

# The cost-effectiveness of public health interventions

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## ABSTRACT

**Background** The need to make best use of limited resources in the English National Health Service is now greater than ever. This paper contributes to this endeavour by synthesizing data from cost-effectiveness evidence produced to support the development of public health guidance at the National Institute of Health and Clinical Excellence (NICE). No comprehensive list of cost-effectiveness estimates for public health interventions has previously been published in England.

**Methods** Cost-effectiveness estimates using English cost data were collected and analysed from 21 (of 26) economic analyses underpinning public health guidance published by NICE between 2006 and 2010.

**Results** Two hundred base-case cost-effectiveness estimates were analysed, 15% were cost saving (i.e. the intervention was more effective and cheaper than comparator). Eighty-five per cent were cost-effective at a threshold of £20 000 per quality-adjusted life year and 89% at the higher threshold of £30 000. A further 5.5% were above £30 000 and 5.5% of the interventions were dominated (i.e. the intervention was more costly and less effective than comparator).

**Conclusions** The majority of public health interventions assessed are highly cost-effective. The next challenge is to provide commissioners with a framework that allows information from economic analyses to be combined with other criteria that supports making better investment decisions at a local level.

**Keywords** economics, public health, research

## Introduction

The need to make the best use of limited resources in the English National Health Service (NHS) has always been a priority but the imperative is now greater than ever. The economic case for public health interventions to contribute to this endeavour hitherto has lacked a systematic compilation of evidence, in both breadth and depth, that would allow informed decisions about the allocation of resources between prevention and treatment options, and between options within prevention options.

Butterfield *et al.*<sup>1</sup> argue that the current 4% of NHS budget spent on prevention needs to be at least maintained to ensure that current levels of health in England do not worsen compared with other European countries. They also highlight that there is much variation in spending on prevention by primary care trusts. This may reflect the original

observation by Wanless<sup>2</sup> that lack of information about cost-effectiveness of interventions hinders priority setting at a local level.

## Preventable disease—the scale of the problem

The health and economic effects of lifestyle diseases are substantial. In 2008 an estimated 170 000 deaths in England and Wales, around a third of all deaths, were premature

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(under the age of 75).<sup>3</sup> Many of these deaths could have been prevented by lifestyle changes undertaken at an earlier time of life.<sup>4,5</sup> The diseases associated with smoking, lack of physical activity, obesity and alcohol misuse feature among the leading causes of premature death in the UK. In 2006, around 30% of premature deaths among men and 21% among women were from cardiovascular disease (CVD), accounting for just over 40 000 premature deaths in that year.<sup>6</sup> In addition, there are an estimated 5.6 million people in the UK living with CVD.<sup>7</sup>

In 2008, the total disease burden attributable to preventable deaths in England and Wales attributable to preventable deaths (that is under the age of 75 but excluding deaths below the age of 28 days<sup>3</sup>) was 44 years of life lost per 1000 population or about 2.6 million life years lost each year. If the NHS is prepared to pay £20 000 per life year gained at full health, as the lower boundary of the cost-effectiveness threshold used by the National Institute of Health and Clinical Excellence (NICE) implies, the value of this loss, for England and Wales as a whole, is about £51 billion per year.

The current level of tobacco use is estimated to cost the NHS around £2.7 billion every year,<sup>8</sup> while treating people with health problems related to being overweight or obese is estimated to cost the NHS £4.2 billion annually, a figure which is forecast to more than double by 2050 in terms of current prices.<sup>9</sup> Physical inactivity is estimated to cost the NHS £1.06 billion per year<sup>10</sup> and the costs of treating the chronic and acute effects of alcohol misuse up to £1.7 billion per year.<sup>11</sup> It is estimated that up to 35% of all accident and emergency attendances and ambulance costs are alcohol related.<sup>11</sup>

Despite this, only 4% of NHS funding is spent on prevention.<sup>12</sup> Some have suggested that this may be because the economic evidence in favour of prevention is largely missing or of poor quality.<sup>13–16</sup> For example, a recent systematic review of economic evaluations of primary prevention targeting CVD or risk reduction found that the vast majority focused on clinical prevention.<sup>15</sup> Another rapid review of public health interventions found that only 27% provided sufficient economic evidence for assessing cost-effectiveness.<sup>16</sup> There may also be more practical reasons for underinvestment which relate to decision-making processes at a local level such as the need for short-term planning and pressures to deliver. Perhaps, there is also a view that the NHS contribution to public health goals is limited compared to the impact that can be made at a population level (e.g. mass-media campaigns or other sectors). All this points to the need to improve both the evidence of cost-effectiveness of public health interventions and how these

data can be fed into the reality of local decision-making processes.

### Methodological challenges and the NICE approach

The methodological challenges of assessing the cost-effectiveness of public health interventions are well documented.<sup>14,15,17–19</sup> In the absence of an established approach, a range of different economic methods have been employed making it difficult to compare public health interventions. In a review undertaken by Drummond *et al.*<sup>17</sup> 37% of the studies identified adopted a cost-effectiveness analysis, 36% a cost-consequence analysis and 27% a cost-utility analysis. When NICE took on responsibility for public health in 2005, it offered an opportunity to build a more systematic approach to assessing the cost-effectiveness of public health interventions.

The main method used—cost-utility analysis—considers the quality of life someone will experience as well as the extra life they will gain, as a result of intervening in a particular way. For public health interventions, the perspective adopted is usually that of the NHS or public sector. The costs of lost production due to illness or incapacity are not routinely included.

The time horizon is chosen to ensure that all important costs and effects are captured, in most cases a lifetime horizon. An annual discount rate of 3.5% is applied to the costs and benefits. Sensitivity analyses are undertaken to handle parameter uncertainty.

The comparator against which the cost-effectiveness of an intervention is assessed varies from study to study. It may be usual practice, best practice or ‘no intervention’. Comparators described as ‘no intervention’ typically involve the assessment of the intervention against a background rate where this is known.

In general, interventions costing less than £20 000 per quality-adjusted life year (QALY) are considered by NICE to be cost-effective. Interventions costing between £20 000 and £30 000 per QALY may be considered cost-effective if certain conditions are satisfied. NICE does not usually recommend an intervention if it costs more than £30 000 per QALY (other than for certain end-of-life treatments) unless a strong case can be made that it is an effective use of NHS resources.<sup>20</sup>

### Methods

We examined the cost-effectiveness estimates produced for all public health guidance published until June 2010. The topics for the guidance are referred to NICE by the

**Table 1** Number (%) and median values of ranges of the estimated incremental cost per QALY for public health interventions

	Cost saving (intervention dominates)	£0– $<$ £20 000	£20 000–£30 000	$>$ £30 000	Intervention was dominated
Number (%)	30 (15)	141 (70.5)	7 (3.5)	11 (5.5)	11 (5.5)
Median	N/A	£1030	£25 150	£90 786	N/A

Department of Health and although the assessment of cost-effectiveness has focused on interventions, the published guidance reflects a broader understanding of public health which takes into account the systems and structures for improving public health as well as the interventions.

For the analysis in this paper, we focused on the 21 (of 26) publications which included base-case cost–utility analyses (that is, those that were based on a cost per QALY). The estimates were extracted from economic models commissioned by Centre for Public Health Excellence. Full details of the models are available on the NICE website.

## Results

The 21 publications studied yielded 200 base-case cost-effectiveness estimates given in terms of QALYs gained (see Table 1). Of these, 30 were cost saving (that is, the intervention was more effective and cheaper than the control). A further 141 were estimated to cost less than £20 000 per QALY and of these 69 cost less than £1000 per QALY. Seven cost between £20 000 and £30 000. Eleven estimates were above £30 000 per QALY and a further 11 interventions were dominated (that is, the intervention was more costly and less effective than the comparator).

The median cost per QALY was £365 for the interventions costing less than £20 000 per QALY (including interventions that were cost saving). Even including those estimated to cost more than £20 000 per QALY and interventions that were dominated, the total median cost per QALY is estimated to be £633.

Table 2 presents a summary of the findings by topic. Interventions targeting smoking accounted for the majority of the estimates (63.5%). Physical activity accounted for 10.5%, alcohol prevention 7.5% and prevention of sexually transmitted diseases 7%. A minority of estimates concerned social and emotional wellbeing (5.5%), substance misuse (3%), long-term sickness and incapacity (1.5%), behaviour change (0.5%) and population strategies to prevent CVD (0.5%).

Interventions that were found to be cost-effective at a £20 000 per QALY threshold ranged from those targeted at individuals using face-to-face interventions to those targeted

at whole populations such as mass-media campaigns and legislative measures. Interventions aimed at the general population tended to have a somewhat lower cost per QALY than those targeted at disadvantaged groups. Although the vast majority of interventions were aimed at adults, interventions aimed at children and young people were also found to be cost-effective. It is noteworthy that interventions aimed at the population as a whole are among the cheapest in terms of cost per QALY; examples include mass-media campaigns to promote healthy eating and legislation to reduce young people's access to cigarettes.

## Discussion

### Main findings of this study

This analysis showed that the public health interventions considered by NICE are generally highly cost-effective according to the NICE threshold. As such they represent good value for money. Given that the cost per QALY for most interventions is extremely low, it seems likely that as a nation we are not investing sufficiently in public health interventions.

At the time of writing, the NHS has been undergoing major reform.<sup>21,22</sup> The changes include the transfer of public health functions from the NHS to local authorities along with their associated financial resources. Amidst these changes, the need for evidence of what works and evidence of what is cost-effectiveness is greater than ever.

The analysis in this paper provides a single, comprehensive source of evidence on the cost-effectiveness of public health interventions. It is a first step in compiling the evidence that would allow informed decisions about the allocation of resources between different public health interventions. Clearly, the analysis does not cover all public health interventions and we need to continue in this endeavour.

In this analysis, we have not sought to suggest priorities for interventions. Aside from the fact that studies show that cost-effectiveness is not the only criterion used by decision-makers for allocating resources,<sup>23,24</sup> local demographic and public health data, national and local policies and plans, national guidance, examples of best practice and benchmarking data with other organisations are typically used by

**Table 2** Median and range of values of incremental cost-effectiveness estimates for public health interventions assessed by NICE

Guidance topic classification	Comparator	Median cost/QALY (£)	Range (£) (minimum–maximum)	Number of estimates included in median
<sup>a</sup> PH1: brief interventions (BA) and referral for smoking cessation				
BA only (5 min)	Background quit rate	732	577–1677	8
BA [5 min plus nicotine replacement therapy (NRT)]	Background quit rate	2110	1664–4833	8
BA (5 min plus self-help)	Background quit rate	370	292–847	8
PH2: four commonly used methods to increase physical activity (PA)				
Interview	Advice	84	NA	1
Exercise prescriptions	Advice	77	20–159	4
Interviews with exercise voucher	Advice	227	NA	1
Intensive interviews	Advice	105	NA	1
Exercise prescription and exercise information	Advice	425	NA	1
Exercise prescription with intensive general practitioner (GP) training	Advice	437	NA	1
Intensive interviews with exercise voucher	Advice	430	NA	1
PH3: prevention of sexually transmitted infections and under 18 conceptions				
Tailored skill session	Usual care—didactic messages	3200	NA	1
Accelerated partner therapy—doxycycline	Patient referral	14 025	9350–18 700	2
Accelerated partner therapy—azithromycin	Patient referral	19 425	12 950–25 900	2
Brief counselling	Didactic messages	12 194	12 308–12 080	2
Information and behaviour skills	Didactic information	10 286	NA	1
Information, motivation and behaviour skills	Didactic information	14 143	10 286–18 000	2
Enhanced counselling	Didactic messages	45 606	39 600–51 613	2
Intensive counselling	Treatment as usual	24 000	N/A	1
Behavioural skills counselling	Standard 15 min risk reduction counselling	96 000	N/A	1
PH4: interventions to reduce substance misuse among vulnerable young people				
Life-skills training	Normal education	3492	1296–6846	3
'Say yes first'	Normal education	90 786	N/A	1
Teacher training		157 384	N/A	1
The abecedarian project	Normal child rearing	195 225	NA	1
PH5: workplace interventions (WIs) to promote smoking cessation				
Brief advice plus self-help material	Background quit rate	Dominates	NA	1
Brief advice plus self-help material plus NRT	Background quit rate	Dominates	NA	1
Brief advice plus self-help material plus NRT plus specialist clinic	Background quit rate	Dominates	NA	1
Less intensive counselling and bupropion	Background quit rate	Dominates	NA	1
More intensive counselling and bupropion	Background quit rate	Dominates	NA	1
BA	Background quit rate	Dominates	NA	1
PH6: behaviour change				
Mass media to promote healthy eating	No intervention	87	NA	1
PH8: PA and the environment				
Urban trail	No intervention	10 445	2640–25 150	4
PH10: smoking cessation services				
Brief advice	Background quit rate	Dominates	NA	1
Nicotine patch—pharmacy consultation	Background quit rate	Dominates	NA	1

*Continued*

**Table 2** Continued

Guidance topic classification	Comparator	Median cost/QALY (£)	Range (£) (minimum–maximum)	Number of estimates included in median
Nicotine patch—pharmacy consultation + behavioural programme	Background quit rate	Dominate	NA	1
Brief advice plus self-help material	Background quit rate	Dominate	NA	1
Brief advice plus self-help material plus NRT	Background quit rate	984	NA	1
Brief advice plus self-help material plus NRT plus specialist clinic	Background quit rate	Dominate	NA	1
Less intensive counselling and bupropion	Background quit rate	Dominate	NA	1
More intensive counselling and bupropion	Background quit rate	Dominate	NA	1
Nicotine patch—group counselling	Background quit rate	Dominate	NA	1
Nicotine patch—individual counselling	Background quit rate	Dominate	NA	1
Nicotine patch—no counselling	Background quit rate	Dominate	NA	1
PH12: social and emotional wellbeing in primary education				
Universal intervention (emotional function only)	No intervention	10 594	NA	1
Universal intervention (emotion + cognition)	No intervention	5278	NA	1
Focussed intervention (1 level improvement)	No intervention	988 404	NA	1
Focussed intervention (two-level improvement)	No intervention	177 560	NA	1
PH13: promoting PA in the workplace				
PA counselling	No intervention	864	495–1234	2
PA walking programme	No intervention	686	NA	1
PH14: preventing the uptake of smoking by children and young people				
Mass-media intervention	Background quit rate	49	NA	1
Point-of-sale intervention	Background quit rate	1690	NA	1
PH15: identifying and supporting people most at risk of dying prematurely				
Smoking cessation—general population: incentive schemes workplace	WI with no incentive	2089	NA	1
Smoking cessation—general population: incentive schemes NRT	Intervention no NRT	358	45–671	2
Smoking cessation—general population: incentive schemes NRT	Intervention with free guide but no free aid offered	Dominated	NA	1
Smoking cessation—general population: client centred	Background quit rate; no intervention or usual care	50	0–437	8
Smoking cessation—general population: proactive telephone counselling	Usual care or intervention but no telephone counselling	427	139–1602	9
Smoking cessation—general population: proactive telephone counselling	Intervention but no telephone counselling	Dominated	NA	4
Smoking cessation—general population: recruitment to quit and win	Background quit rate; no intervention or advice	260	77–13 500	15
Smoking cessation—general population: recruitment to quit and win	Intervention or no intervention	Dominated	NA	3
Smoking cessation—general population: identify smokers through other means	No intervention	504	78–4178	4
Smoking cessation—general population: identify smokers through other means	No intervention	Dominated	NA	1
Smoking cessation—general population: drop-in/rolling community based	Background quit rate	91	NA	1

*Continued*

**Table 2** Continued

Guidance topic classification	Comparator	Median cost/QALY (£)	Range (£) (minimum–maximum)	Number of estimates included in median
Smoking cessation—general population: pharmacist based	Usual care	546	438–655	2
Smoking cessation—general population: dentist based	Usual care	302	269–360	3
Smoking cessation—general population: dentist based	Usual care (query contamination)	Dominated	NA	1
Smoking cessation—disadvantaged groups: client-centred social marketing	No intervention	1564	420–6412	3
Smoking cessation—disadvantaged groups: workplace	No intervention	1399	NA	1
Smoking cessation—disadvantaged groups: pregnant women	Usual care	1593	NA	1
Smoking cessation—disadvantaged groups: proactive telephone support pregnant women	Intervention but no offer of telephone support	5992	NA	1
Smoking cessation—disadvantaged groups: incentive NRT prescription	No intervention	1627	NA	1
Smoking cessation—disadvantaged groups: recruitment at paediatric unit	Usual care	1837	NA	1
Smoking cessation—disadvantaged groups: NHS SSS	No intervention	2686	2535–2837	2
Smoking cessation—disadvantaged groups: pharmacist based	No intervention	3151	1030–5272	2
Statins—general population: pharmacist based	Usual care or no intervention	4892	1648–8234	4
Statins—disadvantaged groups: culturally sensitive screening	No intervention	4260	NA	1
Statins—disadvantaged groups: invitation for screening by GP	Usual care or no intervention	4346	4000–4692	2
PH16: mental wellbeing and older people				
Tri-weekly walking programme after 6 months	Information and education	7400	NA	1
Advice about PA	Usual care	35 900	26 200–45 600	2
Advice about PA	Nutrition advice	Dominated	NA	1
PH17: promoting PA for children and young people				
Walking buses	No intervention	4007	NA	1
Dance class programme	No intervention	27 570	NA	1
Free swimming	No intervention	40 462	NA	1
Community sports	No intervention	71 456	NA	1
PH19: management of long-term sickness and incapacity for work				
WI	Usual care for musculoskeletal disorders	Dominates	NA	1
PA and education	Usual care for musculoskeletal disorders	2758	NA	1
PA and education and workplace visit	Usual care for musculoskeletal disorders	Dominates	NA	1
PH20: social and emotional wellbeing in secondary education				
Internet-based expert system + peer initiative to reduce bullying and victimization	No intervention	9600	NA	1

*Continued*

**Table 2** Continued

Guidance topic classification	Comparator	Median cost/QALY (£)	Range (£) (minimum–maximum)	Number of estimates included in median
PH22: promoting wellbeing at work				
Individual stress management	No intervention	4998	3470–15 031	3
PH23: school-based interventions to prevent the uptake of smoking				
Curricular	No intervention or standard education	7200	2030–12 700	4
PH24: alcohol use disorders: preventing harmful drinking—overall population				
Screening and BA at GP registration	No intervention	6500	NA	1
Screening and BA at GP registration	No intervention	Dominates	NA	7
Screening and BA during GP consultation	No intervention	3300	0–6600	3
Screening and BA during GP consultation	No intervention	Dominates	NA	2
Screening and BA during A and E consultation	No intervention	10 400	NA	1
PH25: prevention of CVD—population strategies				
North Karelia Project	No intervention	7000	NA	1
PH26: quitting smoking in pregnancy				
Cognitive behaviour strategies	No intervention (aggregate of controls)	4005	NA	1
Stages of change	No intervention (aggregate of controls)	3033	NA	1
Feedback	No intervention (aggregate of controls)	1992	NA	1
Rewards	No intervention (aggregate of controls)	Dominates	NA	1
Pharmacotherapies	No intervention (aggregate of controls)	2253	NA	1
Other	No intervention (aggregate of controls)	Dominates	NA	1

<sup>a</sup>More detailed descriptions of the interventions can be found on the individual NICE web pages associated with guidance represented here: <http://guidance.nice.org.uk/PHG/Published>.

commissioners of services.<sup>25</sup> A recent survey of 300 NHS commissioning staff showed that local public health intelligence, expert advice and examples of best practice featured among the most sought after types of evidence.<sup>25</sup>

### What is already known on this topic

Only a small percentage of the current NHS budget is spent on prevention. There is a paucity of evidence on the cost-effectiveness of public health interventions. As noted earlier, a recent rapid review found that 15 of 41 published studies of public health interventions contained no economic data and a further 15 which contained insufficient evidence for assessing whether the interventions were cost-effective.<sup>16</sup> The adoption of different economic methods makes it difficult to compare interventions.

### What this study adds

With pressure on budgets and fundamental changes underway in the NHS and public health structure, there is a need for evidence to support the case for investing in public health interventions. This is the first study to provide a comprehensive list of the cost-effectiveness of public health interventions. Using a standard set of methods, the analysis has shown that the vast majority of public health interventions considered thus far by NICE are highly cost-effective.

### Limitations of this study

Estimating the cost-effectiveness of public health interventions poses a number of challenges. Often there is a lack of data, or the data relate to intermediate or short-term outcomes (e.g. knowledge, attitudes, behaviour change within

1 year of the intervention) rather than long-term outcomes that are more relevant. Interventions are rarely well described and often differ in crucial details from those that have been modelled. Study quality varies considerably and interventions carried out elsewhere, or at a different point in time, do not necessarily apply to the UK today. Another important caveat is that there can be rapidly diminishing marginal returns to an intervention.

For some pieces of guidance, the cost-effectiveness of an intervention was determined with respect to 'usual care'. However, not all instances of 'usual care' mean the same thing. In some instances, the cost-effectiveness of an intervention may have been assessed against best practice, in others it may have been assessed against another intervention or 'nothing'. This is crucial because if, for example, one intervention is cheaper and gains more QALYs than any other, then all other interventions will be dominated. However, against 'do nothing' the other interventions might be very cost-effective. In the current analysis, in most of the examples where the intervention was dominated it had been compared with another intervention. In some instances, the only difference between the intervention and the comparator was the *offer* of an additional component.

The efficacy studies underpinning the economic models rarely provide data on the relative effectiveness of individual elements within a multi-component intervention. Similarly, to the authors knowledge, there have been no head-to-head studies to assess any synergy between different combinations (or packages) of public health interventions.

## Conclusion

This synthesis of available economic evidence has shown that the vast majority of public health interventions considered thus far by NICE are a highly cost-effective use of public funds. A next challenge would be to provide commissioners with a framework which combines information gained from economic analyses with other decision-making criteria so that transparent rationales for investment in particular public health interventions can be made.

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