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The cost-effectiveness of public health interventions examined by the National Institute for Health and Care Excellence from 2005 to 2018☆,☆☆

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ABSTRACT

Background: Reviews of economic evaluations of public health (PH) interventions assessed by the National Institute for Health and Care Excellence (NICE) in the periods 2005–2010 and 2011–2016 have been undertaken. This study combines these analyses, adds six further guidelines published since then, and thus provides a summary of cost-effectiveness of NICE's PH interventions to the present.

Methods: As in previous studies, economic evaluations carried out between 2005 and 2018 were categorised by the type of economic analysis used to extract and summarise base-case ICERs. A number of 'sensitivity analyses' were carried out to test the validity of the approach.

Results: Of 71 guidelines examined, 27 used cost utility analysis (CUA) for specific interventions, yielding 380 individual base-case ICER estimates (or 221 taking into account clustering of interventions). The median cost per quality-adjusted life-year (QALY) ICER for the 380 estimates was £1,986. Of these, 21% were cost saving, and 54% ranged from £1 to £20,000, 3% were between £20,001 and £30,000, 16% were above £30,000 and 5% were dominated. Taking clustering into account made relatively little difference to these results. Reducing the threshold from £20,000/QALY to £15,000/QALY would result in 2% of ICERs moving across the threshold.

Conclusions: Seventy-five percent of PH interventions assessed were cost-effective at a threshold of £20,000 per QALY when disregarding clustering, and 68% were cost-effective when clusters were represented by a single ICER. Other analyses gave similar results for the distribution of ICERs. Limitations of the analysis are discussed.

☆ The work was undertaken in the authors' own time using data extracted from economic analyses for public health guidelines available on the NICE website.

☆☆ The views expressed in this article are those of the authors and do not necessarily reflect the views of the organisations they work for.

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Introduction

In 2011, Owen et al.[1] analysed 200 base-case cost-effectiveness estimates of public health (PH) interventions considered in 21 PH guidelines developed by the National Institute for Health and Care Excellence (NICE). Most PH interventions assessed by NICE was estimated to be cost-effective. In 2017, Owen et al.[2] updated this information for 2012 to 2016. They considered 138 further base-case cost-effectiveness estimates. A somewhat smaller majority was estimated to be cost-effective, but a slightly larger proportion was cost saving.[2]

The funding for PH interventions changed in 2013 because of the Health and Social Care Act 2012. Local authorities, which are now responsible for improving PH and reducing health inequalities,[3] still require economic analyses and evidence of cost-effectiveness to secure funding.[4]

The process for selecting topics for PH guideline development by NICE, together with the methodology used by NICE in assessing the cost-effectiveness of interventions, has been outlined in the study by Owen et al.[2] Recent changes impinging on the way that the past PH interventions will be viewed in future are (a) the Department of Health (DH) has introduced a threshold ICER of £15,000 per QALY for its impact assessments, lower than the £20,000 used currently by NICE;[5,6] (b) the DH has reduced the rate of discounting future health costs and benefits to 1.5% from 3.5% in the estimation of ICERs;[7] and (c) the role of the precautionary principle in appraising the prevention of ill health has been strengthened.[8]

This study gives a consolidated summary of all the estimates of cost-effectiveness for PH interventions published by NICE until March 2018 and explores a number of 'sensitivity analyses' of the distribution of ICERs.

Methods

We follow the methods outlined in the study by Owen et al.,[2] augmented as follows.

We include a sixth category for analysing ICERs to examine the impact of using a lower threshold of £15,000/QALY for cost-effectiveness.

We examine the effect of providing a single estimate of cost-effectiveness for an intervention. Clusters of ICERs for an intervention occur because either the results have been reported for subgroups of the population (e.g. by age and gender) or the intervention has been assessed in multiple guidelines. Clustered ICERs are not independent of each other; treating them separately, as in the previous analyses and carried through to the combined period analysis, will overstate the importance of the intervention by counting it a number of times. In addition, we excluded two of the eight ICERs for transition support services for looked after children (Guideline PH28). The source study for these indicated the intervention was not effective, besides which the two arms of the study were not randomised.

We also study the impact of the intervention's comparator. Suppose that currently there is no intervention being applied to a PH problem. If intervention A is tested, the effectiveness and cost-effectiveness for A should use 'no intervention' (also sometimes called 'placebo') as its comparator. If A is found to be both effective and cost effective with respect to placebo, and intervention B is now tested, B's comparator could be either A or placebo. The cost-effectiveness of B will depend critically on which one is used. If B is to replace A, then the comparator should be A, but if A does not work for a patient, then in that case, B's comparator should be placebo. In smoking cessation, if a person is unable to quit using one intervention, then either another intervention or placebo could be the appropriate comparator. In the analyses by Owen et al.,[1,2] no account was taken of which comparator was chosen, and in some cases, several comparators for a particular intervention were used.

We have dealt with this in two ways. The first is to divide the population of ICERs into three categories: (i) the absence of an intervention; (ii) 'usual treatment' which might be the lack of any intervention or alternatively an intervention, the nature of which has not been stated; and (iii) a known intervention. The second way uses a case study to illustrate the impact of using different comparators.

Results

There were 71 PH guidelines were published by NICE between March 2006 and March 2018. Twenty-seven of these used CUA for specific interventions, yielding 380 base-case ICER estimates; 12 used CUA for a threshold or 'what if' analysis, one used a threshold and cost effectiveness analysis (CEA), one used CEA, three used cost consequences analysis (CCA), two used cost benefit analysis (CBA) and CUA and one used CEA and CUA, and seven did not require economic modelling.

CUA base-case ICERs

The median cost per QALY ICER for the 380 estimates was £1,986. Of these, 21% were cost saving, 54% ranged from £1 to £20,000, 3% were between £20,001 and £30,000, 16% were above £30,000 and 5% were dominated (Table 1). Lowering the threshold to £15,000/QALY would result in nine fewer ICERs being considered cost-effective (2% of the total sample).

In total 221 ICERs remained after clustering were taken into account. The reduction was mostly due to a decrease in the number of smoking cessation ICERs, which accounted for 49% before and 36% after declustering. The median for the 221 ICERs increased somewhat to £3,629/QALY, but the percentage that would be considered not cost-effective at the lower threshold of £15,000/QALY remained the same (Table 2).

Table 1 – Number (%) and median values of base-case estimated incremental cost per QALY for public health interventions assessed and published by NICE between March 2006 and March 2018.

ICERs	Cost saving	£1 –£15,000	£15,001 –£20,000	£20,001 –£30,000	>£30,000	Intervention was dominated	Overall
Number (%)	81 (21)	197 (52)	9 (2)	12 (3)	62 (16)	19 (5)	380 (100)
Median	NA	£1,648	£15,962	£25,175	£179,008	NA	£1,986
Interquartile range	NA	£437–£4,833	£15,192–£18,000	£23,023–£26,542	£63,446–£350,817	NA	£87–£18,175

NA, not available; NICE, National Institute for Health and Care Excellence; QALY, quality-adjusted life year.

A summary of the interventions and associated ICERs is shown in Table 3.

The effect of clustering is illustrated in Fig. 1. It shows a slight increase in the proportion of ICERs that are cost saving, a small decrease in the proportion that fall between £1/QALY and £15,000/QALY and a relatively large increase in the proportion that exceed £30,000 per QALY offset in part by a reduction in the proportion dominated.

Analysis of comparators

Table 4 shows that the group comparing interventions with other interventions had more interventions that were cost saving (37%) than the other two groups (22% and 19%, usual care and on intervention, respectively); it also had more interventions that were dominated (27%) than those compared against usual care (3%) or no intervention (3%) ($\chi^2 = 45.6$, $P < 0.01$).

Case study of comparators: smoking cessation interventions

Table 5 shows the impact of a comparator in assessing the cost-effectiveness of an intervention. In this example, the ICER for combination patch and nasal spray is substantially lower than £20,000/QALY, irrespective of the type of comparator used to assess the intervention. The same applies to the assessment of the combination of bupropion and lozenge. In contrast, the ICER for bupropion is dominant when compared with cognitive behavioural therapy (CBT) but dominated when compared with nicotine replacement therapy (NRT).

We identified other problems that had previously been noted in comparing the cost-effectiveness of PH interventions; these include updates of the evidence, assumptions around duration of effect, other model assumptions and the length of the time horizon. For example, the ICERs for brief advice for smoking cessation were between £0 and £20,000/QALY in PH1 but cost saving in subsequent guidelines. The change reflects differences in the effect sizes, costs and the assumption about the background quit rate (the comparator). Perhaps only the most recent estimates, which better reflect the current context, assuming all other things are equal, should be used in assessment of cost-effectiveness.

Discussion

Main finding of this study

This article summarises the cost-effectiveness estimates that have come in evidence before the NICE PH guidelines committee from its first guideline, published in 2006, until the most recent, published in March 2018. It examines some weaknesses in the previous work, but the changes this has made have little material impact on the results. The median ICER has increased somewhat, but crucially, most ICERs (68%) are still below £20,000 per QALY.

Clustering of ICERs

Many ICERs reported in the evidence on cost-effectiveness for NICE PH were carried out on subgroups of the population, such as the cost-effectiveness for an intervention for smoking cessation, with a separate ICER for men and women, and for each of a number of age ranges. The reason for this is to see if the intervention is cost-effective for each subgroup or only for some. If the differences between the subgroups are small enough, each subgroup could be considered to be part of a meta-analysis and lumped together into a single, more powerful analysis with many more degrees of freedom. Assuming the cost per person was also similar across the subgroups, the combined ICER with a much greater weight than that of each of its component subgroups should be used. Working backwards from this point would imply that the analysis we have undertaken should weight all the ICERs we have used according to the uncertainty with which the ICER is associated to determine the median ICER for the whole population of NICE PH ICERs. However, this uncertainty also depends on the variability of costs and the unknown correlation between individual costs and health benefits, so weighting could not easily be carried out.

The subgroups for which there is a separate ICER may have different intervention effects (assuming similar cost distributions for each of the subgroups), so that a meta-analysis with fixed effects is not possible, or if the heterogeneity is

Table 2 – Number (%) and median values of base-case estimated incremental cost per QALY for public health interventions assessed and published by NICE between March 2006 and March 2018 excluding clusters.

ICERs	Cost saving	£1 –£15,000	£15,001 –£20,000	£20,001 –£30,000	>£30,000	Intervention was dominated	Overall
Number (%)	52 (24)	93 (42)	5 (2)	7 (3)	60 (27)	4 (2)	221 (100)
Median	NA	£2,465	£15,962	£25,199	£179,008	NA	£3,620
Interquartile range	NA	£765–£5,278	£15,192–£16,859	£23,523–£27,568	£65,112–£336,272	NA	£87 – £42,145

Table 3 – The value of incremental cost-effectiveness estimates for public health interventions assessed and published by NICE between 2006 and 2018.

Guideline topic and ID	Intervention	Comparator	ICER
NG30: Oral health promotion: general dental practice	One-to-one counselling to parents of children aged 5 years for high-risk caries in socio-economically deprived areas in Northwest England	Usual care	Dominant
NG30: Oral health promotion: general dental practice	Dental hygienists OH prog for children aged 12 years at high risk	Usual care	Dominant
NG30: Oral health promotion: general dental practice	Dental hygienists OH prog for children aged 12 years at average risk	Usual care	£ 14,408
NG30: Oral health promotion: general dental practice	One-to-one counselling to parents of children aged 5 years for average risk caries in socio-economically deprived areas in Northwest England	Usual care	£ 99,826
NG32: Older people: independence and mental wellbeing	Friendship programme	No intervention (waiting list)	Dominant
NG32: Older people: independence and mental wellbeing	Internet and computer training	No intervention (waiting list)	£ 15,962
NG34: Sunlight exposure: risks and benefits	Mass media	No intervention	Dominant
NG34: Sunlight exposure: risks and benefits	Tailored message	No intervention	£ 16,859
NG34: Sunlight exposure: risks and benefits	Text messages	No intervention	£ 65,945
NG34: Sunlight exposure: risks and benefits	Living with the sun	No intervention	£ 312,744
NG34: Sunlight exposure: risks and benefits	Photoageing	No intervention	£ 316,968
NG55: Harmful sexual behaviour	Multisystemic therapy for problem sexual behaviours	Cognitive behavioural therapy	dominant
NG55: Harmful sexual behaviour	Cognitive behavioural therapy	Play therapy	£ 2,685
NG6: Cold homes	Energy efficiency COPD	No intervention	£ 28,324
NG6: Cold homes	Energy efficiency + fuel subsidy COPD	No intervention	£ 33,771
NG6: Cold homes	Fuel subsidy COPD	No intervention	£ 39,437
NG6: Cold homes	Energy efficiency HD	No intervention	£ 157,137
NG6: Cold homes	Energy efficiency age 65+ years	No intervention	£ 157,661
NG6: Cold homes	Energy efficiency + fuel subsidy HD	No intervention	£ 174,467
NG6: Cold homes	Energy efficiency + fuel subsidy age 65+ years	No intervention	£ 180,456
NG6: Cold homes	Fuel subsidy HD	No intervention	£ 188,301
NG6: Cold homes	Fuel subsidy age 65+ years	No intervention	£ 204,076
NG6: Cold homes	Energy efficiency low income	No intervention	£ 275,896
NG6: Cold homes	Energy efficiency + fuel subsidy low income	No intervention	£ 317,927
NG6: Cold homes	Fuel subsidy low income	No intervention	£ 358,089
NG6: Cold homes	Energy efficiency CMD	No intervention	£ 394,556
NG6: Cold homes	Energy efficiency + fuel subsidy CMD	No intervention	£ 452,154
NG6: Cold homes	Fuel subsidy CMD	No intervention	£ 509,205
NG64: Drug misuse - targeted interventions	Family intervention called STRIVE	Standard care	£ 117,000
NG64: Drug misuse - targeted interventions	Motivational interviewing intervention to reduce club drug use and HIV risk behaviours among men who have sex with men	Educational control	£ 131,000
NG64: Drug misuse - targeted interventions	Familias Unidas	No intervention	£ 241,000
NG64: Drug misuse - targeted interventions	Motivational interviewing to reduce drug use in young gay and bisexual men	Content matched education	£ 301,000
NG64: Drug misuse - targeted interventions	Brief, web-based personalised feedback	No intervention	£ 329,000
NG64: Drug misuse - targeted interventions	Motivational interviewing to reduce ecstasy use	Assessment only 3-month delay treatment	£ 485,000
NG64: Drug misuse - targeted interventions	Focus on families	No intervention	£ 99,000,000

NG70: Outdoor air	Street washing and sweeping	No intervention	£ 441
NG70: Outdoor air	Speed restrictions	No intervention	£ 1,293
NG70: Outdoor air	Vehicle idling	No intervention	£ 1,572
NG70: Outdoor air	Low-emission zones	No intervention	£ 2,465
NG70: Outdoor air	Off-road cycle paths	No intervention (on road cycle)	£ 5,075
NG70: Outdoor air	Bypass construction	No intervention	£ 6,971
NG70: Outdoor air	Motorway barriers	No intervention	£ 25,199
NG90: Physical activity	Active Living by Design	No intervention (before, after and no control)	£ 1,397
NG90: Physical activity	Cycling demonstration towns	Placebo (matched town)	£ 2,496
NG90: Physical activity	Smarter Choices, Smarter Places	Placebo (matched control)	£ 4,423
NG90: Physical activity	Connswater Community Greenway	Placebo (control group)	£ 7,652
NG90: Physical activity	Park renovations	Placebo (before, after and control)	£ 215,989
NG92: Smoking cessation interventions and services	Sequence (varenicline, bupropion, SSRI) = 40.30%	No intervention = 2%	Dominant
NG92: Smoking cessation interventions and services	Bupropion and lozenge = 25.60%	No intervention = 2%	Dominant
NG92: Smoking cessation interventions and services	Lozenge = 14.38%	No intervention = 2%	Dominant
NG92: Smoking cessation interventions and services	Patch only = 11.00%	No intervention = 2.00%	Dominant
NG92: Smoking cessation interventions and services	Varenicline + brief advice = 25.00%	Brief advice = 6.60%	Dominant
NG92: Smoking cessation interventions and services	Bupropion (PP) = 47.33%	CBT (PP) = 38.20%	Dominant
NG92: Smoking cessation interventions and services	Bupropion and lozenge = 25.60%	Lozenge = 14.38%	Dominant
NG92: Smoking cessation interventions and services	Bupropion (PP) = 47.33% (pt prev)	Minimal intervention (PP) = 33.66%	Dominant
NG92: Smoking cessation interventions and services	NRT (PP) = 41.30%	Minimal intervention (PP) = 33.66%	Dominant
NG92: Smoking cessation interventions and services	Varenicline + counselling = 27.90%	Placebo + counselling = 15.90%	Dominant
NG92: Smoking cessation interventions and services	Varenicline + counselling = 30.50%	Placebo + counselling = 17.30%	Dominant
NG92: Smoking cessation interventions and services	Varenicline + counselling = 16.61%	Placebo + counselling = 5.91%	Dominant
NG92: Smoking cessation interventions and services	Self-determination intervention = 10.10%	Standard care = 3.51%	Dominant
NG92: Smoking cessation interventions and services	Patch and nasal spray = 27.00%	No intervention = 2.00%	£13
NG92: Smoking cessation interventions and services	Patch and nasal spray = 27.00%	Patch only = 11.00%	£948
NG92: Smoking cessation interventions and services	CBT (PP) = 38.20%	Minimal intervention (PP) = 33.66%	£3,620
NG92: Smoking cessation interventions and services	NRT OTC = 8.65%	No intervention = 13.19%	Dominated
PH2: Physical Activity	Intensive interviews	Brief advice from researcher at the baseline assessment	£ 75.06
PH2: Physical Activity	Intensive interviews with exercise voucher	Brief advice from researcher at the baseline assessment	£ 432.13
PH3: Sexually transmitted diseases	Tailored skill session	Usual care, didactic messages	£3,200
PH3: Sexually transmitted diseases	Information and behaviour skills (women)	Usual care (information only delivered by counsellors in didactic style)	£ 10,286.00
PH3: Sexually transmitted diseases	Brief counselling	Usual care (didactic messages, information intervention to approximate treatment as usual)	£ 12,194.00
PH3: Sexually transmitted diseases	Accelerated partner therapy, doxycycline	Patient referral	£ 12,525.00
PH3: Sexually transmitted diseases	Information, motivation and behaviour skills	Usual care (information only delivered by counsellors in didactic style)	£ 14,143.00
PH3: Sexually transmitted diseases	Accelerated partner therapy, azithromycin	Patient referral	£ 19,425.00
PH3: Sexually transmitted diseases	Intensive counselling	Usual care	£ 24,000.00
PH3: Sexually transmitted diseases	Enhanced counselling	Usual care (didactic messages, informational intervention designed to approximate treatment as usual)	£ 45,606.50

(*continued on next page*)

Table 3 – (*continued*)

Guideline topic and ID	Intervention	Comparator	ICER
PH3: Sexually transmitted diseases	Behavioural skills counselling	Standard 15-min risk reduction counselling	£ 96,000.00
PH4: Substance misuse	Life skills training	Normal education	£ 3,492.00
PH4: Substance misuse	'Say Yes First'	Normal education	£ 90,786.00
PH4: Substance misuse	Teacher training	Usual care (no training, standard education curriculum)	£ 157,384.00
PH4: Substance misuse	Teacher training	Usual care (no training, standard education curriculum)	£ 195,225.00
PH6: Behaviour change	Mass media to promote healthy eating	No intervention	£ 87.00
PH8: Physical activity and the environment	Trail	No intervention	£ 10,445.00
PH10: Smoking cessation	Brief advice	No intervention	Dominant
PH10: Smoking cessation	Nicotine patch, pharmacy consultation	No intervention	Dominant
PH10: Smoking cessation	Nicotine patch, pharmacy consultation + behavioural programme	No intervention	Dominant
PH10: Smoking cessation	Brief advice plus self-help material	No intervention	Dominant
PH10: Smoking cessation	Less intensive counselling and bupropion, workplace	No intervention	Dominant
PH10: Smoking cessation	More intensive counselling and bupropion, workplace	No intervention	Dominant
PH10: Smoking cessation	Nicotine patch, group counselling	No intervention	Dominant
PH10: Smoking cessation	Nicotine patch, individual counselling	No intervention	Dominant
PH10: Smoking cessation	Brief advice plus self-help material plus NRT	No intervention	£ 984.00
PH12: Social and emotional wellbeing in primary schools	Universal intervention, emotion + cognition	No intervention	£5,278.00
PH12: Social and emotional wellbeing in primary schools	Universal, emotion only	No intervention	£10,594.00
PH12: Social and emotional wellbeing in primary schools	Focused intervention, emotion + cognition	No intervention	£ 177,560.00
PH12: Social and emotional wellbeing in primary schools	Focused intervention, emotion only	No intervention	£ 988,404.00
PH13: Physical activity in the workplace	Walking programme	No intervention	£ 686.34
PH13: Physical activity in the workplace	Counselling	Usual care (control group no details in abstract)	£ 864.50
PH14: Preventing the uptake of smoking by children and young people	Mass media	No intervention	£ 49.00
PH14: Preventing the uptake of smoking by children and young people	Point of sale	No intervention	£ 1,690.00
PH15: Risk of dying prematurely - smoking cessation general population	Drop-in/rolling community-based sessions	No intervention (background quit rate)	£ 91.00
PH15: Risk of dying prematurely - smoking cessation general population	Client-centred approaches	No intervention	£ 93.00
PH15: Risk of dying prematurely - smoking cessation general population	Proactive telephone counselling (Ockene et al. review)	Usual care or intervention but no telephone counselling	£ 195.00
PH15: Risk of dying prematurely - smoking cessation general population	Dentist-based interventions	Usual care	£ 331.00
PH15: Risk of dying prematurely - smoking cessation general population	Quit and win	DK, most in Bains review	£ 342.00
PH15: Risk of dying prematurely - smoking cessation general population	Pharmacist-based interventions	Usual care	£ 546.50
PH15: Risk of dying prematurely - smoking cessation general population	Proactive telephone counselling	Usual care or intervention but no telephone counselling	£ 568.00
PH15: Risk of dying prematurely - smoking cessation general population	Identify smokers through other means	No intervention	£ 644.00
PH15: Risk of dying prematurely - smoking cessation general population	Incentive NRT	No intervention	£ 671.00
PH15: Risk of dying prematurely - smoking cessation general population	Workplace intervention (WI)	No intervention	£ 1,399.00
PH15: Risk of dying prematurely - smoking cessation general population	Client-centred social marketing	No intervention	£ 1,564.00
PH15: Risk of dying prematurely - smoking cessation general population	Incentive, NRT prescription	No intervention	£ 1,627.00
PH15: Risk of dying prematurely - smoking cessation general population	Incentive workplace	Usual care (WI with no incentive)	£ 2,089.00
PH15: Risk of dying prematurely - smoking cessation general population	Identifying and reaching	Usual care	£ 2,535.00

PH15: Risk of dying prematurely - smoking cessation general population	Pharmacist-based interventions	No intervention	£ 3,151.00
PH15: Risk of dying prematurely - smoking cessation general population	Brief intervention, pregnant women	Usual care	£ 3,792.50
PH15: Risk of dying prematurely - smoking cessation general population	Invitation for screening	No intervention	£ 4,260.00
PH15: Risk of dying prematurely - smoking cessation general population	Pharmacist-based interventions	No intervention	£ 4,892.00
PH16: Mental wellbeing of older people	Tri-weekly walking programme after 6 months.	Information and education	£ 7,400.00
PH16: Mental wellbeing of older people	Advice about physical activity	Usual care	£ 35,900.00
PH16: Mental wellbeing of older people	Advice about physical activity	Nutrition	Dominated
PH17: Promoting physical activity for children and young people	Walking buses	No intervention	£ 4,007.63
PH17: Promoting physical activity for children and young people	Dance classes	No intervention	£ 27,570.06
PH17: Promoting physical activity for children and young people	Free swimming	No intervention	£ 40,461.56
PH17: Promoting physical activity for children and young people	Community sports	No intervention	£ 71,456.21
PH19: Management of long-term sickness and incapacity for work	WI	Usual care for musculoskeletal disorders	Dominant
PH19: Management of long-term sickness and incapacity for work	Physical activity and education and workplace visit (PW)	Usual care for musculoskeletal disorders	Dominant
PH19: Management of long-term sickness and incapacity for work	Physical activity and education (PA)	Usual care for musculoskeletal disorders	£ 2,758.00
PH20: Social and emotional wellbeing in secondary education	Intervention to reduce bullying	No intervention	£9,600.00
PH22: Promoting mental wellbeing at work	Individual stress management, health coach	No intervention	£3,470.00
PH22: Promoting mental wellbeing at work	Individual stress management, six group sessions	No intervention	£4,998.00
PH22: Promoting mental wellbeing at work	Individual stress management, seven group sessions	No intervention	£15,031.00
PH23: School based interventions to prevent the uptake of smoking	Delay/delay	No intervention (or usual education)	£7,282.50
PH24: Alcohol use disorders: preventing harmful drinking	Screening and brief intervention by practice nurse at GP registration	No intervention	Dominant
PH24: Alcohol use disorders: preventing harmful drinking	Screening and brief intervention by GP during appointment	No intervention	Dominant
PH24: Alcohol use disorders: preventing harmful drinking	Screening and brief intervention at A&E	No intervention	£0.00
PH26: Quitting smoking in pregnancy	Rewards	No intervention (aggregate of controls)	Dominant
PH26: Quitting smoking in pregnancy	Other	No intervention (aggregate of controls)	Dominant
PH26: Quitting smoking in pregnancy	Feedback	No intervention (aggregate of controls)	£1,992.00
PH26: Quitting smoking in pregnancy	Pharmacotherapies	No intervention (aggregate of controls)	£2,253.00
PH26: Quitting smoking in pregnancy	Stages of change	No intervention (aggregate of controls)	£3,033.00
PH26: Quitting smoking in pregnancy	Cognitive behaviour strategies	No intervention (aggregate of controls)	£4,005.00
PH27: Weight management in pregnancy	Weight management interventions	Conventional postnatal care	£ 9,096
PH28: Looked after children, Transition support services	Georgiades (2005) men	Usual care/no intervention	Dominant
PH28: Looked after children, Transition support services	Georgiades (2005) women	Usual care/no intervention	Dominant
PH28: Looked after children, Transition support services	Lindsey & Ahmed (1999) men	Usual care/no intervention	Dominant
PH28: Looked after children, Transition support services	Lindsey & Ahmed (1999) women	Usual care/no intervention	Dominant
PH28: Looked after children, Transition support services	Scannapieco (1996) men	Usual care/no intervention	Dominant
PH28: Looked after children, Transition support services	Scannapieco (1996) women	Usual care/no intervention	Dominant
PH30: Unintentional injuries in the home	Free smoke alarm programme	No intervention	£ 23,046
PH31: Unintentional injuries on the road	Advisory 20 mph zones	No intervention	£ 22,952
PH31: Unintentional injuries on the road	Mandatory 20 mph zones high casualties	No intervention	£ 89,700
PH31: Unintentional injuries on the road	Mixed priority routes	No intervention	£ 304,823
PH31: Unintentional injuries on the road	Mandatory 20 mph zones low casualties	No intervention	£ 457,762
PH32: Skin cancer prevention	Verbal advice and print to parents—children at home (Turissi)	No intervention (current practice)	£ 6,700
PH32: Skin cancer prevention	Verbal advice group session, uni students	No intervention (current practice)	£ 42,000
PH32: Skin cancer prevention	Multicomponent community	No intervention	£ 207,339

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Table 3 – (*continued*)

Guideline topic and ID	Intervention	Comparator	ICER
PH32: Skin cancer prevention	Verbal advice, in school and at home activities children at school and newsletter (School) Buller	No intervention (current practice)	£ 260,000
PH32: Skin cancer prevention	Multicomponent community	No intervention	£ 1,069,469
PH32: Skin cancer prevention	Multicomponent work setting 21- to 65-year-olds	Delayed intervention	£ 1,298,476
PH32: Skin cancer prevention	Construction of shade sail	No built shade	£ 2,394,901
PH32: Skin cancer prevention	Multicomponent beach and pool	No intervention	£ 10,621,954
PH32: Skin cancer prevention	Multicomponent education 2–7 years (Bauer)	3-h education	£ 32,498,835
PH32: Skin cancer prevention	Multicomponent education 13- to 15-year-olds	3-h education	£ 50,940,170
PH32: Skin cancer prevention	Multicomponent healthcare, 13- to 15-year-olds	PA and diet	£ 82,264,556
PH33: HIV testing, increasing uptake in black Africans	Mass media	No intervention	£ 27,566
PH33: HIV testing, increasing uptake in black Africans	Sport	No intervention	£ 30,509
PH33: HIV testing, increasing uptake in black Africans	Choice of rapid or standard testing	No intervention	£ 31,333
PH33: HIV testing, increasing uptake in black Africans	Music	No intervention	£ 32,357
PH34: HIV testing, increasing uptake in MSM	Opt-out intervention	No intervention (no testing)	£ 42,145
PH34: HIV testing, increasing uptake in MSM	Choice or rapid, oral or standard testing	No intervention (no testing)	£ 42,632
PH34: HIV testing, increasing uptake in MSM	Peer referral intervention	No intervention (no testing)	£ 50,358
PH34: HIV testing, increasing uptake in MSM	Retreat intervention	No intervention (no testing)	£ 56,285
PH34: HIV testing, increasing uptake in MSM	Multicomponent mass media	No intervention (no testing)	£ 62,613
PH35: Type 2 diabetes: pop and comm	Large-scale region-wide multicomponent	No intervention	Dominant
PH35: Type 2 diabetes: pop and comm	Multicomponent small scale	No intervention	£ 562
PH35: Type 2 diabetes: pop and comm	Broad dietary education/cooking skills	No intervention	£ 878
PH35: Type 2 diabetes: pop and comm	New food retail outlet	No intervention	Dominated
PH38: Type 2 diabetes, S Asians 25-39	LPDS $\geq$ 5.25, HbA1c $\geq$ 6.0% (+intensive intervention)	Vascular checks (without intervention)	£ 11,273
PH38: Type 2 diabetes, high risk	LPDS $\geq$ 4.75, HbA1c $\geq$ 5.85% (+intensive intervention)	Vascular checks (with intervention)	£ 15,192
PH40: Social emotional wellbeing early years	Sure start, years 1, 3 and 5	No intervention	Dominant
PH40: Social emotional wellbeing early years	Weekly home visits	No intervention	£ 85,097
PH41: Physical activity: walking and cycling	Multicomponent sustainable travel towns	No intervention	£ 997
PH41: Physical activity: walking and cycling	TravelSmart	No intervention	£ 1,400
PH41: Physical activity: walking and cycling	Pedometer	No intervention	£ 1,763
PH41: Physical activity: walking and cycling	Pedometer sustained	No intervention	£ 4,774
PH41: Physical activity: walking and cycling	Multicomponent cycling demonstration	No intervention	£ 4,830
PH41: Physical activity: walking and cycling	Pedometer 4 week	No intervention	£ 12,351
PH43: Hep B&C testing	GP education and paid targeted testing of ex-IDUs	No intervention	£ 13,877
PH43: Hep C testing	Dried blood spot testing in addiction services	No intervention (control not offering DBS, i.e., do nothing)	£ 14,632
PH43: Hep B&C testing	DBS in prison	No intervention (control not offering DBS, i.e., do nothing)	£ 59,418
PH44: Physical activity: brief advice for adults in primary care	Brief advice for 1 year	Usual care	£ 1,730
PH45: Smoking: harm reduction	CDTQ + generic support	No intervention	Dominant
PH45: Smoking: harm reduction	CDTQ	No intervention	Dominant
PH45: Smoking: harm reduction	Reduce	No intervention	Dominant
PH45: Smoking: harm reduction	CDTQ + specialist support	No intervention	£ 437
PH45: Smoking: harm reduction	CDTQ + NCP	No intervention	£ 544
PH45: Smoking: harm reduction	CDTQ + NCP + generic support	No intervention	£ 668
PH45: Smoking: harm reduction	Temporary abstinence + generic support	No intervention	£ 706
PH45: Smoking: harm reduction	Reduce + generic support	No intervention	£ 706

PH45: Smoking: harm reduction	Temporary abstinence + NCP + generic support	No intervention	£ 765
PH45: Smoking: harm reduction	Reduce + NCP + generic support	No intervention	£ 765
PH45: Smoking: harm reduction	CDTQ + NCP + specialist support	No intervention	£ 2,294
PH45: Smoking: harm reduction	Temporary abstinence + NCP + specialist support	No intervention	£ 2,458
PH45: Smoking: harm reduction	Reduce + NCP + specialist support	No intervention	£ 2,458
PH45: Smoking: harm reduction	Abrupt + NCP substitute + generic support	No intervention	£ 3,558
PH45: Smoking: harm reduction	Abrupt + NCP substitute (nb. Source says includes brief advice)	No intervention	£ 7,388
PH45: Smoking: harm reduction	Temporary abstinence + NCP	No intervention	£ 7,843
PH45: Smoking: harm reduction	Reduce + NCP	No intervention	£ 7,843
PH45: Smoking: harm reduction	Temporary abstinence + specialist support	No intervention	£ 8,464
PH45: Smoking: harm reduction	Reduce + specialist support	No intervention	£ 8,464
PH45: Smoking: harm reduction	Temporary abstinence	No intervention	Dominated
PH48: Smoking cessation secondary care	High-intensity behavioural therapy	Brief advice	Dominant
PH48: Smoking cessation secondary care	High intensity behavioural therapy + pharmacological therapy	Brief advice/low intensity	Dominant
PH48: Smoking cessation secondary care	Total smoke-free policy, indoor and outdoor Gadomski	Indoor smoke-free policy	Dominant
PH48: Smoking cessation secondary care	Pharmacological for general inpatients	Low-intensity behavioural therapy	Dominant
PH48: Smoking cessation secondary care	Behavioural therapy+ pharmacological therapy for patients with PTSD	Usual care	Dominant
PH48: Smoking cessation secondary care	Pharmacological for COPD Borglykke	Usual care	Dominant
PH48: Smoking cessation secondary care	High-intensity behavioural intervention for pregnant women	Usual care	£ 634
PH48: Smoking cessation secondary care	Conditional incentives for pregnant women	Unconditional incentives	£ 3,306
PH50: Domestic violence and abuse: multiagency working	Harm reduction, cognitive trauma therapy, battered women	No intervention	Dominant
PH50: Domestic violence and abuse: multiagency working	Incidence reduction, independent domestic violence advisors	No intervention (assuming a percent will access services without IDVA)	Dominant
PH54: Physical activity exercise referral schemes	ERS	Usual care	£ 88,742

OH prog, oral health programme; COPD, chronic obstructive pulmonary disease; HD, heart disease; CMD, common mental disorder; STRIVE, support to reunite, involve and value each other; SSRI, selective serotonin reuptake inhibitors; PP, point prevalence; NRT, nicotine replacement therapy; OTC, over the counter; PW, physical activity and workplace; PA, physical activity; GP, general practitioner; A&E, accident and emergency; MSM, men who have sex with men; LPDS, leicester practice database score; HbA1c, hemoglobin A1c; IDUs, injecting drug users; DBS, dried blood spot; CDTQ, cut down to quit; NCP, nicotine containing product; IDVA, independent domestic violence advisors; ERS, exercise referral scheme; NICE, national institute for health and care excellence; ICER, incremental cost-effectiveness ratio.

great enough, not to enable a meta-analysis to be considered at all. In this case, the ICERs should presumably be kept apart because the effect of the intervention differs either by the population subgroup or by setting.

For the exercise of considering the median of all ICERs considered by NICE PH, the assumption of similar cost distributions for each subgroup (used in the paragraph previously) may not hold. For the so-called hard-to-reach groups or by setting, such as prison or workplace, the average per-person cost may change. This introduces a further complication, which made analysis even more difficult when individual-level costs and effects are correlated.[9]

Thus, a more in-depth analysis is well-nigh impossible to undertake. The best we felt that we could do was to collapse ICERs in places where it looks as if many individual ICERs belong to a similar group but without weighting the corresponding 'meta-ICER' for the increase in degrees of freedom generated by consolidation. This acts as a kind of sensitivity analysis, flawed though it may be.

More fundamentally, what does the distribution of ICERs across all NICE PH evidence really tell us? Its usefulness must be cautionary: of the evidence considered, a moderate number of interventions were cost saving and a high percentage very cost-effective. However, a considerable tail was either not cost-effective (ICERs over £20,000) or a few were not even effective (intervention is dominated by its comparator).

Type of intervention

On the composition of the interventions, some of the least costly interventions, and thus almost certainly, those with low ICERs, have probably been underrepresented. Foremost among these are laws, regulations and taxes to promote good health and avoid illness, such as the ban on smoking in pubs, clubs, restaurants, shops and workplaces that had a one-off cost of legislating and a relatively low enforcement cost, TV and social media advertising giving out messages (on healthy eating and lifestyle, safe sex and so on) and taxing sugary drinks. Even then, not all such laws and regulations would be cost-effective. For example, some building regulations to reduce accidents may cost very large sums for relatively small benefits. However, the absence of the appraisal of areas such as those mentioned previously was not part of NICE's remit after 2010, so the full value of PH interventions will not have been captured in our analysis.

Table 4 – Number (%) of ICERs identified by cost-effectiveness and the type of comparator.

	Comparator		
	No intervention	Usual care	Other intervention
Cost saving	42 (19%)	17 (22%)	22 (37%)
≤£20,000/QALY	124 (54%)	46 (60%)	22 (37%)
>£20,000/QALY	56 (25%)	12 (16%)	6 (10%)
Dominated	4 (2%)	2 (3%)	10 (17%)
Total N	226	77	60

$\chi^2 = 45.6$, $P < 0.01$; in 17 of 380 cases, the comparator could not be categorised, given the information in the reports.
ICERs, incremental cost-effectiveness ratios.

Comparing the cost-effectiveness of PH interventions with technology appraisals

It would be tempting to compare the median ICER estimated for PH interventions with that found in technology appraisals at NICE. However, we think this is ill advised. The underlying conditions that drive the ICERs in the two areas are very different. Many technology appraisal (TA) treatments are concerned with new drugs that are under an active patent at the time of appraisal. Patents are designed to promote innovation and technological advancement. They do this by

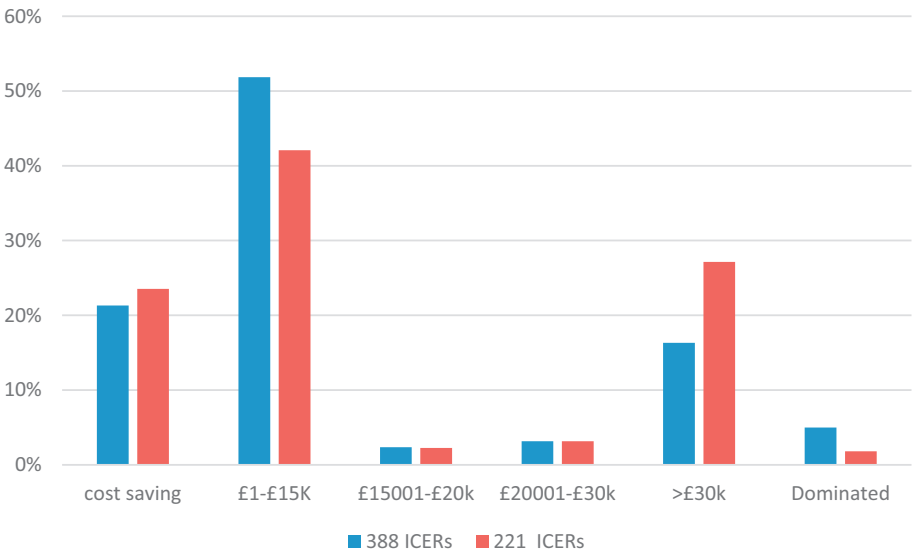

Fig. 1 – Percentage of ICERs from cost saving to dominated for public health interventions assessed and published by NICE from March 2006 to March 2018, including ($n = 380$) and excluding ($n = 221$) clusters of the same intervention or subgroup. ICERs, incremental cost-effectiveness ratios; NICE, National Institute for Health and Care Excellence.

Table 5 – Effect of comparator on incremental cost-effectiveness ratios (ICERs)—illustrative examples from assessment of smoking cessation interventions.

Intervention quit rate	Comparator quit rate	Incremental costs	Incremental QALYs	ICER
Patch and nasal spray 27% (NG92)	No intervention 2%	£3	0.26	£13
Patch and nasal spray 27% (NG92)	Patch only 11%	£158	0.17	£948
Abrupt quit and NRT 6% (PH45)	No intervention 2%	£197	0.035	£5,699
Abrupt quit and NRT 6% (PH45)	Cut down to quit and NRT 7.8%	£292	−0.048	Dominated
Abrupt quit and NRT 6% (PH45)	Abrupt quit and NRT and specialist support 15%	£114	−0.078	Dominated
Bupropion (PA) 29.00% (NG92)	CBT (PA) 20.90%	−£330	0.08	Dominant
Bupropion (PA) 29.00% (NG92)	NRT (PA) 29.60%	£171	−0.01	Dominated

PA is prolonged abstinence, which is a more conservative measure of quitting than point prevalence.
QALYs, quality adjusted life years.

keeping generics at bay for a limited time, allowing the innovator to charge a price sufficiently high to recoup research and development costs and additionally provide a reward for doing so. As a result, new technologies can be expected to have high incremental costs.[10] This situation rarely occurs in PH guidelines. The appraisal of any new drug for secondary prevention (and primary prevention) will be conducted by the TA directorate of NICE and inserted into an appropriate PH guideline (if one exists).

Appropriateness of the QALY and thresholds for local authorities

The needs of local councils with respect to PH are different from those of the NHS, so perhaps, for PH, there should be a wider generic measure of benefit (or at least an augmented measure starting with QALYs but not ending there) that takes other needs of citizens into account.[11,12] For example, what concerns many old people under the care of local authorities is their level of independence and loneliness. For teenagers, in particular, problems, such as boredom and the changing pattern of leisure time towards virtual reality and the consequent lack of social interactions, are not captured by the way health is currently measured. For that reason, it is understandable that many local councils may place less reliance on NICE guidelines on PH than the NHS does on clinical guidelines.

In addition, a lack of sufficient funds for LAs could point to a widening ICER threshold gap between PH interventions carried out by LAs and treatment interventions carried out by the NHS, whose funds have not been cut to the same extent. In a previous paragraph, we pointed out that new drugs had a higher threshold ICER than other interventions in the NHS because that was the way that new drug discoveries were funded by way of patents. However, the erosion of funds for PH[13–15] means that not everything can be funded at the existing ICER threshold. If cuts in PH services were carried out efficiently, the interventions that would no longer be funded would be those with the highest ICERs, so that, de facto, a new and lower ICER would be established. To the extent that some extremely cost effective interventions have been cut,[16] and others without evidence of cost effectiveness have been retained it follows the new and smaller PH budget is not producing as much health gain as it should. This is most obvious for local authorities who, due to commissioning cycles that operate over the short term, are less interested in measuring benefits that occur after 1 to 3 years into the future. Many PH programmes that will be highly cost-effective taken across a lifetime will not be countenanced if the time horizon is truncated so severely. Such neglect of preventive interventions that give few immediate health benefits is likely to lead to huge future costs caused by having to treat what should more cheaply have been prevented.

Owen et al. reported growing evidence that these significant financial pressures are leading local authorities to disinvest in highly cost-effective non-statutory PH services.[2] Unless the trends to lower funding are turned around, the warning given in that article will lead to lower life expectancy in future.

Limitations of this study

In this study, we attempted to address the inclusion of multiple estimates for the same intervention. We did this by combining estimates based on either subgroup analyses or different model assumptions where we thought this to be appropriate. We also limited ICERs to those based on the most recent evidence for a given intervention. These modifications required a judgement of some kind to be made. For example, we combined the ICERs for four interventions of walking trails reported in the physical activity guideline PH8. The ICERs for these trails ranged from £87/QALY to £25,150/QALY. The main difference between them is the wide range in costs of the construction material used for the trails (e.g. concrete or woodchip). Similarly, we combined the four ICERs for an intervention to prevent the uptake of smoking (PH23). The ICERs reflect different modelling assumptions about the long-term effects of school-based prevention programmes. For example, one represented a decrease in smoking prevalence persisting beyond adolescence and another, a delay in smoking uptake without any change in prevalence beyond adolescence. Assuming a decrease in uptake produced an ICER of £2,030/QALY, while assuming a delay in uptake yielded an ICER of £11,300/QALY. Finally, regarding the use of the most recent evidence, some models used estimates of effectiveness from individual studies that were considered to offer the best quality evidence; some used multiple estimates to reflect the range of evidence from different studies, and others used meta-analyses where these were available. Others may take a different view on what is appropriate to combine. Nevertheless, we think it unlikely that reanalyses will change the conclusion that most of the PH interventions considered in NICE guidelines to date are cost-effective.

A further limitation concerns our attempt to explore the impact of the comparator. There were considerable challenges in classifying comparators into three types: 'no intervention', 'usual care' and 'another intervention'. For example, 'usual care' comparators might be no intervention, waiting list control or another intervention. Comparators comprising 'no interventions' require the estimation of baselines against which the interventions can be compared. Thus, further subcategories might be warranted to take account of different approaches to establish baselines. Our initial expectation that interventions compared against 'no intervention' are most likely to be identified as cost-effective or cost saving is not what we found. It is likely there are more meaningful ways, than aggregating data across interventions, to assess the impact of comparators. Nevertheless, the analysis, and our case study of smoking cessation interventions, reinforces the importance of the comparator in determining the cost-effectiveness of an intervention. As concluded by Owen et al.,[2] it is imperative that decision makers ensure that they consider economic analysis that is similar to their decision problem in terms of population, intervention and comparator.

Conclusion

PH grants to local authorities have significantly reduced over recent years, with further cuts set to continue to 2020/2021. It has been said recently that 'Rising rates of obesity, an unhealthy relationship with alcohol and fast food and obstinate pockets of tobacco use are combining with rising life expectancy to exert huge pressures on existing health services.'[17] Further cuts to PH spending and activity will be the 'falsest of false economies, not least for the NHS'.[14]

This analysis shows that most PH interventions considered by NICE represent good value for money but some do not. It also shows that the results can be sensitive to the approach adopted. It is crucial, therefore, that decision makers and commissioners consider these factors, along with the relevant costs and benefits, when deciding which interventions to fund.

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