceptions of the sensitivity of the subject. Goodyear-Smith et al [2] noted in a validation of the CHAT tool that participating GPs were concerned that they would be swamped with newly revealed lifestyle problems, which they would not be able to address, although this did not eventuate when the tool was tried.

International studies that address the issues of encouraging clinicians to screen for alcohol and to implement BI include Chossis et al [31] and Funk et al [32], the latter study partially implemented in New Zealand. Funk concluded that active approaches such as personal visits were needed to encourage GPs to implement BIs in general practice. In this study the New Zealand arm had the highest acceptance rate (those who requested the BI programme), and the second highest level of full implementation among GPs (68 percent), after Belgium.

The issue of perceptions of sensitivity was explored by Babor et al [33] in the *Cutting Back Study* that the University of Connecticut, School of Medicine, where screening of primary care patients in five states in the United States for smoking, diet/exercise and alcohol use was carried out. Less than 9 percent of patients indicated any discomfort or any thought that such information was unimportant to their health care providers. A further study by Babor et al found that primary care services screened approximately 50 percent of eligible patients, with considerable variations from organisation to organisation [34].

Screening is an essential part of providing a BI. There are a number of choices, of which each has strengths and weaknesses for different settings and for different purposes. New Zealand researchers have actively pursued the possibility of pre-screening in a general practice setting [2,7,30], and there is rigorous, relevant information available to support the implementation of screening. Less work has been performed in New Zealand on screening and BI in EDs. The UK research on screening in EDs is probably the most relevant to the New Zealand setting in particular studies undertaken with PAT [24].

7.4 Intervention

Once a patient has been identified as a hazardous consumer of alcohol on the basis of a screening tool, they can be offered a BI to help motivate less risky behaviour. But while the concept of BI is well defined, the specific implementation varies considerably.

The published evidence does not explicitly address the relative effectiveness of different kinds of intervention, although effectiveness can be shown even with some of the relatively short examples of BI.

Types of intervention described in the literature are summarised in Table A5.

Table A5: Types of BI

Study	Intervention
Bertholet et al [35]	5-10 minutes
D'Onofrio and Degutis [36]	Meta-analysis: interventions ranged from 5 to 60 minutes, with 1 session to a maximum of 6 follow-ups
Fleming et al [37]	Two 15-minute sessions scheduled 1 month apart and two 5-minute follow-up phone calls from an office nurse 2 weeks after each intervention
Freeborn et al [38]	Brief clinician advice plus a 15-minute motivational counselling session
Kaner et al [39]	5- to 15-minute intervention if a GP carries it out, a bit longer for a nurse (protocol only)
Kypri et al [40]	10- to 15-minute web-based assessment and personalised feedback
Lock et al [41]	5- to 10-minute nurse intervention using the "Drink Less" protocol
McQueen et al [42]	Cochrane review: BIs ranged from a single session providing information and advice to 1-3 sessions of motivational interviewing or skills-based counselling involving feedback and discussion on responsibility and self-efficacy
Schaus et al [43]	2 BIs of 20-minute sessions, 2 weeks apart founded in motivational interviewing techniques
Tariq et al [44]	10- to 15-minute short-duration counselling intervention, with feedback about drinking, advice and goal-setting, and a follow-up contact (1 or more discussions lasting 10-15 minutes with a primary care physician). GP provides follow-up at 6 and 12 months
Wilk et al [45]	BI of 10-15 minutes of short motivational counselling, including feedback and education on the harm of heavy drinking and advice to moderate drinking to low-risk levels

Clearly, there is a range of intervention approaches used by different researchers in different settings. This reflects the different populations towards which some of these studies are targeted, the different resources available for developing interventions, and the varying disciplinary backgrounds from which researchers begin to construct programmes.

7.5 Effectiveness

Measurements of the effectiveness of BI have been produced from a large number of studies, often in different ways and with a variety of methods and different types of implementation of the interventions in the first place. Consideration here will be limited to reviews and meta-analyses rather than duplicating the existing review work of other authors. Reviews are summarised in Table A6.

Table A6: Effectiveness of BI

Author	Scope	Key effectiveness findings
Wilk et al [45]	Meta-analysis of RCTs	Pooled odds ratio from 8 RCTs of 1.95 that intervention groups will reduce alcohol intake
Moyer et al [46]	Meta-analysis of controlled studies, comparing BI with more extended interventions	BI not less effective than more extended interventions BI vs control shows significant effect sizes for composite outcomes
D'Onofrio and Degutis [36]	Systematic review of BI in ED, assessing recommendations from high-quality studies	Positive effects found in large number of studies, including in ED settings
Beich et al [9]	Systematic review and meta-analysis of BI in general practice	Sources of bias in studies, leading to overestimation of effect. Very small proportions of screened patients were given BI, and across the whole population effects were positive but very small
Bertholet et al [35]	Systematic review and meta-analysis of BI in primary care settings	Pooled mean reduction of 37.87 grams alcohol per week
Kaner et al [47]	Cochrane review and meta-analysis of BI in primary care	Reduction of 38 grams alcohol per week in men (not significant in women)
McQueen et al [42]	Cochrane review: BI for heavy drinkers in hospital wards	Little evidence of effect
Jenkins et al [48]	Systematic review and meta-regression of change in control groups in BI studies	Control groups often reduce alcohol intake, possibly as a result of screening and invitation to participate. Too much heterogeneity to make a pooled estimate
Nilsen et al [49]	Systematic review of emergency care brief alcohol interventions for injury patients	Of the 14 studies identified, 11 found significant effects of the intervention on at least some outcomes. 6 studies found BI specifically reduced drinking and/or drink-related consequences, and 4 did not find a reduction

The reviews considered here, frequently based on RCTs, largely confirm the finding that BI has a statistically significant effect on the reduction of alcohol consumption. Conversely, Moyer found that BI was not less effective than more extended interventions for alcohol [46].

There are two reviews that did not find substantial effects from BI. McQueen's study is not based in a primary care setting so, while interesting, is of limited applicability to the current project [42]. The Beich review is of studies set in primary care, and requires further interpretation [9].

The important aspect of the Beich study is that the authors used a very large denominator against which to compare the number of patients who modified their drinking behaviour. They argued that only two or three people out of 1,000 originally screened would benefit from BI. This throws the key issue of cost effectiveness back onto the cost and accuracy of screening, since this is the tool that identifies patients who will benefit from the actual BI. Beich also made a number of useful criticisms of BI trial methodologies, which serve as a reminder to be careful with the large effect sizes observed in some trials. In particular, the issues of attrition bias, lack of blinding and self-selection may have influenced the positive results of some BI studies.

While bearing in mind the caveats expressed by Beich, the consistent message from other meta-analyses and systematic reviews is that BI has a strong, statistically significant effect on hazardous drinking behaviour. If BI can be implemented routinely in a way that reflects the effectiveness observed in the trials, with screening regimes that effectively identify patients who will accept and benefit from the interventions, BI will produce reductions in alcohol-related harm, and is likely to produce reductions in health care and other costs.

The difficulty with the BI literature as it stands arises when trying to quantify the gains from BI in a way that reflects direct impacts on the level of health care that patients are likely to need. Studies tend to express results in a variety of ways, including the average reduction in weekly alcohol consumption. But reporting an average, as so many studies do, has the problem of masking the heterogeneous experience of individual patients, some of whom may have continued with unchanged alcohol consumption, and some of whom may have made very dramatic changes to their behaviour.

Moyer's meta-analysis is even harder to interpret in terms of health care, since she uses a composite effect size, regardless of what actual measure was used in the original study. This convincingly shows the direction of effect of BI, but is not clearly interpretable in terms of behaviour or specific health care impacts.

In general, while some studies find reductions in specific uses of health care, what this means in terms of health care is not clear, although it seems likely that some proportion of patients will move from hazardous drinking behaviour to a state of less or non-hazardous drinking.

The overall messages that come from the BI literature are:

- The strong evidence for the effectiveness of BI, in a variety of settings, and across a considerable variety of specific implementations of intervention;

- The importance of effective screening to identify a population who will benefit from BI; and
- The uncertainty of actual effect size and how it can be interpreted in terms of the changed risk behaviour of individuals.

7.6 Cost effectiveness

In terms of the cost effectiveness of BIs, it is difficult to make comparisons across countries as there is no consistent method for quantifying the gains from BI in a way that reflects direct impacts on the level of health care that patients are likely to need.

Table A7: Cost effectiveness of BI

Author	Scope	Key findings
Fleming et al [37]	48-month efficacy and benefit-cost analysis of Project TrEAT (Trial for Early Alcohol Treatment), a RCT of brief physician advice for the treatment of problem drinking	Significant reductions (p _ 0.01) in 7-day alcohol use, number of binge-drinking episodes and frequency of excessive drinking as compared with the control group were observed, as well as fewer days of hospitalisation (p _ 0.05) and fewer ED visits (p _ 0.08). The benefit-cost analysis suggests a $43,000 reduction in future health care costs for every $10,000 invested in early intervention. The benefit-cost ratio increases when including the societal benefits of fewer motor vehicle events and crimes
Tariq et al [44]	Used RIVM[6] Chronic Disease Model to compare an SBI scenario with no SBI and extrapolate from decreased alcohol consumption to effects on health care costs and QALYs gained	Implementing SBI in primary care setting in The Netherlands would lead to health gains at a low cost. 56,000 QALYs were gained at an additional cost of EUR$298,000,000 due to providing alcohol SBI in the target population, resulting in a cost-effectiveness ratio of EUR$5,400 per QALY gained. This can be considered to be cost effective.

Two representative international studies that address cost and cost effectiveness found strong evidence of cost effectiveness (Table A7). Fleming et al [37] found that a group receiving a BI not only had significant reductions in alcohol use, they also had

[6] A state transition Markov-type simulation model that describes how morbidity and mortality for several chronic diseases change over time in the Dutch population as a result of changes in epidemiological risk factors

fewer hospital days and fewer ED visits. The intervention cost $205 per person ($166 from the clinic perspective and $39 from the client's perspective) and saved $712 in health care costs. The benefit-cost ratio of 4:3 suggests a $43,000 saving in future health care costs for every $10,000 spent for early intervention. The benefit-cost ratio increased to 39:1 after factoring fewer motor vehicle and legal events into the analysis.

Tariq [44] found 56,000 QALYs were gained at an additional cost of EUR$298,000,000 due to providing alcohol SBI in the target population, resulting in a cost-effectiveness ratio of EUR$5,400 per QALY gained. This can be considered to be cost effective.

7.7 Gaps in the literature

From the point of view of this study, and from the wider perspective of a health agency seeking to implement BI on a general scale, the literature has a number of notable gaps. These represent areas in which further research is needed, or issues where health planners will need to reach pragmatic judgements in the absence of comprehensive evidence.

The first major issue is the lack of research in New Zealand ED settings. Other than the Auckland study [13] and some elements of the BERL work [10], there is only a small published basis on which to consider the burden of ED attendance that is driven by alcohol, and the extent to which it is amenable to BI. The best available information about the proportion of people who have alcohol-related injuries, and who would accept BI, comes from UK data [23], where the applicability to a New Zealand setting could be questioned. There is clearly a need for more research into the nature of the alcohol-related burden on EDs, and the implementation of BIs in this setting.

The general practice literature is much better served by New Zealand studies, particularly the work of McMenamin and Goodyear-Smith [2,7,30,50]. There have been a number of explicit estimates of the proportion of people attending general practice who would accept help with alcohol use issues, as well as work exploring the barriers to addressing alcohol issues in general practice.

The literature on the effectiveness of BIs has a number of key gaps that will require further research and evaluation. The effectiveness of BI in a population screening context is identified as an issue by Beich [9] and is an important issue for widespread implementation. The subtle impacts of screening approaches on the overall cost effectiveness of BI require further research, although this might best be understood in the context of pilot implementations rather than pure research projects.

The actual effectiveness of BI is commonly reported in the literature in a variety of ways, making comparisons between studies difficult and sometimes impossible. In some cases a measure may make for a straightforward and easily interpreted research outcome (such as the number of grams of alcohol consumed per week –

sometimes reported without baseline levels of consumption), but it has limited interpretation in terms of real changes in health risk and health care costs. The direct consequences of BI for health care activity seem not to be frequently measured or reported endpoints.