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Health Inequalities Tool for Scotland

Modelling the impact of interventions on health inequalities: a commentary

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Contents

Executive summary

- The Health Inequalities Tool for Scotland provides new insights into the potential impact of NHS smoking cessation services, alcohol brief interventions and Counterweight (an intervention to reduce body mass index) on overall population health and health inequalities.[a] These interventions were chosen because evidence of their effectiveness was available.

- For individuals at risk, the benefits of stopping smoking, reducing their alcohol intake and reducing their weight is not in doubt. This tool is instead concerned with the health inequalities impact of specific interventions which seek to modify these health behaviours.

- This commentary presents illustrative results and considers findings from the tool that have important implications for tackling health inequalities in Scotland.

- The tool has limited scope, is based on various assumptions and uses methods and input data that have important limitations; results should be interpreted accordingly.

- The tool models the impact of the interventions over a one-year period. The impact of successful interventions will continue to accumulate over a longer period of time as long as the health behaviour changes concerned are sustained. Likewise, the impact on the population will accumulate if the investment was repeated annually over a longer time period, if there remains an at-risk population to reach. However, the tool does not model a time lag between intervention and benefit, and assumes that the benefit is sustained. The tool therefore presents an optimistic impact of the interventions over a one-year period.

- For all the interventions we modelled, the impact on health inequalities and overall population health was modest, and was not sensitive to changes in the key assumptions. However, the interventions did all produce improvements in life expectancy and a reduction in the number of hospital admissions.

- Effective targeting of the modelled interventions to the most deprived population groups was necessary to maximise their impact on health inequalities. However, targeting is difficult to achieve in practice and, even if it were to be achieved, the impact on health inequalities remains small.

- Of the three interventions modelled, the results suggest that alcohol brief interventions offer the best return on investment in terms of increasing life expectancy, preventing hospital admissions and reducing health inequalities. This observation may reflect differences and limitations in the data used to model each intervention.

- The modest impacts of the modelled interventions may be because they are examples of service responses to problems rather than interventions which change the social determinants of health and health inequalities. Action on the determinants of health inequalities and universal interventions that are not dependent on individual choices are more likely to make a substantial difference.

[a] Some authors use inequalities to denote differences between groups and inequities to denote unjust differences between groups, but this distinction is not consistently applied across the literature. The more commonly used term ‘inequality’ has been adopted throughout this report to describe unjust differences.

Overview

The Health Inequalities Tool for Scotland (HITS) is a numerical model of the impact of three interventions on health and health inequalities. It was developed for the Scottish Government by the Scottish Public Health Observatory (ScotPHO) and updates a previous HITS intervention tool published in 2009.

The objectives of this work are to:

- Provide practical tools allowing users to compare the impact of public health interventions on population health and health inequalities in a range of different scenarios.
- Show current expenditure and allow modelling of costs required to achieve particular outcomes.

The current suite of tools allows users to model three different interventions:

- NHS smoking cessation services
- Alcohol brief interventions
- Counterweight (an intervention programme to reduce body mass index (BMI))

For each intervention, the tool applies user-defined data (relating to the population of interest, reach/coverage of the intervention and number of interventions) to estimate the impact across a range of population health and health inequalities outcomes. It also allows users to model the impact of the intervention for their local population.

Since the modelled interventions are already being used in Scotland to some extent, the Health Inequalities Tool is designed to inform decision-makers about the likely impact of a change in either the number of interventions, or the composition of the populations which take up the interventions. They do this by comparing the impact of modelled scenarios with a pre-specified baseline scenario reflecting current practice. This means that maintaining existing levels of investment is required to maintain existing health outcomes; if the modelled scenario represents disinvestment (i.e. fewer interventions being carried out) a negative impact may be observed.

A key feature of the tools is that they allow users to specify whether they wish to target the intervention by deprivation, and to which Scottish Index of Multiple Deprivation (SIMD)[b] deprivation quintiles. It is well recognised that targeting of interventions which require some individual agency is challenging, and to illustrate this the tool allows users to model 'partial' targeting in which uptake of the intervention extends beyond the intended target group.

This commentary includes an overview of the approach used in creating the Health Inequalities Tool for Scotland, some illustrative results and a discussion of the broader learning about how best to reduce health inequalities.

[b] The Scottish Index of Multiple Deprivation (SIMD) uses routine administrative data relating to income, employment, health, education, skills and training, housing, geographic access and crime to rank small geographical areas in Scotland. Further details are available at **www.scotland.gov.uk/Topics/Statistics/SIMD**

It is important that those using this tool understand the numerous limitations to the work. These arise because of: the limited range and number of interventions included within the tool; the limited numbers of health outcomes modelled; the limited time (one year) in which impacts are modelled to occur; the large number of assumptions which are required to model the impact on mortality (as a common important outcome measure); the limited data which are available for modelling; and the likelihood of competing causes of mortality reducing the overall impact on health inequalities. A particularly important consideration is the length of time that the effect of an intervention persists; clearly if the health behaviour changes achieved through delivery of the modelled interventions persist for life the long-term benefits will be far greater than if they are transient. In addition, the tool only considers the cost of intervention delivery in relation to health outcomes; it does not constitute a full cost-benefit analysis.

We are aware that the current financial constraints placed on the public sector in Scotland means that difficult decisions are being made about which interventions and services to fund. Often these, decisions are taken without the benefit of good evidence or data. In recognition of the difficulties faced by those tasked to reduce health inequalities, we sought to support decision-making by providing a tool which could be used to explore which interventions, implemented in what way, would be most likely to make a positive contribution. Although at present the Health Inequalities Tool for Scotland (HITS) is very limited in its scope, we hope that it makes some contribution and that it will be useful for decision-makers within the Scottish Government, local Health Boards and Community Planning Partnerships (CPPs).

We intend to add a wider range of interventions to the HITS tool as part of a Chief Scientist's Office (CSO) funded follow-up project which will report in the latter half of 2013.

Introduction

Substantial health inequalities are evident in Scotland, and the strikingly unequal health outcomes that arise from differences in socio-economic status have been well characterised.[1,2]

A recognition that such health inequalities are unfair and unjust has led to health inequalities being afforded a high priority for action across the Scottish Government, the NHS and other delivery organisations. *Equally Well*, the 2008 Report of the Ministerial Task Force on Health Inequalities, stated that 'reducing inequalities in health is critical to achieving the Scottish Government's aim of making Scotland a better, healthier place for everyone'.[3] This policy focus provides a clear impetus for action to be taken at national and local level to reduce health inequalities. However, ongoing efforts are undermined by a paucity of information about which interventions work best in practice to reduce health inequalities. Such information is urgently needed to guide decisions about how scarce resources can best be directed.[4,5]

Interventions designed to tackle health inequalities can be described as 'upstream' or 'downstream' though, in reality, there is a continuum between the two. Upstream interventions act on the social determinants of health, or act to create a healthier environment or culture (e.g. legislation on smoking in public places). Downstream interventions seek to address an existing health problem or risk factor (e.g. smoking cessation services). Another key distinction is whether an intervention is applied at a whole population level (e.g. alcohol minimum unit pricing) or at the individual level (e.g. alcohol brief interventions). These characteristics have a huge influence on the potential of an intervention to reduce health inequalities.[6]

Although the overall impact on the health of the population and the impact on health inequalities are very important in making investment decisions, we recognise that they are not the only factors which need to be considered. The cost of the intervention, the capacity to deliver, public and political opinion and the opportunity costs may be as or more important. However, it is important that the potential impact of interventions is part of that process and this tool aims to contribute in that domain.

This commentary aims to provide an illustration of the impacts of the interventions on the overall health of the Scottish population and on health inequalities within Scotland. In doing so, learning about the scale of intervention required to reduce inequalities and the advantages and disadvantages of differing implementation strategies will be highlighted.

Methods

The Health Inequalities Tool for Scotland (HITS) is based on a series of spreadsheets, one for each intervention modelled. This approach was adopted as it is more flexible and more transparent than a web-based tool, and enables users to see and, if necessary, modify all inputs and assumptions.

Each tool takes the form of a static arithmetic model which uses the best available data on population demographics, prevalence of health behaviours, effectiveness of interventions and health impacts, to calculate the potential outcomes of a specified level of intervention. Information on the data and assumptions underlying the tool are made explicit, and guidance is provided on the appropriate interpretation of results. Users are asked to specify: the population of interest; baseline throughput (the number currently receiving the intervention); and 'modelled' throughput or investment. The outputs compare scenarios in terms of costs, life expectancy and intermediate outcomes.

For modelling purposes, it is necessary to make a number of assumptions about how the available information applies to the scenario being modelled. To assist interpretation, the sources of the data used and assumptions made in the models have been made as explicit as possible throughout the tools and accompanying documentation. Data were drawn from routine administrative sources in Scotland and from the scientific literature. The most robust data available, as identified and appraised by the HITS project team, have been used to inform the tools. However, there are limitations to the data and significant gaps exist which have necessitated some extrapolations from alternative sources. The assumptions underlying the tools and the boundaries of data availability and quality are important limitations of this work, and consideration of both is crucial to interpretation of the outputs. Full details of the modelled interventions are given in the HITS spreadsheets and are summarised in Table 1.

Table 1 – Overview of modelled interventions

	NHS smoking cessation services	Alcohol brief interventions	Counterweight
Brief description	NHS smoking cessation services in Scotland comprise a variety of interventions offered in a primary care or pharmacy setting to support smokers to quit.	Alcohol brief interventions (ABIs) are short, evidence-based, structured conversations about alcohol consumption with a patient/service user that seek to motivate and support the individual to reduce their risk of harm.	Counterweight is a programme of interventions for reducing body mass index (BMI).
Current use in Scotland	Widely used and promoted through routine practice (108,269 interventions were delivered in 2011).	ABIs are being delivered through routine practice across Scotland, driven by HEAT targets (97,830 interventions were carried out in 2011/12).	Counterweight is currently being rolled out in Scotland, following introduction as part of the Keep Well health check programme. More than 6,000 interventions have been carried out in Scotland to date.
Definition of a 'successful' intervention	Smoking cessation maintained at 12-month follow-up.	A decrease in weekly alcohol consumption at follow-up, assumed to be about 4.75 units on average.	A reduction in BMI at 12-month follow-up, assumed to be 1.36kg/m2 on average.

The Health Inequalities Tool for Scotland requires users to specify the average cost per person of delivering an intervention. This approach is intended to ensure that current local costs are used to inform modelling wherever possible, and that careful consideration is given to cost inputs, particularly where comparisons are being made between interventions. The cost estimates shown in Table 2 are used throughout this commentary and have considerable influence on the findings. They are based on current information on costs at a national level as of August 2012, but are not necessarily robust and are subject to change over time.

Table 2 – Estimated costs per individual intervention delivered

Intervention	Estimated cost	Reference
NHS smoking cessation services	£98	Evaluation of quit4u, NHS Health Scotland 2012 (available at **www.healthscotland.com/documents/5827.aspx**)
Alcohol brief interventions	£25	Approximation, based on NICE public health guidance #24, 2010.
Counterweight	£72	Counterweight Project Team, personal communication.

The Health Inequalities Tool for Scotland (HITS) enables users to model the delivery of interventions at national level or for local Health Boards, local authorities and Community Health Partnerships. For illustrative purposes, this commentary presents modelled results for the whole of Scotland, comparing different levels of investment and different targeting strategies in terms of their potential impact on both population health and health inequalities. To explore the influence of key inputs and assumptions on the modelled results, a series of sensitivity analyses were run using smoking cessation services as an exemplar. These examined the influence of the following factors: cost; success rate of intervention; and impact of a successful intervention on an individual's health.

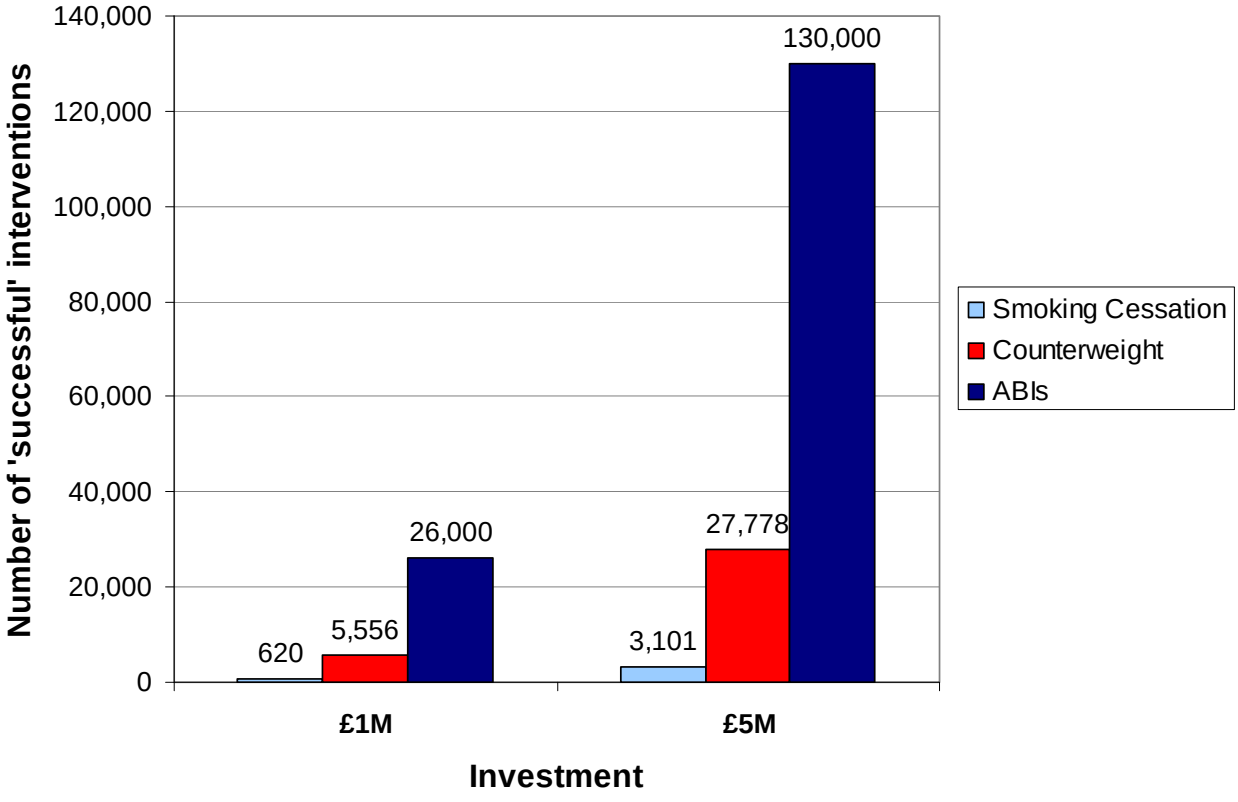
Results

Additional investment without targeting of interventions

Modelling the anticipated outcomes resulting from the same fixed level of investment generates the fairest comparisons between the three interventions. The following results describe the modelled impact of investing up to £5 million at a national level, based on the above estimated costs for delivering a single intervention. All results assume a baseline of zero interventions being delivered; this is not intended to represent a realistic baseline scenario (as would be done in the normal course of using the tool) but is used to generate valid comparisons between interventions. These illustrations assume that the distribution of interventions delivered is proportional to eligibility (i.e. related to risk factor status) and not otherwise targeted towards specific population groups.

Figure 1 shows the stark differences in the number of 'successful' interventions per unit investment. Clearly, ABIs generate the most 'successful' interventions and smoking cessation the least number per unit cost.

Figure 1 – Modelled number of 'successful' interventions per year for investment of £1m and £5m



The modelled impact of interventions on life expectancy across the whole population is shown in Figure 2. The suite of tools suggests that alcohol brief interventions are the best-performing intervention for this particular outcome; as can be seen from Figure 1, this is largely due to the much larger number of successful interventions delivered for a fixed investment. It is important that the tool assumes that the beneficial impacts of a successful intervention occur within one year (and therefore represents an optimistic view of the

impact), but also assumes that the intervention is only implemented for a single year and is not part of an ongoing investment programme.

Another striking observation from Figure 2 is that for all interventions, the modelled impact on life expectancy is modest; less than a month even for a £5 million investment in ABIs and only 1–2 days for a £1 million investment in smoking cessation or Counterweight. Measuring the number of deaths prevented per year offers an alternative mortality outcome against which to assess impact; this ranges from two to five for a £1 million investment in smoking cessation or Counterweight to over 100 for a £5 million investment in ABIs.

Figure 2 – Modelled gain in life expectancy

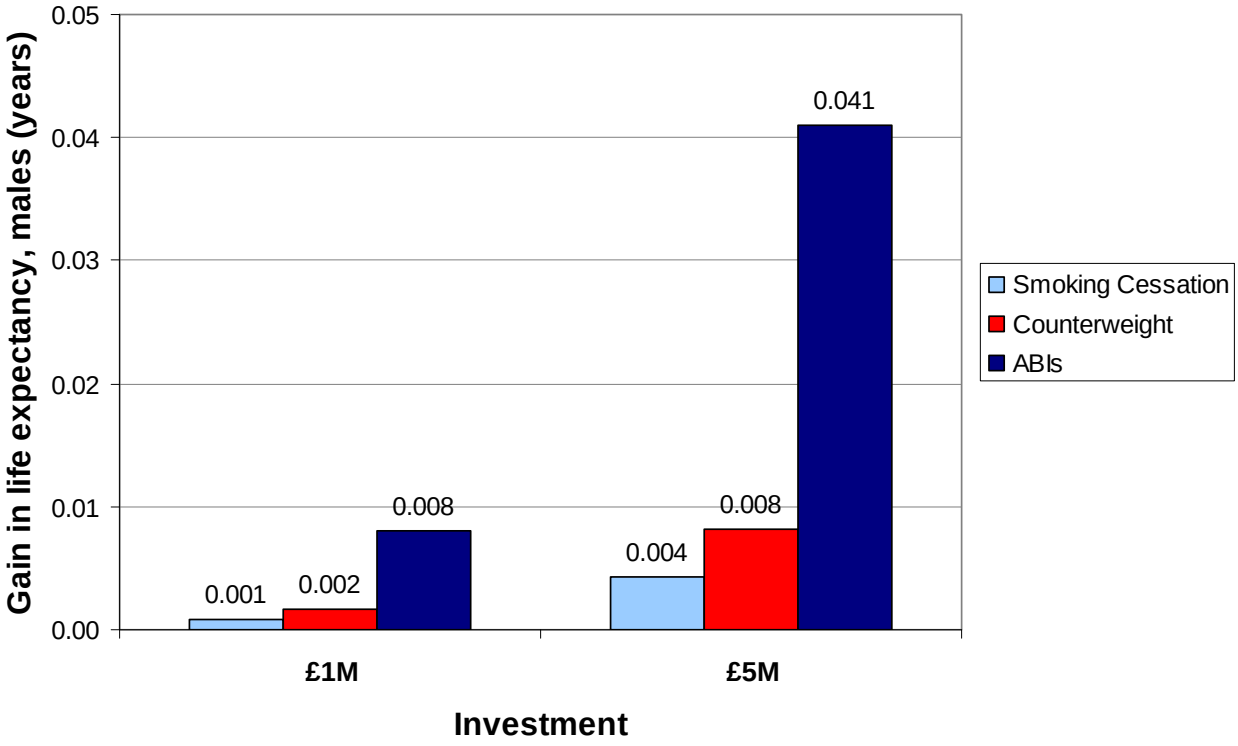
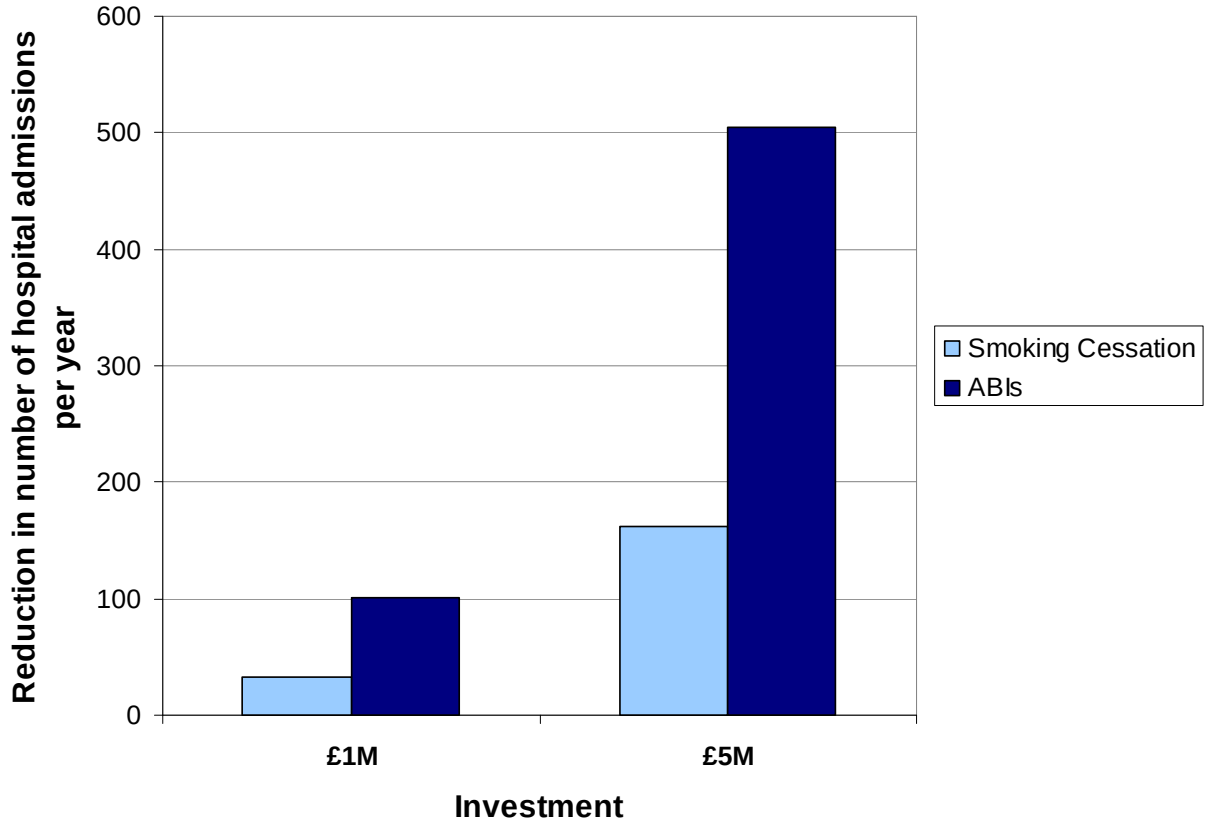


Figure 3 shows the modelled impact of ABIs and NHS smoking cessation services on hospital admissions (this outcome could not be modelled for Counterweight). As with mortality outcomes, a major part of the differential results is accounted for by the larger number of successful ABIs delivered per specified investment. Key assumptions about the effect of stopping smoking or reducing alcohol consumption also apply.

Figure 3 – Modelled reduction in the number of hospital admissions per year



In the above scenario, where the distribution of interventions delivered is 'proportional to eligibility', the distribution of health benefits by Scottish Index of Multiple Deprivation (SIMD) quintile will vary in accordance with four main factors: (i) distribution of eligibility (risk factor status), (ii) differences in health outcomes, (iii) differences in success rate of interventions, and (iv) differences in the impact of interventions. Although there is potential for interventions to have different success rates and impact depending on an individual's SIMD group, there are no robust data available to support such variations within the HITS models. Accordingly, the modelled distribution of health benefits only varies in accordance with eligibility and pre-existing distribution of outcomes. Put simply, these assumptions mean that a reduction in inequalities will only be seen where more individuals in deprived groups are eligible for the intervention, or where negative health outcomes cluster in deprived groups. Unless these effects are very marked, only small effects on health inequalities would be anticipated (particularly given the modest effect on population health described above).

A measure of the percentage change in the life expectancy gaps between the most and the least deprived quintiles facilitates an assessment of the capacity of the three interventions to reduce health inequalities in the absence of targeting. Table 3 shows the headline results, based on a £1 million investment.

Table 3 – Change in life expectancy gap between most and least deprived quintiles arising for a £1 million investment

	NHS smoking cessation services	Counterweight	Alcohol brief interventions
Change in life expectancy gap, males (years)	-0.01%	-0.01%	-0.04%
Change in life expectancy gap, females (years)	-0.02%	-0.02%	-0.01%

The largest modelled change occurs in the male life expectancy gap following investment in ABIs. This is because both excessive alcohol consumption and alcohol-related deaths are strongly patterned by SIMD in males, with the latter association being particularly strong. In absolute terms this change in the life expectancy gap represents around 13 deaths being prevented per year in the most deprived quintile by this level of investment in ABIs, more than a third of the total number of deaths prevented.

However, the most striking feature of the results in Table 3 is the very small scale of the changes. Further, a crucial issue here is that delivery of interventions 'proportional to eligibility' is itself only an assumption; in practice it is likely that people from more affluent population groups will be more likely to benefit from an intervention being made available. Such an effect would exacerbate health inequalities. This issue is well recognised as a major risk of interventions delivered at the individual level, and is discussed further later on. Overall, it is likely that the results in Table 3 represent a highly optimistic prediction of the impact of these three interventions on health inequalities in the absence of targeting, with an exacerbation of health inequalities being a more plausible result.

Additional investment with targeting to the most deprived quintile

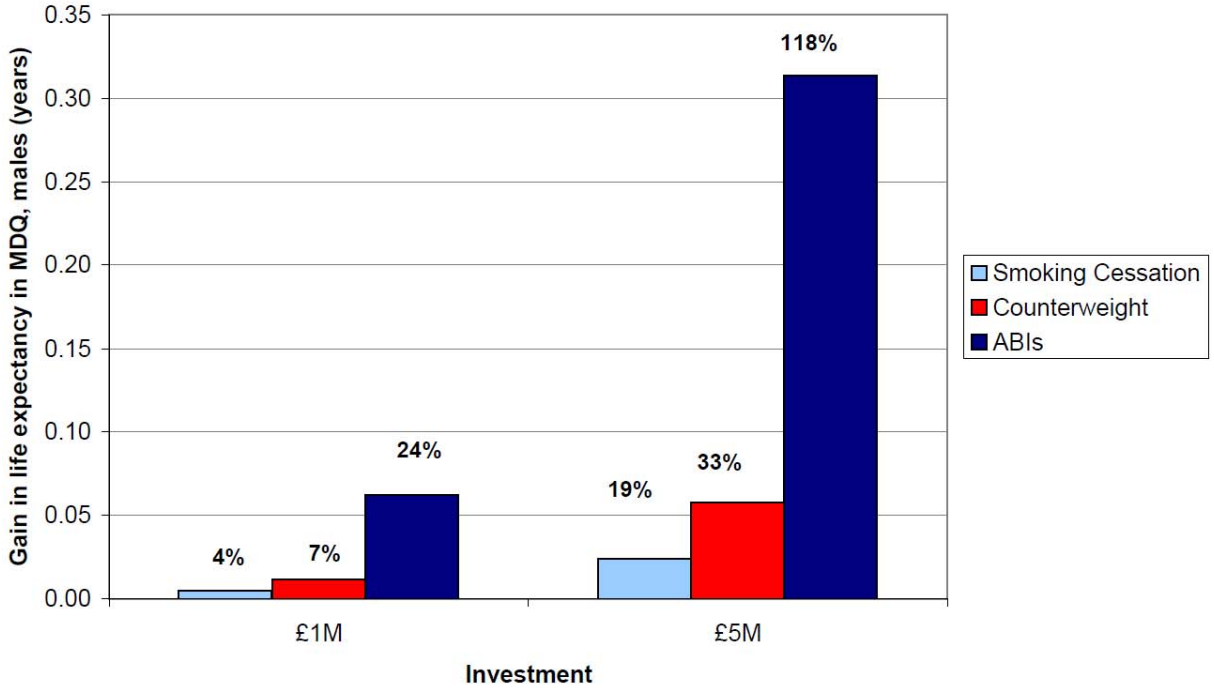
As illustrated above, the HITS models suggest that, in the absence of targeting, the impact of these interventions on health inequalities will be very small at best, and negative at worst. Targeting is, therefore, an essential element of any attempt to reduce health inequalities using interventions that are delivered at the individual level. The HITS tool enables users to study the effect of targeting on the basis of SIMD quintile. The following illustration considers, for each intervention, a £1 million and £5 million investment against a baseline of no intervention, with all interventions targeted to quintile 1 (the most deprived quintile). The absolute impact on life expectancy and hospital admissions in the most deprived quintile are shown in Figures 4 and 5 respectively, and the change in the life expectancy gap resulting from a £2 million investment is shown in Table 4.

Figure 4 shows that the modelled gain in life expectancy in the most deprived quintile is estimated to be greatest following investment in ABIs. However, this disregards another issue that becomes particularly important when interventions are being targeted; namely, the recruitment rate required. For all interventions, the proportion of eligible individuals that needs to be recruited under high levels of investment is considerable. This is a particular problem for ABIs in this illustration, where investing £5 million in ABIs and targeting the most deprived quintile is not feasible as it would require more eligible individuals than exist in that group; these data are therefore not shown. Well before that point, recruitment is likely to be difficult, since some individuals will be difficult to recruit or will refuse to

participate. For this reason the HITS models flag up recruitment rates greater than 25% as being potentially problematic.

The relatively high number of hospital admissions prevented following delivery of ABIs partly results from the fact that alcohol-related admissions are very strongly associated with deprivation, to a greater extent than smoking-related admissions.

Figure 4 – Modelled gain in life expectancy following targeting of investment to most deprived quintile (MDQ) and the proportion of the eligible population required to go through intervention (%)



As Figure 4 demonstrates, the modelled gain in life expectancy is not achievable since a £5 million intervention in ABIs targeted to the most deprived quintile would require more than 100% of the eligible population to go through the intervention. However, as discussed later, recruitment is likely to become challenging well before the required rate reaches the maximum.

Figure 5 – Modelled reduction in the number of hospital admissions following targeting of investment to most deprived quintile

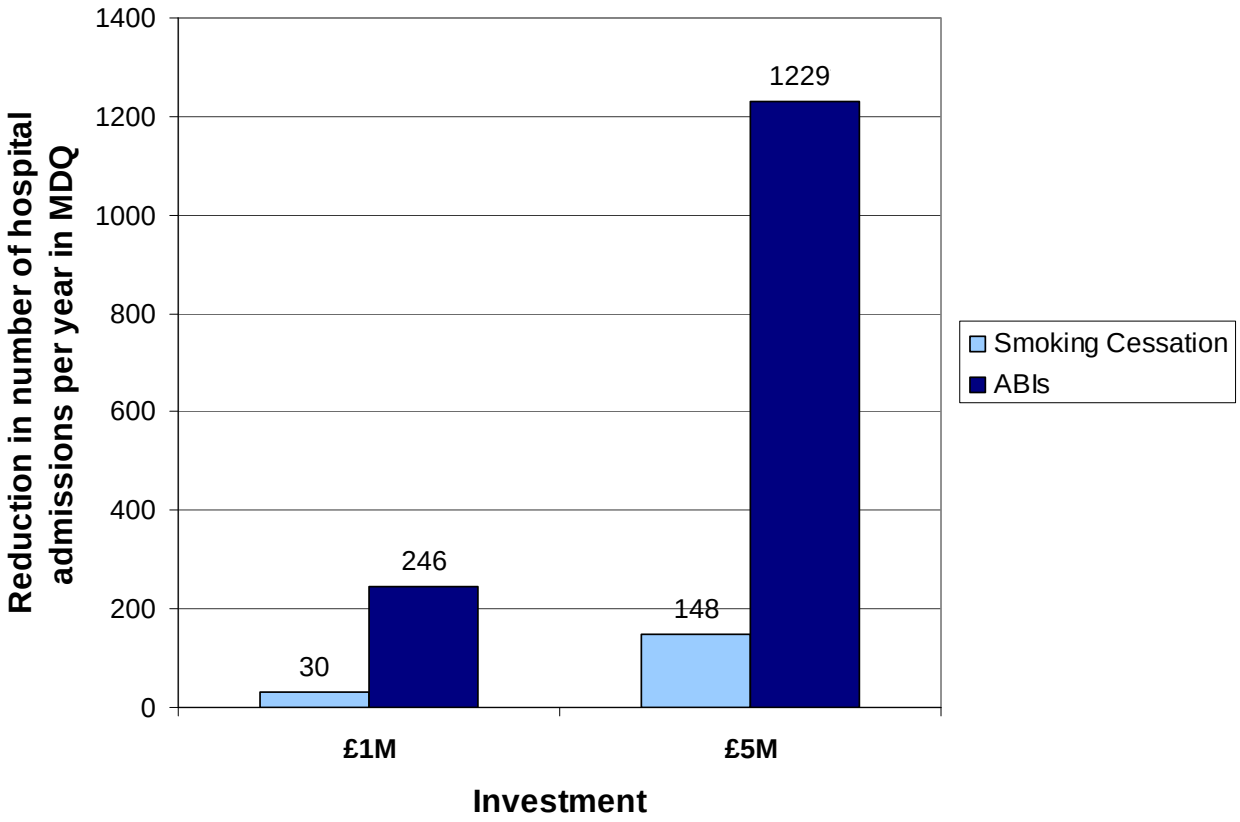


Table 4 shows the change in the life expectancy gap between the most deprived quintile and the least deprived quintile following a £1 million investment targeted to the most deprived quintile.

Table 4 – Change in life expectancy gap, £1 million investment targeted to most deprived quintile

	NHS smoking cessation services	Counterweight	Alcohol brief interventions
Change in life expectancy gap, males (years)	-0.04%	-0.10%	-0.57%
Change in life expectancy gap, females (years)	-0.06%	-0.13%	-0.31%

Comparison between Tables 3 and 4 demonstrates the value of targeting for tackling health inequalities using individual-based interventions.

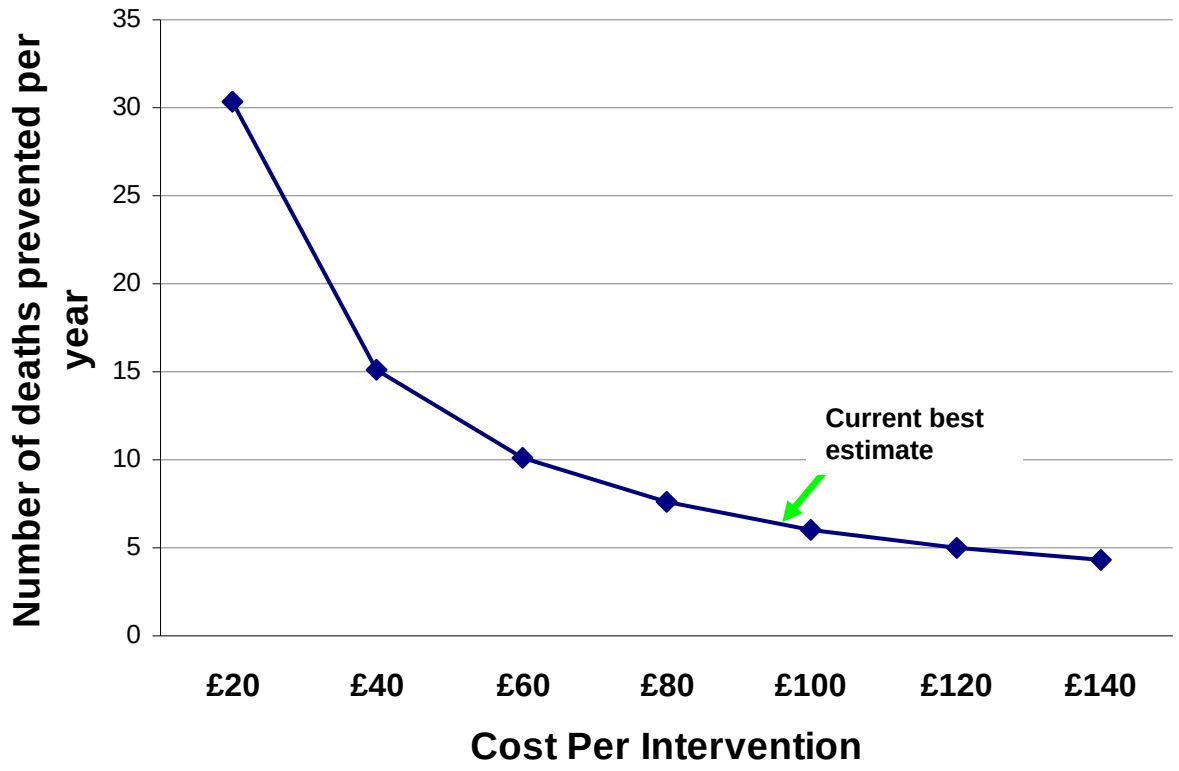
Sensitivity of the model to variations in the key assumptions

The main factors that influence the impact of interventions on population health are considered below in the form of sensitivity analyses and discussion, using the example of NHS smoking cessation services. When considering health inequalities, the variation of each of these factors by deprivation group also becomes crucial.

1. Cost

This commentary uses an estimated cost per NHS smoking cessation services intervention of £98 for illustration. The effect of varying this assumption on number of deaths prevented per year is shown in Figure 6.

Figure 6 – Number of deaths prevented per year following £2 million new investment in NHS smoking cessation services, according to individual cost of intervention

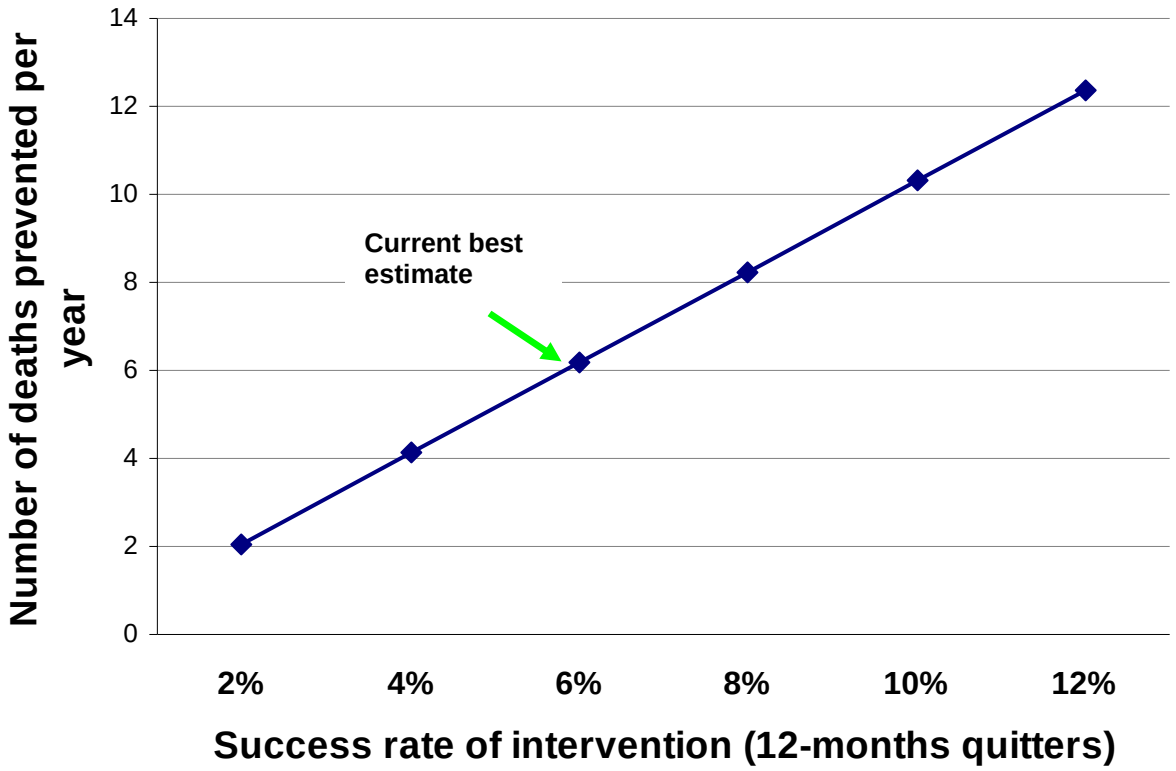


As expected, the cost of an intervention changes the population health impact of a fixed level of investment. However, a very large decline in the mean cost per intervention is required to substantially change the health outcomes.

2. Success rate

For NHS smoking cessation services, the success rate is defined as being a non-smoker after 12 months and is estimated, based on available follow-up data from the Scottish smoking cessation database, to be 6% of those who go through the service. The influence of the success rate on number of deaths prevented per year is shown in Figure 7.

Figure 7 – Number of deaths prevented per year following £2 million new investment in NHS smoking cessation services, according to success rate of intervention



3. Impact of a successful intervention on health outcomes

The impact of quitting smoking on numbers of deaths prevented depends on the change in mortality rate, which in turn depends on (i) the relative risk of death for smokers versus non-smokers and (ii) the relative risk of death for ex-smokers (i.e. successful interventions) versus non-smokers. The estimates used by the HITS model are 2.19 and 1.31 respectively. Figures 8 and 9 show how varying these estimates affect the predicted number of deaths prevented.

Figure 8 – Sensitivity of the number of deaths prevented per year by investment of £2 million in smoking cessation services to variation in the relative risk of death of current smokers to non-smokers

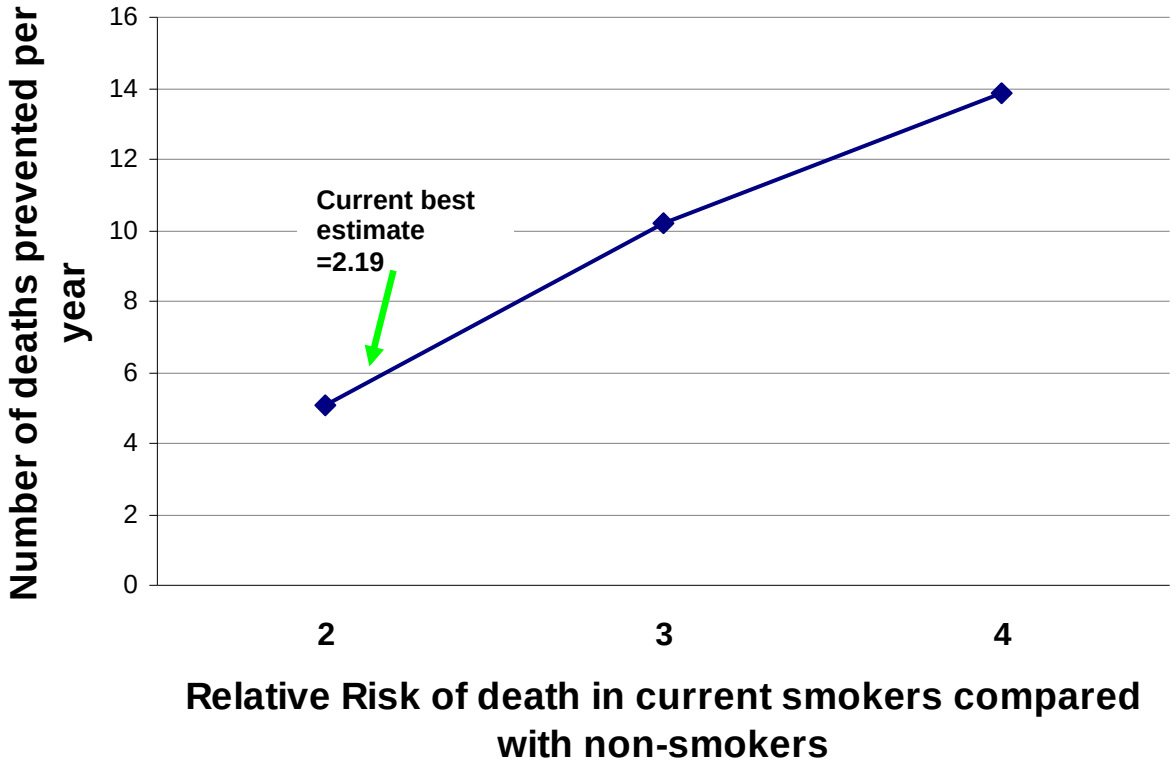
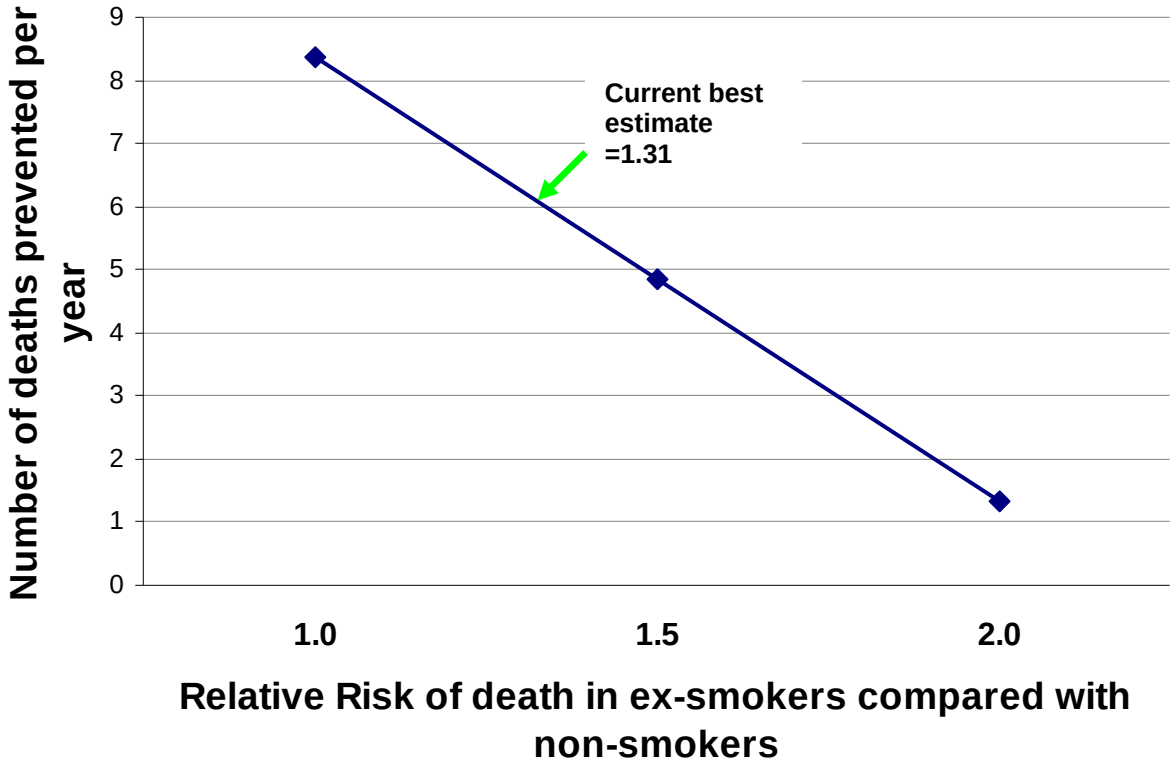


Figure 9 – Sensitivity of the number of deaths prevented per year by investment of £2 million in smoking cessation services to variation in the relative risk of death of ex-smokers to non-smokers



4. Combination of favourable estimates

The maximum plausible impact of NHS smoking cessation services on population health outcomes according to the HITS model can be illustrated by modelling the same scenario (£2 million new investment) using the most optimistic assumptions (Table 5).

Table 5 – Parameters for the most optimistic sensitivity analysis

Parameter	Default estimate	Parameters for most optimistic sensitivity analysis
Success rate	6%	10%
Relative risk of death in smokers	2.19	3.0
Relative risk of death in ex-smokers	1.31	1.0
Cost per intervention	£98	£50

Under this highly optimistic scenario, the modelled results indicate that £2 million additional investment would produce a gain in life expectancy for males of 0.01 years, 40 deaths prevented per year, and 212 hospital admissions saved per year. This is a substantial improvement on outcomes estimated using default estimates, but it is clear that the impact on population health remains modest. This modest impact on overall population health is similar for ABIs and Counterweight.

Key factors influencing impact of interventions on health inequalities

The above results suggest that the overall capacity for the selected interventions to improve health at the population level is modest, and this inevitably has a bearing on the magnitude of the impact that they can have on health inequalities. In relative terms, the capacity of the interventions to reduce rather than exacerbate inequalities depends largely on the distribution of intervention delivery, i.e. the extent to which the intervention reaches deprived population groups compared with the rest of the population. The HITS models allow modelling of various targeting strategies. The differential impact on the life expectancy gap between the most and least deprived quintile is shown in Figure 10. Again, NHS smoking cessation services is used as an example, with a new investment of £2 million at Scotland level and all other inputs at default values.

Figure 10 – Sensitivity of the modelled reduction in life expectancy gap (females) between the most and least deprived quintiles to a change in the targeting strategy of smoking cessation services

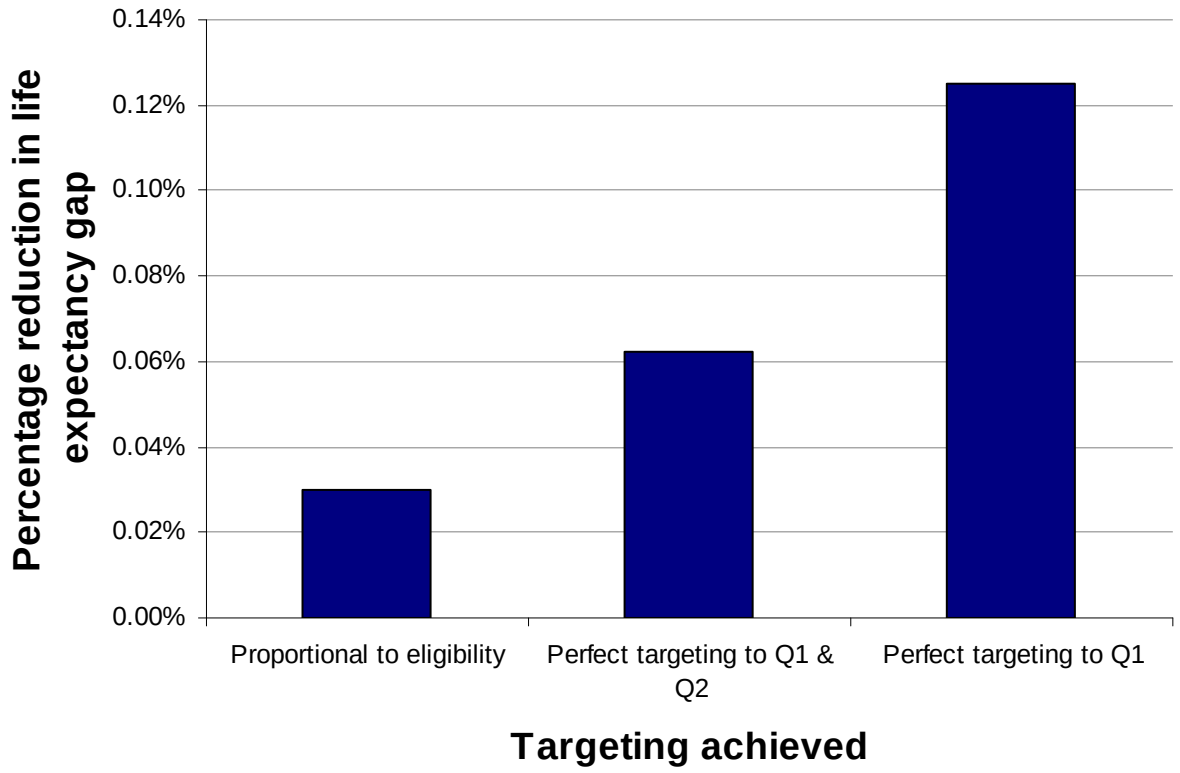


Figure 10 illustrates the value of targeting, but two points are of particular note.

Firstly, even perfect targeting results in a very small reduction in the life expectancy gap. This is perhaps not unexpected as smoking is only one factor that contributes to the gap in life expectancy, and smoking cessation services result in a health benefit for only a small proportion of the population.

Secondly, the results shown in Figure 10 assume that all SIMD quintiles will receive the intervention equally in the absence of targeting and that perfect targeting can be achieved in practice; both assumptions are implausible.

Discussion

Key findings

The above illustrations show the value of the Health Inequalities Tool for understanding the potential for selected interventions to influence health inequalities. For all modelled interventions, the tool suggests that this potential is modest and, although there are significant assumptions and data limitations behind the tools, the results of a simple sensitivity analysis indicate that this remains the case even under highly optimistic assumptions. The reason for the modest effect size is twofold. First, the interventions may have only small capacity for improving population health and, second, the targeting of intervention to more deprived population groups that is required for optimum impact on inequalities is unlikely to be achieved in practice.

Limitations of modelling

The numerous limitations to the work noted in the overview sections are crucial considerations for the use of the tools and interpretation of the findings. These include:

- **The limited range and number of interventions included within the tool**
  The HITS models only include three interventions, all of which are downstream interventions that aim to change health behaviour and require individual agency for uptake.

- **The limited number of health outcomes modelled**
  Being a numerical tool, restricted by the availability of data, the HITS models only consider a small number of health outcomes; alternative outcomes may be relevant to the interpretation of findings and decision-making concerning the use of the interventions.

- **The limited time (one year) in which impacts are modelled to occur**
  A key consideration when interpreting results from the HITS models is the timescale over which the anticipated benefits of the intervention are likely to become apparent. The tool provides static arithmetical models; they report intervention activity in one year and the resulting health outcomes for a single subsequent year. Where the health behaviour change that occurs as a result of the intervention is sustained, health benefits (and return on investment) will continue to accrue over a longer period of time. Likewise, continued investment over a series of years where the population experiencing a successful intervention accumulates will multiply long-term impact. However, the tool does not model a time lag between intervention and benefit, and assumes that the benefit is sustained. The tool, therefore, presents an optimistic impact of the interventions over a one-year period and simply summing the outcomes reported by the model is likely to overestimate the long-term impacts.

- **The limited data which are available for modelling**
  This has meant that many assumptions have had to be included in the model, which may be sources of error or bias. However, the sensitivity analyses suggest that plausible variations in the key assumptions do not radically change the overall results.

- **The inability to model multiple interventions in the same population**

- **The likelihood of competing causes of mortality reducing the overall impact on health inequalities**
  There is evidence to suggest that interventions which aim to reduce health inequalities which impact on only a single health behaviour are subject to competing causes of mortality. This is, therefore, likely to be a source of overestimation of the modelled impact on health inequalities.

- **Consideration of wider costs**
  The tool only considers the cost of intervention delivery in relation to health outcomes; it does not constitute a full cost-benefit analysis.

- **Practicalities of intervention delivery**
  The Health Inequalities Tool for Scotland takes a theoretical approach to intervention delivery, and does not consider the practicalities of identifying and recruiting eligible individuals. In practice, this would often involve either individuals seeking help with a health behaviour or opportunistic recruitment through primary care. This presents challenges in terms of recruitment (i.e. although the impact of recruiting large numbers of individuals can be modelled it may not be feasible), and also adds to the potential of interventions to exacerbate health inequalities.

All of the above issues influence the findings reported here, which are considered in more detail below, and also have implications for how the findings are interpreted and applied in practice.

Impact of modelled interventions on population health

The Health Inequalities Tool for Scotland generates modelled results that suggest the overall impact of the interventions in question is modest, even given high levels of investment. This results from three related issues; (i) each intervention tackles only one health behaviour, whereas the health challenges faced in Scotland arise from a range of different determinants, (ii) the interventions can only reach a small proportion of the total population, and (iii) the proportion of interventions which are successful can be very low. The result is that the number of people who benefit from an intervention is small in comparison to the population of Scotland (see Figure 1). The other key factor is the impact of a ‘successful’ intervention on an individual’s health, but even where this is substantial (e.g. quitting smoking) the effect may be small at the population level unless the number of successful interventions is large.

There are important caveats to the observation that ABIs are the best-performing intervention per unit cost in terms of life expectancy, which stem from the assumptions and data underlying the models. In particular, the ‘success rate’ of ABIs used in the model is high at 65%; this is based on a systematic review that encompassed heterogeneous studies from various countries[7] and may exceed what is achievable in routine practice in Scotland. In contrast, for NHS smoking cessation services and Counterweight, information on the success or otherwise of an intervention in routine practice is available, and it is these potentially more conservative estimates that are used to inform the model. Similarly, the effect size associated with an individual intervention comes from the same review for ABIs and from routine practice for Counterweight (for smoking cessation, success is not variable as it simply relates to smoking status). The lower estimated cost of delivering an ABI is also important. Nonetheless, the modelled results do suggest that ABIs offer some advantages over the other modelled interventions in terms of the impact on life expectancy per specified level of investment.

For Counterweight and ABIs these figures are based on an assumption that, for the successful interventions, the individuals concerned immediately adopt the mortality rate associated with their new risk factor status (i.e. as if they had never had a higher body mass index (BMI) or a higher level of alcohol consumption). For smoking, although it is also assumed that there will be an immediate benefit, the tools model a change to ex-smoker status, with a mortality rate intermediate between smokers and never-smokers. These assumptions reflect limitations in available data to inform the models but, since a more conservative assumption is used for smoking, this may partly explain the differences in deaths prevented per year.

Impact of modelled interventions on health inequalities

Comparison between the change in life expectancy gap achieved by delivering interventions proportional to eligibility and targeted to the most deprived quintile shows the far greater impact on health inequalities that results from a targeted strategy. It should be noted though that caveats and challenges considered above (including optimistic assumptions about the effectiveness of ABIs, and the difficulties of recruiting large numbers of individuals) apply, and the modelled changes in the life expectancy gap remain modest.

Key factors influencing the impact of interventions

The prevalence and distribution of risk factors has been modelled using input data inferred from the Scottish Health Survey. Although there are limitations to the methods used and the data are self-reported, these data can be considered reasonably robust for modelling purposes.

Figures 6–9 illustrate the role of cost, success rate and impact of intervention on individual health in determining the overall impact at the population level. These observations show that the impact of these interventions per unit cost could change over time (e.g. if they become cheaper to deliver or more effective). More importantly, they demonstrate the influence of the specific assumptions and data used within the model. Nonetheless, the analysis of a combination of favourable estimates reveals that, whilst the precise results are sensitive to the assumptions and data used, the magnitude of the impact on health and health inequalities remains similar and so the conclusion that these impacts are modest holds.

Targeting

The targeting of interventions is an essential element of any attempt to tackle health inequalities using the modelled interventions. In simple terms, the targeting within the model provides individuals living in deprived areas with an intervention which is denied to others, thereby creating a differential health gain which contributes to a reduction in health inequalities. It is recognised that targeting may also be a highly effective strategy where there are particular groups known to be at very high risk of suffering health inequalities (e.g. looked-after children and homeless services), although the HITS tool does not facilitate modelling of such targeted approaches. Targeting can also provide a means to limit costs (either by restricting interventions to those who are most likely to benefit or to those who have the greatest motivation).

However, interventions that require individuals to take action in order to reap a benefit (i.e. that require individual agency) are particularly prone to exacerbating health inequalities.

This is because deprived groups are less able to take advantage of such interventions. By contrast, interventions applied to the whole population (e.g. legislative change or children's education) may be more likely to reduce health inequalities because they are not subject to individual agency and can address needs directly.[6]

The feasibility and desirability of targeting all interventions to the most deprived quintiles is highly questionable. In terms of feasibility it requires a mechanism for targeting that often does not exist in practice. For example, only 34% of Scottish low income households are in the 20% most deprived areas in Scotland.[8] Targeting may also be undesirable because it can result in such services and interventions being seen as 'poor people's services'. This can create stigma, undermine quality and undermine the collectivism which is essential to support the funding of public services.[9] One approach to avoiding the dangers of 'means testing' is to created services which are both universal and proportionate to need.[10]

Conclusion

Overall, the modelled interventions have a very limited capacity for reducing health inequalities in Scotland. Action on the determinants of health inequalities and universal interventions that are not contingent on individual agency are more likely to make a substantial difference. Further work is required to model interventions which impact on the social determinants of health and their distribution in society which may be more likely to improve overall population health and reduce health inequalities.

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