Guidance Title: Prevention and early identification of alcohol use disorders in adults and young people

Macro-Level Interventions for Alcohol Use Disorders: Cost Effectiveness Review

Produced by   Nick Latimer

The University of Sheffield, School of Health and Related Research (ScHARR)

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CONTENTS

EXECUTIVE SUMMARY

Background

Alcohol misuse is associated with significant clinical and social consequences. The National Institute for Health and Clinical Excellence has been asked by the Department of Health to develop public health guidance to promote the prevention and early identification of alcohol-use disorders in adults and adolescents.

Objectives

The objective of this paper is to conduct reviews to deal with the following macro-level issues from a cost effectiveness perspective:
1. The effectiveness and cost-effectiveness of price controls in reducing alcohol consumption, alcohol misuse, alcohol-related harm or alcohol-related social problems among adults and young people
2. The effectiveness and cost-effectiveness of interventions in managing alcohol availability to reduce levels of consumption, alcohol misuse, alcohol-related harm or alcohol-related social problems among adults and young people
3. The effectiveness and cost-effectiveness of the control of alcohol promotion (e.g. advertising) in reducing levels of consumption, alcohol misuse, alcohol-related harm or alcohol-related social problems among adults and young people

Methods

A detailed literature search and review has recently been completed by ScHARR for the Department of Health (DH). This review was used to inform the reviews of issues 1 and 3, regarding the effectiveness and cost effectiveness of price controls and alcohol promotion. The results of the DH review and evidence statements based upon it are presented. The DH review of price controls included 61 individual studies and 2 meta analyses, covering a total of 284 studies. Two of these studies assessed the cost effectiveness of pricing and taxation interventions. The DH review of promotion interventions included 70 individual studies and 2 meta analyses, covering a total of 207 studies. Three of these studies assessed the cost effectiveness of promotion interventions.

For the second issue, regarding the cost effectiveness of alcohol availability interventions, a detailed literature search and review has been completed. The relevant existing economic literature has been critically appraised. Evidence relating to four key potential availability policy areas was sought and reviewed:
- Minimum legal age of alcohol purchase
- Enforcement of minimum legal age of alcohol purchase and management of the sale of alcohol to intoxicated individuals
- Licensed hours and days of alcohol sale
- Alcohol outlet density

Results and Evidence Statements

Price Controls

To assess the cost effectiveness of price control policies, the DH pricing and promotion review was appraised. Few papers assessing the cost effectiveness of pricing interventions were found and included in the review. The main cost effectiveness pricing discussion focussed on the paper by Chisholm *et al* (2004).

Evidence Statement e1.1: There is limited evidence of the cost effectiveness of price controls in a UK setting. One review (Booth *et al*. 2008) (study quality +) suggests that the available evidence is limited to two studies, one which takes an international perspective, and one set in Estonia. The review reports that the evidence is suggestive that in areas with a high prevalence (greater than 5%) of hazardous drinkers, as is the case in the UK, taxation will be more cost effective than other alcohol misuse macro interventions, but that the evidence base for this is not strong.
Applicability: The studies included by Booth *et al*. were drawn from a range of countries.

Promotion Controls

Similarly, few papers assessing the cost effectiveness of promotion interventions were found and included in the DH review. The main cost effectiveness promotion discussion also focussed on the paper by Chisholm *et al* (2004).

Evidence Statement e3.1: There is limited evidence of the cost effectiveness of promotion controls in a UK setting. One review (Booth *et al*. 2008) (study quality +) suggests that the available evidence is limited to three studies, one which takes an international perspective, one set in Estonia and one set in Canada. The review reports that the evidence is suggestive that in areas with a low prevalence (less than 5%) of hazardous drinkers, which is not the case in the UK, an advertising ban will be more cost effective than other alcohol misuse macro interventions, but that the evidence base for this is not strong.
Applicability: The studies included by Booth *et al*. were drawn from a range of countries.

Availability Restrictions

For the review of the cost effectiveness of alcohol availability interventions we identified and reviewed five relevant papers. The studies were of moderate quality and none were set in the UK. None of the papers were full economic evaluations.

- **Minimum legal age of alcohol purchase**
  One paper was found which analysed the economic characteristics of a minimum legal age of alcohol purchase policy (Kenkel 1993). The paper was set in the US and was of moderate quality. The study found that an alcohol taxation policy levied on young people that has an equivalent consumption effect compared to a minimum legal age of alcohol purchase policy is likely to be preferable due to being associated with lower societal costs in terms of lost consumer surplus. The consumer surplus is equivalent to the amount that consumers benefit by being able

to purchase a product at a price lower than the maximum that they would be willing to pay. Policies that have an identical impact on consumption reduce the consumer surplus similarly. In the case of a tax (rather than a minimum age law) some of the consumer surplus lost is redistributed elsewhere in the economy through an economic transfer. This is because in the case of a tax the consumption that continues involves the payment of the tax, whereas in the case of a minimum age law the consumption that continues does not involve any additional transfer of funds that can be redistributed throughout society.

It is important to note that this finding may be largely only of theoretical importance – it is reliant on having the choice of either levying a tax or implementing a minimum age law and knowing that either option will have an identical impact on consumption. In reality it is unlikely that the taxation and age levels required to reach equivalence between the two policies will be known.

Evidence Statement e2.1: There is limited evidence from one study of moderate quality which suggests that an alcohol taxation policy which has an equivalent consumption effect compared to an alcohol availability policy may be preferable to the availability policy because it may result in lower societal losses, through a reduced consumer surplus deadweight loss (Kenkel 1993) (study quality +). In the instance of equal intervention application costs the taxation policy would therefore be preferable to the availability policy from an economic perspective. This is a theoretical result which may not be relevant in practice, because consumption effect equivalence of taxation and availability policies is unlikely to be realistic.
Applicability: 1 US study provides evidence on the theoretical advantages of taxation policies compared to a minimum legal age of alcohol purchase policy. The study is useful but the overall relative cost effectiveness of the interventions (assuming equal effect on consumption and therefore future quality adjusted life years (QALYs)) will also depend on the intervention implementation costs, which are not discussed in the paper. The theoretical application of the results of this study to the UK is reasonable, although much more detailed analysis would be required in order for policy recommendations to be made – for example taxation and availability policies which have equivalent consumption effects would need to be identified.

- **Enforcement of minimum legal age of alcohol purchase and management of the sale of alcohol to intoxicated individuals**
  Three studies were found which address the cost-benefit of server interventions which are designed to stop irresponsible alcohol sales to intoxicated people. The studies were all of moderate quality and none were full economic evaluations. One study was set in the US, one study presented a critique of this US study, and one study was set in Sweden.

  Levy and Miller (1995) present a US cost benefit analysis of a server intervention. They measure the effectiveness of the intervention by analysing driving while intoxicated incidents following introduction of the intervention. Stringham and Pulan (2006) illustrate the short-comings of Levy and Miller's analysis – most notably the unreliable effectiveness estimates – and therefore the results of Levy and Miller's analysis are not informative. Even without Stringham and Pulan's critique extrapolating US server intervention and driving while intoxicated data to the UK may not be reliable. Mansdotter et al (2007) present an analysis of a

server intervention set in Sweden. The study suffers from similar problems as Levy and Miller (1995) – it is difficult to attribute any impacts on outcomes to the intervention, and specifically it is difficult to determine whether crime reductions following the intervention reflects a real reduction in crime, or a displacement of crime.

Evidence Statement e2.2: There is limited evidence of the cost effectiveness of server interventions in a UK setting. One study of moderate quality set in the US (Levy *et al.* 1995) (study quality +) and one study of moderate quality set in Sweden (Mansdotter *et al.* 2007) (study quality +) produce uncertain results which cannot be meaningfully interpreted for a UK setting.
Applicability: 1 US study and 1 Swedish study present favourable findings for the cost effectiveness of server interventions. However the analyses are open to substantial bias and are very uncertain. Given this uncertainty the application of the results of these studies to the UK is unlikely to be suitable.

- **Licensed hours and days of alcohol sale**
  One study was found which analysed the cost effectiveness of an opening hours intervention (Chisholm *et al.* 2004). The study was of moderate quality and takes an international perspective. The authors found that reducing the licensed hours of alcohol sale provided quality of life benefits, but that these were small compared to a number of other possible interventions. The opening hours intervention was also estimated to be relatively low-cost, and compared to no intervention it was likely to be cost effective. However the authors estimated that an advertising ban was associated with similar costs but would be more effective, suggesting that an opening hours policy may not be the most cost effective policy option. Given that the Chisholm *et al* (2004) paper also suggests that a taxation policy is likely to be more cost effective than an advertising ban in a country like the UK, it appears unlikely that an opening hours policy would prove more cost effective than a taxation policy. In addition, little detail is given about the specific policy analysed, and so extrapolation to a UK-specific setting is difficult.

Evidence Statement e2.3: There is limited evidence of the cost effectiveness of opening hours interventions in a UK setting. One study of moderate quality that takes an international perspective (Chisholm *et al.* 2004) (study quality +) provides evidence that reducing licensed hours of sale provides relatively small quality of life benefits compared to other alcohol misuse interventions.
Applicability: 1 international study presents ambiguous findings regarding the cost effectiveness of opening hours interventions. The study may be cost effective compared to no intervention, but is unlikely to be cost effective compared to some other alcohol misuse interventions. Little detail is given about the specific policy analysed, so extrapolation to a UK context is of uncertain merit.

- **Alcohol outlet density**
  No relevant studies were found which conducted an economic evaluation of alcohol outlet density interventions.

Evidence Statement e2.4: No evidence was found of the cost effectiveness of outlet density interventions.
Applicability: Not applicable

Conclusion

Evidence of the cost effectiveness of pricing, promotion and availability interventions is scarce. As such the evidence statements based on the literature reviewed are relatively uninformative. Further economic analysis and research is very desirable in these areas.

The available evidence suggests that in the UK a taxation intervention may be more cost effective than other macro interventions (such as promotion restrictions) for preventing heavy drinking.

The evidence also suggests that minimum legal age of alcohol purchase interventions may be sub-optimal compared to taxation, from a societal perspective. The cost effectiveness of server interventions in a UK setting is very uncertain due to a lack of UK evidence and the flaws that are apparent in the studies reviewed. Similarly, the cost effectiveness of opening hours and outlet density interventions in the UK is very uncertain due to a lack of UK analyses.

INTRODUCTION

Alcohol misuse is associated with significant clinical and social consequences. The National Institute for Health and Clinical Excellence has been asked by the Department of Health to develop public health guidance to promote the prevention and early identification of alcohol-use disorders in adults and adolescents. In order to develop such guidance both clinical and health economic aspects must be taken into account. The aim of this paper is to conduct three reviews to address the following macro-level issues from a cost effectiveness perspective:

1. The effectiveness and cost-effectiveness of price controls in reducing alcohol consumption, alcohol misuse, alcohol-related harm or alcohol-related social problems among adults and young people
2. The effectiveness and cost-effectiveness of interventions in managing alcohol availability to reduce levels of consumption, alcohol misuse, alcohol-related harm or alcohol-related social problems among adults and young people
3. The effectiveness and cost-effectiveness of the control of alcohol promotion (e.g. advertising) in reducing levels of consumption, alcohol misuse, alcohol-related harm or alcohol-related social problems among adults and young people

To complete reviews 1 and 3, this paper presents a critical appraisal of a recent literature search and review conducted by ScHARR for the Department of Health (DH). A detailed critical appraisal of existing health economic studies which examine the management of alcohol availability is also presented, in order to complete review 2.

METHODS

Reviews 1 and 3: Pricing and Promotion

The School of Health and Related Research (ScHARR) conducted a review entitled "Independent Review of the Effects of Alcohol Pricing and Promotion. Part A: Systematic Review" for the DH, and this was published in December 2008 (Booth, Meier, Stockwell, Sutton, Wilkinson, Wong, Brennan, O'Reilly, Purshouse, & Taylor 2008). The authors set out to conduct a clinical and economic review of the effect on alcohol consumption and harms of tax and price increases and decreases, policies with a direct effect on pricing (eg minimum price schemes), and advertising and promotion. This therefore covers two of the reviews that this document attempts to complete (reviews 1 and 3).

The authors of the DH review state that economic studies were defined in a broad sense, and so cost studies as well as economic evaluations were included. Often NICE guidelines focus only on economic evaluations, stretching to costing studies where data is limited or where time is available. Therefore the inclusion of costing studies as well as economic evaluations in the DH report inclusion criteria satisfactorily meets the NICE economic review criteria.

It is noted by the authors of the DH review that their reviews were not intended to capture benefits in terms of 'feel good factors' or general quality of life. However health benefits such as cardioprotection and reduced risk of stroke are examined. NICE cost effectiveness reviews do not typically search for papers specifically studying quality of life, rather papers that analyse costs and quality of life. Therefore the broad inclusion criteria of the DH report, discussed above, would be expected to satisfy the NICE requirements even though quality of life was not explicitly searched for because economic evaluations analysing costs and health related quality of life would have been picked up.

The economic outcome measures focussed upon in the DH review were economic harm, economic benefit, and price elasticity. These would be expected to pick up any cost-effectiveness, cost-utility, cost-benefit or cost minimisation data within reviewed papers, which is suitable for the NICE review.

159 papers were initially identified by the pricing and taxation literature search. 13 papers were excluded due to lack of availability. A further 82 papers were excluded due to not meeting the study inclusion criteria. 61 individual studies and 2 meta-analyses were identified and included in the pricing and taxation review. This included 1 meta-analysis identified from the grey literature. In total, these papers covered the findings of 284 studies. Two of these studies analysed the cost effectiveness of pricing and taxation interventions.

279 papers were initially identified by the promotion literature search. 60 papers were excluded due to lack of availability. A further 148 papers were excluded due to not meeting the study inclusion criteria and 1 further paper was excluded at the review stage. 70 individual studies and 2 meta-analyses were identified and included in the promotion review. This included 5 papers identified from the grey literature. In total,

these papers covered the findings of 207 studies. Three of these studies analysed the cost effectiveness of promotion interventions.

The DH review includes details of studies, study outcomes and results which are explained and interpreted. Each individual study is included in a table of studies which notes the authors, study design, sample and interventions, methods, harm outcomes, limitations and conclusions.

There is relatively little discussion about cost-effectiveness studies in the DH pricing and promotion review. However cost-effectiveness studies are included and economic studies were one of the specific study types searched for in the review. Their small role within the review is likely to be due to the small number of economics papers found in this area. This is particularly likely given the comprehensive search strategy and inclusion criteria used in the report.

Overall it is clear that the DH review includes an economics review that satisfactorily meets the requirements of NICE public health guidelines. The broad inclusion criteria and the databases searched means that all relevant economics papers are likely to have been identified.

In the 'Results' section of this paper, the results of the DH review regarding the cost effectiveness of price and promotion controls are presented and analysed.

Review 2: Availability Restrictions

A detailed literature search was undertaken for both the clinical and economic sections of the availability review. For the cost effectiveness review, the first search undertaken involved searching the Reference Manager database of studies retrieved for the effectiveness review (see methods for effectiveness reviews for search terms and databases searched) for studies which related to cost effectiveness, costs or economics. The keywords used for this search are presented in Table 1, below. Following this, specific searches were undertaken in NHS EED and Econlit. The search terms used for these databases are also presented in Table 1. Finally, handsearching and checking reference lists of included papers was undertaken.
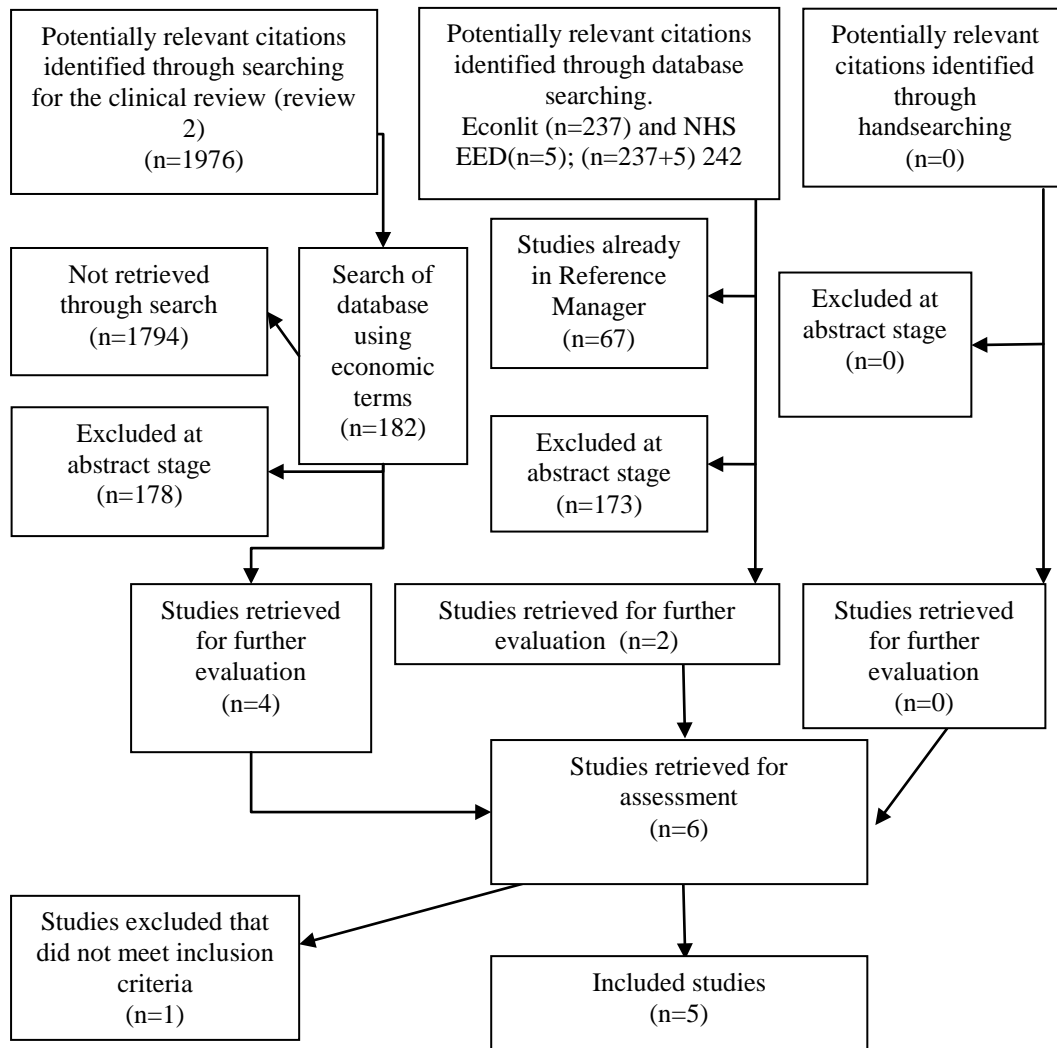
Table 1: Economics Review Search Terms

Database	Search Terms
Reference Manager effectiveness review search results (terms applied to keywords)	(Alcohol-Related Disorders/ec [Economics]) OR (Advertising as Topic/ec [Economics]) OR (Alcohol Drinking/ec [Economics]) OR (Alcoholic Beverages/ec [Economics]) OR (Alcoholic Intoxication/ec [Economics]) OR (Alcoholic/ec [Economics]) OR (Alcoholics Anonymous/ec [Economics]) OR (Alcoholism/ec [Economics]) OR (Amphetamine/ec [Economics]) OR (Beer/ec [Economics]) OR (Cannabinoids/ec [Economics]) OR (Child Abuse/ec [Economics]) OR (Cocaine-Related Disorders/ec [Economics]) OR (Commerce/ec [Economics]) OR (Consumer Satisfaction/ec [Economics]) OR (Cost-Benefit Analysis) OR (Cost-Benefit Analysis/ec [Economics]) OR (Cost-Benefit Analysis/sn [Statistics & Numerical Data]) OR (Cost Control/lj [Legislation & Jurisprudence]) OR (Cost of Illness) OR (Cost Savings) OR (Cost Sharing) OR (Costs and Cost Analysis) OR (Costs and Cost Analysis/ec [Economics]) OR (Costs and Cost Analysis/sn [Statistics & Numerical

	Data]) OR (Dental Caries/ec [Economics]) OR (Economic) OR (Economic Competition) OR (Economics) OR (Financing) OR (Food/ec [Economics]) OR (Health Care Costs) OR (Health Care Costs/sn [Statistics & Numerical Data]) OR (Health Care Reform/ec [Economics]) OR (Health Promotion/ec [Economics]) OR (Health/ec [Economics]) OR (Hospitalization/ec [Economics]) OR (Insurance/ec [Economics]) OR (Licensure/ec [Economics]) OR (Life/ec [Economics]) OR (Marijuana Abuse/ec [Economics]) OR (Marketing/ec [Economics]) OR (Mental Health Services/ec [Economics]) OR (Old Age Assistance/ec [Economics]) OR (Patient Education as Topic/ec [Economics]) OR (Pharmacies/ec [Economics]) OR (Psychiatric/ec [Economics]) OR (Quality-Adjusted Life Years) OR (Quality of Life) OR (Restaurants/ec [Economics]) OR (Smoking/ec [Economics]) OR (Social Problems/ec [Economics]) OR (Social Security/ec [Economics]) OR (Substance-Related Disorders/ec [Economics]) OR (Substance Abuse Detection/ec [Economics]) OR (Taxes/ec [Economics]) OR (Traffic/ec [Economics]) OR (Trauma Centers/ec [Economics]) OR (Violence/ec [Economics]) OR (Wine/ec [Economics]) OR (Wounds and Injuries/ec [Economics]) OR (wounds)
NHS EED (terms applied to title, abstract, or keyword)	Alcohol AND (Restrict* or enforce* or legislat* or law or legal or Outlet* or premis* or licenc* or licens* or shop* or supermarket* or store* or vendor* or sale* or sell* or purchas* or buy*) or Pub* or nightclub* or bar*) or ((drinking or minimum or under or legal) and age) or Server or (responsible adj2 beverage adj2 service$)) or outlet adj density
Econlit (terms applied to title or abstract)	Alcohol AND (Restrict* or enforce* or legislat* or law or legal or Outlet* or premis* or licenc* or licens* or shop* or supermarket* or store* or vendor* or sale* or sell* or purchas* or buy*) or Pub* or nightclub* or bar*) or ((drinking or minimum or under or legal) and age) or Server or (responsible adj2 beverage adj2 service$)) or outlet adj density

The number of papers found at each stage of the literature search is outlined below.

Figure 1: Studies included in cost effectiveness review

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┌─────────────────────────┐  ┌─────────────────────────┐  ┌─────────────────────────┐
│ Potentially relevant    │  │ Potentially relevant    │  │ Potentially relevant    │
│ citations identified    │  │ citations identified    │  │ citations identified    │
│ through searching for   │  │ through database        │  │ through handsearching   │
│ the clinical review     │  │ searching.              │  │ (n=0)                   │
│ (review 2) (n=1976)     │  │ Econlit (n=237) and NHS │  │                         │
│                         │  │ EED(n=5); (n=237+5) 242 │  │                         │
└─────────────────────────┘  └─────────────────────────┘  └─────────────────────────┘

┌──────────────┐  ┌──────────────┐  ┌──────────────┐     ┌──────────────┐
│ Not retrieved│  │ Search of    │  │ Studies      │     │ Excluded at  │
│ through      │  │ database     │  │ already in   │     │ abstract     │
│ search       │  │ using        │  │ Reference    │     │ stage        │
│ (n=1794)     │  │ economic     │  │ Manager      │     │ (n=0)        │
└──────────────┘  │ terms        │  │ (n=67)       │     └──────────────┘
                  │ (n=182)      │  └──────────────┘
┌──────────────┐  │              │  ┌──────────────┐
│ Excluded at  │  └──────────────┘  │ Excluded at  │
│ abstract     │                    │ abstract     │
│ stage        │                    │ stage        │
│ (n=178)      │                    │ (n=173)      │
└──────────────┘                    └──────────────┘

┌──────────────┐  ┌──────────────────┐  ┌──────────────┐
│ Studies      │  │ Studies retrieved│  │ Studies      │
│ retrieved    │  │ for further      │  │ retrieved    │
│ for further  │  │ evaluation (n=2) │  │ for further  │
│ evaluation   │  └──────────────────┘  │ evaluation   │
│ (n=4)        │                        │ (n=0)        │
└──────────────┘                        └──────────────┘

                  ┌──────────────────┐
                  │ Studies retrieved│
                  │ for assessment   │
                  │ (n=6)            │
                  └──────────────────┘

┌──────────────┐  ┌──────────────────┐
│ Studies      │  │ Included studies │
│ excluded that│  │ (n=5)            │
│ did not meet │  └──────────────────┘
│ inclusion    │
│ criteria     │
│ (n=1)        │
└──────────────┘
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For each study reviewed relevant details were extracted and these are presented in evidence tables in Appendix A. These details were extracted by one reviewer who ordered and analysed each study included in the review.

The following section presents a critical appraisal of each study reviewed, ordered by specific availability areas:

- Minimum legal age of alcohol purchase
- Enforcement of minimum legal age of alcohol purchase and management of the sale of alcohol to intoxicated individuals
- Licensed hours and days of alcohol sale
- Alcohol outlet density

For ease of reference, a list of all the included studies is given in the table below:

Table 2: Included Studies

Study	Setting	Intervention	Comparator	Design	Perspective	Quality Score (++, +, -)
Kenkel (1993)	US	Minimum drinking age	Young drinker alcohol tax and a general alcohol tax	Societal cost economic analysis	Societal	+
Levy and Miller (1995)	US , tavern-related DWIs	Enforcement of server laws	Pre intervention program	Cost benefit analysis	Societal	+
Stringham, and Pulan (2006)	US, critique of Levy and Miller (1995)	Enforcement of server laws	See Levy and Miller (1995)	Critique of Levy and Miller's cost benefit analysis	Societal	+
Mansdotter et al. (2007)	Stockholm, Sweden	Server training and enforcement of server laws	Nearby control area which did not use the intervention	Cost effectiveness analysis	Societal	+
Chisholm et al. (2004)	International perspective	Various, including reduced hours of sale	No intervention	Cost effectiveness analysis	Societal	+

RESULTS

Reviews 1 and 3: Pricing and Promotion

One literature review has been identified and included in this economics review. The paper is written from a UK perspective (Booth, Meier, Stockwell, Sutton, Wilkinson, Wong, Brennan, O'Reilly, Purshouse, & Taylor 2008) and provides a detailed literature review of the effect of pricing and taxation on alcohol consumption. The review is well-conducted and comprehensive and receives a + quality score because there is some under-reporting of the cost-effectiveness results of one reviewed paper in the promotion section (Makowsky & Whitehead, 1991). This is unlikely to be of significance to the review results, because the paper in question is dated and is not from a UK perspective. This has no significance for the pricing and taxation review.

Only two cost-effectiveness papers were identified by the authors in the pricing and taxation section of the review (Chisholm *et al.* 2004; Lai *et al.* 2007). The same two papers, as well as one additional Canadian paper (Makowsky & Whitehead, 1991) were identified in the promotion section of the review. The Makowsky & Whitehead, 1991 paper is not discussed any further because the review does not present any cost effectiveness results from it.

The authors note that one of the included papers takes an international perspective (Chisholm *et al.* 2004), and one is set in Estonia (Lai *et al.* 2007). The authors note that Chisholm *et al* (2004) model the impact of an advertising ban as causing a 2-4% reduction in the incidence of hazardous alcohol use, which the authors conclude is plausible. Using this assumption, Chisholm *et al* (2004) estimate that in a population with a high prevalence of hazardous drinkers (i.e. more than 5% as is the case in the UK) the most effective and cost effective intervention for tackling alcohol misuse is taxation. This is compared to interventions such as breath testing, restricted access, advertising bans, and brief interventions. In areas where there is a low prevalence of hazardous drinkers advertising bans are more effective than taxation. However the authors note that the underlying evidence upon which Chisholm *et al's* (2004) conclusions are based does not appear strong.

In addition, the authors note that a tax on alcohol may increase economic efficiency if societal costs are reduced overall, but that such a tax will also reduce the economic well-being of those that continue to regularly consume alcohol. The consumer and producer surplus impacts of a tax are not discussed in the review, probably because no papers were identified that address this issue.

The identified paper set in Estonia (Lai *et al*. 2007) is reported to have shown that increased excise taxes are the most cost effective intervention to reduce hazardous alcohol consumption (compared to other macro interventions), using cost per Disability Adjusted Life Year (DALY) averted as the outcome measure. The paper is not discussed in the summary of the evidence section of the DH report, probably due to the difficulty of extrapolating results of a study from Estonia to the UK.

Evidence Statement e1.1: There is limited evidence of the cost effectiveness of price controls in a UK setting. One review (Booth *et al*. 2008) (study quality +) suggests

that the available evidence is limited to two studies, one which takes an international perspective, and one set in Estonia. The review reports that the evidence is suggestive that in areas with a high prevalence (greater than 5%) of hazardous drinkers, as is the case in the UK, taxation will be more cost effective than other alcohol misuse macro interventions, but that the evidence base for this is not strong.

Applicability: The studies included by Booth *et al*. were drawn from a range of countries.

Evidence Statement e3.1: There is limited evidence of the cost effectiveness of promotion controls in a UK setting. One review (Booth *et al*. 2008) (study quality +) suggests that the available evidence is limited to three studies, one which takes an international perspective, one set in Estonia and one set in Canada. The review reports that the evidence is suggestive that in areas with a low prevalence (less than 5%) of hazardous drinkers, which is not the case in the UK, an advertising ban will be more cost effective than other alcohol misuse macro interventions, but that the evidence base for this is not strong.

Applicability: The studies included by Booth *et al*. were drawn from a range of countries.

Review 2: Availability Restrictions

Minimum legal age of alcohol purchase

One paper has been identified and included in the economics review. The paper was of moderate quality and was set in the US. Brief details of this study are given in the table below.

Table 3: Studies Reviewed – Minimum Age

Study	Setting	Intervention	Comparator	Design	Perspective	Quality Score (++, +, -)
Kenkel (1993)	US	Minimum drinking age	Young drinker alcohol tax and a general alcohol tax	Societal cost economic analysis	Societal	+

Kenkel (1993) shows that an alcohol tax aimed at young drinkers would provide societal benefits compared to a minimum drinking age law. The paper primarily focuses on consumer surplus and economic transfers. The consumer surplus is equivalent to the amount that consumers benefit by being able to purchase a product at a price lower than the maximum that they would be willing to pay. As the real price (ie monetary price plus any cost of consuming – such as risk of arrest) of a product increases a consumer purchases less of it and therefore the consumer surplus reduces. Policies that have an identical impact on consumption reduce the consumer surplus similarly. In the case of a tax (rather than a minimum age law) some of the consumer surplus lost is redistributed elsewhere in the economy through an economic transfer. This is because in the case of a tax the consumption that continues involves the payment of the tax, whereas in the case of a minimum age law the consumption that continues does not involve any additional transfer of funds that can be redistributed throughout society.

Therefore, a tax that reduces consumption by the same amount as a minimum drinking age law would reduce the consumer surplus by the same amount, but a substantial amount of that consumer surplus loss would form an economic transfer in the form of tax revenue which could be used for societal gain. Hence the societal loss would be lower in the taxation scenario than in the minimum drinking age scenario. In this case, a taxation policy would be preferable compared to an availability restriction policy. There are some caveats to this conclusion however, relating to the extent to which tax evasion can be expected, and whether taxation rather than prohibition would stimulate increased demand for alcohol due to the psychological message portrayed by the policy – ie alcohol is no longer illegal for young people.

It is also important to note that this finding may be largely only of theoretical importance – it is reliant on having the choice of either levying a tax or implementing a minimum age law and knowing that either option will have an identical impact on consumption. In reality it is unlikely that the taxation and age levels required to reach equivalence between the two policies will be known.

Evidence Statement e2.1: There is limited evidence from one study of moderate quality which suggests that an alcohol taxation policy which has an equivalent consumption effect compared to an alcohol availability policy may be preferable to the availability policy because it may result in lower societal losses, through a reduced consumer surplus deadweight loss (Kenkel 1993) (study quality +). In the instance of equal intervention application costs the taxation policy would therefore be preferable to the availability policy from an economic perspective. This is a theoretical result which may not be relevant in practice, because consumption effect equivalence of taxation and availability policies is unlikely to be realistic.
Applicability: 1 US study provides evidence on the theoretical advantages of taxation policies compared to a minimum legal age of alcohol purchase policy. The study is useful but the overall relative cost effectiveness of the interventions (assuming equal effect on consumption and therefore future quality adjusted life years (QALYs)) will also depend on the intervention implementation costs, which are not discussed in the paper. The theoretical application of the results of this study to the UK is reasonable, although much more detailed analysis would be required in order for policy recommendations to be made – for example taxation and availability policies which have equivalent consumption effects would need to be identified.

More details of the study are given below.

Kenkel DS, Prohibition versus taxation: Reconsidering the legal drinking age, *Contemporary Policy Issues***, 1993; XI: 48-57. Quality Score: +**

In this paper the author presents an analysis of the societal cost differences of applying a minimum legal drinking age compared to an alcohol tax (Kenkel 1993). The paper is largely based on economic theory, but does also attempt to quantify estimates. The paper focuses on consumer surplus, and shows that a minimum age law has the effect of increasing the real price of consuming alcohol to underage consumers. This is because added to the market price of alcohol are additional 'illegality' costs, such as the expected costs of arrest, the cost of obtaining a fake ID, the cost of searching for a willing retailer, and psychological costs of breaking the

law. These additional costs have the impact of reducing the underage consumer's demand for alcohol, away from what would be their optimal level of drinking at the market price. This creates reduces the consumer surplus, and because very few of the illegality costs represent real transferable costs from the underage consumer to another economic agent, this represents an overall societal loss. The author then shows that if an underage specific alcohol tax can be levied that reduces underage consumption by the same amount as the minimum drinking age law, societal costs will be lower. This is because the same level of underage consumption has been achieved, but the reduced demand will be because of the tax rather than illegality costs. Because tax revenues represent a transfer of funds the majority of the consumer surplus lost in this case will not represent a societal cost. There will remain some deadweight societal costs due to the reduction in consumption, but this will be present under the minimum age law and taxation scenario. Thus a specific alcohol tax on young drinkers will result in a lower societal cost than a minimum age law, if consumption is reduced by the same amount.

The authors use US econometric data to estimate how much alcohol prices would need to rise by to reduce alcohol consumption of young people to the same levels as are achieved by implementing a minimum drinking age of 21 rather than 18. They estimate that a tax would need to increase alcohol prices by somewhere between 12 to 86%, and that this would provide tax revenue of between $564 million and $4.03 billion – representing the societal gain associated with the tax revenue compared to the minimum drinking age law.

Kenkel (1993) notes that there are three circumstances under which the superiority of a specific tax compared to a minimum age law would be less certain. First, if the minimum age law reduces underage drinking to zero, then an equivalent tax would not raise any revenue and therefore the societal losses of both would be equal. Second, if levying a tax rather than a minimum age law induced demand for alcohol because of the policy message – ie that alcohol for underage drinkers is no longer illegal – then the consumption effect of the tax may not equal that of the minimum age law and therefore the societal costs may differ. Finally, if there was substantial tax evasion of a tax aimed specifically at young people, then the revenue raised by the tax would be decreased and the policy efficiency would be diminished. One way of avoiding this scenario would be to levy a general tax rather than an age-specific tax. However, a general tax would create a reduction in alcohol consumption for all drinkers, not only young drinkers, causing a much larger deadweight societal loss than a targeted tax. Therefore, for an equivalent general tax to result in a lower societal cost than a minimum age law the tax increase required would have to be low.

The paper also argues that an alcohol tax may impact more upon heavy drinking young consumers than moderate consumers, because the marginal cost of all subsequent drinks following the first drink increases compared to a case under a minimum age law whereby the initial cost of obtaining a first drink may be high, but then the cost of future drinks is likely to fall to the market price for all future drinks – thus a minimum age law may prevent moderate drinkers from drinking at all, whereas determined heavy drinkers may not be deterred.

Enforcement of minimum legal age of alcohol purchase and management of the sale of alcohol to intoxicated individuals

Two papers (Levy and Miller, 1995 and Mansdotter *et al* 2007) were found which analyse the cost-benefit of server interventions. Both profess to take a societal perspective. One paper is set in the US and one is set in Sweden. One paper (Stringham and Pulan 2006) presents a critique of Levy and Miller (1995). Brief details of the studies are given in the table below.

Table 4: Studies Reviewed – Server Interventions

Study	Setting	Intervention	Comparator	Design	Perspective	Quality Score (++, +, -)
Levy and Miller (1995)	US , tavern-related DWIs	Before and after a program which increase the enforcement of server laws relating to serving intoxicated people	Pre intervention program	Cost benefit analysis	Societal	+
Stinrgham, and Pulan (2006)	US, critique of Levy and Miller (1995)	Enforcement of server laws – critique of Levy and Miller (1995) analysis	See Levy and Miller (1995)	Critique of Levy and Miller's cost benefit analysis	Societal	+
Mansdotter et al. (2007)	Stockholm , Sweden	Programme which combines community mobilisation, training of staff and stricter enforcement of laws	Nearby control area which did not use the intervention	Cost effectiveness analysis	Societal	+

Levy and Miller (1995) and Mansdotter *et al* (2007) estimate that the savings associated with a server intervention outweigh the costs by far. Although the results of Levy and Miller (1995) and Mansdotter *et al* (2007) are very positive, the validity of the studies is open to question, primarily due to possible confounding involved in the studies, and due to the questionable degree to which results can be expected to be replicated elsewhere. Stringham and Pulan (2006) argue that the analysis conducted by Levy and Miller (1995) is fundamentally flawed for a number of reasons. In particular, the effect attributed to the intervention by Levy and Miller (1995) may not be a true reflection of the impact of the intervention, and important societal costs – particularly producer and consumer surpluses – were omitted. These arguments could also be applied to Mansdotter *et al* (2007) partly due to the possible confounding present in the study.

As noted above, the consumer surplus is equivalent to the amount that consumers benefit by being able to purchase a product at a price lower than the maximum that they would be willing to pay. The producer surplus is the amount that producers benefit by being able to sell a product at a price higher than they would be willing to sell for. As the price of a product increases the consumer surplus typically reduces and the producer surplus typically increases. However this may not be the case,

particularly if subsequent demand reductions mean that revenue and profits fall. The extent to which this occurs will depend upon the elasticity of demand for the product – an elastic elasticity of demand represents demand which is responsive to changes in price, whereas an inelastic elasticity represents demand which is relatively unresponsive. Because alcohol misuse interventions attempt to reduce the consumption of alcohol it may be argued that producer and consumer surplus impacts should be considered in a societal analysis of all interventions. In practice very few of the economic studies identified in this review have considered such issues.

Evidence Statement e2.2: There is limited evidence of the cost effectiveness of server interventions in a UK setting. One study of moderate quality set in the US (Levy *et al.* 1995) (study quality +) and one study of moderate quality set in Sweden (Mansdotter *et al.* 2007) (study quality +) produce uncertain results which cannot be meaningfully interpreted for a UK setting.
Applicability: 1 US study and 1 Swedish study present favourable findings for the cost effectiveness of server interventions. However the analyses are open to substantial bias and are very uncertain. Given this uncertainty the application of the results of these studies to the UK is unlikely to be suitable.

More details of the studies are given below.

Levy DT and Miller TR. A Cost-Benefit Analysis of Enforcement Efforts to Reduce Serving Intoxicated Patrons. *Journal of Studies on Alcohol*, 1995; 56: 240-24. Quality Score: +

The authors present a cost benefit analysis of a pilot program of increased enforcement of laws forbidding service to intoxicated persons (Levy, & Miller 1995). The study is set in a county within Michigan State in the US, takes a societal perspective, and is of moderate quality. The intervention involved the employment of specially trained plainclothes officers who were paid overtime to periodically enter bars and restaurants to monitor servers and cite those found dispensing alcohol to intoxicated patrons. Establishments cited were given warnings during a transition period and later subjected to fines and suspension of their liquor license. A total of 457 visits were made between 1990-91 leading to 13 citations and 11 warnings. The intervention also included workshops for the county's 205 tavern licensees (105 attended) which disseminated information on the enforcement effort.

The outcome measured in the trial was the number of tavern-related driving while intoxicated (DWIs) events that occurred in the county in the 12 months after the introduction of the intervention compared to the number that occurred in the 12 months before the introduction of the intervention.   The authors estimated that the intervention led to an 11% reduction in DWIs. This was translated into a $3.7 million saving in total monetary costs ($10.1 million when quality of life impacts were included) for the county. The cost of the intervention was estimated at approximately $51,000 ($48,000 for staff costs and $3,000 for promotion of the scheme). Therefore the savings created by the scheme were estimated to far outweigh the costs (approximately 72:1, 196:1 when quality of life impacts are included, though these ratios are not stated in the paper). It is not clear exactly how quality of life impacts were factored into the analysis, but even without these the cost savings clearly outweigh the costs.

The authors note that the results of the analysis are highly uncertain. This is primarily due to key concerns surrounding both the internal and external validity of the study. From an internal validity perspective the results of the study are uncertain because it cannot be certain that the results of the study were due to the intervention or due to some other programme being run in the county. The authors note that they have no evidence of other programmes, but that it cannot be ruled out. Also, the study only looks at tavern-based DWIs – the total number of DWIs actually increased. If this is because people substituted drinking elsewhere before driving then the intervention may not have had a beneficial impact. From an external validity perspective it is not clear whether the study is relevant for areas in the UK as the impact of the intervention could depend on the characteristics of the geographical area and other sociological factors.

Stringham E and Pulan I. Evaluating Economic Justifications for Alcohol Restrictions, *The American Journal of Economics and Sociology*, **2006; 65; 4: 971-90.**

In this paper, the authors present a detailed critique of the Levy and Miller (1995) cost benefit analysis discussed above (Stringham 2006). Four main criticisms of the Levy and Miller (1995) paper are made.

First, the authors state that the fact that the total number of DWIs actually increased after implementation of the intervention is of high importance. Levy and Miller (1995) assume that this is not due to the intervention and therefore assume that the intervention is 100% effective – it does reduce tavern-based DWIs while having no impact on other DWI incidents. However, Stringham and Pulan (2006) note that the evidence shows that the intervention may have encouraged more problematic drinking in settings other than taverns – and therefore that the intervention may have had a net negative effect.

Second, Stringham and Pulan (2006) argue that Levy and Miller (1995) include cost savings which they class as societal that should not be included. For example, productivity losses, medical costs and legal costs incurred by drink drivers who have an accident are included as societal costs of drink driving. However Stringham and Pulan (2006) argue that when deciding to drink the person must have decided that the expected value of drinking is greater than the expected costs, and therefore any costs incurred cannot be treated as additional societal losses. This implies that there is a social benefit of drinking which is not taken into account in the Levy and Miller (2005) analysis. This argument appears reasonable, unless drinking decisions are only made once a person has already drunk enough for their decision making to become impaired.

The third and fourth criticisms of the Levy and Miller (1995) analysis made by Stringham and Pulan (2006) relate to the exclusion of producer surplus and consumer surplus considerations from the analysis. The authors conducted a survey to assess the relative size of producer savings from reduced property damage due to less problem drinking, and the size of revenue losses due to stricter alcohol availability regulations. They estimated that while revenue losses could be around 20%, gains due to less property damage will only equal around 1% of this value. Hence, in total

the lost producer surplus due to less alcohol sales will result in a very significant societal cost which is not included in the Levy and Miller (1995) analysis.

Stringham and Pulan (2006) also note that the consumer surplus of both patrons who planned on driving and patrons who did not will be reduced by stricter regulations on the availability of alcohol, because the amount they can drink would be restricted. Hence many patrons would experience a reduction in consumer surplus even if they were not planning on drinking and driving – ie the intervention is not targeted at drivers. People who would have chosen to drink more than they are subsequently allowed experience a decrease in utility. Assuming that these utility decrements do not need to be included in the analysis may be reasonable if the future health gains of drinking less are estimated to cancel out initial utility decrements. However including future utility increases and no initial decrements may be incorrect. Stringham and Pulan (2006) suggest that this assumption inherently assumes that from a moral perspective drinking needs to be restricted, but they quote evidence which suggests that drinkers on average earn more and provide more social capital than abstainers. On the other hand, increases in utility due to heavy drinking are likely to be very short term, whereas the quality of life benefits associated with safer drinking seem likely to be more important in the long term.

These issues are important and suggest that the CBA undertaken by Levy and Miller (1995) is incomplete. In particular, the effect of the intervention studied by Levy and Miller (1995) is called into question, and the exclusion of consumer surplus considerations means significant societal costs are ignored (although this could be used as a criticism of any of the economic evaluations of alcohol mis-use interventions that have been reviewed). Stringham and Pulan (2006) do not produce re-estimates for Levy and Miller's analysis and therefore do not show that the intervention is not cost effective. However their analysis does cast doubt over whether the intervention is likely to be cost effective.

Mansdotter AM, Rydberg MK, Wallin E, Lindholm LA and Andreasson S. A cost-effectiveness analysis of alcohol prevention targeting licensed premises. *European Journal of Public Health*, **2007, 17; 6: 618-623. Quality Score: +**

In this paper the authors evaluate the cost effectiveness of a programme which has been enforced in Stockholm, Sweden, since 1996. The programme has three elements:

1. Community mobilisation: aimed at increasing awareness of problems connected with alcohol consumption and at seeking support for action
2. 2-day responsible beverage service (RBS) training course about alcohol law, medical effects and conflict management for servers, doormen and restaurant owners
3. Strengthened enforcement of alcohol laws

The effectiveness of the programme in terms of certain police-reported incidents was assessed by Wallin et al (2003), and the authors used this analysis to evaluate the cost effectiveness of the programme. Wallin et al (2003) found that the programme led to a 29% reduction in assault, unlawful threat/harassment and assault/threat towards officials such as policemen and doormen committed indoors and outdoors between

10pm and 6am, compared to a part of Stockholm city where the programme was not used.

In order to assess the cost savings associated with the programme the authors conducted a survey of 604 people who had been the victim of the relevant crimes in the area in 2003. The response rate to the questionnaire was low, at only 32% (n = 194). Cost components included in the savings estimates included savings for the judicial system, productivity changes, health care savings and other damage savings. Hence a societal perspective was taken. Cost estimates for each component were made by analysing the resource use answers given by survey respondents and by allocating national costs (eg for the judicial system and health care costs) and respondents salaries (for productivity costs) where applicable.

The cost of the intervention was estimated using account data for the project. Administration costs, the costs of studies of alcohol serving practices, costs associated with community mobilisation, RBS training, and alcohol law enforcement costs were included. These costs were very comprehensive.

The authors also estimated health gains associated with the intervention, by asking survey respondents to complete the EQ-5D health related quality of life (HRQL) questionnaire. This involved respondents reporting their HRQL for their health state 'before violence', 'two weeks after violence' and 'at present'. It was assumed that HRQL improvements from 'two weeks after violence' until 'at present' were linear. Using the scores obtained and this assumption the number of Quality Adjusted Life Years (QALYs) gained due to the intervention were calculated. This is a positive aspect of the study, but the linear relationship assumed for the 'after violence' period may overestimate QALY gains because the 'at present' measure was usually around 2 years after the crime incident, and so it was assumed that the crime impacted upon the HRQL of the respondent for that entire period. It may have been more realistic to assume that HRQL returned to normal more quickly and then reached a plateau, which would result in fewer QALYs gained due to the intervention.

The authors estimated that the total cost of the intervention over a 5.5 year period was 795,828 euros. In the base case it was estimated that the intervention led to net cost savings of over 30 million euros. Over 24 million euros were saved for the judicial system, just under 5 million were saved due to productivity and around 1.5 million euros were saved due to health care savings. This is equivalent to a cost to savings ratio of 1:39. In addition, the intervention was estimated to lead to savings of 236 QALYs.

It is clear that the vast majority of the cost savings were for the judicial system, largely due to very high prison and probation costs. The avoidance of these costs represents a societal gain. Productivity and health care savings were also large. Also, the estimated QALY gain was such that even if it was assumed that the intervention led to no savings the ICER compared to no intervention would be relatively low, at 3,372 euros. However caution should be taken with this result due to the possible over-estimation of the QALY gain. Taking this into account, the results remain positive in favour of the intervention.

Possible problems with the study mainly surround the way that cost savings were estimated. The response rate to the survey was very low, and as such the confidence intervals around the cost assumed for each type of crime were very large. This uncertainty was not dealt with in the analysis. An additional limitation of the study is that if drinkers were displaced from the intervention area to the nearby control area the results of the study may have been confounded. This may result in an overestimation of the reduction in crime, and due to the very high costs associated with crime this could result in very large over-estimates of cost savings.

Licensed hours and days of alcohol sale

One study was found which estimates the cost effectiveness of an opening hours intervention (Chisholm *et al* 2004). The study has an international setting and takes a societal perspective, and is of moderate quality. Brief details of the study are given in the table below.

Table 5: Studies Reviewed – Opening Hours

Study	Setting	Intervention	Comparator	Design	Perspective	Quality Score (++, +, -)
Chisholm *et al*. (2004)	International perspective	Various, including reduced hours of sale	No intervention	Cost effectiveness analysis	Societal	+

Chisholm *et al* (2004) assess a scheme whereby alcohol hours of sale from retailers are reduced. The authors find that the cost of restricting access to alcohol is relatively low compared to other potential interventions, but also that the effect of the intervention is relatively low. Compared to the current situation Chisholm *et al* (2004) estimate that restricting availability is a cost effective add-on, although the analysis does not conduct a true incremental analysis which would show that other options are more cost effective than restricting availability.

Evidence Statement e2.3: There is limited evidence of the cost effectiveness of opening hours interventions in a UK setting. One study of moderate quality that takes an international perspective (Chisholm *et al.* 2004) (study quality +) provides evidence that reducing licensed hours of sale provides relatively small quality of life benefits compared to other alcohol misuse interventions.
Applicability: 1 international study presents ambiguous findings regarding the cost effectiveness of opening hours interventions. The study may be cost effective compared to no intervention, but is unlikely to be cost effective compared to some other alcohol misuse interventions. Little detail is given about the specific policy analysed, so extrapolation to a UK context is of uncertain merit.

More details of the study are given below.

Chisholm D, Rehm J, Van Ommeren M and Monteiro M. Reducing the Global Burden of Hazardous Alcohol Use: A Comparative Cost-Effectiveness Analysis. *Journal of Studies on Alcohol*, **2004, 65: 782-793. Quality Score: +**

Here, the authors conduct an economic evaluation using a state transition population model that traces the development of a subregional population over a life time horizon (Chisholm, Rehm, Van Ommeren, & Monteiro 2004). Disability Adjusted Life Years (DALYs) were used as the outcome measure. A societal perspective was adopted but factors such as productivity, crime, and family effects were not included. The analyses were carried out at the level of WHO regions. A number of interventions were compared to 'no intervention'. In each intervention scenario it was assumed that the intervention would be implemented for 10 years, following which epidemiological rates and health state valuations move back to natural history values. The interventions evaluated were: Tax on alcoholic beverages; Drink-driving legislation and road-side breath testing; Reduced hours of sale; Advertising bans; Brief Interventions. Lack of cost data

The risk factor studied by the authors relates to hazardous alcohol use, defined as an average rate of consumption of more than 20g pure alcohol daily for women and more than 40g for men. Rates of hazardous alcohol use were taken from the WHO comparative risk assessment (2002) as were fatality rates (Rehm et al. 2003). Based on these the authors estimated relative risks of mortality for hazardous and non-hazardous drinkers (2.5 for people aged 15-44, 1.3 for men aged over 44, 1.4 for women aged over 44). Health state valuations were included so that DALYs could be computed. A health state valuation of 0.846 was derived based on the proportion of hazardous (80%) and harmful (20%) drinkers in the WHO comparative risk assessment, and preference values for these health states from a Dutch disability weight study (Stouthard, Essink-Bot, & Bonsel 2000).

Availability was modelled by considering the impact of reducing the number of hours in which alcohol could be sold by retailers. This was based on evidence from Scandinavia, and it was assumed that the strategy would lead to a 1.5%-3.0% reduction in the incidence of hazardous drinking, and 1.5% - 4.0% reduction in alcohol-related traffic fatalities, depending upon the subregional pattern of drinking with the largest effects in subregions with the highest levels of hazardous drinking occasions.

Costs included in the analysis consisted of program-level resource inputs used in the production of an intervention, patient-level resource inputs used in the provision of an intervention, and unit costs of program-level and patient-level resource inputs. The costs of the restricted access strategy are related to legislation activities, administration and enforcement of laws once passed. These costs were low in comparison to the other interventions considered. Costs were stated in International dollars. Costs were converted to this measure using international prices for traded goods and a regression approach to establish the price of non-traded goods in each subregion. Costs and DALYs were discounted at 3%.

For Europe Region A (high income, low premature mortality) restricted availability was estimated to be the equal least expensive of the interventions considered (Int$0.27m per 1m population per annum, equal in cost to a ban on advertising, and much less expensive than, for example, a brief intervention for which the cost was estimated at Int$4.44m per 1m population per annum). Restricted availability was also estimated to be one of the least effective interventions, averting 251 DALYs per 1 million population compared to 459 for an advertising ban, 1,365-1,764 for different

taxation scenarios, and 1,889 for a brief intervention. Because of the relatively low cost restricted access had a fairly low average cost per DALY averted (Int$1,087), but this was higher than a number of the other interventions, although lower than that for brief interventions (Advertising ban = Int$594; Tax scenarios = Int$258 – 333; Brief intervention = Int$2,351). When compared to the current taxation schemes in place in the Europe Region A countries the incremental cost per additional DALY averted was Int$164 for restricted access which was actually lower than the ICER estimated for an advertising ban (Int$201). However this is not a fair reflection of the ICERs of these strategies as both are cheaper than the current taxation situation and less effective and so the figures stated are actually costs saved per DALY lost and so a higher figure is better. If the two interventions were compared incrementally the restricted access intervention would not be cost effective compared to the advertising ban since it is the same price but less effective. Unfortunately the authors do not conduct a true incremental analysis in this way and so the incremental analysis presented is not informative.

Intuitively, the model results showed that in regions where there was a high prevalence of hazardous drinking the most effective single interventions were BI and taxation. In other areas where there was a lower prevalence of hazardous drinking the differences in the effects of the interventions was not so pronounced. This increases confidence in the validity of the model.

Probabilistic sensitivity analysis was undertaken but the presentation of results is unhelpful in determining the results of this. The currency used by the authors is difficult to interpret but the authors state that in each of the subregions the most efficient strategy averts 1 DALY for less than the average annual income per capita, which the authors believe demonstrates cost effectiveness. While in this study it appears that restricting access may be a cost effective strategy on top of the current taxation system, the results suggest other strategies may be more incrementally cost effective due to similar costs and higher effectiveness.

Because the authors consider a number of interventions there is not a large amount of detail provided surrounding the model inputs for each individual intervention. This represents a key weakness in the paper and means that we cannot be sure exactly what costs were included. Also, the model results are not specific for any single country, making it more difficult to determine applicability in an English context.

Alcohol outlet density

No studies were found which analysed the cost effectiveness of alcohol outlet density interventions.

Evidence Statement e2.4: No evidence was found of the cost effectiveness of outlet density interventions.
Applicability: Not applicable

EVIDENCE SUMMARY

This review shows that the economics evidence for the cost effectiveness of price controls, promotion controls, and availability interventions is very limited. The studies reviewed are of moderate quality and none are full economic evaluations. Importantly none of the studies are set in the UK, and due to the macro-level of the interventions being considered and the different characteristics and levels of taxation, promotion and availability policies currently in force in different countries (eg geographical factors, age limits, opening hours), it is difficult to extrapolate results of studies set in different countries to the UK.

Regarding pricing and promotion interventions, evidence from Chisholm *et al* (2004) seems to suggest that in the UK, where there is a relatively high prevalence (greater than 5%) of hazardous drinkers, taxation is likely to be a more cost effective policy than an advertisement-based policy. However, the evidence base for this conclusion is not strong.

With regard to alcohol availability interventions, the evidence provided by Levy and Miller (1995) and Mansdotter *et al* (2007) is indicative of a positive effect of server training and a favourable benefit–cost ratio. However, in both studies the effect measure appears unreliable – it is questionable whether driving while intoxicated incidents decreased or increased in the experiment reported by Levy and Miller (1995), and displacement of crime to other nearby areas – rather than a reduction in crime – could also have occurred in the study reported by Mansdotter *et al* (2007). Stringham and Pulan (2006) appear to discredit Levy and Miller's results, and their criticisms could also be applied to Mansdotter *et al* (2007).

Chisholm *et al* (2004) estimate that reducing opening hours does result in quality of life benefits, although the benefits achieved are estimated to be relatively small compared to other alcohol-related interventions. The authors calculate that reducing opening hours is a relatively cheap policy, but an incremental analysis of their results suggests that an advertising ban is likely to be of similar cost but more effective, suggesting that an availability policy might not be the most cost effective policy option. Given that the Chisholm *et al* (2004) paper also suggests that a taxation policy is likely to be more cost effective than an advertising ban in a country like the UK, it appears unlikely that an opening hours policy would prove more cost effective than a taxation policy in a UK setting.

Kenkel (1993) shows the theoretical advantages of taxation compared to a minimum age drinking policy. This may not be directly relevant in the UK, if minimum age laws are unlikely to be changed. However, this analysis can be extrapolated to other availability policies whereby consumption is reduced causing lost consumer surplus which is not transferred to another economic agent. Thus it would appear likely that a price or tax policy that had an equivalent consumption effect compared to an availability policy would be likely to be preferable from an economic consumer surplus perspective – consumption and therefore long term quality of life and societal outcomes would be equal, but the methods of reaching the desired consumption level would incur lower societal costs. However, in practice this finding may be of limited importance because it is unlikely that policy levels required to reach equivalence between two availability interventions will be known.

CONCLUSIONS

The lack of high quality reliable evidence and UK-specific evidence means that it is not possible to draw detailed conclusions regarding the cost effectiveness of alcohol pricing, promotion and availability policy options from a UK perspective. More research is needed in this area. The evidence statements that can be made largely comment on the scarcity of cost effectiveness evidence in this area, while one (e2.1) relates to the theoretical advantage that taxation policies hold over availability policies with regard to societal losses.

EVIDENCE STATEMENTS

Evidence Statement e1.1: There is limited evidence of the cost effectiveness of price controls in a UK setting. One review (Booth *et al*. 2008) (study quality +) suggests that the available evidence is limited to two studies, one which takes an international perspective, and one set in Estonia. The review reports that the evidence is suggestive that in areas with a high prevalence (greater than 5%) of hazardous drinkers, as is the case in the UK, taxation will be more cost effective than other alcohol misuse macro interventions, but that the evidence base for this is not strong.
Applicability: The studies included by Booth *et al*. were drawn from a range of countries.

Evidence Statement e2.1: There is limited evidence from one study of moderate quality which suggests that an alcohol taxation policy which has an equivalent consumption effect compared to an alcohol availability policy may be preferable to the availability policy because it may result in lower societal losses, through a reduced consumer surplus deadweight loss (Kenkel 1993) (study quality +). In the instance of equal intervention application costs the taxation policy would therefore be preferable to the availability policy from an economic perspective. This is a theoretical result which may not be relevant in practice, because consumption effect equivalence of taxation and availability policies is unlikely to be realistic.
Applicability: 1 US study provides evidence on the theoretical advantages of taxation policies compared to a minimum legal age of alcohol purchase policy. The study is useful but the overall relative cost effectiveness of the interventions (assuming equal effect on consumption and therefore future quality adjusted life years (QALYs)) will also depend on the intervention implementation costs, which are not discussed in the paper. The theoretical application of the results of this study to the UK is reasonable, although much more detailed analysis would be required in order for policy recommendations to be made – for example taxation and availability policies which have equivalent consumption effects would need to be identified.

Evidence Statement e2.2: There is limited evidence of the cost effectiveness of server interventions in a UK setting. One study of moderate quality set in the US (Levy & Miller 1995) (study quality +) and one study of moderate quality set in Sweden (Mansdotter *et al* 2007) (study quality +) produce uncertain results which cannot be meaningfully interpreted for a UK setting.
Applicability: 1 US study and 1 Swedish study present favourable findings for the cost effectiveness of server interventions. However the analyses are open to substantial bias and are very uncertain. Given this uncertainty the application of the results of these studies to the UK is unlikely to be suitable.

Evidence Statement e2.3: There is limited evidence of the cost effectiveness of opening hours interventions in a UK setting. One study of moderate quality that takes an international perspective (Chisholm *et al*. 2004) (study quality +) provides evidence that reducing licensed hours of sale provides relatively small quality of life benefits compared to other alcohol mis-use interventions.
Applicability: 1 international study presents ambiguous findings regarding the cost effectiveness of opening hours interventions. The study may be cost effective compared to no intervention, but is unlikely to be cost effective compared to some

other alcohol mis-use interventions. Little detail is given about the specific policy analysed, so extrapolation to a UK context is of uncertain merit.

Evidence Statement e2.4: No evidence was found of the cost effectiveness of outlet density interventions.
Applicability: Not applicable

Evidence Statement e3.1: There is limited evidence of the cost effectiveness of promotion controls in a UK setting. One review (Booth *et al*. 2008) (study quality +) suggests that the available evidence is limited to three studies, one which takes an international perspective, one set in Estonia and one set in Canada. The review reports that the evidence is suggestive that in areas with a low prevalence (less than 5%) of hazardous drinkers, which is not the case in the UK, an advertising ban will be more cost effective than other alcohol misuse macro interventions, but that the evidence base for this is not strong.
Applicability: The studies included by Booth *et al*. were drawn from a range of countries.

Appendix A: Evidence Tables

Appendix A: Evidence Tables Promotion	
Bibliographic reference	Booth, A, Meier M, Stockwell T, Sutton A, Wilkinson A, Wong R, Brennan A, O'Reilly D, Purshouse R and Taylor K.. Independent review of the effects of alcohol pricing and promotion, Part A: Systematic Reviews. Department of Health December 2008 Ref ID: 2864
Economic study type	The authors set out to conduct a clinical and economic review of the effect on alcohol consumption and harms of tax and price increases and decreases, policies with a direct effect on pricing (eg minimum price schemes), and advertising and promotion.
Population, country & perspective	Review is not limited by country or population setting.
Intervention Comparison(s)	Interventions with an effect on pricing, advertising and promotion. The authors state that economic studies were defined in a broad sense, and so cost studies as well as economic evaluations were included. Often NICE guidelines focus only on economic evaluations, stretching to costing studies where data is limited or where time is available. Therefore the inclusion of costing studies as well as economic evaluations in the DH report inclusion criteria satisfactorily meets the NICE economic review criteria.
Source of effectiveness data	Literature search. It is noted by the authors that the reviews were not intended to capture benefits in terms of 'feel good factors' or general quality of life. However health benefits such as cardioprotection and reduced risk of stroke are examined. NICE cost effectiveness reviews do not typically search for papers specifically studying quality of life, rather papers that analyse costs and quality of life. Therefore the broad inclusion criteria of the DH report, discussed above, would be expected to satisfy the NICE requirements even though quality of life was not explicitly searched for because economic evaluations analysing costs and health related quality of life will be picked up.
Method of eliciting health valuations (if applicable)	NA
Cost components included	The authors state that economic studies were defined in a broad sense, and so cost studies as well as economic evaluations were included. Often NICE guidelines focus only on economic evaluations, stretching to costing studies where data is limited or where time is available. Therefore the inclusion of costing studies as well as economic evaluations in the DH report inclusion criteria satisfactorily meets the NICE economic review criteria.
Currency and cost	NA

year	
Results - cost per patient per alternative	NA
Results - effectiveness per patient per alternative	NA
Results - incremental cost-effectiveness	The authors report results from Chisholm *et al* (2004), Lai *et al* (2007) and Makowsky and Whitehead (1991). The authors state that Chisholm et al present results that show that in areas with high prevalence of hazardous drinkers (more than 5%) (eg the UK) taxation is the most effective and cost effective intervention (500 DALYs averted per million). In areas of low hazardous drinking prevalence taxation was stated to be less effective than brief physician advice, roadside breath testing and advertising bans. The results of Chisholm et al are reported in more detail here for ease of reference: Results are only presented here for Europe Region A (high income, low premature mortality category, country examples France and Norway).

Intervention

Taxation	Cost (I$m per 1m pop p.a)	Effect (DALYs per 1m pop p.a.)	Average CER (I$ per DALY)	ICER (I$ per DALY)
Current	0.45	1,365	333	*
Current + 25%	0.45	1,576	289	*
Current + 50%	0.45	1,764	258	*
Breath testing	0.61	247	2,467	Dominated
Restricted access	0.27	251	1,087	164
Advertising ban	0.27	459	594	201
Brief Intervention	4.44	1,889	2,351	7,607
Highest tax + ad ban	0.69	2,178	317	291
Highest tax + ad ban + brief intervention	4.96	3,988	1,244	1,718

Estimated costs include programme-level costs (eg. administration) and patient-level costs (eg. primary care visits). Any cost savings arising from reduced prevalence of hazardous drinking are excluded from the analysis.

Note that ICERs are all compared to the current Taxation costs and benefits – rather than an incremental comparison of all alternatives. ICERs for

increased tax are zero since additional health gains can be achieved at negligible extra cost.

Note that there were differences in results in different subregions. In areas with a high prevalence of hazardous drinking (such as high income countries in Europe) the most effective single interventions were taxation and brief interventions. In other areas this was not so pronounced and other interventions sometimes appeared more effective.

Taxation was the most cost effective strategy in 6 of the subregions with a high prevalence of heavy drinkers. In areas with a low prevalence of hazardous alcohol use interventions other than taxation are either dominant or have very low ICERs compared to current taxation levels.

Lai et al (2007) was stated to show that increased excise taxes are most cost-effective intervention to reduce hazardous alcohol consumption at 759 Estonian Kroons (EEK) per DALY averted. Imposing additional advertising bans would cost 1331 EEK per DALY.

The DH review reports that Makowsky and Whitehead (1991) show that sales of beer increased and sales of spirits decreased following the change in legislation that permitted alcohol advertising in Saskatchewan. The review reported that there was no evidence of an impact on wine and total alcohol sales from the introduction of alcohol advertising. The review reports that the authors suggest that alcohol advertising may have produced a substitution effect with respect to beer and spirits, but this was not predicted. No cost effectiveness ratios are reported in the review, although the paper is reported to be a cost effectiveness analysis.

Results - uncertainty	NA
Time horizon & discount rate	NA
Source of funding	Department of Health
Comments	The economic outcome measures focussed upon were economic harm, economic benefit, and price elasticity. These would be expected to pick up any cost-effectiveness, cost-utility, cost-benefit or cost minimisation data within reviewed papers, which is suitable for the NICE review.

The review includes details of studies, study outcomes and results which are explained and interpreted. Each individual study is included in a table of studies which notes the authors, study design, sample and interventions, methods, harm outcomes, limitations and conclusions. It is not clear whether individual economic checklists were completed for each economics paper included, which would normally occur in NICE projects. Also the quality of each study included is not stated.

There is relatively little discussion about cost-effectiveness studies in the review. However cost-effectiveness studies are included and their small role within the review is likely to be due to the small number of economics papers in this area. This is particularly likely given the comprehensive search strategy and inclusion criteria used in the report. The reporting of the Makowsky and Whitehead 1991 paper appears slightly incomplete. This is unlikely to be of importance as the paper does not appear to produce cost effectiveness results that are key for the UK. |

Overall study quality (++,+,-)	+

Evidence Table Availability	
Bibliographic reference	Levy DT and Miller TR. A Cost-Benefit Analysis of Enforcement Efforts to Reduce Serving Intoxicated Patrons. Journal of Studies on Alcohol, 1995; 56: 240-24. Ref ID: 1530
Economic study type	Cost benefit analysis of a pilot program of increased enforcement of laws forbidding service to intoxicated persons. The study provides a methodology for translating reported driving while intoxicated events (DWIs) into cost savings, as well as measuring benefits in terms of pain and suffering, productivity losses, social and individual costs.
Population, country & perspective	Analysis based on a case study conducted in 1990-91, Washtenaw, Michigan, US. The county housed 205 tavern licensees. Societal perspective is taken, and the population is a tavern-attending population.
Intervention Comparison(s)	The intervention is a pilot program to increase enforcement of laws prohibiting service to intoxicated patrons of taverns, referred to as the SIP program. The control uses data regarding DWIs prior to the introduction of the pilot program. In the year before implementation of SIP, the enforcement of alcohol server laws was close to zero. The SIP involved the employment of specially trained plainclothes officers who were paid overtime to periodically enter bars and restaurants to monitor servers and cite those found dispensing alcohol to intoxicated patrons. Establishments cited were given warnings during a transition period and later subjected to fines and suspension of their liquor license. Half of the enforcement visits were concentrated on 10 establishments most responsible for DWIs according to arrest reports. A total of 457 visits were made between 1990-91 leading to 13 citations and 11 warnings. SIP also included workshops for the county's 205 tavern licensees (105 attended) which disseminated information on the enforcement effort. After-visit reports were given to noncited licensees and the program received media coverage.
Source of effectiveness data	Data was used from police files on the sources of DWIs before an after implementation of a program designed to increase enforcement of alcohol server laws. Gains and losses are evaluated in terms of the value of productive resources and personal loss.
Method of eliciting health valuations (if applicable)	NA
Cost components included	The analysis is limited to savings from reduced traffic accidents and so does not include benefits such as long-term health problems, productivity loss, crime and insurance costs. Productive resources include direct allocations of manpower, capital or material resources, and implicit changes in the value of worker productivity or other inputs. Personal loss is based on individual assessments of pain and suffering and changes in quality of life. The reduction in tavern-related DWIs is translated into cost savings from reductions in fatalities, injuries and property damage. The authors correct for harmful substitute behaviours which may offset some of the effects of tavern-related DWIs, such as the higher risk propensity of those drinking and driving at lower levels of alcohol consumption and of those engaging in drinking at non-tavern locations and driving.

	The dollar value of alcohol-related DWIs was estimated using alcohol-specific crash costs developed by Miller et al (1991) and Miller and Blincoe (1993).
	The total monetary costs included were (from Miller and Blencoe, 1993): - medical, hospital and rehab care and ancilliary expenses - emergency services, including fire, police and emergency medical services - travel delay for motorists not involved in the crash - damage to vehicles and other property - costs to employers due to workplace disruption, the need to hire and train permanent and temporary replacements etc - administrative costs, including claims-processing costs, as well as legal and court costs incurred by plaintiffs seeking restitution, and defence costs - productivity losses, including after-tax wages, taxes on wages, fringe benefits and household production
	For comprehensive costs pain, suffering and quality of life were included in addition to the above, not using Miller and Blencoe. It is not clear how quality of life values were obtained.
	External costs include travel delay, work-place, emergency, foregone taxes and administrative costs, damage to other people's vehicles, medical, productivity and QoL losses of victims who were not driving while intoxicated. Effects on the at-fault driver are not included in external costs.
Currency and cost year	1990 US $
Results - cost per patient per alternative	The primary costs of the intervention are related to additional police and supervisory staff. Total police, supervisory and miscellaneous costs in Washtenaw County were $48,400, and an additional $3,000 was incurred to publicise the program and train individuals. Thus total costs were $51,400.

Results - effectiveness per patient per alternative

	12 months pre SIP	1 month pre SIP	3 months	6 months	12 months
% cases where server intervened by not serving alcohol to those simulating intoxication	----	17.5%	54.3%	47.4%	41.0% (p<0.001)
% of DWI arrestees whose last drink was at a tavern	31.7%				23.3% (p<0.01)
Number of tavern-related DWIs	128				112
Number of DWIs	404				435

[authors note that the above data may be confounded, so analysed DWIs in other nearby counties too, and none were stat. sig.]
% of tavern-related DWIs

Cook County	43.2%	44.2%
Ingham County	31.7%	36.7%
Kalamazoo County	39.5%	36.3%

The authors state that this suggests the data changes in Washtenaw County are likely to be due to SIP, but other reasons such as increased enforcement of other alcohol abuse programs or traffic safety programs cannot be excluded (although none of these were known to have happened in the county during the study period).

% reduction in all DWIs due to SIP   10.95%

The authors correct for the % of DWIs that were not the fault of the intoxicated driver and which therefore would occur anyway. Using Borkenstein et al (1974) the authors estimate that a driver with a BAC ≥ 0.10 is on average 16 times as likely to cause a crash as a sober driver. Therefore the excess probability that a crash occurs due to alcohol is 1- the probability that a crash would have occurred anyway, ie $1 - 1/16 = 0.9375$. It was estimated that 57% of crashes involve single vehicles (using national crash data) and that 0.9375 of these are due to alcohol. 43% of crashes were assumed to be 2-vehicle crashes and it was assumed that 16/17 (0.9412) of these were due to alcohol, giving a total % of crashes attributable to alcohol of 91.4% [Unsure as to whether all of these probabilities are appropriate]. Despite these calculations a further correction was made because it was assumed that people may continue to drive after drinking after the introduction of SIP, but that they may drink less, and not be over the legal limit. They may still represent an increased risk of accidents though, and so because of this DWI crashes are multiplied by 85.3% to get attributable cases.

Results - incremental cost-effectiveness

Note, in tables below the costs in the first three columns are costs per incident while the cost n the last column are for all incidents. Note these costs are for the US as a whole, not for Washtenaw County alone.

Total Costs of DWI crashes (1990 US$)

	Fatal	Non-fatal injury	PDO vehicle	Cost for all cases ($millions)
Medical	6,693	4,203	-	4,127
Emergency services	930	194	24	281
Productivity	665,453	7,919	35	19,391
Employer costs	6,679	530	31	723
Administrative	48,337	1,259	127	2,474
Legal	70,935	1,703	-	2,869
Travel delay	387	187	107	543
Property damage	8,059	3,231	1,157	7,082
Monetary cost	807,473	19,244	1,481	37,490
Quality of life	1,977,529	48,367	-	80,832
Comprehensive cost	2,785,002	67,611	1,481	118,322

External Costs of DWI crashes (1990 US$)

	Fatal	Non-fatal injury	PDO vehicle	Cost for all cases ($millions)
Medical	6,024	3,840	-	3,749
Emergency services	930	194	24	281
Productivity	289,985	4,988	14	9,860
Employer costs	6,679	530	31	723
Administrative	48,337	1,259	127	2,474
Legal	70,935	1,703	-	2,869
Travel delay	387	187	107	543
Property damage	3,132	1,255	450	2,752
Monetary cost	426,409	13,956	752	22,855
Quality of life	731,686	20,390	-	32,274
Comprehensive cost	1,158,095	34,346	752	55,129

A break-down of the costs in Washtenaw County is not given. The cost savings are stated to be:

Total Costs
Medical benefits = $0.47million
Monetary benefits = $3.7million
Total comprehensive costs = $10.1 million

External Costs
Monetary benefits = $2.3million
Total comprehensive costs = $4.9 million

Thus the benefits of the scheme vary largely depending upon the benefits measured.

A ratio of costs to benefits is not given, it is instead noted that the benefits greatly exceed the costs no matter which benefit measure is used.

Results - uncertainty	
	The authors clearly state that their results are uncertain, because it is difficult to untangle whether the reduction in DWIs was due to SIP or some other confounding reason. The authors also state that while the relationship between SIP and tavern-related DWIs was statistically significant, the confidence intervals around the estimated effects are quite large, and they state that further study is necessary to determine if the results can be

	replicated. Other impacts such as study duration, geographical nature, other laws and programs in place, whether those refused service continue drinking somewhere else are also potential confounders.
Time horizon & discount rate	1 year pilot program.
Source of funding	Not stated
Comments	The authors discuss three issues which they state are important for measuring the benefits of programs aimed at destructive behaviour: 1. Whether the human losses include the reduction in pain, suffering and lost quality of life, or only the reduction in productive value (eg wages), or even whether to limit human losses to medical costs. 2. Whether to include benefits to the individual from reducing their own harmful behaviour, or only the benefits to other members of society. 3. Whether to deduct any individual losses from substituting other destructive activity. From an NHS & PSS perspective quality of life impacts on the patient and medical costs (NHS & PSS) should be included. It is less clear whether quality of life impacts on other people should be included. From a societal perspective quality of life impacts and all cost impacts (on the individual and others) should be included. If other destructive activity is substituted then this should be included in the analysis in order to reflect likely effects of the program. Importantly, the authors note that if people drink and drive after being somewhere other than a tavern due to SIP, this will not be picked up in the results. If this substitution occurred, the intervention may not have reduced DWIs due to alcohol. The key problems of the study are internal validity (confounding) and external validity (area similarity compared to other places / places in the UK). Not having data for the cause of all DWIs is a weakness. Eg has the program reduced all alcohol related DWIs, or just tavern-related ones – have home-related drinking DWIs increased? This is key to the overall impact of the scheme.
Overall study quality (++,+,-)	+

	Evidence Table Availability
Bibliographic reference	Stringham E and Pulan I. Evaluating Economic Justifications for Alcohol Restrictions, The American Journal of Economics and Sociology, 2006; 65; 4: 971-90. Ref ID: 2436
Economic study type	Review of the Levy and Miller (1995) cost benefit analysis of server enforcement regulations. See above evidence table for details of this study.
Population, country & perspective	The Levy and Miller (1995) analysis is based on a case study conducted in 1990-91, Washtenaw, Michigan, US. The county housed 205 tavern licensees. Societal perspective is taken, and the population is a tavern-attending population.
Intervention Comparison(s)	See evidence table above (Levy and Miller 1995)
Source of effectiveness data	See evidence table above (Levy and Miller 1995)
Method of eliciting health valuations (if applicable)	See evidence table above (Levy and Miller 1995)
Cost components included	See evidence table above (Levy and Miller 1995)
Currency and cost year	See evidence table above (Levy and Miller 1995)
Results - cost per patient per alternative	See evidence table above (Levy and Miller 1995)
Results - effectiveness per patient per alternative	See evidence table above (Levy and Miller 1995)
Results - incremental cost-effectiveness	See evidence table above (Levy and Miller 1995)
Results - uncertainty	See evidence table above (Levy and Miller 1995)
Time horizon & discount rate	See evidence table above (Levy and Miller 1995)
Source of funding	See evidence table above (Levy and Miller 1995)
Comments	The authors present a critique of Levy and Miller (1995). The problems with the Levy and Miller (1995) analysis that are identified are: 1. Failure to measure the total effects of the project. Levy and Miller (1995) recognise that social costs are not reduced if a program causes

costs to shift in full. Ie if if one type of drink driving is replaced with another. The authors note (as noted in the Levy and Miller (1995) evidence table above, in the 'Comments' section) that total DWIs increased, even though tavern-based DWIs decreased. The authors question whether the policy in question might have actually encouraged more problematic drinking. The authors state that this is "assumed away" by Levy and Miller (1995) and that it is therefore assumed that the intervention is 100% effective, which may be unlikely.

2. Mixing of private costs and social costs. The authors state that some of the costs included as external costs by Levy and Miller (1995) are actually internalised though insurance markets are contracts – eg drunk drivers compensated portion of medical costs. Also Levy and Miller (1995) include the productivity losses due to injury of at-fault drivers. The authors state that when deciding to drink and drive the person must have decided that the expected value of drinking is greater than the expected costs, and so these can not be included as costs. Based on this argument, the authors state that none of the external medical, legal and personal costs incurred by the drinker should be included in the analysis. This may be reasonable for someone who plans on drinking and driving, but for someone who only decides to drive once they are already drunk this argument may not hold, as the person may not be thinking rationally.

3. Ignoring lost producer surplus associated with alcohol. The authors note that a cost benefit analysis should take into account both consumer and producer surplus, because the analysis involves a product which is for sale. It is stated that lost producer surplus (due to decreased alcohol sales) are not included as a cost of the intervention. The possible savings to owners (property damage) do not make sense as if the expected cost of this outweighed the revenue from selling the alcohol, the alcohol would not be sold. The authors conducted a survey of Washtenaw County's 40 bars, pubs and clubs in order to gain information on the size of each tavern, how much business was related to alcohol, and how the alcohol restrictions would affect business. The respondents were informed that their answers would remain confidential. The response rate was 39% (15 replies). The survey ascertained that the average tavern's repair bill due to damage caused by customers is less than 1% of sales. Therefore, the offsetting benefits to tavern owners of the alcohol restrictions are likely to be less than 1% of sales. The survey also asked the establishment to estimate how much revenue would fall by if selling to intoxicated patrons was prohibited. On average establishments received just over 50% of revenue from alcohol, and estimated that revenues would drop by around 20%. The authors note that this might be an overestimate, but that this is more reasonable than Levy and Miller's assumption of no effect on revenue.

4. Ignoring the lost consumer surplus associated with alcohol. The authors note that the consumer surplus would be reduced both for patrons who plan on driving, and also patrons who never planned to drive. The authors state that in the area where the study was undertaken many patrons walked to bars from a nearby university. Levy and Miller (1995) do not include these consumer surplus costs at all. Not including these costs is similar to assuming that drinking morally needs to be restricted. Based on earnings data, which show that drinkers often earn more and have more social capital than abstainers, the authors note that this assumption is not justified.

These issues are important and suggest that the CBA undertaken by Levy and Miller (1995) is incomplete. Consumer and producer surplus are important considerations which have not been included in any of the alcohol intervention evaluations. They could be argued to be relevant for any intervention which impacts upon consumption. The authors give details on possible revenue impacts of the Levy and Miller intervention in this

	paper, but do not quantify this to allow a reanalysis of Levy and Miller's results. Hence this paper does not show that the intervention is not cost effective, but certainly casts significant doubt over whether it is likely to be cost effective,
Overall study quality (++,+,-)	+

Evidence Table Brief Interventions	
Bibliographic reference	Chisholm D, Rehm J, Van Ommeren M and Monteiro M. Reducing the Global Burden of Hazardous Alcohol Use: A Comparative Cost-Effectivenss Analysis. Journal of Studies on Alcohol, 2004, 65: 782-793 Ref ID: 1740
Economic study type	Cost effectiveness analysis, using DALYs as the outcome measure. A state transition population model that traces the development of a subregional population taking into account births, deaths and the specified risk factor was used. Key transition rates included the incidence of hazardous alcohol use in the population, case-fatality, and remission. Health state values were specified for time spent at risk or as a heavy drinker.
Population, country & perspective	Societal perspective. Analyses were carried out at the level of WHO regions (Africa, The Americas, Eastern Mediterranean, Europe, South East Asia, Western Pacific) each of which was split into subregions based on rates of adult and child mortality. Rates of alcohol use were very low in the Eastern Mediterranean region so this region was excluded from the analysis.
Intervention Comparison(s)	Two epidemiological scenarios were modelled: 　1.　No interventions available to reduce hazardous alcohol use (natural history) 　2.　The population-level impact of each specified intervention implemented for a period of 10 years (after which epidemiological rates and health state valuations move back to natural history values) The difference between these scenarios represents the population-level health gain (expressed as DALYs averted) as a result of the intervention. Interventions included were: 　-　Tax on alcoholic beverages 　-　Drink-driving legislation and RBT (roadside breath testing) 　-　Reduced hours of sale (retail outlets) 　-　Advertising bans 　-　Brief interventions
Source of effectiveness data	The analysis relates to the risk factor of hazardous alcohol use, defined as an average rate of consumption of more than 20g pure alcohol daily for women and more than 40g for men. Rates of hazardous alcohol use were taken from the WHO comparative risk assessment (2002) as were fatality

rates. From these the following relative risks of mortality were derived:

2.5: men and women aged 15-44

1.3: men in older age groups

1.4: women in older age groups

Remission rates were derived with reference to an average duration of 10.9 years to recovery.

A health state valuation of 0.846 was derived for hazardous alcohol use (equivalent to a disability weighting of 0.154) which represented a weighted average based on the severity breakdown of hazardous drinkers from the WHO comparative risk assessment (80% hazardous, 20% harmful) and preference values for these health states from the Dutch disability weight study (0.89 and 0.67 respectively, Stouthard et al 2000).

- Taxation. This reduces consumption based on price elasticities. Price elasticities (adjusted downwards by one third to reflect reduced responsiveness in heavy drinkers) were derived with respect to preferred type of alcohol (wine, beer, spirits) in the 12 subregions. These were constructed from country level data contained in WHO's Global Alcohol Database. Baseline elasticities were 0.3 for the most preferred beverage, -1.0 for the next most preferred and -1.5 for the least preferred. The current level of tax as well as increases of 25% and 50% was evaluated, adjusting for expected unrecorded use (due to illicit production or smuggling). In countries where unrecorded consumption is high tax increases can have a regressive impact on incidence if unrecorded consumption also increases.
- Drink drive legislation and RBT. This was based on a strategy which has been used in Scandinavia prevent alcohol sales for a 24-hour period at the weekend. On the basis of studies analysing this strategy the authors modelled a reduction of 1.5%-3.0% in the incidence of hazardous drinking and 1.5%-4.0% in alcohol-related traffic fatalities, depending on the subregional pattern of drinking (largest effects in areas with the highest level of hazardous drinking occasions).
- Advertising bans. The effects of a comprehensive advertising ban are modelled, based on the latest international time-series analysis (Grube and Agostinelli, 2000; Saffer, 2000; Saffer and Dave 2002). The effect is modelled as a 2-4% reduction in the incidence of hazardous drinking, adjusted for subregional variations in patterns of drinking.
- Reduced hours of sale (retail outlets). This strategy involved the assumption that retail outlets could not sell alcohol for a 24-hour period at the weekend. In Scandinavia this has been shown to reduce consumption and alcohol-related harm (Leppanen, 1979, Norlund, 1984, Norstrom and Skog, 2003). Based on these studies the authors assumed that the strategy would lead to a 1.5%-3.0% reduction in the incidence of hazardous drinking, and 1.5% - 4.0% reduction in alcohol-related traffic fatalities, depending upon the subregional pattern of drinking (largest effects in subregions with the highest levels of hazardous drinking occasions (Rehm et al 2004).
- Brief Interventions. These were modelled to influence the prevalence of hazardous drinking by increasing remission and reducing disability. The authors note that efficacy reviews show an estimated 22% net reduction in consumption amongst hazardous drinkers (Babor et al 2003, Higgins-Biddle and Babor 1996, Moyer et al 2002). If applied to the total population at risk this would reduce overall prevalence by 35%-50%, equivalent to a 14%-18% improvement in the rate of recovery over no treatment. However the authors take into account treatment adherence (70%) and target coverage in the population (50% of hazardous drinkers), population-level remission rates were estimated to be 4.9%-6.4% better than natural history rates. Additionally an expected reduction in the number of heaviest drinkers

	while in treatment (but prior to remission) was assumed and resulted in a small gain in the average level of disability – treated health state valuation was 0.858, an improvement of 1.3% after adjusting for coverage and adherence
Method of eliciting health valuations (if applicable)	A health state valuation of 0.846 was derived for hazardous alcohol use (equivalent to a disability weighting of 0.154) which represented a weighted average based on the severity breakdown of hazardous drinkers from the WHO comparative risk assessment (80% hazardous, 20% harmful) and preference values for these health states from the Dutch disability weight study (0.89 and 0.67 respectively, Stouthard et al 2000).
Cost components included	- Program-level resource inputs used in the production of an intervention. These are used in the production of an intervention at the level above the patient or health care facility. Eg administrative functions or resources devoted to enforcing drink-drive legislation by police officers. Estimated quantities of resources required were estimated by costing experts from each subregion and validated against the literature. - Patient-level resource inputs used in the provision of an intervention. These were only relevant for BIs. An average of 4 primary care visits over 1 year was estimated for the intervention itself (this included initial assessment, educative sessions and follow-up) plus an additional resource of 0.33 outpatient visits and 0.25 inpatient days based on Fleming et al 2000. These resource inputs were applied to the 50% of prevalent hazardous drinkers in receipt of brief advice in year 1, and because we model an enduring effect for 10 years, also in year 6; and to the 50% of incidence cases in years 2-5 and 7-10. - Unit costs of program-level and patient-level resource inputs. These include the salaries of central administrators, capital costs of vehicles and equipment and the cost per outpatient visit. Data were obtained from a literature review supplemented by primary data from a number of countries and converted to international dollars. Fully worked cost templates can be found on the WHO website. The costs of the restricted access strategy are related to legislation activities, administration and enforcement of laws once passed.
Currency and cost year	International $s. Costs are converted to international dollars using international prices for traded goods and a regression approach to establish the price of non-traded goods in each subregion. One I$ buys the same quantity of health care resources in China or India as it does in the US.
Results - cost per patient per alternative	---
Results - effectiveness per patient per alternative	---
Results - incremental cost-effectiveness	Results are only presented here for Europe Region A (high income, low premature mortality category, country examples France and Norway). Hazardous Alcohol users per million population was estimated to be 125.4

Intervention	Cost (I$m per 1m pop p.a)	Effect (DALYs per 1m pop p.a.)	Average CER (I$ per DALY)	ICER (I$ per DALY)
Taxation				
Current	0.45	1,365	333	*
Current + 25%	0.45	1,576	289	*
Current + 50%	0.45	1,764	258	*
Breath testing	0.61	247	2,467	Dominated
Restricted access	0.27	251	1,087	164
Advertising ban	0.27	459	594	201
Brief Intervention	4.44	1,889	2,351	7,607
Highest tax + ad ban	0.69	2,178	317	291
Highest tax + ad ban + brief intervention	4.96	3,988	1,244	1,718

Note that ICERs for increased tax are zero since additional health gains can be achieved at negligible extra cost.

Note that there were differences in results in different subregions. In areas with a high prevalence of hazardous drinking (such as high income countries in Europe) the most effective single interventions were taxation and brief interventions. In other areas this was not so pronounced and other interventions sometimes appeared more effective.

Note that brief interventions and breath testing are the most expensive interventions.

Taxation was the most cost effective strategy in 6 of the subregions with a high prevalence of heavy drinkers.

Note that ICERs are all compared to the current Taxation costs and benefits – rather than an incremental comparison of all alternatives.

In areas with a low prevalence of hazardous alcohol use interventions other than taxation are either dominant or have very low ICERs compared to current taxation levels.

Results - uncertainty	Sensitivity analysis around price elasticities was performed.

A series of one-way sensitivity analysis were performed. Best and worst case scenarios were generated using upper and lower estimates of total intervention cost (+/- 20% patient-level, +/-10% program-level); effectiveness (upper/lower range elasticities for tax [+/-30%], +/-20%-30% intervention effect for other strategies).

Probabilistic sensitivity analysis was also conducted using baseline data and pessimistic and optimistic scenarios as ranges. |

	Discount rates had only a small effect on the results. Removal of age weighting on DALYs reduces health gain estimates by 10%-22%, as many alcohol-related illnesses happen relatively early in life. Use of unadjusted DALYs (no discounting or age weighting) increased total effectiveness by 43%-59%. Under the best case scenario total costs were 10%-20% lower and effects 20%-30% higher than the base case, improving the average cost per DALY averted by 33%. For the worst case scenario the average cost per DALY averted were increased by 50%-65%, though the rank order of cost effectiveness was unchanged. The PSA illustrated uncertainty, but this was presented in a relatively unhelpful scatter plot which can not be usefully interpreted.
Time horizon & discount rate	Life time (100 years). DALYs were age-weighted and discounted at 3%, with sensitivity analysis investigating the impact of removing these weights. Costs were also discounted at 3%.
Source of funding	Not stated
Comments	Results based on I$ are difficult to interpret, but the authors state that in each of the subregions the most efficient strategies avert 1 DALY for less than average annual income per capita. A societal perspective is taken but factors like productivity, crime, family effects are not included. Tax revenues are also not included as a benefit as they represent transfer payments.
Overall study quality (++,+,-)	+

Evidence Table	
Availability	
Bibliographic reference	Mansdotter AM, Rydberg MK, Wallin E, Lindholm LA and Andreasson S. A cost-effectiveness analysis of alcohol prevention targeting licensed premises. European Journal of Public Health, 2007, 17; 6: 618-623 Ref ID: 158
Economic study type	Cost effectiveness analysis of the 'restaurant intervention' (RI)
Population, country & perspective	Societal perspective. Swedish setting. Restaurant-attending population.
Intervention Comparison(s)	Since 1996 a programme has been ongoing in Stockholm, Sweden, which has combined community mobilisation, training of responsible beverage service (RBS) (not serving alcohol to intoxicated or underage patrons), and stricter enforcement of existing alcohol laws. The programme is being run jointly be the authorities and the hospitality industry and is referred to as the restaurant intervention (RI). The RI includes: - community mobilisation: aimed at increased awareness of problems connected with alcohol consumption and at seeking support for action - 2-day RBS training course about alcohol law, medical effects and conflict management for servers, doormen and restaurant owners - strengthened enforcement of alcohol laws Wallin et al (2003) assessed the effectiveness of the programme at a time at which the intervention was active in only parts of Stockholm. The authors used a part of the city where the intervention was not active as the control. The authors compared the intervention and the control with respect to differences in police-reported incidents of assault, unlawful threat/harassment and assault/threat towards officials such as policemen and doormen; committed indoors and outdoors between 10pm and 6am. The results showed a 29% reduction in the considered indicators of violence in the intervention arm of the study.
Source of effectiveness data	The impact of the RI was taken from the Wallin et al (2003) paper – ie a 29% reduction in the considered indicators of violence. For the purpose of estimating what the 29% decrease meant in terms of societal savings and health gains, a survey was conducted among victims. Respondents were randomly selected from the National Police Board's register of assaults, unlawful threats/harassment and assaults/threats towards officials during 2003 in Stockholm – ie the same indicators as included in Wallin et al (2003). In order to obtain firm cost estimates the proportion of respondents varied by type of crime based on the proportions seen in Wallin et al. 604 questionnaires were sent out to: - victims of serious assault (n = 83) - other assaults (n = 288) - unlawful threat (n = 152) - assault/threat towards officials (n = 81)

	The total number of the type of violent crimes considered during the intervention period studied by Wallin et al (Jan 1998 – Sept 2000) in the specific area of the city was 7,368. With a preventative effect of 29% the number of prevented crimes was 3,009. It was assumed when calculating savings and health gains that the proportions of prevented violence were similar to the proportions of occurred violence, ie 56% assault, 13% unlawful threat, 31% assault/threat towards officials.
Method of eliciting health valuations (if applicable)	Health gains were included in the study. Respondents were asked to complete the EQ-5D for their health state 'before violence', 'two weeks after violence' and 'at present'. These were converted into utilities by applying values of health profiles based on a UK population sample. QALYs were estimated from these by using the scores and by assuming that improvements after the violence were linear. Given that the 'at present' score was around 2 years after the event, this may overestimate the QALY gain as respondents may be more likely to experience quicker improvement in QoL followed by a plateau.
	Respondents were also asked to complete the EQ VAS during the period from the violent crime and 12 months after.
	The response rate to the questionnaire was 32% (n = 194). Non-responders differed from responders with regards to gender and time point of violence. Females were more inclined to respond, and those who were victims of violence between 10pm and 6am were less likely to respond compared to victims from other times of day.
Cost components included	Included intervention cost components were:
	- administration costs. Eg salaries for project staff, offices, travel, conferences, office supplies and literature, overheads. These were estimated based on account data for the project
	- studies of alcohol serving practices. Eg renumeration for actors for studying the service to underage and intoxicated patrons in 4 studies that have taken place. Training of these people has also been included.
	- community mobilisation. Eg a key part of this component is an advisory group of local officials. Costs of this were estimated based on minutes of meetings and average salaries/payroll taxes.
	- RBS training. This was a 2-day course. Costs for material, food, actors, course fee * participants, brochures, film, production loss for participants, lecturers were all included.
	- Alcohol law enforcement. This involves joint controls by the Licensing Board and the Police and the increase of notification letters in the intervention area. These were costed based on the estimated time each control and letter took.
	Savings were also included in the study. These were based on the survey of victims of violence which consisted of questions aimed at calculating the monetary consequences to the:
	- judicial system
	- production changes
	- health care
	- other damage
	Responses related to the judicial system were combined with National Police Board, and other national judicial sources. Responses to health care

	questions were combined with national health care resource use sources. Production changes were estimated based on respondents' salaries. Other damage cost estimates were based purely on the questionnaire.						
Currency and cost year	The Koronor was converted to 2005 Euros using the mean exchange rate between January and September 2006. Costs and benefits are presented in both discounted (3%) and undiscounted forms.						

Results - cost per patient per alternative

Costs (Euro, undiscounted)

	1995	1996	1997	1998	1999	Jan-Sep 2000	Total, all years
Administration	7,692	97,831	97,383	131,271	126,268	75,660	536,105
Studies	0	7,801	7,915	2,641	11,102	366	29,825
Community mobilisation	509	1,299	3,494	3,512	7,396	21,882	38,092
RBS training	0	6,223	24,155	28,768	78,220	111,604	248,970
Law enforcement	0	0	0	3,954	9,668	10,792	24,414
Total per year	8,201	113,154	132,947	170,146	232,654	220,304	877,406
Discounted							795,828

The average cost of a violent crime was estimated at 19,049 euros, based on the answers given to specific questions in the questionnaire. Detailed break-downs of these costs are given, some of which are shown below:

Type	Cost (Euros)
Assault	20,145 (6,076 – 34,214)
Unlawful threat	21,382 (10,800 – 31,964)
Violence towards official	10,870 (3,756 – 17,983)

Note that the value of an assault was down-valued to 9,935 euros because serious assaults were over-represented in the respondent data. This was adjusted to reflect police register proportions of serious and non-serious assaults.

Sector	Cost (Euros)
Judicial System	14,847
Production changes	2,873
Health care	953
Other damages	376

These savings were applied to all events, not just for those who responded, though this was tested in sensitivity analysis.

Results - effectiveness per patient per alternative	Utility scores: Before violence 0.8647 2 weeks after violence 0.6776 at present 0.8729 (approx 2 years after violence) The average health gain associated with one prevented assault was adjusted as for cost savings, and the overall QALY saving was estimated to be 266 (167 due to prevented assault, 43 due to prevented unlawful threat, and 56 due to prevented threat/assault towards officials).
Results - incremental cost-effectiveness	Costs and benefits (undiscounted) |	Base Case	Savings & health gains restricted to the police for non-respondents	Savings & health gains restricted to the police for all victims
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Costs	795,828 (877,406)	795,828 (877,406)	795,828 (877,406)
Savings			
Judicial system	24,393,381 (27,454,965)	11,246, 438 (12,657,964)	5,349,588 (6,021,009)
Production change	4,728,370 (5,321,823)	2,179,990 (2,453,598)	---
Health care	1,565,686 (1,762,193)	721,850 (812,449)	---
Other damages	626,274 (704,877)	288,741 (324,980)	---
Total	31,313,711 (35,243,858)	14,437,019 (16,248,991)	5,349,588 (6,021,009)
Net Savings	30,517,883 (34,366,452)	13,641,191 (15,371,585)	4,553,760 (5,143,603)
QALY gains	236 (266)	83 (93)		 In the base case the ratio between costs and savings is 1:39. In the sensitivity analysis the ratio is 1:18 and 1:7.
Results - uncertainty	The confidence intervals around cost savings were very large, and the respondents may not have been representative – particularly for assaults were a larger than proportionate amount of people who had experienced a serious assault responded. The authors dealt with this by down-valuing the saving associated with an assault. Other sensitivity analysis included assuming that the only cost associated with non-respondents was police handling of the crime. Here the savings were lower. As a worst case scenario this assumption was also tested for all crimes, which still resulted in a substantial net saving.
Time horizon & discount rate	5 years of costs included. Crimes avoided only those estimated to be avoided during a 2.5 year period.
Source of funding	Swedish National Institute of Public Health
Comments	The vast majority of cost savings are to the judicial system, in particular prison/probation costs.

	QALYs likely to be overestimated due to linear improvement assumption. Also respondents were asked to remember what health states were like which could result in inaccuracies.

Nothing is done with the QALY gain in the analysis. However it is stated that if it were assumed that the RI resulted in no cost savings, the ICER in the base case would be 3,372 euros. Caution should be taken with this though considering the probable over-estimate of QALYs gained.

The authors note the uncertainty in their analysis. Costs were largely based on respondents to a survey which may be inaccurate. Also the intervention may have been undercosted as it may have led to other enforcement activities which have not been included. The low response rate to the survey is a large limitation, as the respondents may be an unrepresentative sample. There are also limitations associated with the outcome measure which only includes decline of violence. Also the results may have been confounded if drinkers were displaced from the intervention area to the nearby control area.

The authors also note that some estimates may have been underestimated. For example cost savings due to avoided damage to proprietors were not included, and survey respondents were asked to report monetary consequences for only 12 months, which may miss out on some longer term effects. In contrast, long term effects were assumed for prison/probation (eg 6 years for a serious assault was assumed to equal 696,540 euros) which may explain the large saving associated with judicial costs.

The authors note the seeming inconsistency of some results. For example the cost of an assault was much lower than that of a threat, and threats were also associated with the largest utility decrement. This may have been because unlawful threats were associated with more enduring violence than assaults.

Note that only crimes avoided during a 2.5 year period are included, even though the full 5 year costs of the intervention are included – any crimes avoided in the first 2.5 years of the intervention are thus not included, and so the cost savings could be an underestimate. |
| **Overall study quality (++,+,-)** | + |

Evidence Table	
Availability	
Bibliographic reference	Kenkel DS, Prohibition versus taxation: Reconsidering the legal drinking age, Contemporary Policy Issues, 1993; XI: 48-57 Ref ID: 2341
Economic study type	Economic analysis of the societal costs of prohibition and legal drinking age. A cost benefit analysis focussing on consumer surplus and deadweight loss.
Population, country & perspective	US, young and older drinkers. Societal perspective.
Intervention Comparison(s)	Minimum drinking age of 21 compared to a young adults alcohol tax or a general alcohol tax.
Source of effectiveness data	Consumption effects of the minimum drinking age and alcohol taxes are taken from the literature.
Method of eliciting health valuations (if applicable)	NA
Cost components included	Societal costs of prohibition and taxation. Costs of implementing the interventions are not included in the analysis.
Currency and cost year	1990 US$
Results - cost per patient per alternative	Minimum age restrictions on purchasing alcohol increases the real cost of purchasing alcohol for underage people, because added to the market price are illegality costs (eg expected penalty costs of arrest, cost of fake ID, costs of searching for a willing retailer, psychic costs of breaking the law). This reduces underage demand for alcohol and results in a reduction in consumer surplus. Because the majority of the illegality costs do not include a transfer, this loss of consumer surplus represents a deadweight loss, or a societal cost. This may result in other societal gains, but this is not investigated by the author. On the other hand, if a tax was levied that achieved the same consumption decrease as the minimum age restriction, illegality costs would be reduced to zero, and the increase in the price would represent the tax. Paying the tax would result in a societal transfer, not a cost, and as such the deadweight loss (societal cost) of the taxation programme would be less than the societal cost of the minimum age programme. Thus, if a young adult alcohol tax could be levied which reduced consumption by the same amount as the minimum age restriction, the tax would be optimal from a societal perspective. The authors use data from the US 1985 Health Interview Survey and other literature to estimate underage demand for alcohol in the US. Using Grossman et al (1987), Coate and Grossman (1987), Saffer and Grossman (1987) and Kenkel (1993) the author estimates that if noone evades the underage alcohol tax, a tax increase that increases prices by 12 to 86% is equivalent to the legal drinking age, and this would provide tax revenue of

	$564 million to $4.03 billion. This tax revenue is equal to the societal cost gain of the underage alcohol tax compared to a minimum drinking age.
Results - effectiveness per patient per alternative	Data is used from Grossman et al (1987), Coate and Grossman (1987), Saffer and Grossman (1987) and Kenkel (1993) to estimate the effectiveness of tax and minimum age policies.
Results - incremental cost-effectiveness	NA
Results - uncertainty	A potential problem with the underage alcohol tax policy is that tax evasion may occur. This would reduce the societal benefits of the programme. Also, if the tax and the minimum age restriction reduced underage drinking to zero independently then the tax would offer no advantage compared to the minimum age restriction, because no tax revenues would be obtained. One way of avoiding tax evasion is to implement a general tax increase rather than an age-based tax increase. The authors only find that this is an optimal policy (compared to a minimum age restriction) if the tax equivalent to the legal age is low. This is because the welfare loss of imposing a tax will impact upon all drinkers, not just young drinkers, whereas the minimum age restriction only impacts upon young drinkers. The author extends his analysis to consider the relative impact of minimum age restrictions and taxation on different types of drinkers. The author assumes that in many circumstances a minimum age restriction will create a high fixed cost to obtaining the first drink, after which the price per drink becomes the market price. The high initial cost will put off moderate drinkers from drinking but not heavy drinkers, who then face a low marginal cost for future drinks. A tax will therefore result in a higher average cost per drink for heavy drinkers than a minimum age restriction, and hence a minimum age restriction will impact more than proportionately on moderate drinkers than heavy drinkers, suggesting that a tax may be preferable.
Time horizon & discount rate	NA
Source of funding	National Institute on Alcohol Abuse and Alcoholism.
Comments	The author notes in concluding comments that the policy 'message' may also be important. Prohibition may send out a strong message to underage people that drinking is bad, whereas a tax may not. Therefore if lifting prohibition and levying a tax induces more drinking taxation policies will have more difficulty in achieving target alcohol consumption levels.
Overall study quality (++,+,-)	+

Appendix B: Excluded Studies

The table below lists the studies which were evaluated but excluded from the economics review – ie they are those that were ordered based on their abstract but later rejected due to not being relevant. One paper was excluded (Miller et al. 2000).

Reference	Reference ID	Reason for exclusion
Miller, TR and Levy DT, Cost-outcome analysis in injury prevention and control: eighty-four recent estimates for the United States, Medical Care, 2000; 38; 6: 562-582	80	Very little detail is given on the server intervention included, which is one of many interventions reviewed. The server intervention data appears to be directly taken from the Levy and Miller 1995 paper already included in this review.

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