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Estimating the cost-effectiveness of brief interventions for heavy drinking in primary health care across Europe

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Abstract

Background

Screening and Brief Interventions for alcohol are an effective public health measure to tackle alcohol-related harm, however relatively few countries across the European Union (EU) have implemented them widely. This may be due to a lack of understanding of the specific financial implications of such policies within each country.

Methods

A novel 'meta-modelling' approach was developed based on previous SBI cost-effectiveness models for four EU countries. Data was collected on the key factors which drive cost-effectiveness for all 28 EU countries (mean per capita alcohol consumption, proportion of the population to be screened over a 10-year SBI programme; per capita alcohol-attributable mortality; per capita alcohol-attributable morbidity; mean cost of an alcohol-related hospitalisation and mean SBI-delivery staff cost). Regression analysis was used to fit two meta-models estimating net programme costs and quality-adjusted life-years (QALYs) gained, to calculate cost-effectiveness estimates specific to each EU country.

Results

Costs are dependent upon the proportion of the population covered by the screening programme, the country-specific per capita mortality and morbidity rate and the country-specific costs of GP care and hospitalisation. QALYs depend on the proportion of the population screened and per capita alcohol consumption. Despite large inter-country variability in factor values, SBI programmes are likely to be cost-effective in 24 out of 28 EU countries and cost-saving in about 50% of countries.

Conclusion

Implementing national programmes of SBI in primary health care would be a cost-effective means of reducing alcohol-attributable morbidity and deaths in almost all countries of the EU.

Key words: Alcohol Consumption, Early Intervention, Primary Health Care, Cost-Effectiveness

Introduction

The negative health consequences of excessive alcohol consumption represent a substantial burden on health care systems throughout Europe (1,2). One of the key recommended policy approaches to target this problem is a programme of screening and brief interventions for heavy drinking in primary health care (SBI) (3,4), which has been shown to result in significant reductions in alcohol consumption (5,6). The primary health care setting is ideal for SBI as individuals can be screened opportunistically when at the practice for other reasons e.g. new patient registration or a standard health check, with the intervention taking place as part of a general conversation around the patient's health (7).

A recent systematic review looking at the cost-effectiveness of SBI programmes concluded that they were likely to be cost-effective despite heterogeneity around delivery methods, length of brief interventions and outcome measures (8), a finding that a number of subsequent studies have echoed (3,9,10). However, the majority of existing studies are from the United Kingdom (UK), United States (US) or Australia meaning that the conclusions may not be transferable to other countries, including mainland Europe where several nations have already implemented SBI programmes to various extents (11). Furthermore, there is evidence that both the costs and potential benefits, and thus cost-effectiveness, of SBI is likely to be heterogeneous across Europe and therefore a single cost-effectiveness conclusion for the entire region may potentially be inaccurate for the individual countries concerned (3,12). Given the importance of alcohol consumption as a risk factor for ill health and mortality, the existence of good quality cost-effectiveness evidence tailored to each European country is essential if uptake of SBI amongst primary health care practitioners is to be promoted by healthcare services and governments.

Clinical guidelines for Europe recommend that health services should provide funding for primary health care based SBI, and that practitioners should receive training and support to be able to carry

these out (13) and both the World Health Organisation and Organisation for Economic Co-operation and Development (OECD) have recommended more widespread implementation (3,14). However, in practice uptake varies considerably across Europe and overall fewer than 10% of heavy drinkers are currently identified in this setting (15,16). Government support and financial incentives for SBI in the UK have led to high general practitioner (GP) familiarity with standardised screening tools and brief intervention practices (16,17), and, in the case of Scotland, the delivery of 272,000 brief interventions between 2008 and 2012 (18), but only a handful of other European countries including Sweden, Finland and Italy have invested significant efforts in the institutionalisation of SBI programmes, supported by national laws, policies or guidelines (11). In most of the EU, GPs are poorly informed and feel uncomfortable about discussing alcohol with their patients, and as a result the uptake of SBI remains low (16,19,20).

This analysis aims to bridge the gap between the existing evidence around cost-effectiveness of SBIs and the large number of European countries for which no cost-effectiveness studies have been performed. We have previously used the Sheffield Alcohol Policy Model (SAPM) to estimate costs and effectiveness of SBI in Italy, the Netherlands, Poland and England (7,21,22). Whilst the 'gold-standard' approach for other EU countries may be to adapt or develop similar, highly detailed, models to assess the potential impacts of SBI programmes, such models are generally costly and time-consuming to develop and require data to parameterise them which may not exist for all countries. Here we extend this existing analysis using a 'meta-modelling' approach to provide an estimate of the cost-effectiveness of carrying out a national SBI programme in each EU member state.

Methods

Modelling Screening and Brief Interventions using the Sheffield Alcohol Policy Model

Our approach was based on pre-existing SBI modelling work using SAPM, which was developed to model the health impact of a range of government policies on alcohol (23,24). SAPM was used to model the effect of carrying out a ten year programme of delivering SBIs to all patients registering with a new GP in four countries: England, Italy, Poland and the Netherlands (7,21,22). In each case the model was adapted to reflect the best available country-specific data; however, all 4 models utilised the same structure, outcome measures and perspective (that of the healthcare sector). Results were harmonised across the 4 models by converting all costs to Euros using the Organisation for Economic Co-operation and Development (OECD) purchasing power parities (PPPs) (25) and inflated to 2013 prices using the country-specific harmonised inflation rate (26). All cost and QALY outcomes were discounted at 3.5% per year (27). The cost-effectiveness outcomes of the four individual models are presented in Table 1.

INSERT TABLE 1 ABOUT HERE

Developing the meta-model

A meta-model is a simplified version of a complex model, which can be used to generate predictions about the outputs of that model (28,29). In the present context, the development of a meta-model enables cost-effectiveness results to be predicted for countries beyond the four already modelled in detail. To construct the meta-model it was necessary to identify a set of key numbers or ‘factors’ which summarised the key model inputs and captured the aspects likely to affect the cost-effectiveness of SBI programmes between countries. Factors which did not have a common definition across all 4 countries, such as measures of binge drinking, or for which country-specific data was unlikely to be available for other EU countries, such as the distribution of drinking across the population, were excluded.

Six factors were identified that fulfilled the above criteria: 1) The mean alcohol consumption of the modelled population (grams of pure alcohol per day); 2) The proportion of the population screened over the modelled ten year programme; 3) The per capita mortality rate from all alcohol-related health conditions combined; 4) The per capita morbidity rate for all alcohol-related health conditions combined; 5) The mean cost per hospitalisation for an alcohol-related health condition; 6) The per-minute cost of the health professional who delivers the SBI. The baseline values for these six factors for the four SAPM model adaptations are shown in Table 1.

In order to efficiently establish the impact of varying these six factors on the model outputs, in terms of the net cost of the SBI programme and total Quality-Adjusted Life Years (QALYs) gained, we employed a fractional factorial design methodology (29). Within each country, the value of each factor was varied across two levels, the observed value and an alternative value chosen to cover the potential range of values across the remaining 24 EU countries. For example, GP costs in the UK are among the highest in Europe so the alternative value chosen was 50% of this level. New combinations of input factors, selected to efficiently cover the decision space, were run through the country-specific models in order to estimate the net costs and QALY gains of the SBI programme for each alternative scenario. These alternative scenarios can be conceptualised as ‘pseudo-countries’, with each country model run a total of 16 times (including once with the original, baseline, factor values) to give 64 combinations of model inputs and outputs from which to fit the meta-models. A detailed description of meta-model development and the selection of levels can be found in the ODHIN project report (10).

Fitting the meta-model

For each of these 64 pseudo-countries, results were divided by the number of eligible adults (those aged 18+) in each country to give per capita values. The impact of the six factors on the modelled cost-effectiveness was then assessed by developing ordinary least squares (OLS) regression models

for each country, separately for both cost and QALY output. Selection of included independent variables for each model was undertaken using log-ratio tests and by comparing Bayesian Information Criteria (BIC) and adjusted R-squared values. All models were fitted and analysed in Stata 12 (30).

Data collection to inform the six meta-model parameters

Data was collected to inform the six factor parameters for all 28 EU member states. Collected values are presented in Table S1 in the Supplementary Material. Large databases from organisations such as the WHO and Eurostat were used as much as possible in order to ensure standardisation of data between countries. If a choice was available, data from 2008 (or as close to 2008 as possible) was preferred to match the input data for the 4 existing country models. Data for Italy, Poland and the Netherlands was gathered in the same way as for the other EU countries, to act as a comparison between the data gathering methods used for this analysis and the much more extensive data collection process used for the country-specific models.

1) *Alcohol consumption*: In order to maintain consistency with the input data used in the 4 original country models, self-reported alcohol consumption data, rather than consumption estimates derived from national-level sales data were preferred. Mean consumption of alcohol in grams per day was therefore calculated from the Dynamo Health Impact Assessment model (DYNAMO-HIA), which is based upon survey data from individual EU countries (31). DYNAMO-HIA estimates the number of individuals in each age group of the population of a country that fall into five categories for daily drinking (0-0.25g, 0.25-20g, 20-40g, 40-60g, >60g). Mean g/day consumption was calculated by multiplying the number of individuals in each group by the category mean (32) and dividing by the total population. Twelve EU countries were missing from the DYNAMO-HIA database due to lack of survey data. A value for alcohol consumption was estimated for these countries by using data from a geographically adjacent country with similar levels of alcohol consumption according to WHO

sales data (33). As we do not have detailed data on patterns of alcohol consumption or levels of heavy episodic drinking associated with acute health harms such as alcohol poisoning, mean consumption acts as a proxy in the model for overall levels of harmful drinking.

2) The *proportion of the population screened over ten years* was based upon internal migration data from the Internal Migration Around the Globe (IMAGE) project (34). This study identified proportions of the population in countries of the world who moved address within a one or five year period. To extrapolate to ten years it was assumed that the probability of moving in each year was independent of previous years and that every move would result in registering with a new GP practice. Data was not available for Luxembourg, which was assumed to be the same as for France.

3) *Per capita mortality rate for alcohol-related health conditions* was obtained from Eurostat for all countries (35).

4) *Per capita morbidity rate for alcohol-attributable conditions* was obtained from the WHO as the sum of inpatients plus day-cases per 1000 population (2), divided by an adjustment coefficient to avoid double counting repeat admissions from the same individual (36). Three countries had data for inpatients but not day-cases, in which case the mean day-case value for all countries was added to the inpatient value. Four countries were missing data, in which case values were used from neighbouring countries with similar costs of hospitalisation (see below).

5) *Mean costs of hospitalisation* for each country were obtained from Eurostat by dividing hospital health expenditure by total number of inpatient discharges for all health conditions (35). Missing values for five countries were obtained from 2008 values for geographically and economically similar countries.

6) *Per minute costs of health professionals delivering the SBI* were based on GP salary and hours worked per week, and were obtained from three different sources; the OECD, the International Labour Organisation (ILO) and Kroneman et al (37–39). These values did not take into account administration costs or training. All costs were inflated to 2013 prices in local currency and converted to euros using PPPs (25,26).

Calculating cost-effectiveness of SBI for all EU countries

Total incremental costs and QALYs per capita for SBI versus control were calculated for each EU country from the collated data using the fitted cost and QALY meta-models. An incremental cost-effectiveness ratio (ICER = costs/QALYs) was then derived for each country. In the absence of a single common threshold for cost-effectiveness across all 28 countries we applied the standard UK threshold of £20000/QALY (approx €26000), adjusted using PPPs, for all countries (27).

Results

The coefficients from the final fitted OLS regression models for costs and QALYs per capita are presented in Table 2. Costs are dependent upon the proportion of the population screened, the mortality rate per capita and GP cost, and are inversely correlated with morbidity rate per capita and the mean cost per hospitalisation. This means that in the long-term and from a whole healthcare system perspective, SBIs are more expensive overall in countries where there is high mortality from alcohol-attributable conditions but low morbidity, as preventing morbidity is cost-saving whereas preventing mortality actually leads to higher costs as surviving patients may subsequently become ill, using additional healthcare resources. Similarly, SBI programmes are more expensive in countries where GP consultations are expensive, but hospital care is cheap, as the initial SBI delivery phase is high, while the future cost savings produced by the beneficial effect of SBI on morbidity diminish as costs of hospital care go down. Health gains, in terms of additional QALYs, are dependent only upon mean alcohol consumption and the proportion of the population screened, none of the other factors showing a significant relationship. For both models, interaction terms between input factors were tested but none proved to be significant.

INSERT TABLE 2 ABOUT HERE

The model coefficients were used together with the collected data on the six factors to calculate mean costs and QALYs per capita and associated ICERs for each EU country. A national SBI programme is estimated to be cost-effective in 24 of 28 EU countries and dominates (i.e. is more effective and less costly than) a scenario with no SBI delivery in 14 countries (see Table 3 for a complete list of country-specific results). Figure 1 shows these results on the cost-effectiveness plane, with 95% confidence intervals around both costs and QALY estimates, illustrating that countries group into distinct clusters. The greatest health gains are estimated to be delivered in northern European countries such as the UK and Scandinavia, with SBI policies being generally cost-

saving. In Mediterranean countries such as Spain, France and Greece, SBI shows a more moderate QALY gain, but is also generally cost-saving. Eastern European countries however tend to have both the lowest QALY gains and the highest costs and this group includes the 4 nations: Bulgaria, Croatia, Estonia and Romania, for whom SBIs are not estimated to be cost-effective. In general we observe that the cost-effectiveness of SBI programmes shows a positive correlation with the GDP of a country.

INSERT TABLE 3 & FIGURE 1 ABOUT HERE

Comparison of meta-model results for cost-effectiveness in Italy, Poland, the Netherlands and the UK/England using either values from the 4 country-specific models or from the standardised factor values collected for all 28 countries demonstrate some notable discrepancies. For Italy the results are fairly similar whichever factor values are used. However, for the Netherlands and the UK/England, costs are vastly underestimated and QALYs are over-estimated using collected factor values rather than baseline factor values results, and consequently the policies are estimated to be more cost-effective. Conversely, for Poland, QALYs are under-estimated and costs are roughly the same meaning that cost-effectiveness is lower when using collected rather than baseline factor values. Note that these discrepancies arise primarily from differences in the input data rather than uncertainty in the regression model. The biggest differences arise from variation in the estimates of GP costs and the proportion of the population screened. As GP costs for the collected values were based upon salary alone and didn't include administration or training costs, a sensitivity analysis was performed whereby they were increased by five-fold. However, despite no longer dominating the control scenario, SBI remained a cost-effective or highly cost-effective option in 20 of the 28 EU countries (see Table S3 in the Supplementary Material) indicating that inaccuracy in estimating GP cost is unlikely to change the decision about whether or not to implement SBI. Sensitivity analyses altering the proportion of the population screened were also performed. Increasing the proportions

(e.g. screening at next GP consultation rather than screening at new GP registration) tended to increase cost-effectiveness, with all 28 nations becoming cost-effective or cost-saving (see Table S4 in the Supplementary Material), whereas reducing the proportion screened by 50% tended to reduce cost-effectiveness meaning that SBI was no longer cost-effective for the majority of Eastern European countries(see Table S5 in the Supplementary Material). This indicates that in lower GDP countries, a cost-effective SBI policy relies upon a sufficient proportion of the population being screened.

Discussion

The results presented here indicate that implementing a national programme of SBI is likely to be an effective and cost-effective option for almost all EU countries, despite large inter-country variability in healthcare costs, alcohol consumption and alcohol-attributable health outcomes. Although in the short-term the interventions tend to be costly (21,22), savings are accrued over the medium-long term (5-30 years) due to reduced hospital admissions, making SBI cost-saving overall in half of the countries. Intervention effectiveness appears to be correlated with GDP, whilst costs are inversely correlated, meaning that SBI is more likely to be cost-effective in countries with higher GDP.

Previous economic analyses of SBI in Europe have generally focussed on evaluating its cost-effectiveness in one or two individual countries, and have shown that SBI is likely to be cost-effective in the UK, Italy, Poland, the Netherlands, the Czech Republic and Germany (8,40). The one exception to this is a study by Chisholm and others, which compared the cost-effectiveness of different alcohol interventions, including SBI, across different WHO geographic regions, including 3 broad regions of Europe (12). In contrast with our results they found that cost-effectiveness was higher in the poorer eastern European regions than in the richer northern and western European region. However, their costing analysis covered intervention implementation costs only and did not incorporate the cost savings accrued due to the reduction in alcohol-attributable hospital admissions, which have a disproportionate effect in richer countries. In addition, Chisholm used disability-adjusted life years (DALYs) to assess intervention effects rather than QALYs, which can produce quite different estimates of effectiveness (41). Given this fuller treatment of relevant costs and the provision of estimates for individual countries, we believe that the meta-model results presented here represent the most accurate source of current information about the cost-effectiveness of SBI for the majority of EU countries.

There are several limitations to the modelling process that should be taken into account when interpreting the results. Firstly, the model does not take drinking patterns within each country into account, instead depending simply on the measure of mean consumption in grams per day. Binge drinking has a different profile of risks than drinking a consistent amount of alcohol every day (42), yet the model is unable to distinguish between drinking patterns and overall consumption. One issue with incorporating such information into any international model is that currently there is a lack of standardisation between countries in how different drinking patterns should be defined (43), meaning that data from different individual-level surveys often cannot be easily compared.

Secondly, the model shares those limitations inherent in SAPM; for example it does not account for heterogeneity in response to SBI, either within subgroups of the population of a country or between countries. If the effectiveness of SBIs were to vary according to the drinking patterns of the recipient this may bias the results presented here, although there is some evidence that SBIs work equally well across a range of countries and contexts (44). It is also important to note that the uncertainty estimates presented here are likely to be under-estimates of the true level of uncertainty associated with the cost-effectiveness results, as they can only incorporate the statistical uncertainty within the meta-model regression and are unable to take account of either parameter uncertainty or structural uncertainty. An additional consideration is our use of a single cost-effectiveness threshold applied to all countries. The true value of any intervention depends on the absolute scale of the problem it seeks to address as well as the benefit associated with the available alternative investment options, both of which will vary between countries. Policy makers are therefore advised to consider these factors alongside the disaggregated costs and benefits and the overall cost-effectiveness figure.

A final limitation of the model is that the results not only assume that all internal migration events result in new GP registration, but also assume 100% implementation of SBI in newly registering patients. This is unlikely to happen in practice as currently there are many barriers to implementation of large-scale national programmes, including GP attitudes and a general lack of

training, resources or incentives (11,45). The result is that the number of beneficiaries and hence the overall costs and benefits of a national SBI programme at the population level would be lower than predicted by the meta-model. The sensitivity analysis indicates that if only 50% of the expected population is screened then SBI may no longer be a cost-effective option for the less wealthy European countries. However, the low level of internal migration (used as a proxy for new GP registration) in eastern Europe is one of the factors that contributes to poor cost-effectiveness results in the meta-model and it may be that SBI would be better implemented in a different manner in such countries to improve population uptake e.g. perhaps at next GP consultation instead.

There are several avenues for further research, both to improve the accuracy of the meta-model predictions and to increase knowledge about the costs, effectiveness and challenges inherent in SBI implementation in Europe. Many of the model inputs are based on data that would be much improved by standardisation to aid inter-country comparisons. Currently factors such as mortality and morbidity rates are fairly comparable, but good quality data on self-reported alcohol consumption is lacking in many countries, as are standardised costs for time spent with healthcare professionals such as GPs. Further research assessing barriers to implementation in different EU countries would also be useful if uptake of SBI is to be encouraged. Of course, any country wishing to implement SBI on the basis of these results would be advised to evaluate their impact, as there have been very few effectiveness trials in Europe and local factors may affect the achieved effectiveness in unpredictable ways.

In summary, SBI is likely to be cost-effective throughout the EU, except in those countries with the lowest GDPs. Whilst the findings presented here do not furnish decision makers with the same level of detail or precision as a bespoke prospective policy appraisal, they provide valuable insight into the potential costs and benefits of SBI policies and may help to guide future policy and research priorities.

Whilst there are challenges, countries should consider the best ways of developing and implementing SBI programmes in their context, which may include screening patients at their next primary health care appointment or in other settings. Future research should aim at reducing existing uncertainties and resolving implementation problems, which together should facilitate increased uptake of SBI in Europe.

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Declaration of competing interests

PA received reimbursement of the costs of his attendance to give a presentation on trends in research on health and alcohol to the Global Advisory Council of AB InBev in London, July 2015. CA, CT, PSM and AB have no interests to declare.

Key points

- Programmes of Screening and Brief Interventions (SBI) in primary health care are an effective measure to reduce alcohol-related harm, but are not widely implemented across Europe. A lack of understanding of the likely health and budget impacts specific to each country may be a significant barrier to more widespread uptake.
- This study provides country-specific estimates of costs and effects from national SBI programmes in all 28 EU countries. Results demonstrate that widespread national programmes of SBIs are likely to be cost-effective in 24 of 28 EU countries with 50% of countries estimated to save money following their introduction
- These results provide strong support for widespread adoption of large scale SBI programmes across Europe although some consideration should be given to methods of implementation, particularly in less wealthy countries

References

1. Rehm J, Mathers C. Global burden of disease and injury and economic cost attributable to alcohol use and alcohol-use disorders. *Lancet*. 2009;373:2223–33.
2. World Health Organization (Geneva). European Hospital Morbidity Database [Internet]. 2015 [cited 2015 Jul 7]. Available from: <http://data.euro.who.int/hmdb/>
3. OECD. Tackling Harmful Alcohol Use: Economics and Public Health Policy. Sassi F, editor. OECD Publishing; 2015.
4. Hutubessy R, Chisholm D, Edejer TT-T. Generalized cost-effectiveness analysis for national-level priority-setting in the health sector. *Cost Eff Resour Alloc*. 2003 Dec 19;1(1):8.
5. Kaner EFS, Beyer F, Dickinson HO, Pienaar E, Campbell F, Schlesinger C, et al. Effectiveness of brief alcohol interventions in primary care populations. *Cochrane database Syst Rev Online*. Wiley Online Library; 2007;4(2):CD004148.
6. O'Donnell A, Anderson P, Newbury-Birch D, Schulte B, Schmidt C, Reimer J, et al. The impact of brief alcohol interventions in primary healthcare: a systematic review of reviews. *Alcohol Alcohol*. 2013 Nov 13;49(1):66–78.
7. Purshouse R, Brennan A, Rafia R, Latimer NR, Archer RJ, Angus CR, et al. Modelling the cost-effectiveness of alcohol screening and brief interventions in primary care in England. *Alcohol Alcohol*. 2013 Sep 25;48(2):180–8.
8. Angus C, Latimer N, Preston L, Li J, Purshouse R. What are the Implications for Policy Makers? A Systematic Review of the Cost-Effectiveness of Screening and Brief Interventions for Alcohol Misuse in Primary Care. *Front psychiatry*. 2014 Jan;5:114.
9. Zur RM, Zaric GS. A Microsimulation Cost-Utility Analysis of Alcohol Screening and Brief Intervention to Reduce Heavy Alcohol Consumption in Canada. *Addiction*. 2015 Oct 19;
10. Shepard DS, Lwin AK, Barnett NP, Mastroleo N, Colby SM, Gwaltney C, et al. Cost-

- effectiveness of motivational intervention with significant others for patients with alcohol misuse. *Addiction*. 2016 May;111(5):832–9.
11. Colom J, Scafato E, Segura L, Gandin C, Struzzo P. Brief Interventions Implementation on Alcohol from the European Health Systems Perspective. *Front Psychiatry*. Frontiers; 2014 Nov 11;5.
 12. Chisholm D, Rehm J, van Ommeren M, Monteiro M. Reducing the global burden of hazardous alcohol use: a comparative cost-effectiveness analysis. *J Stud Alcohol*. 2004;65:782–93.
 13. Anderson P, Gual A, Colom J. Alcohol and Primary Health Care: Clinical Guidelines on Identification and Brief Interventions. Barcelona; 2005.
 14. World Health Organization. Global strategy to reduce the harmful use of alcohol [Internet]. Available from: http://www.who.int/substance_abuse/alcstratenglishfinal.pdf?ua=1
 15. Anderson P, Wojnar M, Jakubczyk A, Gual A, Segura L, Sovinova H, et al. Managing alcohol problems in general practice in Europe: results from the European ODHIN survey of general practitioners. *Alcohol Alcohol*. Jan;49(5):531–9.
 16. The AMPHORA Project. Alcohol Policy in Europe: Evidence from AMPHORA. Anderson P, Braddick F, Reynolds J, Gual A, editors. 2012.
 17. BMA & NHS Employers. Clinical Directed Enhanced Service (DES) Guidance for GMS contract 2008/9. NHS Employers and BMA. London; 2008.
 18. Beeston C, McAuley A, Robinson M, Craig N, Graham L. Monitoring and Evaluating Scotland's Alcohol Strategy. 2nd Annual Report. Edinburgh; 2012.
 19. Bendtsen P, Anderson P, Wojnar M, Newbury-Birch D, Müssener U, Colom J, et al. Professional's Attitudes Do Not Influence Screening and Brief Interventions Rates for Hazardous and Harmful Drinkers: Results from ODHIN Study. *Alcohol Alcohol*. 2015 Mar 18;agv020 – .

20. Wojnar M. Optimizing delivery of health care interventions (ODHIN): Survey of attitudes and managing alcohol problems in general practice in Europe - final report. Warsaw; 2014.
21. Angus C, Scafato E, Ghirini S, Torbica A, Ferre F, Struzzo P, et al. Cost-effectiveness of a programme of screening and brief interventions for alcohol in primary care in Italy. *BMC Fam Pract.* 2014 Jan;15(1):26.
22. Angus C, Scafato E, Ghirini S, Torbica A, Ferre F, Struzzo P, et al. Optimizing delivery of health care interventions (ODHIN): Cost-effectiveness - model report. Sheffield; 2013.
23. Purshouse R, Brennan A, Latimer N, Meng Y, Rafia R, Jackson R, et al. Modelling to assess the effectiveness and cost-effectiveness of public health related strategies and interventions to reduce alcohol attributable harm in England using the Sheffield Alcohol Policy Model version 2.0. Report to the NICE Public Health Programme Development Group. Sheffield; 2009.
24. Holmes J, Meng Y, Meier PS, Brennan A, Angus C, Campbell-Burton A, et al. Effects of minimum unit pricing for alcohol on different income and socioeconomic groups: a modelling study. *Lancet.* 2014 May 10;383(9929):1655–64.
25. OECD. Purchasing Power Parities (PPPs) Data [Internet]. 2013 [cited 2013 Jul 8]. Available from: <http://www.oecd.org/std/prices-ppp/purchasingpowerparitiespppsdata.htm>
26. www.inflation.eu. Historic HICP harmonised inflation [Internet]. 2013 [cited 2013 Jul 26]. Available from: <http://www.inflation.eu>
27. National Institute of Health and Clinical Excellence (NICE). Guide to the methods of technology appraisal 2013. 2013.
28. Thode HC. Statistical Tools for Simulation Practitioners. *Technometrics.* Taylor & Francis Group; 1988 Mar 23;30(4):464–464.
29. Law AM. *Simulation Modeling and Analysis: 4th Edition.* McGraw-Hill Higher Education; 2006.
30. StataCorp. *Stata Statistical Software: Release 12.* College Station, TX: StataCorp LP; 2011.

31. Lhachimi SK, Nusselder WJ, Smit HA, van Baal P, Baili P, Bennett K, et al. DYNAMO-HIA--a Dynamic Modeling tool for generic Health Impact Assessments. *PLoS One. Public Library of Science*; 2012 Jan 10;7(5):e33317.
32. Lhachimi SK, Cole KJ, Nusselder WJ, Smit HA, Baili P, Bennett K, et al. Health impacts of increasing alcohol prices in the European Union: a dynamic projection. *Prev Med (Baltim)*. 2012 Sep;55(3):237–43.
33. Anderson P, Moller L, Galea G. Alcohol in the European Union: Consumption, harm and policy approaches. 2012.
34. Bell M, Charles-Edwards E, Ueffing P, Stillwell J, Kupiszewski M, Kupiszewska D. Internal Migration and Development: Comparing Migration Intensities Around the World. *Popul Dev Rev*. 2015 Mar;41(1):33–58.
35. European Commission. Eurostat [Internet]. 2013 [cited 2013 Aug 7]. Available from: <http://epp.eurostat.ec.europa.eu/portal/page/portal/eurostat/home/>
36. Angus C, Meng Y, Ally AK, Holmes J, Brennan A. Model-based appraisal of minimum unit pricing for alcohol in Northern Ireland. Sheffield; 2014.
37. OECD. Health at a glance 2013: OECD indicators. Paris; 2013.
38. International Labour Organisation. LABORSTA Labour Statistics Database [Internet]. 2008. Available from: <http://laborsta.ilo.org/>
39. Kroneman MW, Van der Zee J, Groot W. Income development of General Practitioners in eight European countries from 1975 to 2005. *BMC Health Serv Res*. 2009 Jan;9(1):26.
40. Devaux M, Sassi F. Alcohol consumption and harmful drinking. OECD Publishing; 2015.
41. Sassi F. Calculating QALYs, comparing QALY and DALY calculations. *Health Policy Plan*. 2006 Sep 1;21(5):402–8.
42. Rehm J, Baliunas D, Borges G. The relation between different dimensions of alcohol

- consumption and burden of disease: an overview. *Addiction*. 2010;105(5):817–43.
43. Devaux M, Sassi F. Alcohol consumption and harmful drinking: Trends and social disparities across OECD countries. 2015. Report No.: 79.
 44. World Health Organisation. WHO collaborative project on identification and management of alcohol-related problems in primary health care: Report on Phase IV. Nick Heather, editor. Geneva; 2006.
 45. Wolstenholme A, Drummond C, Deluca P, Davey Z, Elzerbi C, Gual A, et al. Alcohol Interventions and Treatments in Europe. In: Anderson P, Braddick F, Reynolds J, Gual A, editors. *Alcohol Policy in Europe: Evidence from AMPHORA*. 2012. p. 65–80.

Tables

Table 1: Baseline factor values and SAPM adaptation results

Country	Mean consumption (g/day)	Alcohol-Attributable mortality rate (per capita)	Alcohol-Attributable morbidity rate (per capita)	Mean cost of hospitalisation (€)	Cost of GP (€/min)	Population coverage (%)	Net programme cost (€ per capita)	QALYs gained per capita	ICER (€/QALY)
England	15.6	0.00456	0.0527	7698	3.85	39.8	5.29	0.00117	4533
Netherlands	12.8	0.00240	0.0468	8583	3.01	35.9	-0.58	0.00088	Dominates*
Poland	7.0	0.00439	0.0319	2810	0.28	67.2	1.69	0.00107	1584
Italy	12.2	0.00404	0.0327	5854	0.96	69.8	1.53	0.00135	1135

*Dominates – the programme is both health-improving and cost-saving compared to no SBI delivery

Table 2: Cost and QALY regression model coefficients and goodness-of-fit statistics

Factor	Cost regression model			QALY regression model		
	Coefficient	Standard Error	p Value	Coefficient	Standard Error	p Value
Mean Consumption	-			0.0000601	0.000009	0.000
% Population Screened	5.52	2.77	0.051	0.00203	0.000198	0.000
Mortality Rate Per Capita	1400.87	378.32	0.000	-		
Morbidity Rate Per Capita	-102.59	44.66	0.025	-		
Mean Cost/Hospitalisation	-0.00124	0.000207	0.000	-		
GP Cost	3.918	0.286	0.000	-		
Constant	-0.996	3.191	0.756	-0.000726	0.000191	0.000
Adjusted R-Squared	0.7917			0.6236		

Table 3: Costs, QALYs, ICERs and cost-effectiveness thresholds predicted for all EU countries using the meta-model

Country	Costs (€ per capita)	QALYs (per capita)	ICER (€/QALY)	Cost-effectiveness threshold (€)	Cost-effectiveness (WHO guidelines)
<i>Using baseline factor values</i>					
England	7.72	0.00102	7574	26873	Cost-effective
Italy	1.66	0.00142	1168	24139	Cost-effective
Netherlands	0.70	0.00077	903	25705	Cost-effective
Poland	3.20	0.00106	3021	13109	Cost-effective
<i>Using collected factor values</i>					
Austria	-2.07	0.00117	-1767	24541	Cost-saving
Belgium	-1.05	0.00158	-664	25027	Cost-saving
Bulgaria	10.89	0.00059	18499	11497	Not cost-effective
Croatia	6.49	0.00033	19921	15984	Not cost-effective
Cyprus	-2.16	0.00075	-2884	21709	Cost-saving
Czech Republic	2.98	0.00055	5457	16030	Cost-effective
Denmark	-4.53	0.00188	-2408	32482	Cost-saving
Estonia	7.10	0.00027	26549	17690	Not cost-effective
Finland	2.29	0.00168	1363	28743	Cost-effective
France	-0.77	0.00120	-641	25237	Cost-saving
Germany	2.05	0.00124	1650	23999	Cost-effective
Greece	-0.93	0.00091	-1020	20681	Cost-saving
Hungary	7.94	0.00104	7632	13974	Cost-effective
Ireland	-6.94	0.00101	-6860	28322	Cost-saving
Italy	1.38	0.00127	1086	24139	Cost-effective
Latvia	8.70	0.00055	15890	16474	Cost-effective
Lithuania	8.85	0.00083	10680	14792	Cost-effective
Luxembourg	-5.97	0.00120	-4970	28135	Cost-saving
Malta	-1.10	0.00071	-1544	19068	Cost-saving
Netherlands	-5.93	0.00151	-3928	25705	Cost-saving
Poland	3.34	0.00034	9784	13109	Cost-effective
Portugal	-0.13	0.00083	-150	19162	Cost-saving
Romania	7.26	0.00023	31888	12549	Not cost-effective
Slovakia	3.46	0.00033	10619	16101	Cost-effective
Slovenia	0.69	0.00029	2347	19582	Cost-effective
Spain	-3.47	0.00070	-4968	22013	Cost-saving
Sweden	-5.02	0.00157	-3192	30916	Cost-saving
United Kingdom	-3.98	0.00213	-1872	26873	Cost-saving

Figure 1: The estimated impact of national programmes of SBI for different EU countries with 95% confidence intervals.

