A model to assess the cost-effectiveness of alcohol education developed for NICE public health guidance on personal, social, health and economic (PSHE) education

National Collaborating Centre for Women's and Children's Health

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Background

PSHE consist of planned programmes which aim to improve to promote emotional and social development and health and wellbeing so that children and young people have the knowledge and practical skills to lead a healthy, safe, fulfilled and responsible life.

The consumption of alcohol by young people in England is increasing. The rate of increase is faster than for any other drug and its consumption causes numerous problems (Advisory Council on the Misuse of Drugs 2006). In 2006, 21% of young people aged 11-15 years had drunk alcohol in the previous week with average consumption among those who drank increasing from 5.3 units in 1990 to 10.44 units per week in 2000 and 11.4 in 2006. (Home Office 2007 and http://www.ic.nhs.uk). The proportion of women age 16-24 years whose drinking exceeded recommended levels almost doubled to 33% between 1992 and 2002 (Advisory Council on the Misuse of Drugs 2006). Alcohol consumption is also a risk factor for unprotected sexual intercourse (ESPAD) and sexual intercourse that is regretted the next day (Hibbell 2004).

Therefore, there is the potential for alcohol education delivered as part of PSHE to deliver important improvements to the public health of young people if it is able to change behaviour that moderates alcohol consumption. However, in a world with finite resources, devoting more resources to alcohol education means that fewer resources are available for alternative uses. This opportunity cost, as economists call it, implies that benefits might be foregone elsewhere. Therefore, it is important to demonstrate "value for money" in the use of public funds.

The NCC-WCH was commissioned by the National Institute for Health and Clinical Excellence (NICE) to undertake a literature review and an economic evaluation of alcohol education amongst primary and secondary school pupils to aid the recommendations of the PSHE programme development group (PDG).

Evidence on the cost-effectiveness of alcohol intervention programmes in schools and the community was presented in the community and schools review. In summary four papers were reviewed. Two of the papers, Spoth (2002) and Pentz (1998), focussed on community based interventions while the other two, Swisher (2004) and Jones (2007), focussed on school based interventions. The cost-effectiveness of community interventions has not been clearly established in the UK. The analysis undertaken in the US by Spoth et al 2002 suggested that Iowa Strengthening Families Program (ISFP) and the Preparing for the Drug-Free Years Program (PDFY) were cost-effective in the US, especially in the short term (up to 1 year). Pentz (1998) assessed the costs, benefits and cost-effectiveness of the Midwestern Prevention Project (MPP). The results demonstrated a $700 net saving per family per year resulting from a reduction in the incidence of monthly drunkenness.

Jones at al (2007) conducted a cost-effectiveness analysis of three school based interventions to determine the percentage of students reporting hazardous/harmful drinking at follow-up ranging between 12 and 32months amongst children aged 11-14 years. The incremental cost-effectiveness ratios (ICER)[1] indicated that compared to the brief intervention programme STARS for Families; the classroom-based SHAHRP was the most cost-effective intervention with an estimated ICER of £257 per case of hazardous/harmful drinking averted. Both STARS for Families and SHAHRP dominated the Lion’s Quest SFA programme as they were shown to be less costly and more beneficial. See appendix A for fuller description of the individual studies.

The review did not uncover any additional evidence to that reported recently by the National Collaborating Centre for Drug Prevention (Jones et al 2007) who concluded in their review on the effectiveness and cost-effectiveness of interventions delivered in primary and secondary schools to prevent and/or reduce alcohol use by young people under 18 years old that:

[1] The ICER is a measure of the additional costs from an action or intervention relative to some alternative intervention or action divided by the additional benefit. Therefore it provides a measure of the cost per unit of effect.

"There is inconsistent and insufficient evidence to determine the cost-effectiveness of school-based interventions that aim to prevent or reduce alcohol use in young people under 18 years old."

Therefore, the additional modelling undertaken for this commission from NICE, and reported here, was seen as an important tool to aid the PDG in making their recommendations.

Aims

To explore the cost-effectiveness of alcohol education interventions for children and young people aged 11 to 19 years in full-time education or who are looked after by local authorities, including those with physical/learning disabilities.

Methods

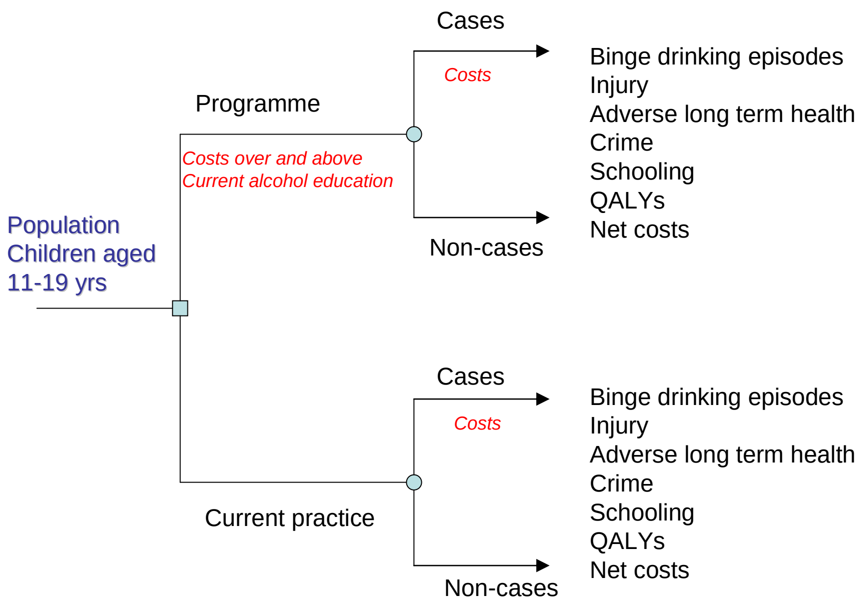
A model was developed in Microsoft Excel™. A user-friendly interface allows the user to navigate the model using menus and on-screen buttons. The user is able to alter the model inputs and can view the results for any particular scenario they create. In addition, the user can set lower and upper bounds for pre-programmed one-way sensitivity analyses, in which one parameter's values are changed holding all other values in the model constant

The basic analytic approach is illustrated by the simple schematic in Figure 1 below. Economic evaluation of an alcohol education intervention or programme involves comparing its net costs and effects relative to current practice. If a programme generates benefits alongside net savings (where programme costs are less than the 'downstream' savings resulting from averting unwanted outcomes such as accidental injury or pregnancy (i.e. the intervention is cheaper and more effective) then the cost-effectiveness of the intervention is unambiguous. The intervention is said to *dominate* current practice. However, if the programme produces additional benefits but at a net cost, then the decision maker must decide whether this represents good value for money, based on the opportunity costs (benefits foregone) of not employing those resources in some alternative use.

Owing to the lack of evidence about the efficacy of school based alcohol education especially in a UK context, hypothetical scenarios were evaluated using a "what-if" approach. Using this approach, it is possible to estimate various thresholds for cost-effectiveness. For example, what is the maximum a programme could cost and still be considered cost-effective at different levels of programme effectiveness? Potentially, such a model could be adapted to new evidence as and when it became available.

In accordance with NICE methods for public health guidance (NICE, 2006) a public sector perspective, in addition to an NHS and Personal Social Services (PSS) perspective, was adopted.

Figure 1: Schematic diagram showing the economic evaluation approach to Alcohol



It is assumed that the intervention is being delivered in England on a country-wide basis and the costs and benefits reported herein are predicated on that assumption. However, the model allows the population size to be easily varied. The population was sub-divided into various age groups to reflect different drinking patterns by age.

Table 1: The model population for England

Age	Females	Males
11	297,600	311,100
12	298,000	313,900
13	304,500	321,000
14	307,800	325,300
15	318,900	337,700
16	325,000	346,900
17	323,000	344,100
18	325,000	344,900
19	333,600	354,900

Source: ONS 2009 (Mid-2007 population estimates)

Modelling Effectiveness

Effectiveness is modelled as a percentage reduction in 'hazardous' or 'harmful' drinking. This includes binge drinking episodes but also, where the harm exhibits a dose-response relationship, a reduction in the volume of alcohol consumption. There is no agreed definition of binge drinking; however, for the purpose of our model we used the ONS definition (men and women who exceed the recommended daily limit, four units and three units respectively, at least one day during the previous week). (http://www.statistics.gov.uk/CCI/nugget.asp?ID=1894&Pos=&ColRank=2&Rank=224)

Alcohol consumption has been shown to increase the risk of a number of chronic diseases including various cancers, stroke and cirrhosis of the liver (Rehm et al., 2003). In their review of interventions to reduce and prevent alcohol use by young people, the National Collaborating Centre for Drug Prevention (Jones 2007) used data from studies showing a dose-response relationship between alcohol exposure and various diseases to develop a causality model. Risk difference estimates were derived which were then used to estimate the hypothetical number of alcohol related events that would occur in the 2005 birth cohort for England and Wales for these outcomes, although the authors noted that the actual number of events was sensitive to the risk estimates used. In particular, the authors cautioned that whilst the estimates for lung cancer were based on a strong association in a group of males classified as ‘never smoking’, using alternative estimates can show a protective effect of 15 to 30mg/day of alcohol. For the purpose of this modelling, we assume these events divided by the size of the 2005 cohort population give an estimate of the lifetime population attributable risk of these outcomes for current baseline levels of drinking in young people. Further, we assume that the dose-response relationship is linear with respect to reductions in alcohol consumption as estimated by programme effectiveness. Disease outcomes where the 95% confidence intervals for the expected number of alcohol-related cases crossed zero were excluded from the analysis. The outcomes that are included in the model are shown in Table B.1 in Appendix B. It is assumed that the reduction in alcohol consumption as a result of the intervention is sustained over the lifetime of the young people given the education intervention.

We also used binge drinking episodes as a measure of outcome in the model, although this is obviously correlated with other outcomes and is perhaps best seen as a proxy or intermediate measure of the true outcomes of interest, namely the harms of damaging levels of alcohol consumption. The binge drinking prevalence for young people is shown in Table 2. Hibell et al. (2004) found that 54% of 15-16 year olds met the criteria for binge drinking in the last 30 days. To estimate the prevalence in younger groups, data from Becker et al. (2006) on the percentage of 11-15 year olds who had ever had an alcoholic drink by age and gender was utilised. It was assumed that the prevalence of binge drinking in each age and gender category would be in the same ratio as the proportion that had ever had an alcoholic drink. In other words, the data from Becker et al. (2006) showed that the percentage of 11 year-old boys who had ever had an alcoholic drink was about ¼ of the percentage in boys aged 15-16 years. Therefore, the assumption made in the model was that the prevalence of binge drinking in 11 year-old boys would be approximately ¼ of that in 15 year old boys. As the prevalence data were for binge drinking in the last 30 days, we multiplied the prevalence and population data by 12 to estimate episodes of binge drinking over a one-year period.

Table 2: Prevalence of binge drinking by age and gender

Age	Prevalence Boys	Prevalence Girls	Source	Notes
11	14%	22%	Becker (2006)	Calculated relative to 15-16
12	24%	26%	Becker (2006)	Calculated relative to 15-16
13	35%	40%	Becker (2006)	Calculated relative to 15-16
14	47%	50%	Becker (2006)	Calculated relative to 15-16
15	54%	54%	Hibell (2004)	
16	54%	54%	Hibell (2004)	
17	54%	54%	Assumption	Same as 15/16-year olds
18	54%	54%	Assumption	Same as 15/16-year olds
19	54%	54%	Assumption	Same as 15/16-year olds

However, the harms of alcohol use are not restricted to health outcomes only. Therefore, we also considered the potential effects of an intervention on crime (Table 3) and schooling (Table 4). Baseline data is indicated in Tables 4 and 5. For these outcomes the intervention is assumed to achieve an effect (reduce the occurrence of binge drinking which will lead to a proportional reduction in, for example, crime) lasting one year. In other words, it is not assumed that the intervention would reduce offending by 15 year-olds who received the intervention/programme at age 11.

The number of criminal offences by young people where drunkenness was cited as the motivation has been estimated for 10-17 year olds (Budd et al., 2005). As a simplifying assumption, we assumed that none of these offences were accounted for by 10 year-olds. We then used the prevalence of binge drinking by age and the population to estimate the proportion of offences committed by each age group. We then estimated the number of offences that would have been committed by 18 and 19-year olds based on their binge drinking prevalence and population. This gave us an estimate of the total number of drinking related criminal offences which we then divided by the population to give an overall offending rate across the age range.

Table 3: Offending rates for 11-19 olds per annum by offence category

Offence	Offending rate	Source
Any violent offence	1.9%	Budd et al. (2005), Calculation
Any property offence	0.7%	Budd et al. (2005), Calculation

Additionally we followed Jones et al. (2007) in assuming that that the arrest rate for these offences was 3.0%.

Table 4: Problems experienced at school because of own alcohol use and population attributable risk of excessive alcohol consumption to 5+ truanting episodes

School outcome	Boys	Girls	Source
Performed poorly	3%	4%	Hibbell et al (2003)
5+ episodes of truanting	29%	29%	Best (2006)

Modelling Costs

This model is not evaluating any particular intervention and therefore there are no programme costs as such. Rather the model takes a threshold and/or "what-if" approach to programme costs.

a) for a hypothetical intervention producing a certain behaviour change what is the maximum a programme could cost and still be considered cost-effective?
b) for a given programme efficacy and cost, what is the cost-effectiveness?

It is assumed in the model that the programme or intervention costs are those over and above the existing provision of alcohol education rather than over and above 'do nothing'. The default programme cost of £200 million in the model is a hypothetical value and doesn't necessarily give any indication of the resources that would be required to deliver a certain effect size. It is based on an approximate cost of £30 per student which is consistent with the range of values in the programmes evaluated by Jones (2007).

However, in addition to the resource use associated with delivering the intervention, it is important in economic evaluation to consider the impact of the intervention on “downstream” resource use arising from any impact on health outcomes and/or behaviour. Reducing or preventing alcohol consumption has a potentially large impact not only on future health status but also on criminal justice and educational performance, for example. Therefore, the model allows the user to input and vary the savings associated with averting certain outcomes. These are shown in Table C.1 in Appendix C.

Some of the limitations of this cost data have been discussed previously (Jones et al., 2007). For example, it wasn’t possible from the reported data to estimate the onset of disease and therefore the costs are not discounted as would normally be expected according to NICE methods. Nevertheless, the model allows the importance of uncertainty with respect to unit costs to be assessed as part of a sensitivity analysis.

Valuing Outcomes

At the most basic level, the model can provide a cost consequences analysis where the changes in the outcomes as a result of the intervention are given alongside the costs. However, such information can be difficult for decision makers to interpret because, in itself, it gives no indication of the valuation that is placed on the benefits of the intervention and whether they are worthwhile given the opportunity costs.

NICE’s preferred measure for economic evaluation is the quality adjusted life year (QALY) which facilitates a comparison of cost-effectiveness across health interventions which may differ in terms of their impact on the various dimensions of health. Such an analysis using the incremental cost per QALY is one of the outputs of the model, and is available if the user assigns a QALY loss to the outcomes listed in Table 2[2]. As with all the model's outputs it is possible to produce the analysis for numerous "what-if" scenarios.

However, the default in the model is not to assign QALYs to outcomes (the user can change the default by ticking a check box on the main menu page). Nevertheless, even in this default mode the results give the minimum QALY gain needed to achieve cost-effectiveness for the given willingness to pay (WTP) for a QALY threshold. The default WTP for a QALY threshold is set at £20,000 per QALY, which is consistent with current NICE advice.

Clearly the potential benefits of alcohol education interventions are not just limited to health related quality of life. Therefore, the model also provides a cost-benefit analysis, which is arguably the most appropriate evaluation technique for interventions with a multi-sectoral impact. This involves placing a monetary valuation on the benefits so that they can directly be compared with costs. In this approach, interventions where the monetary valuation of the benefit exceeds the cost are considered to represent good value for money. In order to estimate a monetary valuation of the benefits of the intervention the user is required to state their willingness to pay for such a benefit. The default model WTP values are shown in Table 5. Other than the WTP for a QALY, which is based on NICE methods guidance (2009), the values are arbitrarily chosen. However, the implications of changing these values can be explored in sensitivity analysis.

Due to the combination of health and non-health outcomes, the model also allows a cost-benefit approach to be combined with an incremental cost per QALY analysis. This involves taking the net cost (which is programme cost less 'downstream savings' from averted adverse outcomes) and placing a monetary value on the non-health benefits. This is then subtracted from the net cost to give an indication of the resources remaining to generate health related quality of life benefits. Where QALYs are not specified, the threshold QALY gain needed for cost-effectiveness is given. Where QALYs are

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[2] QALY's are a measure of health related quality of life (HRQoL) and aren't intended to capture improvements in quality of life arising from a reduction in crime, for example

estimated the incremental cost-effectiveness ratio is calculated by dividing the net cost less the monetary valuation of the non-health benefits by the QALY gain. The usual ‘decision rules’ can then be applied to such a summary measure of cost-effectiveness.

Table 5: Willingness to pay for model outcome

Outcome	WTP	Source
QALY	£20,000	NICE 2009
Averted episode of binge drinking	£100	Assumption
Prevent a child performing poorly at school	£100	Assumption
Prevent a 5+ truanting episode*	£50	Assumption
Avert a violent offence	£300	Assumption
Avert a property offence	£1000	Assumption
Avert a teenage conception	£2,000	Assumption

* Having missed school on at least 5 occasions within a year

Results

The” what-if” nature of the model means that no greater weight should be attached to base case results than those of alternative scenarios. In this paper by ‘base case’ we simply mean the default values of the model’s inputs. Some of these have a definite source but others are purely hypothetical. In the analyses where a model input is varied, other model inputs are held constant.

Analysis 1 – The base case

An alcohol education intervention or programme delivered on a nationwide basis and costing £200 million reduces harmful alcohol consumption by 2%. The ‘consequences’ of such an intervention are shown in Figure 2.

Figure 2: Changes in outcomes as a result of the intervention

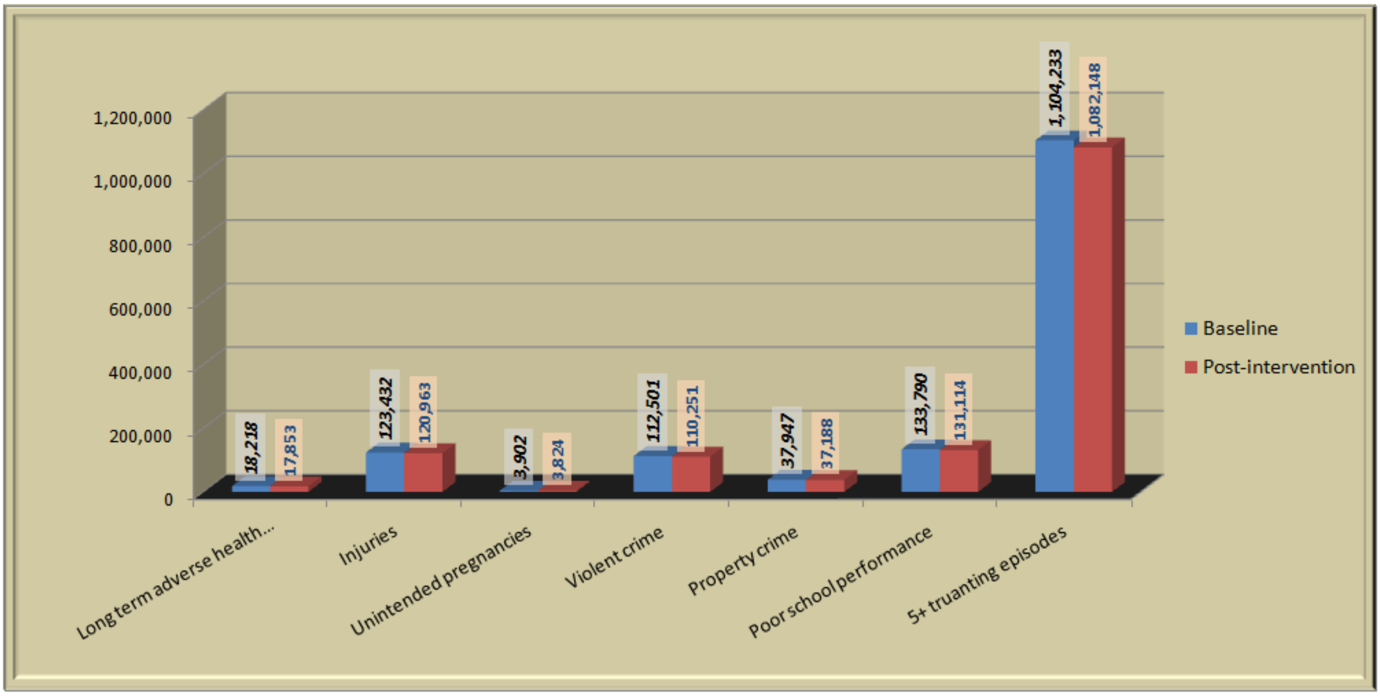


Table 6: Costs

Costs	
Programme	£200,000,000
Less savings	
Long term adverse health outcomes	£1,531,780
Injury	£260,554
Teenage pregnancy	£95,722
Crime	£143,930
NET COST	**£197,968,013**

Table 6 shows that the savings from averted outcomes offsets the programme cost by just over £2 million, giving a net cost of just under £198 million. In Table 7, the bulk (£65.3 million) of the benefits of the intervention (totalling £69.0 million) derive from the reduction in binge drinking, because binge drinking is so prevalent and because it assumes that society is willing to pay £100 to prevent each episode. If only the monetary valuation placed on the benefits of the programme (£68 million) is taken into account, this gives a net benefit of – £130 million. As costs exceed benefits this would not be considered cost beneficial. However, in this analysis no valuation of the benefits of improved health outcomes has been made. The model results for this scenario suggest that a minimum of 6,483 QALYs would be needed for the programme to be considered cost-effective as this number of QALYs valued at £20,000 each would produce a positive net benefit.

Table 7: Cost-effectiveness

Cost-effectiveness	
WTP QALY gained	£0
WTP conceptions averted	£165,524
WTP averted binge drinking	£65,934,840
WTP to avert a child performing poorly in school	£283,736
WTP to avert an episode of 5+ truanting	£1,170,904
WTP to avert a violent offence	£675,204
WTP to avert a property offence	£75,916
Total WTP for benefits of intervention	£68,306,123
Summary	
Net Benefit	**-£129,661,890**
Cost/QALY........(Net Cost ÷ QALY)	**Zero QALY**
Cost/QALY........(Net Cost less WTP benefit ÷ QALY)	**Zero QALY**
QALY gain needed for cost-effectiveness (Net cost)	**9,898**
QALY gain needed for cost-effectiveness (Net cost less WTP benefit)	**6,483**

Analysis 2- Sensitivity analysis varying the effectiveness of the programme

In this analysis the effectiveness of the programme in terms of reduced harmful/hazardous drinking is varied between 0.5% and 30%.

Figure 3: Net costs varying the effectiveness of the intervention

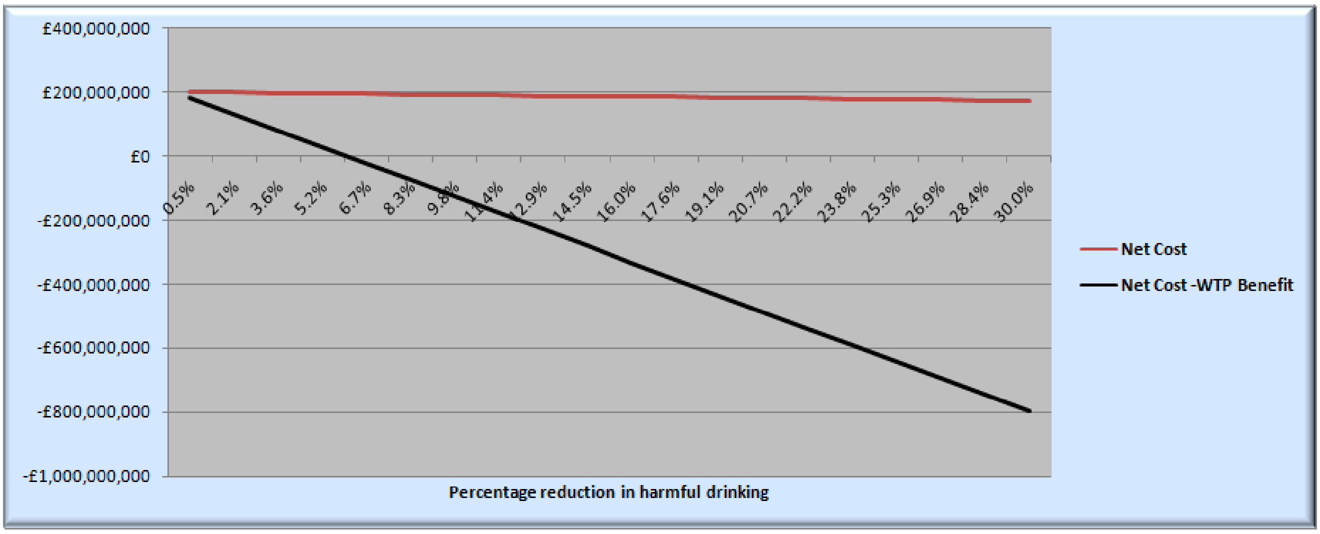
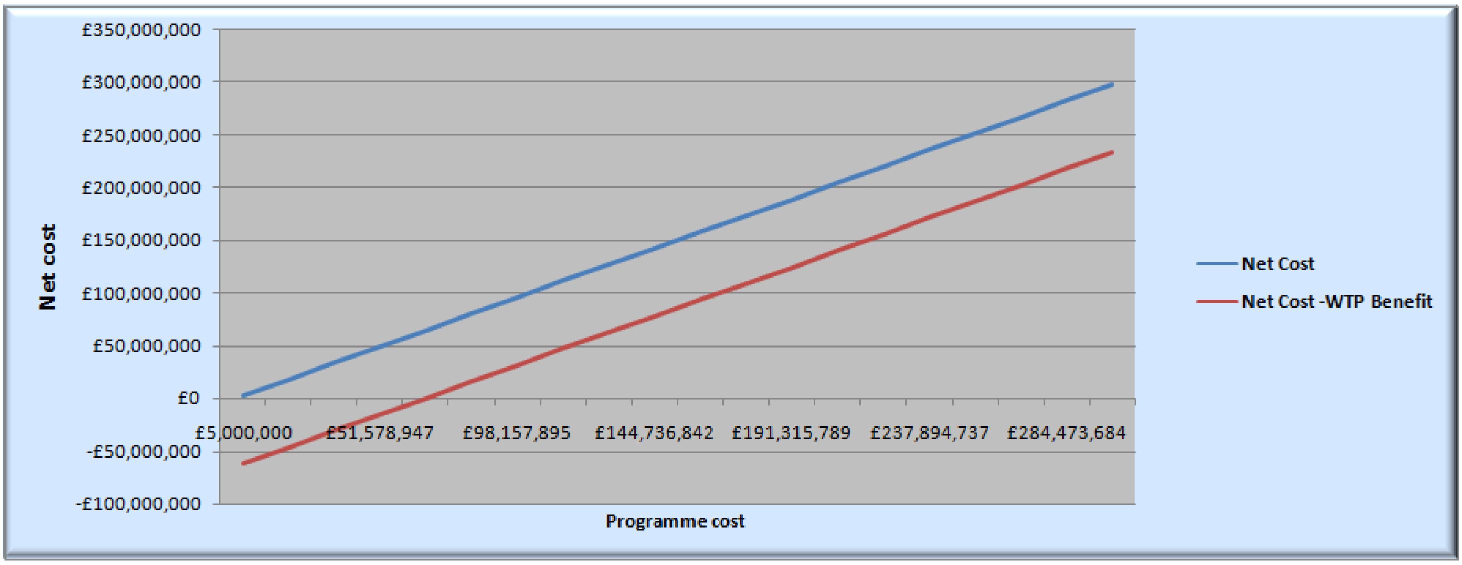


Figure 3 shows the impact of varying the programme effectiveness holding all other inputs in the model constant. As at higher levels of effectiveness there is a fall in net costs resulting from increased ‘downstream’ savings[3] from averted adverse events. However, there is a steeper fall in the net costs less the monetary valuation of the benefits which reflects the increased monetary valuation the decision maker places on more averted adverse outcomes. Even ignoring any valuation of health benefits, the model suggests that the intervention (costing £200 million) would be unambiguously considered cost beneficial if a reduction of 6% or greater in harmful drinking was achieved.

Analysis 3 – Sensitivity analysis varying the cost of the programme

The “what-if” approach is based on a hypothetical intervention. As such it is not known what resources would be needed as part of an intervention to achieve a certain change in alcohol consumption behaviour. This analysis explores scenarios from where a 2% reduction in alcohol consumption could be achieved with a relatively low cost intervention (£5 million) through to a much more intensive option (£300 million)

Figure 4: Net costs varying the programme cost



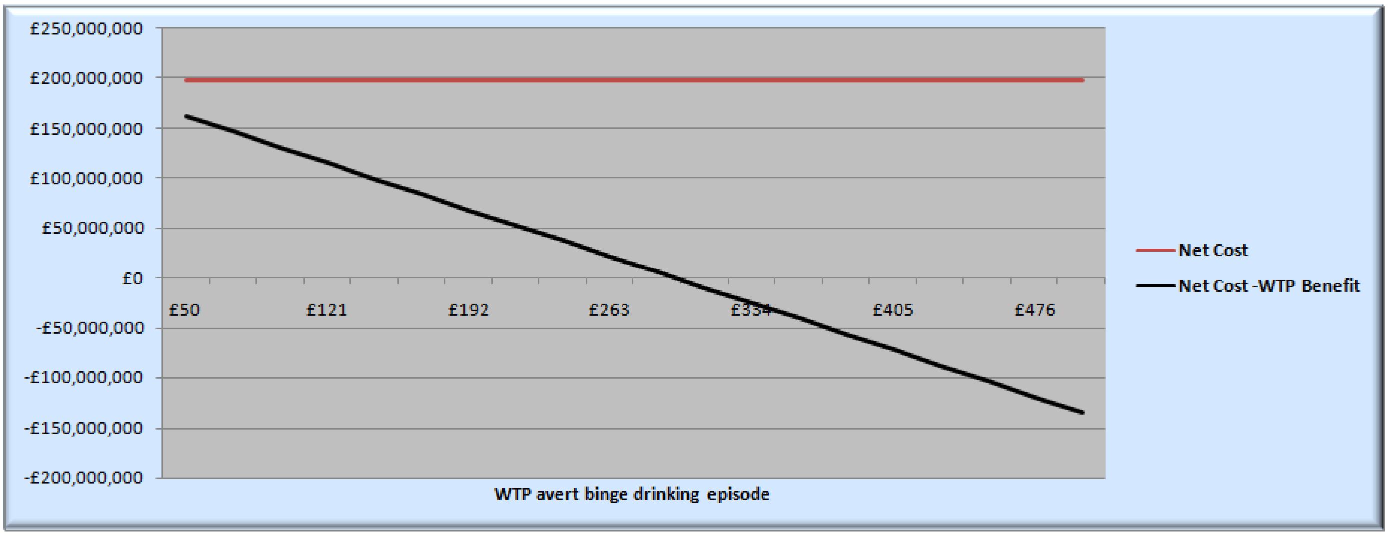
[3] ‘downstream’ savings occur as a direct consequence of an intervention/action but subsequent to it

This result shows how net costs rise in a linear fashion with increasing programme cost costs (Figure 4). They also show that, ignoring any consideration of health benefits, the programme would be cost beneficial at a programme cost of approximately £75 million and a 2% reduction in harmful drinking.

Analysis 4 – Sensitivity analysis varying the WTP to avert an episode of binge drinking

This analysis explores how sensitive the results are to the willingness to pay for an averted episode of binge drinking for a programme costing £200 million and producing a 2% reduction in harmful drinking. Again this is an important unknown especially as some of the benefits of averted binge drinking are captured by other model values. To reflect this uncertainty we explore the implication of varying the willingness to pay for an averted episode of binge drinking from £50 through to £500.

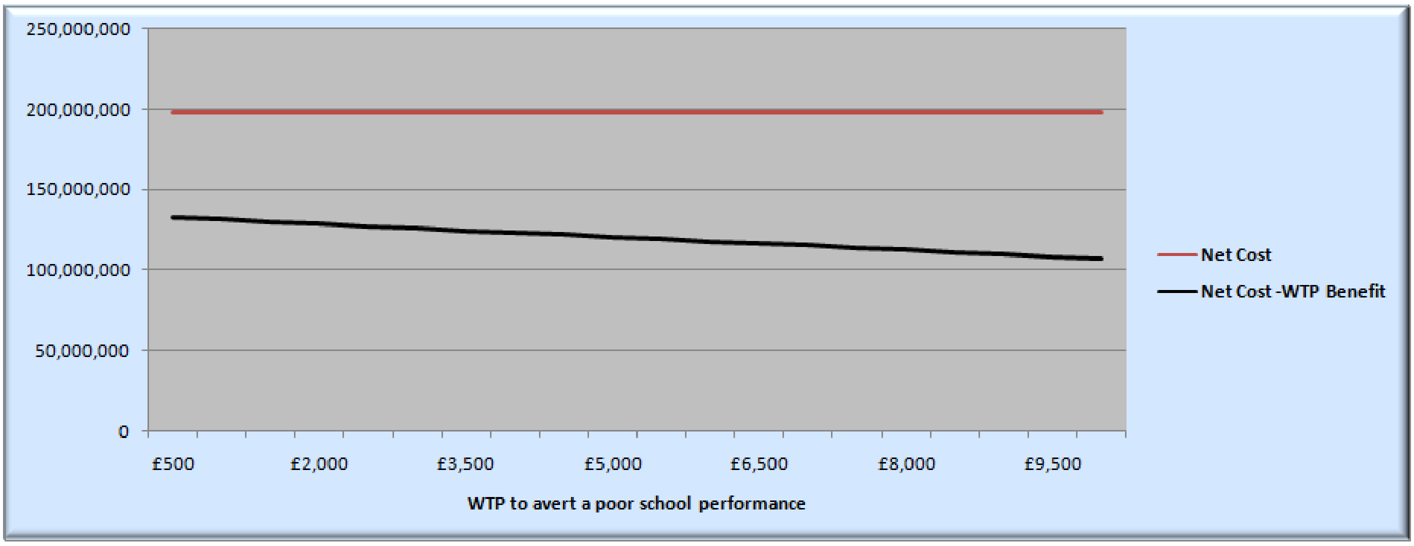
Figure 5: Net costs varying the WTP to avert an episode of binge drinking



As Figure 5 shows, varying the WTP has no effect on net cost, but does lessen the differential between net costs and the monetary valuation of benefits. This analysis shows that a WTP to avert a binge drinking episode of £300 or more is sufficient to produce a cost beneficial result even in the absence of any consideration of the valuation placed on improved health outcomes.

Analysis 5 – Sensitivity analysis varying the WTP to prevent a poor school performance

Figure 6: Net costs varying the WTP to prevent a poor school performance

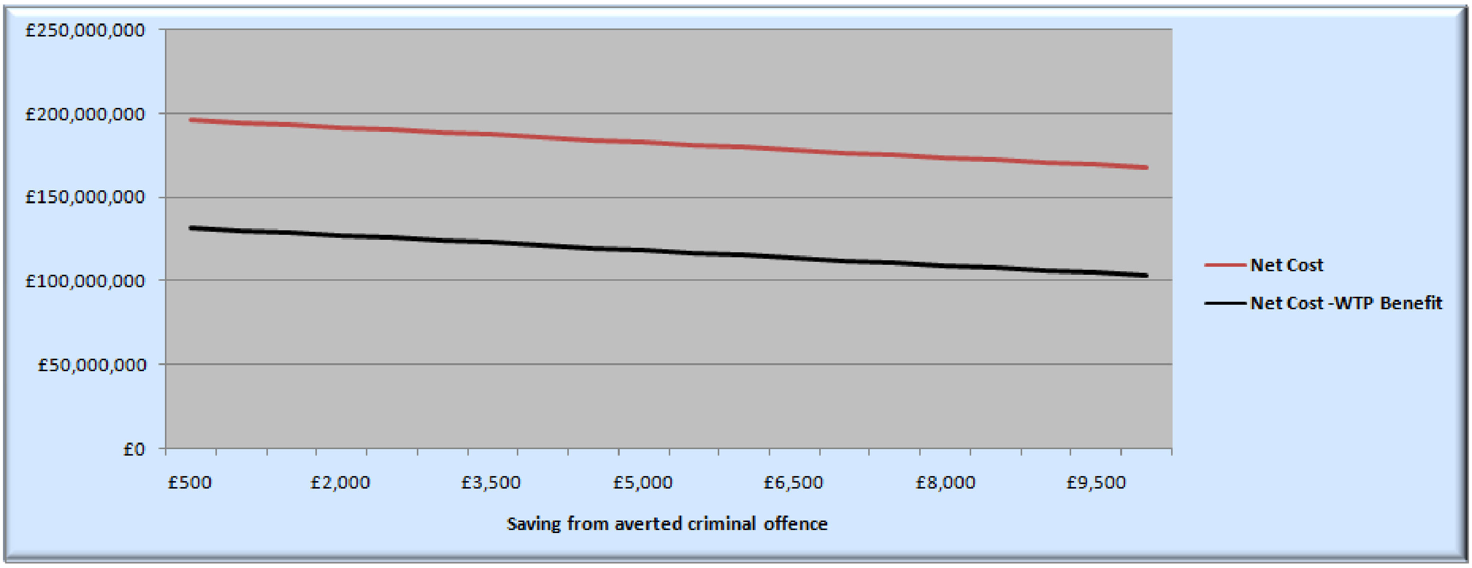


Again the results show how the cost benefit ratio improves with higher valuation of the intervention's benefits. However, it also shows that even a tenfold difference in WTP does not have a very dramatic effect on the overall result.

Analysis 6 – Sensitivity analysis varying the savings from an averted criminal offence

The model in its default state already factors in the costs of an arrest associated with criminal offending. However, there are potentially many other costs such as vandalism repair, youth detention centres, probation etc. So in this analysis we vary the savings from an averted criminal offence over and above that linked to arrests.

Figure 7: Net costs varying the saving from an averted criminal offence



Increased savings from an averted criminal offence impact directly on net costs as a reduction in 'downstream' resource use. However, the overall impact on net costs in varying the saving from zero to £10,000 is relatively minor

Analysis 7 – Assigning QALYs to health outcomes

Here we assume that 5 QALYs are gained for every long term adverse health outcome avoided. We also assume that 0.01 QALY is gained for every injury averted. These values are somewhat arbitrary but the model allows them to be readily altered. The long term outcomes typically have a considerable loss in health state utility often experienced over a number of years and may often lead to death. On the other hand the injuries will typically be of a relatively short duration, measured in days rather than years. Whilst the associated pain may induce considerable disutility it will by comparison be a short term experience. To put this into context, the absolute maximum QALY loss of an adverse outcome experienced for a day is 0.003 QALYs, based on utility loss deemed equivalent to death.

The costs are unchanged from the base case analysis. The total QALY gain is indicated in Table 8.

Table 8: QALY gained

QALYs gained	
Long term health	1,932
Injury	26
Pregnancy	0.00
Total	**1,958**

Table 9: Cost-effectiveness

Cost-effectiveness	
WTP QALY gained	£39,164,974
WTP conceptions averted	£165,524
WTP averted binge drinking	£65,934,840
WTP to avert a child performing poorly in school	£283,736
WTP to avert an episode of 5+ truanting	£1,170,904
WTP to avert a violent offence	£675,204
WTP to avert a property offence	£75,916
Total WTP for benefits of intervention	£107,471,097
Summary	
Net Benefit	**-£90,496,916**
Cost/QALY........(Net Cost ÷ QALY)	**£101,094**
Cost/QALY........(Net Cost less WTP benefit ÷ QALY)	**£66,213**
QALY gain needed for cost-effectiveness (Net cost)	**9,898**
QALY gain needed for cost-effectiveness (Net cost less WTP benefit)	**6,483**

Table 9 shows that in this analysis the monetary valuation of the QALY gained is approximately £39 million at a WTP for a QALY threshold of £20,000 per QALY. This almost doubles the monetary valuation of the benefits of the intervention; however it is still not sufficient to offset the net programme costs, as is indicated by the net benefit of -£90 million. Taking into account the value placed on non-health benefits the incremental cost-effectiveness ratio is approximately £66,000 per QALY, which is well above the level which would be considered cost-effective. It is evident why this is the case, as 1,958 QALYs gained falls well short of the almost 6,500 QALYs needed for cost-effectiveness.

Of course, this finding is based on a £200 million programme cost and a 2% reduction in harmful drinking. It is possible to explore what the programme cost and effectiveness thresholds are in order for the programme to be considered cost-effective. Keeping the reduction in harmful drinking constant, then an intervention producing these QALY gains would be cost-effective (i.e. less than £20,000 per QALY) if the programme cost was £113 million or under. Keeping the programme cost constant at £200 million an intervention with the above QALY gains per averted case would be cost-effective if the reduction in harmful drinking was 3.7% or higher.

Discussion

The analyses presented above are illustrative and, in the absence of information about the specific costs and effectiveness of any programme or intervention, are rightly considered hypothetical. Furthermore, in that context it should be noted that the results presented above are just an illustrative subset of the huge number of all possible scenarios. For example, all the analyses presented could have been repeated but using different levels of programme cost.

As with all analyses of this type, it is important for the model developers to be transparent about the simplifying assumptions and data sources used. One of the key facets of this model is that effectiveness has different temporal dimensions according to outcome. For health outcomes where there is thought to be a dose-response relationship between alcohol consumption over a fairly long period of time it is assumed hypothetically that the intervention produces a sustained reduction in alcohol consumption. For other outcomes such as criminal offending, injury or poor school performance the intervention is assumed to produce a change in alcohol consumption behaviours limited to only one year in duration. Now of course in a hypothetical model of this type it is not unreasonable to posit an effect which leads to a long term reduction in overall consumption of alcohol units whilst at the same time only affecting other types of hazardous/harmful drinking over a much shorter timeframe. Nor it is unreasonable in a hypothetical model to assume that the percentage reduction in harmful drinking is the same for both behaviours having a more immediate impact and those having longer term effects. Of course, what the effects of a real programme on these type of behaviours is ultimately an empirical question and it seems unlikely that the actual relationship between behavioural effects and the intervention would be quite as straightforward as that presented in this analysis.

If decision makers want to give as much weight to non health outcomes as to health outcomes then cost benefit analysis provides the most relevant information. However, considerable caution needs to be exercised in the use and interpretation of the willingness to pay values for these non health outcomes. Conceptually and methodologically, the approach is correct but the extent to which the decision maker would really know his/her or society's willingness to pay to avert these outcomes is debatable. It is best to interpret the results in terms of "what-if" these were the willingness to pay values. That is not to say that some sensible estimates could not be derived, at least in terms of upper and lower bounds. For example, the plausibility of the WTP values could be benchmarked against the WTP to avert various adverse health events based on their associated QALY loss. How does a single binge drinking episode, which has a relatively low probability of a significant adverse health or societal outcome, compare to the loss of a quality adjusted life year? Surely, the WTP to avert a binge drinking episode is much less than the WTP for a QALY?

It is also important that the WTP to avert the various outcomes does not embody double counting. For example, society may be willing to pay to avoid an episode of binge drinking for a whole range of reasons. These might include the unacceptability of the behaviour itself, the fear induced by drunken behaviour, CCTV surveillance, adverse health outcomes and criminal acts. However, some of those outcomes are explicitly measured by the model independently and therefore the willingness to pay to avert a binge drinking episode must strip out the perceived benefit in terms of reduced crime, for example, if the willingness to pay for those outcomes has also been factored in elsewhere in the model.

Finally, the model does not include all adverse outcomes associated with harmful or hazardous drinking. In particular it does not address the outcome of accidental death such as that arising from drowning or road traffic accidents. The QALY losses and costs from such outcomes are considerable and their omission may cause the cost-effectiveness of any alcohol education programme or intervention to be underestimated.

Conclusion

The model is not intended to demonstrate whether an alcohol education intervention or programme is cost-effective. It is believed that there is not the evidence from interventions relevant to an England and Wales setting to do that. Rather, it uses a "what-if" analysis to explore the scenarios when such a programme would be cost-effective and the scenarios when it would not be. It does this by positing a relationship between alcohol consumption behaviours and outcomes and then works backwards to say what if a programme costing a hypothetical amount produced a given change in those behaviours. Potentially, such a model could be adapted to new evidence as and when it became available.

By exploring different scenarios through the use of sensitivity analysis, it is also possible to gain insights into what factors are key drivers in determining the cost-effectiveness of an alcohol education programme.

The model does show that there might be plausible scenarios where an effective alcohol education programme would be a very cost-effective use of public money and the key, therefore, is to find that intervention which delivers changes in behaviour at an acceptable cost. So, for example, a programme costing £75 million and averting long term adverse health outcomes due to alcohol with an associated gain of five QALYs would be cost-effective providing it led to a relatively modest 1.4% reduction in alcohol consumption within the target population of youths.

Appendix A: ***Description of the Alcohol studies included in the Jones Review 2007***

School Health and Harm Reduction Programme (SHAHRP) was based on a quasi-experimental design. Fourteen schools were allocated to intervention and control conditions. It was a curriculum-based programme conducted over two phases. Phase one was implemented when students were aged 13 years and consisted of 17 consecutive skills-based activities conducted over 8 to 10 lessons. Phase two was conducted in the following year when students were aged 14 years, and consisted of 12 consecutive activities delivered over 5 to 7 weeks. The emphasis of the activities in both phases was on the identification of alcohol-related harm and the development of harm reduction strategies. Intervention and control groups were followed up at three time points: (1) following delivery of phase one (8 months from baseline); (2) following delivery of phase two (20 months from baseline); and (3) one-year later (32 months from baseline).

The Lion's Quest SFA programme was a 40-session curriculum delivered to 7th grade students. The authors used an RCT design with schools as the unit of assignment to examine the effects of the SFA programme. Thirty-four schools were pair-matched within districts on sixth grade prevalence of the previous 30 days use of tobacco, alcohol or illicit drugs and then randomised within pairs to the intervention or control condition (usual drug programming). The aim of the curriculum was to teach social competency and refusal skills. Students were followed up at the end of the intervention school year (post-test) and one year later in eighth grade (1 year follow-up).

Start Taking Alcohol Risks Seriously (STARS) for Families program, was a 2-year preventive intervention based on a stage of acquisition model, and consisting of nurse consultations and parent materials. A randomized controlled trial was conducted, with participants receiving either the intervention (STARS) or a minimal intervention control. Participants included a cohort of 650 sixth-grade students from two urban middle schools located in the economically disadvantaged inner city of Jacksonville —one magnet (bused) and one neighbourhood**.**

Students assigned to receive the STARS for Families program were provided with a 2-year, multi-component intervention. Prevention messages addressed specific stage status and risk/protective factors of individual youth. During the fall semester of the sixth grade, intervention youths received a brief one-on-one health consultation provided by a nurse about why and how the child should avoid alcohol use. During the spring semester of the sixth grade, intervention youths received a series of prevention postcards mailed to parents/guardians providing key facts on what to say to their children about avoiding alcohol. During the fall semester of the seventh grade, intervention youths received a follow-up nurse consultation. Lastly, during the spring semester of the seventh grade, intervention youths received four family take-home lessons providing activities to enhance parent–child communication regarding prevention skills and knowledge.

Students assigned to the minimal intervention control condition were given alcohol education booklets. These booklets included information concerning alcohol's effects on the body, risks of using alcohol for youths, reasons why youths drink, reasons not to drink alcohol, ways of refusing alcohol use offers, alternatives to drinking, learning to feel good about oneself, the stages of intoxication, types of drinkers, the characteristics of alcohol abuse, the effect of alcohol on health, and other questions and answers about alcohol.

Appendix B*: Risk of adverse outcomes due to alcohol*

Table B.1: Risk of various outcomes due to alcohol at baseline level of consumption

Outcome	Risk	Source
Cancers of the lip, oral cavity and pharynx	0.0053%	Jones (2007)
Oesophageal cancer	0.0063%	Jones (2007)
Cancer of the larynx	0.0017%	Jones (2007)
Breast cancer (females)	0.0218%	Jones (2007)
Lung cancer	0.2453%	Jones (2007)
Adenocarcinoma of the small intestine	0.0026%	Jones (2007)
Stomach cancer	0.0009%	Jones (2007)
Colon cancer	0.0051%	Jones (2007)
Liver cancer	0.0005%	Jones (2007)
Ovarian cancer	0.0011%	Jones (2007)
Essential hypertension	0.0002%	Jones (2007)
Haemorrhagic stroke	0.0009%	Jones (2007)
Cirrhosis of the liver	0.0017%	Jones (2007)
Chronic pancreatitis	0.0008%	Jones (2007)
Depression	0.0181%	Jones (2007)
Luxation	0.5449%	Jones (2007), Nordquist (2006)
Contusion	0.5026%	Jones (2007), Nordquist (2006)
Fracture	0.4973%	Jones (2007), Nordquist (2006)
Gaping wound	0.4549%	Jones (2007), Nordquist (2006)
Concussion	0.0212%	Jones (2007), Nordquist (2006)
Exam after accident	0.0053%	Jones (2007), Nordquist (2006)
Other	0.0899%	Jones (2007), Nordquist (2006)
Abortion	0.0478%	Jones (2007), Lakha and Glasier (2006)
Miscarriage	0.0043%	Jones (2007), Lakha and Glasier (2006)
Live birth	0.0147%	Jones (2007), Lakha and Glasier (2006)

Appendix C*: Savings from averted outcomes due to alcohol*

Table C.1 Savings per averted outcome

Outcome	Saving	Source	Notes
Cancers of the lip, oral cavity and pharynx	£1,155	NHS Reference Costs 2005/06	
Oesophageal cancer	£2,693	NHS Reference Costs 2005/06	
Cancer of the larynx	£2,693	NHS Reference Costs 2005/06	
Breast cancer (females)	£1,494	NHS Reference Costs 2005/06	
Lung cancer	£4,621	NHS Reference Costs 2005/06	
Adenocarcinoma of the small intestine	£3,423	NHS Reference Costs 2005/06	
Stomach cancer	£2,742	NHS Reference Costs 2005/06	
Colon cancer	£3,641	NHS Reference Costs 2005/06	
Liver cancer	£1,094	NHS Reference Costs 2005/06	
Ovarian cancer	£1,231	NHS Reference Costs 2005/06	
Essential hypertension	£1,338	NHS Reference Costs 2005/06	
Haemorrhagic stroke	£2,794	NHS Reference Costs 2005/06	
Cirrhosis of the liver	£2,106	NHS Reference	

		Costs 2005/06	
Chronic pancreatitis	£2,076	NHS Reference Costs 2005/06	
Depression	£236	NHS Reference Costs 2005/06	
Luxation	£106	NICE 2007	
Contusion	£106	NICE 2007	
Fracture	£106	NICE 2007	
Gaping wound	£80	NICE 2007	
Concussion	£134	NICE 2007	
Exam after accident	£80	NICE 2007	
Other	£80	NICE 2007	
Abortion	£530	NICE 2009	SRE model
Miscarriage	£460	NICE 2009	SRE model
Live birth	£3,400	NICE 2009	SRE model
Arrest	£1,594	Field (1997), HM Treasury (2000), Parrott (1999)	In Jones (2007)
Violent offence excluding arrest cost	£0	Assumption	Can be varied as part of a “what-if” analysis
Property offence excluding arrest cost	£0	Assumption	Can be varied as part of a “what-if” analysis

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