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Economic Evaluation

Modeling the Potential Health, Health Economic, and Health Inequality Impact of a Large-Scale Rollout of the Drink Less App in England

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ABSTRACT

Objectives: Alcohol places a significant burden on the National Health Service (NHS); yet, uptake of cost-effective approaches remains low. Digital interventions may overcome some barriers to delivery. The Drink Less app has evidence of being effective at supporting heavier drinkers to reduce their alcohol intake. In this study, we estimate the longer-term health impacts, cost-effectiveness, and health inequality impact of a large-scale rollout of the Drink Less app.

Methods: We used the Sheffield Alcohol Policy Model to estimate changes in alcohol consumption, hospital admissions, mortality, and NHS costs of 2 rollout scenarios over a 20-year time horizon: (1) a mass media awareness campaign and (2) a targeted drive to embed referral to Drink Less within primary care. We modeled the cost-effectiveness and inequality impact of each approach in a distributional cost-effectiveness analysis.

Results: A mass media campaign is estimated to reduce per capita alcohol consumption by 0.07 units/week and avert 108 556 hospital admissions and 2606 deaths over 20 years, gaining 24 787 quality-adjusted life-years at a net saving to the NHS of £417 million. Embedding in primary care is estimated to reduce consumption by 0.13 units/week, saving 188 452 admissions and 4599 deaths and gaining 38 897 quality-adjusted life-years at a net saving of £590 million. Both scenarios are estimated to reduce health inequalities, with a larger reduction for the primary care approach.

Conclusions: A large-scale rollout of the Drink Less app is estimated to be health improving, cost saving, and reducing health inequalities. Embedding the use of Drink Less within primary care is likely to be the more effective approach.

Keywords: alcohol policy, distributional cost-effectiveness analysis, health inequalities, public health.

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Highlights

- Digital interventions are an effective tool to support reducing alcohol consumption, but uptake is generally low and the cost-effectiveness of strategies to increase their uptake is unclear.
- Both a mass media campaign and promotion through General Practice of the Drink Less app would reduce alcohol consumption, improve health, reduce costs to the National Health Service, and reduce health inequalities, with promotion through General Practice providing the largest benefit.

Introduction

Alcohol consumption places a significant burden on public health, causing an estimated 6% of all deaths and a loss of 21 million (m) disability-adjusted life-years in Europe in 2019.[1] Alcohol brief interventions (BIs), in which a healthcare professional discusses an individual's alcohol consumption and offers them support to cut down where appropriate, are one of the World Health Organization's recommended policies to tackle alcohol-related harm.[2] This is supported by a substantial evidence base demonstrating the effectiveness[3] and cost-effectiveness[4] of BIs delivered in primary care for reducing alcohol consumption among increasing- and higher-risk drinkers (individuals scoring 8+ on the Alcohol Use Disorders Identification Test[5]). However, in spite of this evidence and their inclusion in clinical guidelines, rates of BI delivery in practice in England remain low,[6] notwithstanding attempts to increase delivery through financial incentives to practitioners.[7]

One potential approach to address these low delivery rates is the use of digital, rather than face-to-face, interventions.[8] Digitally delivered interventions have been demonstrated to be effective[9] and have the potential to reach large numbers of increasing- and higher-risk drinkers at relatively low incremental costs. However, digital interventions still have low uptake across England, with <4% of increasing- and higher-risk drinkers reporting using one to help when making an attempt to reduce their alcohol intake.[10] There are a variety of ways that people can discover apps, including through searching a commercial app store or online libraries of publicly endorsed health apps; recommendations from healthcare practitioners or trusted providers,[11,12] widespread media coverage,[13] friends, and family[14]; or from reading user reviews on app stores.[15] App awareness has been identified as an important factor for uptake of an app,[16] and mass media campaigns are one way of increasing app awareness, with many studies showning that mass media campaigns lead to the uptake of digital interventions.[17,18]

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Drink Less is a theory- and evidence-informed app designed to help increasing- and higher-risk drinkers reduce their alcohol consumption.[19] Evidence from a randomized controlled trial (iDEAS) has demonstrated the effectiveness of the Drink Less App in reducing alcohol consumption in this population.[20] Specifically, we found that users of the Drink Less app reduced their alcohol consumption by an average of 2 UK units of alcohol per week (1 UK unit = 10 mL or 8 g of ethanol), relative to a comparator group (usual digital care), an effect size comparable with other digital and in-person interventions.[3,21] An economic evaluation alongside the iDEAS trial suggests that wider rollout of the app may be cost-effective or cost saving in the short term,[22] but a longer-term model-based appraisal is required to quantify the potential costs and benefits of wider implementation and to compare the potential impact of alternative promotion strategies in the population.

The Sheffield Alcohol Policy Model (SAPM) is a widely used alcohol policy appraisal tool that has been used over the past 15 years to estimate the potential impact of a wide range of alcohol policies, from minimum unit pricing for alcohol[23,24] and changes to alcohol taxes[25,26] to programs of screening and BIs.[27,28] SAPM is a hybrid econometric-epidemiological model that estimates the effects of an alcohol policy intervention on alcohol consumption and the subsequent implications of these effects on alcohol-attributable hospital admissions, mortality, and National Health Service (NHS) costs. A key feature of SAPM is the ability to disaggregate model results by population subgroup, allowing the potential differential impact of any intervention on different age, sex, or socioeconomic groups to be modeled.[29]

This study aims to use SAPM to appraise the potential long-term impact on alcohol consumption, alcohol-attributable hospital admissions, deaths, and quality-adjusted life-years (QALYs) lived in the English adult population under 2 alternative scenarios: a mass media campaign designed to increase uptake of the app and a policy of embedding the app as part of conversations that general practitioners (GPs) have with their patients about alcohol. For each scenario, we also estimate the cost-effectiveness from the perspective of the National Health Service and use a distribution cost-effectiveness analysis (DCEA) approach to estimate the health inequality impact.[30,31] DCEA is a methodology for incorporating equity impacts into cost-effectiveness analysis, accounting for population-level aversion to inequalities in health and the implication of this aversion that the public is willing to pay more for an intervention, which reduces inequality (and less for one that increases it).[30,32]

Methods

The COVID-19 pandemic has had widespread impacts across many aspects of public life and public health, and affecting the collection of many health-related data sets. The most recently available data for many of the data sets used in our modeling are from 2020 and 2021, when fluctuations due to the pandemic and associated restrictions were likely to be at a peak. As such, we used prepandemic data for all inputs to minimize the potential for short-term pandemic effects to distort our findings. We do not attempt to model the effects of the pandemic (for which high-quality data are not yet available), and all modeled scenarios are compared with a counterfactual in which there is no uptake of the app.

Policy 1: Mass Media Campaign

This scenario assumed a large-scale public-facing media campaign across multiple media designed to increase downloads and use of the Drink Less app among increasing and higher-risk drinkers. Data from the Alcohol Toolkit Study, a large, nationally representative survey of adults in England,[33] suggest that 26.9% of increasing- and higher-risk drinkers in 2019 wanted to or felt that they should reduce their alcohol intake. Evidence from the iDEAS trial found that 67% of increasing- and higher-risk drinkers who reported motivation to reduce their alcohol consumption subsequently downloaded the Drink Less app when recommended to do so.[20] Mass media campaigns have the potential to increase the uptake of public health interventions, with a recent study finding that a smoking cessation campaign appeared to increase registrations for digital support.[34]

In this scenario, we modeled a one-off (ie, only having an impact in the first year of the model) mass media campaign to increase the uptake of the Drink Less app. We assumed that this did not change overall levels of motivation to reduce alcohol consumption but led to 67% of the 26.9% of increasing- and higher-risk drinkers who are already motivated to drink less to download the app. The cost of the campaign was assumed to be £889 549.96, the same cost as the Stoptober mass media smoking cessation campaign run by Public Health England in 2019 (data were provided by Public Health England).

Policy 2: Embedding in General Practice

This scenario assumed that recommendations to download the Drink Less app are embedded into existing conversations that GPs have with increasing- and higher-risk drinkers about alcohol. Data from the Alcohol Toolkit Study show that 5.5% of increasing and higher-risk drinkers under 35 and 12.9% of those aged 35 or more in England had spoken to a GP or other healthcare professional about their drinking in 2019.[33]

In this scenario, we modeled 5 years of this embedding, assuming that all increasing- and higher-risk drinkers who talk to their healthcare practitioner about drinking will be recommended to download the app, and that 67% of those will follow through on this recommendation.[20] We assumed that these conversations last 5 min, on average, and conservatively cost that time using the cost of patient contact for a GP of £226/h.[35]

Long-Term Modeling

The long-term impact of each policy scenario on health was estimated using SAPM version 4.1. SAPM consists of 2 linked models: an individual-level simulation model estimating the impact of each scenario on alcohol consumption and an integrated Markov/lifetable model estimating the health impacts of these consumption changes. For a comprehensive description of SAPM, please see Meier et al,[26] Brennan et al,[29] Angus et al.[36] Baseline alcohol consumption data are taken from the Health Survey for England 2018 and 2019 pooled. Mortality rates for 45 different conditions linked to alcohol[37] and all other causes were taken from pooled data for 2012 to 2016 from the Office for National Statistics. Hospital admission rates for these conditions were taken from NHS Hospital Episode Statistics for the financial years 2012/13 to 2016/17. Health-state utilities stratified by age (18-24, 25-34, 35-54, and 55+) and sex for each health condition and for the general population were taken from previously published estimates, as were annual NHS costs associated with each health condition.[28] In line with results from the iDEAS trial, we assumed the effect of using the Drink Less app is a 2 unit/week reduction in mean alcohol consumption. As previous evidence has shown, the effects of an in-person BI may be sustained for at least 4 years,[38] and because of the fact that, unlike a BI in which there is no further contact after the intervention itself, people will continue to have access to the app, we assumed that this reduction is maintained for the duration of the modeled period (ie, 20 years). Previous studies have shown that there can be a significant time delay between changes in alcohol consumption and changes in risk for some health conditions,[39] and we, therefore, modeled a time horizon of 20 years to allow the full health impact of each policy scenario to be captured.

Health Outcomes

For each modeled policy we estimated the net change in population-level mean alcohol consumption (measured in units per adult per week) compared with no intervention delivery. We also estimated the cumulative change over 20 years in alcohol-attributable hospital admissions and deaths and the cumulative QALYs gained.

Health Economic Analysis

For each modeled policy, we calculated the net intervention costs and combined these with the net changes in NHS costs attributable to alcohol, cumulatively over the 20-year time horizon, to estimate the net program cost. These were compared with the cumulative number of QALYs gained or lost to estimate the incremental cost-effectiveness ratio (ICER) of each program, in line with standard National Institute for Health and Care Excellence (NICE) guidance.[40] An ICER of £20 000 to £30 000 is usually considered to be cost-effective.[41] All costs were inflated to 2023 prices using healthcare-specific inflation indices,[35] except for the costs of the mass media campaign, which were inflated using the consumer prices index,[42] and all costs and QALYs were discounted at 3.5% in line with NICE guidance for public health interventions.[40]

Inequality Analysis

The health inequality impact of each policy scenario was assessed by stratifying primary model outcomes (changes in alcohol consumption and alcohol-attributable deaths, hospital admissions, and QALYs gained or lost) by quintiles of the English Index of Multiple Deprivation.[43] This analysis was supplemented by a DCEA, formally incorporating equity considerations into a cost-effectiveness framework.

Baseline quality-adjusted life expectancy, measured in QALYs and the socioeconomic distribution of current healthcare spending, was taken from recent English analyses.[44,45] Health benefits were monetized, assuming a threshold of £20 000 per QALY. For each modeled scenario, we used a measure of inequality aversion—the extent to which decision makers are willing to trade off the magnitude of health gains against equality in their distribution—to derive a level of equally distributed equivalent (EDE) health for each scenario. The EDE represents the level of health improvement that would be considered equal in value to the observed QALY gains if it were distributed equally across the population. In a scenario in which there is no inequality aversion, the EDE is simply the mean QALY gain in the population. See Asaria et al[46] for full details of this approach. Inequality aversion was quantified using the Atkinson index, assuming a value of 10.95 from a UK-based population survey.[47] The net inequality impact was then calculated as the difference between the observed net health benefit and the net benefit of the EDE. If this value is positive, then the societal value of the scenario is positive, with higher positive values representing a greater positive impact on reducing health inequalities at a price consistent with cost-effectiveness considerations.

Sensitivity Analyses

The robustness of our results to alternative assumptions was tested in a range of scenario sensitivity analyses (SAs). For the mass media campaign, we model a more optimistic scenario in which the campaign increased motivation to reduce alcohol consumption by a further 22% (SA1)[48] and a more pessimistic scenario in which we assumed no such increase in motivation and that only 33.5% of those motivated to reduce their alcohol intake downloaded the Drink Less app (ie, half those downloading it in the iDEAS trial) (SA2). For embedding in GP practice, we modeled a more optimistic scenario that assumed the availability of the app would lead to a 50% increase in the number of healthcare professionals talking to their patients about their drinking (SA1). We also modeled a more pessimistic scenario in which only 33.5% of those who spoke to a healthcare professional subsequently downloaded the app (SA2). For both policies, we also modeled a third SA in which the reduction in consumption for people using the app is not sustained in the longer term. In this scenario, we assume that the reduction decreased linearly to 0 over 7 years, with no further effect beyond this (SA3), in line with previous BI modeling studies.[28,36]

In addition to these planned SAs, we have also conducted a range of additional, unplanned analyses. These include adjusting the baseline alcohol consumption data to reflect evidence of changes to drinking patterns during the pandemic, assuming a lower effectiveness of the app, assuming both lower uptake (SA2) and waning of effect (SA3) together, and testing higher and lower values of the inequality aversion parameter. See Supplemental Materials found at https://doi.org/10.1016/j.jval.2024.11.007 for full details.

Preregistration

The analysis protocol for this study was preregistered on the Open Science Framework (https://osf.io/v4fpz). There were 2 changes to the published protocol: first, the primary health outcomes (hospital admissions, deaths, and QALYs) were presented cumulatively over 20 years, not in the 20th year as stated in the protocol, in line with standard health economic practice.[40] Second, the baseline distribution of quality-adjusted life expectancy was taken from a different source[44] because the article cited in the protocol only presented results for the whole English population, not stratified by the English Index of Multiple Deprivation quintile as required for this analysis. Patients and the public were involved in the overall design and interpretation of the iDEAS trial but did not contribute to the present analysis.

Results

Primary Outcomes

The primary outcomes of the long-term analysis for each policy are presented in Table 1. Both scenarios lead to a small reduction in population alcohol consumption, but as this is targeted entirely at increasing- and higher-risk drinkers, this leads to substantial reductions in alcohol-related harm. Embedding in General Practice is estimated to lead to almost double the reach, in terms of the number of downloads of the Drink Less app by the target population compared with a mass media campaign and, as a result, has a substantially greater impact on all modeled outcomes. Both policies increase the number of QALYs lived in the population, and the costs of the policies are outstripped by the downstream cost savings through reduced costs to the NHS. Because both policies are cost saving and health improving, they are considered to dominate the counterfactual scenario with no uptake of the app. Additionally, embedding in General Practice dominates the mass media campaign in a marginal comparison.

Table 1. Primary outcomes for both modeled policies.

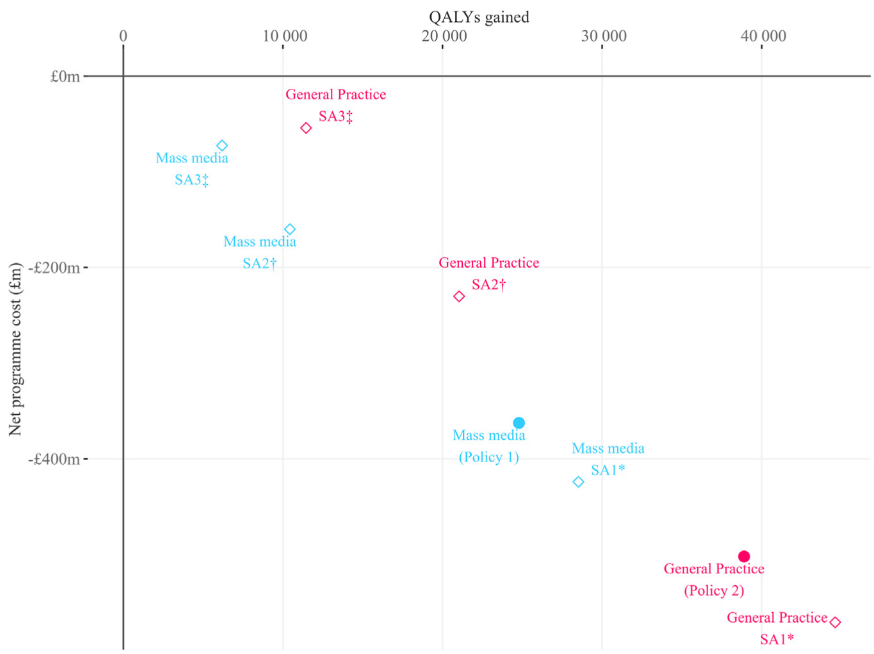
Outcome measure	Mass media (policy 1)	Mass media SA1*	Mass media SA2†	Mass media SA3‡	General practice (policy 2)	General practice SA1*	General practice SA2†	General practice SA3‡
App downloads	1 606 520	1 848 517	782 966	1 606 520	3 042 760	3 916 103	1 686 074	3 042 760
Intervention cost (£m) (discounted)	£1.06	£1.06	£1.06	£1.06	£90.86	£133.01	£90.86	£90.86
Change in population alcohol consumption (units per week)	−0.07	−0.08	−0.03	0.00	−0.13	−0.17	−0.07	0.00
Cumulative change in alcohol−attributable hospital admissions	−108 556	−114 763	−50 494	−19 521	−188 452	−228 214	−102 423	−36 662
Cumulative change in alcohol-attributable deaths	−2606	−2601	−1003	−463	−4599	−5417	−2505	−858
Cumulative change in QALYs accrued	24 787	24 629	9911	7066	38 897	44 602	21 042	11 450
Cumulative change in NHS costs (£m) (discounted)	−£417.67	−£431.55	−£185.81	−£97.04	−£681.32	−£808.84	−£368.98	−£166.67
Net program cost (£m) (discounted)	−£416.61	−£430.48	−£184.75	−£95.98	−£590.46	−£675.83	−£278.12	−£75.81
ICER vs no intervention	Dominates	Dominates	Dominates	Dominates	Dominates	Dominates	Dominates	Dominates

ICER indicates incremental cost-effectiveness ratio; m, million; NHS, National Health Service; QALY, quality-adjusted life-year; SA, sensitivity analysis.
*Higher uptake.
†Lower uptake.
‡Waning effectiveness.

Figure 1 presents both modeled policy scenarios and all SAs on the cost-effectiveness plane compared with no uptake. Even under the most pessimistic scenario (SA3), in which the reductions in alcohol consumption wane over time, both policies remain health improving and cost saving. This is also true for the additional unplanned SAs, with the exception of assuming both lower uptake and a waning of effect in the General Practice scenario, under which the policy has a net cost of £0.9m and an ICER vs no intervention of £150. See Appendix Tables S1-S3 and Figure S1 found at https://doi.org/10.1016/j.jval.2024.11.007 for full results.

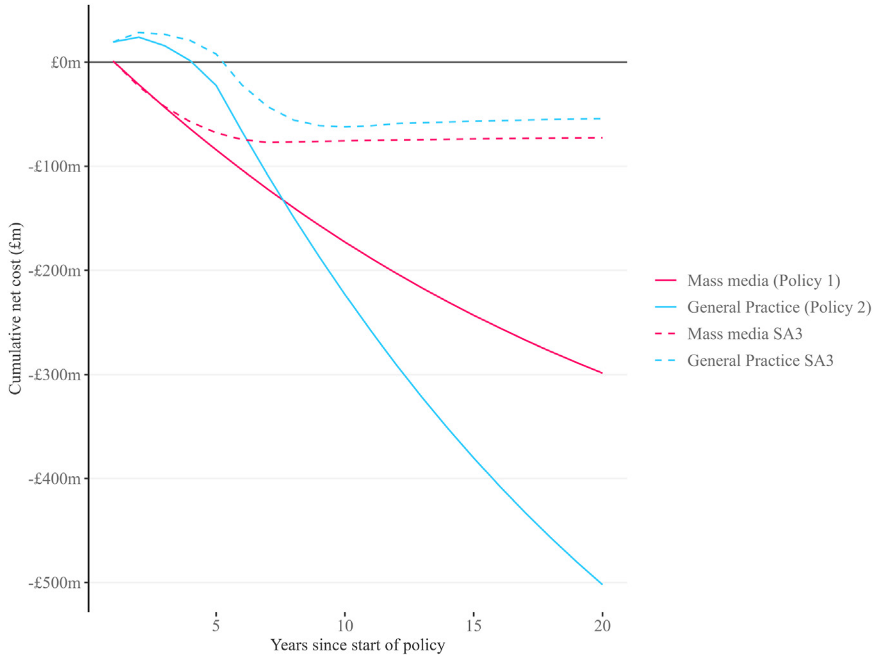
Figure 2 presents the cost profile of each modeled policy in both the baseline and the most pessimistic of the sensitivity analyses - SA3. A mass media campaign is estimated to be cost saving from year 1 because the initial cost of the mass media campaign is more than offset by the reduction in NHS costs in the short term. Embedding in General Practice, however, has a higher up-front intervention cost and does not break even until year 4.

Figure 1. Cost-effectiveness plane showing all modeled policies and planned sensitivity analyses.



m indicates million; QALY, quality-adjusted life-year.

Figure 2. The evolution of the cumulative net cost of each modeled policy over time.



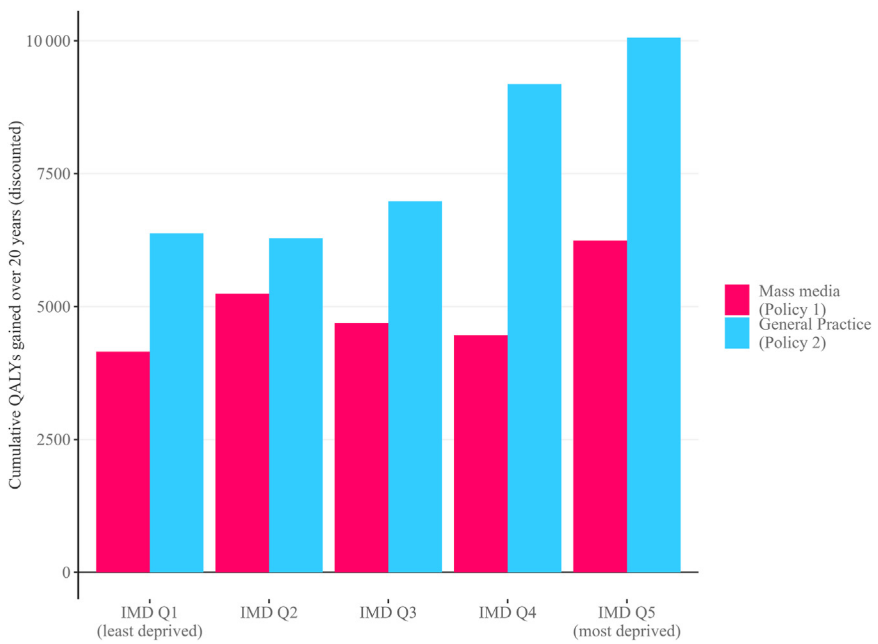
m indicates million; SA, sensitivity analysis.

Inequality Impacts

Figure 3 shows the distribution of QALY gains for each of the 2 modeled policy scenarios. This illustrates that not only does embedding in General Practice lead to a larger improvement in population health, but it also has the greatest impact on the most deprived groups. In contrast, a mass media campaign has a marginally greater impact on the health of the least-deprived groups.

DCEA results are summarized in Table 2 and visualized on an equity-impact plane in Figure 4. This shows that both policies are estimated to reduce inequality overall. In the case of a mass media campaign, this is found in spite of the direct health benefits being greater in less-deprived groups. Because the current distribution of

Figure 3. Socioeconomic distribution of QALY gains for modeled policy scenarios.



IMD indicates index of multiple deprivation; Q, quintiles; QALY, quality-adjusted life-year.

Table 2. Distributional cost-effectiveness analysis results for all modeled scenarios.

Outcome measure	Mass media (policy 1)	Mass media SA1*	Mass media SA2†	Mass media SA3‡	General practice (policy 2)	General practice SA1*	General practice SA2†	General practice SA3‡
Net health benefit	42 906	43 351	17 942	11 235	63 997	73 143	32 552	14 159
Equivalently distributed net health benefit (EDE)	49 202	48 340	21 578	13 057	75 394	79 666	39 680	16 287
Net inequality impact	6297	4989	3635	1823	11 398	6523	7128	2129

EDE indicates equally distributed equivalent, SA, sensitivity analysis.
*Higher uptake.
†Lower uptake.
‡Waning effectiveness.

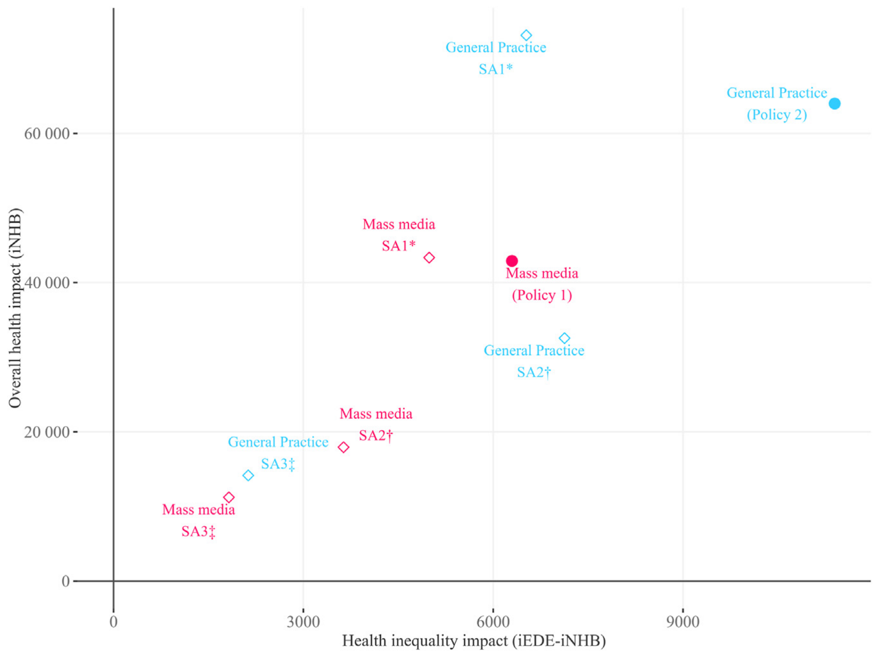
healthcare spending in the NHS is skewed toward more-deprived groups, a policy that is cost saving for the NHS enables a larger increase in NHS funding for treatment among more-deprived groups as a result. For the mass media campaign, this increase is sufficiently large to more than offset the negative inequality impact of the intervention itself, whereas for embedding in General Practice, it serves to substantially increase the larger positive impact on health inequalities under this scenario. These conclusions do not change under any of the prespecified or unplanned SAs, although the magnitude of the health inequality impact varies, except for the General Practice policy, when we assume a greater aversion to inequality. See Appendix Tables S4 and S5 and Figure S2 found at https://doi.org/10.1016/j.jval.2024.11.007 for full results.

Discussion

Both modeled scenarios, a mass media campaign and embedding in General Practice, would reduce alcohol consumption through increased uptake of the Drink Less app, leading to improved population health. Both scenarios are estimated to be both health improving and cost saving. Embedding the app in General Practice will lead to a greater contribution to reducing health inequalities, with a mass media campaign only leading to a reduction in inequalities after accounting for the redistribution between socioeconomic groups of the NHS costs saved by the intervention. The GP embedding scenario is estimated to achieve all of these outcomes to a greater extent. These conclusions appear robust to a range of alternative assumptions, although the absolute magnitude of the benefits varies. Our finding that the Drink Less app is both health improving and inequality reducing is not universal among public health interventions, with almost half of the interventions considered by NICE failing to meet both of these criteria.[49]

To our knowledge, this study represents one of the first applications of DCEA methodology to alcohol interventions and the first to assess the inequality impacts of digital interventions. Two

Figure 4. Equity-impact plane showing the health inequality and overall health impact of all modeled policy scenarios and sensitivity analyses. *More optimistic scenario, †more pessimistic scenario, ‡waning effectiveness.



iEDE-iNHB indicates marginal difference between incremental Equally Distributed Equivalent health and incremental Net Health Benefit; SA, sensitivity analysis.

previous studies have looked at the inequality impacts of BIs delivered in primary care, both concluding that BIs are likely to be health improving and inequality reducing.[50,51] However, despite this evidence BI delivery rates remain low,[6] in part because of low confidence among GPs in discussing alcohol consumption with patients and a perceived lack of resources in screening and advising patients on their alcohol consumption.[52] Having access to digital interventions, supported by evidence that they can be both cost-effective and inequality reducing and which practitioners can recommend to people who they have identified as potentially benefiting from reducing their alcohol consumption, may help to overcome some of these barriers.

We have drawn on a wide range of large, nationally representative data sources to produce robust estimates of the costs, effects, and distributional impacts of the potential rollout of the Drink Less app in England and applied a range of plausible assumptions ranging from pessimistic to optimistic. The study also builds on a well-established modeling framework, the SAPM.

However, there are several important limitations to our approach. First, we are limited by the representativeness of these data, particularly data from surveys, which have been shown to undersample some population groups, particularly dependent drinkers.[53] Because the Drink Less app has not been designed for or trialed in this population, the impact of underrepresenting them in the model is unclear. Second, we have assumed equal effects of the intervention across all individuals and population groups. There is scant evidence of heterogeneity in response to digital interventions, such as Drink Less, and little evidence around differential effectiveness of BIs more broadly,[3] although studies looking at other health behaviors, such as smoking, have sometimes found greater response to BIs in higher socioeconomic groups.[54,55] If the same were true for the effectiveness of Drink Less, then this may attenuate the inequality reductions estimated in our study; however, analysis of data from the iDEAS trial did not demonstrate any differential effectiveness across socioeconomic groups.[20] We have also assumed equal uptake of the app across socioeconomic groups among those exposed to it in each policy scenario and that all higher-risk drinkers who are motivated to cut down their alcohol consumption are exposed to the mass media campaign in policy 1. In addition, we have not attempted to model the possibility that some lower-risk drinkers may see the mass media campaign in policy 1 and subsequently download the app. The net effects of these assumptions on our estimates of the overall health and health economic impact of each policy are unlikely to be large, although the impact on the inequality analysis is less clear. A further consideration is that we have modeled only the future healthcare costs associated with conditions that are related to alcohol. Although this is the approach prescribed by NICE in the United Kingdom,[40] it remains contested in the wider literature.[56] Including future unrelated costs in our modeling would likely reduce the cost-effectiveness of both scenarios and potentially negate the conclusion that they are cost saving

Finally, because of a combination of theoretical and practical reasons, we have not attempted a probabilistic SA (PSA). SAPM is a large, complex model with thousands of input parameters, many of which will be correlated, but there is no robust basis on which to estimate this covariance. Alternatively, assuming complete independence between parameters would substantially overstate the estimated uncertainty. PSAs in DCEA models are also rare because of a combination of challenges in their undertaking and presenting their results in a digestible format.[30] Further, several of the key uncertainties in our modeling could not readily be parameterized in a standard PSA approach. We have therefore taken a scenario analytic, or possibilistic, approach to explore key uncertainties in our results.

Although our base case modeling has not accounted for the effects of the COVID-19 pandemic because of a lack of available data, alcohol consumption in the United Kingdom since 2019 has changed markedly, with clear evidence of polarization in drinking—heavier drinkers increasing their consumption during the pandemic, whereas moderate drinkers reduced theirs[57-59]—something that has been found in many countries around the world.[60] In our SA exploring the potential impact of this polarization, we find that this has a relatively small impact on our results. However, these changes in drinking have also been accompanied by a sharp increase in alcohol-specific deaths, which rose by 35.5% between 2019 and 2022 to their highest levels on record.[61] This suggests a greater need for effective interventions to address heavy alcohol use, in which digital interventions may have a valuable role to play.

Conclusions

This study demonstrates the potential for a large-scale rollout of the Drink Less app to improve population health, while reducing costs to the NHS and improving health inequalities. Both a one-off mass media awareness campaign and embedding the use of Drink Less within primary care are estimated to be health improving, cost saving, and reducing health inequalities. Embedding the use of apps in primary care is likely to have greater benefits than a mass media campaign to increase their uptake, although the initial costs may be greater before savings accrue in later years.

Author Disclosures

Author disclosure forms can be accessed below in the Supplemental Material section.

Supplemental Material

Supplementary data associated with this article can be found in the online version at https://doi.org/10.1016/j.jval.2024.11.007.

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REFERENCES

1. Murray CJL, Aravkin AY, Zheng P. Global burden of 87 risk factors in 204 countries and territories, 1990-2019: a systematic analysis for the Global Burden of Disease Study 2019. *Lancet*. 2020;396(10258):1223–1249.
2. The SAFER initiative. World Health Organization. https://www.who.int/initiatives/SAFER. Accessed December 20, 2023.
3. Kaner EF, Beyer FR, Muirhead C, et al. Effectiveness of brief alcohol interventions in primary care populations. *Cochrane Database Syst Rev*. 2018;2(2):CD004148.
4. 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;5:114.
5. Babor TF, Higgins-Biddle JC, Saunders JB, Monteiro MG. AUDIT: the Alcohol Use Disorders Identification Test : guidelines for use in primary health care. World Health Organization. https://apps.who.int/iris/handle/10665/67205. Accessed January 3, 2022.
6. Buss VH, Cox S, Moore G, et al. Alcohol and smoking brief interventions by socioeconomic position: a population-based, cross-sectional study in Great Britain. *BJGP Open*. 2023;7(4):BJGPO.2023.0087.
7. O'Donnell A, Angus C, Hanratty B, Hamilton FL, Petersen I, Kaner E. Impact of the introduction and withdrawal of financial incentives on the delivery of alcohol screening and brief advice in English primary health care: an interrupted time–series analysis. *Addiction*. 2020;115(1):49–60.
8. West R, Michie S. A Guide to Development and Evaluation of Digital Interventions in Healthcare. *Sutton*. United Kingdom: Silverback Publishing; 2016.
9. Beyer FR, Kenny RPW, Johnson E, et al. Practitioner and digitally delivered interventions for reducing hazardous and harmful alcohol consumption in people not seeking alcohol treatment: a systematic review and network meta-analysis. *Addiction*. 2023;118(1):17–29.
10. Perski O, Jackson SE, Garnett C, West R, Brown J. Trends in and factors associated with the adoption of digital aids for smoking cessation and alcohol reduction: a population survey in England. *Drug Alcohol Depend*. 2019;205:107653.
11. Peng W, Yuan S, Holtz BE. Exploring the challenges and opportunities of health mobile apps for individuals with type 2 diabetes living in rural communities. *Telemed E-Health*. 2016;22(9):733–738.
12. Pung A, Fletcher SL, Gunn JM. Mobile app use by primary care patients to manage their depressive symptoms: qualitative study. *J Med Internet Res*. 2018;20(9):e10035.
13. Garnett C, Perski O, Beard E, Michie S, West R, Brown J. The impact of celebrity influence and national media coverage on users of an alcohol reduction app: a natural experiment. *BMC Public Health*. 2021;21(1):30.
14. Peng W, Kanthawala S, Yuan S, Hussain SA. A qualitative study of user perceptions of mobile health apps. *BMC Public Health*. 2016;16(1):1158.
15. Perski O, Blandford A, Ubhi HK, West R, Michie S. Smokers' and drinkers' choice of smartphone applications and expectations of engagement: a think aloud and interview study. *BMC Med Inform Decis Mak*. 2017;17(1):25.
16. Szinay D, Jones A, Chadborn T, Brown J, Naughton F. Influences on the uptake of and engagement with health and well-being smartphone apps: systematic review. *J Med Internet Res*. 2020;22(5):e17572.
17. Langley TE, McNeill A, Lewis S, Szatkowski L, Quinn C. The impact of media campaigns on smoking cessation activity: a structural vector autoregression analysis. *Addiction*. 2012;107(11):2043–2050.
18. Bui QM, Huggins RM, Hwang WH, White V, Erbas B. A varying coefficient model to measure the effectiveness of mass media anti-smoking campaigns in generating calls to a quitline. *J Epidemiol*. 2010;20(6):473–479.
19. Garnett C, Crane D, West R, Brown J, Michie S. The development of Drink Less: an alcohol reduction smartphone app for excessive drinkers. *Transl Behav Med*. 2019;9(2):296–307.
20. Oldham M, Beard E, Loebenberg G, et al. Effectiveness of a smartphone app (Drink Less) versus usual digital care for reducing alcohol consumption among increasing-and-higher-risk adult drinkers in the UK: a two-arm, parallel-group, double-blind, randomised controlled trial. *EClinicalMedicine*. 2024;70:102534.
21. Kaner EF, Beyer FR, Garnett C, et al. Personalised digital interventions for reducing hazardous and harmful alcohol consumption in community-dwelling populations. *Cochrane Database Syst Rev*. 2017;9(9):CD011479.
22. Garnett C, Oldham M, Loebenberg G, et al. NIHR Journals Library PHR Synopsis NIHR135857: Evaluating the effectiveness of the Drink Less smartphone app for reducing alcohol consumption compared with usual digital care: a comprehensive synopsis from a six-month follow-up RCT (PHR NIHR127651). https://www.journalslibrary.nihr.ac.uk/phr; 2023. Accessed January 8, 2025.
23. Holmes J, Meng Y, Meier PS, et al. Effects of minimum unit pricing for alcohol on different income and socioeconomic groups: a modelling study. *Lancet*. 2014;383(9929):1655–1664.
24. Angus C, Holmes J, Pryce R, Meier PS, Brennan A. Model-based appraisal of the comparative impact of minimum unit pricing and taxation policies in Scotland: an adaptation of the Sheffield alcohol policy model version 3. University of Sheffield. https://www.sheffield.ac.uk/media/13073/download. Accessed May 5, 2021.
25. Angus C, Henney M. Modelling the impact of alcohol duty policies since 2012 in England & Scotland. University of Sheffield. https://www.sheffield.ac.uk/media/13068/download. Accessed April 5, 2021.
26. Meier PS, Holmes J, Angus C, Ally AK, Meng Y, Brennan A. Estimated effects of different alcohol taxation and price policies on health inequalities: a mathematical modelling study. *PLoS Med*. 2016;13(2):e1001963.
27. Angus C, Li J, Romero-Rodriguez E, Anderson P, Parrott S, Brennan A. Cost-effectiveness of strategies to improve delivery of brief interventions for heavy drinking in primary care: results from the ODHIN trial. *Eur J Public Health*. 2019;29(2):219–225.
28. Angus C, Gillespie D, Ally A, Brennan A. Modelling the impact of minimum unit price and identification and brief advice policies using the Sheffield alcohol policy model version 3. University of Sheffield. https://www.sheffield.ac.uk/media/13079/download. Accessed May 5, 2021.
29. Brennan A, Meier P, Purshouse R, et al. The Sheffield alcohol policy model–a mathematical description. *Health Econ*. 2015;24(10):1368–1388.
30. Cookson R, Griffin S, Norheim OF, Culyer AJ, eds. *Distributional Cost-Effectiveness Analysis: Quantifying Health Equity Impacts and Trade-Offs*. Oxford, United Kingdom: Oxford University Press; 2020.
31. Cookson R, Mirelman AJ, Griffin S, et al. Using cost-effectiveness analysis to address health equity concerns. *Value Health*. 2017;20(2):206–212.
32. Asaria M, Griffin S, Cookson R, Whyte S, Tappenden P. Distributional cost-effectiveness analysis of health care programmes – a methodological case study of the UK bowel cancer screening programme. *Health Econ*. 2015;24(6):742–754.
33. Discover major findings relating to Alcohol in England. Monthly tracking KPI. Alcohol in England. https://www.alcoholinengland.info/graphs/monthly-tracking-kpi. Accessed May 9, 2023.
34. Schillo BA, Mowery A, Greenseid LO, et al. The relation between media promotions and service volume for a statewide tobacco quitline and a web-based cessation program. *BMC Public Health*. 2011;11(1):939.
35. Jones KC, Weatherly H, Birch S, et al. *Unit Costs of Health and Social Care 2023 Manual*. Technical report. Kent, UK: Personal Social Services Research Unit (University of Kent) & Centre for Health Economics (University of York); 2024. https://doi.org/10.22024/UniKent/01.02.105685.
36. Angus C, Scafato E, Ghirini S, et al. Cost-effectiveness of a programme of screening and brief interventions for alcohol in primary care in Italy. *BMC Fam Pract*. 2014;15(1):26.
37. Angus C, Henney M, Webster L, Gillespie D. *Alcohol-Attributable Diseases and Dose-Response Curves for the Sheffield Alcohol Policy Model Version 4.0.*. 2019. https://doi.org/10.15131/shef.data.6819689.v2.
38. Fleming MF, Mundt MP, French MT, Manwell LB, Stauffacher EA, Barry KL. Brief physician advice for problem drinkers: long-term efficacy and benefit-cost analysis. *Alcohol Clin Exp Res*. 2002;26(1):36–43.
39. Holmes J, Meier PS, Booth A, Guo Y, Brennan A. The temporal relationship between per capita alcohol consumption and harm: a systematic review of time lag specifications in aggregate time series analyses. *Drug Alcohol Depend*. 2012;123(1):7–14.
40. NICE health technology evaluations: the manual. National Institute for Health and Care Excellence. https://www.nice.org.uk/process/pmg36/resources/nice-health-technology-evaluations-the-manual-pdf-72286779244741. Accessed December 7, 2024.
41. 7 Assessing cost effectiveness | The guidelines manual. National Institute for Health and Care Excellence. https://www.nice.org.uk/process/pmg6/chapter/assessing-cost-effectiveness. Accessed July 12, 2024.
42. Consumer price inflation time series. Office for National Statistics. https://www.ons.gov.uk/economy/inflationandpriceindices/datasets/consumerpriceindices. Accessed January 12, 2023.
43. English indices of deprivation. *Ministry of Housing*. Communities & Local Government; 2019. https://www.gov.uk/government/statistics/english-indices-of-deprivation-2019. Accessed December 16, 2021.
44. Love-Koh J, Schneider P, McNamara S, Doran T, Gutacker N. Decomposition of quality-adjusted life expectancy inequalities by mortality and health-related quality of life dimensions. *Pharmacoeconomics*. 2023;41(7):831–841.
45. Love-Koh J, Cookson R, Claxton K, Griffin S. Estimating social variation in the health effects of changes in health care expenditure. *Med Decis Making*. 2020;40(2):170–182.
46. Asaria M, Griffin S, Cookson R. Distributional cost-effectiveness analysis: a tutorial. *Med Decis Making*. 2016;36(1):8–19.
47. Robson M, Asaria M, Cookson R, Tsuchiya A, Ali S. Eliciting the level of health inequality aversion in England. *Health Econ*. 2017;26(10):1328–1334.
48. Beard E, Shahab L, Brown J. UCL modelling of recommendations for the Tobacco Control Plan. https://osf.io/6hkpv/. Accessed July 10, 2023.
49. Griffin S, Love-Koh J, Pennington B, Owen L. Evaluation of intervention impact on health inequality for resource allocation. *Med Decis Making*. 2019;39(3):171–182.
50. Yang F, Angus C, Duarte A, Gillespie D, Walker S, Griffin S. Impact of socioeconomic differences on distributional cost-effectiveness analysis. *Med Decis Making*. 2020;40(5):606–618.

51. McAuley A, Denny C, Taulbut M, et al. Informing investment to reduce inequalities: a modelling approach. *PLoS One*. 2016;11(8):e0159256.
52. Rosário F, Santos MI, Angus K, Pas L, Ribeiro C, Fitzgerald N. Factors influencing the implementation of screening and brief interventions for alcohol use in primary care practices: a systematic review using the COM-B system and Theoretical Domains Framework. *Implement Sci*. 2021;16(1):6.
53. Meier PS, Meng Y, Holmes J, et al. Adjusting for unrecorded consumption in survey and per capita sales data: quantification of impact on gender- and age-specific alcohol-attributable fractions for oral and pharyngeal cancers in Great Britain. *Alcohol Alcohol*. 2013;48(2):241–249.
54. Brown J, Michie S, Geraghty AWA, et al. Internet-based intervention for smoking cessation (StopAdvisor) in people with low and high socioeconomic status: a randomised controlled trial. *Lancet Respir Med*. 2014;2(12):997–1006.
55. West R, May S, West M, Croghan E, McEwen A. Performance of English stop smoking services in first 10 years: analysis of service monitoring data. *BMJ*. 2013;347:f4921.
56. Rappange DR, van Baal PHM, van Exel NJA, Feenstra TL, Rutten FFH, Brouwer WBF. Unrelated medical costs in life-years gained. *Pharmacoeconomics*. 2008;26(10):815–830.
57. Angus C, Henney M, Pryce R. *Modelling the Impact of Changes in Alcohol Consumption During the COVID-19 Pandemic on Future Alcohol-Related Harm in England*. Sheffield: The University of Sheffield; 2022. https://doi.org/10.15131/shef.data.19597249.v1.
58. Angus C, Morris D, Leeming G, et al. *New Modelling of Alcohol Pricing Policies, Alcohol Consumption and Harm in Scotland: an Adaptation of the Sheffield Tobacco and Alcohol Policy Model*. Sheffield: University of Sheffield; 2023. https://doi.org/10.15131/shef.data.21931386.
59. Jackson SE, Garnett C, Shahab L, Oldham M, Brown J. Association of the COVID-19 lockdown with smoking, drinking and attempts to quit in England: an analysis of 2019-20 data. *Addiction*. 2021;116(5):1233–1244.
60. Acuff SF, Strickland JC, Tucker JA, Murphy JG. Changes in alcohol use during COVID-19 and associations with contextual and individual difference variables: a systematic review and meta-analysis. *Psychol Addict Behav*. 2022;36(1):1–19.
61. Alcohol-specific deaths in the UK. Office for National Statistics. https://www.ons.gov.uk/peoplepopulationandcommunity/birthsdeathsandmarriages/deaths/bulletins/alcoholspecificdeathsintheuk/2021registrations. Accessed January 12, 2023.