

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.*¹ 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 Wanless² 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).³ Many of these deaths could have been prevented by lifestyle changes undertaken at an earlier time of life.^{4,5} 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.⁶ In addition, there are an estimated 5.6 million people in the UK living with CVD.⁷

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 days³) 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,⁸ 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.⁹ Physical inactivity is estimated to cost the NHS £1.06 billion per year¹⁰ and the costs of treating the chronic and acute effects of alcohol misuse up to £1.7 billion per year.¹¹ It is estimated that up to 35% of all accident and emergency attendances and ambulance costs are alcohol related.¹¹

Despite this, only 4% of NHS funding is spent on prevention.¹² Some have suggested that this may be because the economic evidence in favour of prevention is largely missing or of poor quality.^{13–16} 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.¹⁵ Another rapid review of public health interventions found that only 27% provided sufficient economic evidence for assessing cost-effectiveness.¹⁶ 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.^{14,15,17–19} 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.*¹⁷ 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.²⁰

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

| | <i>Cost saving (intervention dominates)</i> | <i>£0–<£20 000</i> | <i>£20 000–£30 000</i> | <i>>£30 000</i> | <i>Intervention was dominated</i> |
|------------|---|-----------------------|------------------------|--------------------|-----------------------------------|
| 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.^{21,22} 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,^{23,24} 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

| <i>Guidance topic classification</i> | <i>Comparator</i> | <i>Median cost/QALY (£)</i> | <i>Range (£) (minimum–maximum)</i> | <i>Number of estimates included in median</i> |
|---|--|-----------------------------|------------------------------------|---|
| ^a 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

| <i>Guidance topic classification</i> | <i>Comparator</i> | <i>Median cost/QALY (£)</i> | <i>Range (£) (minimum–maximum)</i> | <i>Number of estimates included in median</i> |
|--|---|-----------------------------|------------------------------------|---|
| Nicotine patch—pharmacy consultation + behavioural programme | Background quit rate | Dominates | NA | 1 |
| Brief advice plus self-help material | Background quit rate | Dominates | 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 | 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 |
| Nicotine patch—group counselling | Background quit rate | Dominates | NA | 1 |
| Nicotine patch—individual counselling | Background quit rate | Dominates | NA | 1 |
| Nicotine patch—no counselling | Background quit rate | Dominates | 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

| <i>Guidance topic classification</i> | <i>Comparator</i> | <i>Median cost/QALY (£)</i> | <i>Range (£) (minimum–maximum)</i> | <i>Number of estimates included in median</i> |
|---|--|-----------------------------|------------------------------------|---|
| 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: BA 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 |

^aMore 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.²⁵ 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.²⁵

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.¹⁶ 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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