Evidence review

School-based interventions to prevent the uptake of smoking among children and young people: cost-effectiveness review

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School-based interventions to prevent the uptake of smoking among children and young people: cost-effectiveness review

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West Midlands Health Technology Assessment Collaboration

The West Midlands Health Technology Assessment Collaboration (WMHTAC) is an organisation involving several universities and academic groups who collaboratively undertake research synthesis to produce health technology assessments. Most of our members are based in the Public Health, Epidemiology & Biostatistics Unit, University of Birmingham, however other members are drawn from a wide field of expertise including economists and mathematical modellers from the Health Economics Unit, University of Birmingham.

WMHTAC produce systematic reviews, health technology assessments and economic evaluations for NHS R&D HTA programme (NCCHTA), the National Institute for Health and Clinical Excellence (NICE), and for the health service in the West Midlands. WMHTAC also undertakes methodological research on research synthesis, and provides training in systematic reviews and health technology assessment.

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WMHTAC work in close collaboration with the Peninsula Technology Appraisal Group (PenTAG) with respect to providing support to the CPHE.

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Executive Summary

Objectives:

This report is a cost-effectiveness review which complements three additional reports (effectiveness review, qualitative review and economic modelling report). The four reports together form the evidence review which aims to address the two key questions defined in the NICE scope:

- Which school-based interventions, or combination of school-based interventions, are effective and cost-effective in preventing children and young people from taking up smoking?
- What factors aid the delivery of effective school-based interventions to prevent the uptake of smoking? What are the barriers to successful delivery?

This cost-effectiveness review specifically address the following question:

Are any school-based interventions more cost-effective than usual practice, minimal or no intervention, or other school-based interventions in preventing children and young people from taking up smoking?

Methods:

A systematic review of economic literature was undertaken. Major bibliographic databases including the Cochrane Library, York CRD database, MEDLINE, EMBASE ERIC, PsycINFO, ASSIA, HMIC were searched from inception to October 2008. This was supplemented by searches of selected websites.

Study selection was carried out using pre-determined criteria based on the scope issued by NICE. Economic evaluations that were conducted in OECD countries published in English from 1990 onwards and that assessed the cost-effectiveness of school-based interventions to prevent the uptake of smoking among children and young people were included. Data extraction and quality assessment was undertaken by one reviewer and checked by a second reviewer based on the *Methods for development of NICE public health guidance.*

Eight potentially relevant studies were identified and six were included in this review. Three articles analysed results from an experimental study while three modelled a hypothetical programme, although in one case an actual programme was used as an exemplar for estimating intervention costs. In all cases, the costs and benefits of the intervention were compared to controls which received usual education only. Two articles presented cost-effectiveness analyses (one from a health care provider perspective and another from a societal perspective), while four articles presented cost-benefit analyses. Studies were published between 2000 and 2008, although they used effectiveness data from the 1980s and 1990s. The three articles based on experimental studies all used interventions based partly or wholly on social influence models.

Synthesis was narrative and meta-analysis was not employed. The methodological quality of each study was rated using the Drummond checklist, and its applicability to the relevant population in the UK assessed. There was particular focus on whether sufficient economic evaluations exist to address issues of cost-effectiveness and, in existing models, how outcomes at the end of the intervention period or the last follow-up of an effectiveness study are used to estimate lifetime smoking and health-related outcomes.

Evidence statements are given below:

Cost effectiveness evidence statements

Excluding two studies that appear to be unrepresentative outliers, the cost of the intervention ranged from C$67 (£30) to €75 (£60) per participant.

Indirect costs and benefits formed a large proportion of total costs and benefits in all studies conducted from a societal perspective.

Four articles represented the effect size in terms of reduction in smoking prevalence in the intervention group, ranging from 2.04% to 4.5%. Two articles represented the effect size in terms of reduction in smoking uptake in the intervention group, ranging from 16.8% until age 18 to 56% for 4 years.

The three cost-effectiveness analyses suggested that in the base case cost per QALY gained ranged from $448 (£360) to €19,900 (£16,000). Two of them reported the cost per LY gained ranged from $703 (£560) to €18,200 (£15,000). The wide range in these figures is largely due to the low estimate of intervention costs reported in the study with the lowest cost per LY/QALY gained.

All three cost-benefit analyses suggested that the modelled intervention would be of net benefit, with the benefit-cost ratio ranging from 2.0 to 15.4. However, the lower figure

represents the ratio for a generic drug prevention programme and does not include indirect (productivity loss) costs of smoking, so is not directly comparable with the other two analyses.

Overall conclusions about net benefit or cost-effectiveness were robust to changes in single parameters except for the discount rate, time horizon, prevalence of smokers at baseline, effect size and duration of effect.

No conclusions could be drawn about the interaction between intensity of intervention, social determinants of health (age, sex, ethnicity and socio-economic status) and the cost-effectiveness of the modelled interventions.

Four studies found that the conclusions were robust to changes in the parameters governing costs and the health effects of smoking when varied using probabilistic sensitivity analysis, a technique in which the value of each parameter is sampled many times from a joint distribution representing the uncertainty in parameter values.

Conclusions:

All of the studies reviewed suggest that school-based smoking prevention programmes may be an efficient use of resources within the health care and education jurisdictions considered. However, the two studies that considered indirect benefits found that the majority of benefits accrued by such interventions were attributable to a reduction in productivity loss due to smoking-related morbidity and premature mortality. Hence it is not certain whether the conclusions of these studies are applicable to the UK where such considerations are not taken into account in the NICE reference case. Furthermore, most of the studies failed to take into account the deterioration of the effect of such interventions in the long-term, and hence may have overestimated the impact of school-based smoking prevention programmes.

1 Introduction

1.1 Aims

The National Institute for Health and Clinical Excellence (NICE) has been asked by the Department of Health (DH) to develop guidance on public health interventions aimed at preventing the uptake of smoking among schoolchildren (National Institute for Health and Clinical Excellence, 08). This cost-effectiveness review is part of the evidence review undertaken by the West Midlands Health Technology Assessment Collaboration (WMHTAC) and commissioned by NICE to support the development of this guidance. The report reviews existing evidence on the cost-effectiveness of school-based interventions to prevent the uptake of smoking among children and young people. The findings of the report will be used to inform the development of a de novo economic modelling on this topic, which will be described in a separate report (the 'economic modelling report'). These two reports will be complemented by another review of evidence on the effectiveness of school-based interventions (the 'effectiveness review'), and a further review of qualitative literature that explores facilitators and barriers to the successful delivery of these interventions (the 'qualitative review').

1.2 Background

Smoking is responsible for about one fifth of deaths in the UK, including more than a third of deaths from respiratory causes and more than a quarter of deaths due to cancer (Peto, Lopez, Boreham, and Thun, 06). The cost of smoking to the NHS was recently estimated at £2.7 billion in 2006-7 (Callum, 08).

About two-thirds of respondents in the General Household Survey of Great Britain who were smokers or ex-smokers reported that they started smoking before the age of 18 (Robinson and Lader, 07). An early age of smoking initiation has been found to be associated with not quitting smoking later in life (Khuder, Dayal, and Mutgi, 99;Breslau and Peterson, 96), and to have a higher risk of smoking related morbidity (Muller, 07).

A 1998 Department of Health White Paper set a target to reduce smoking prevalence in children from 13% to 9% or less by the year 2010; with a decrease to 11% by the year 2005 (Department of Health, 98). This appears to have been successful, since among secondary school pupils aged 11 to 15, the proportion who smoked regularly has decreased from 11% in 1982 to 6% in 2007 (Clemens, Jotangia, Lynch, Nicholson, and Pigott, 08). The decline of 3% points between 2006 and 2007 was substantially larger than the overall trend seen between 1982 and 2006. However, the prevalence of smoking in young people has declined much more gradually than prevalence of

smoking in adults, which has declined steadily from 45% in 1974 to a little over 20% in 2007 (Robinson et al. 07).

One option for further decreasing the rate of smoking initiation during adolescence is through school-based smoking prevention programmes. Reviews of effectiveness studies of such programmes in the literature have shown that they can reduce the prevalence of smoking among adolescents in the short term, but have little or no effect in the long-term (Wiehe, Garrison, Christakis, Ebel, and Rivara, 05;Thomas and Perera, 06). This was confirmed by the results of our own effectiveness review.

1.3 Structure of report

The structure of this report is as follows:

- Chapter 2 discusses the scope of the research questions, how the literature search was conducted, the retrieval of papers, the selection of studies for inclusion, data extraction and quality assessment.
- Chapter 3 provides the cost-effectiveness findings.
- Chapter 4 discusses the review findings, highlighting their applicability, limitations and any gaps.

Appendices present supporting documents, namely protocol, example search strategies, inclusion/exclusion checklists, and quality assessment tools.

2 Methods

2.1 Research questions

Two key questions were specified in the scope published by NICE for this guidance (National Institute for Health and Clinical Excellence, 08):

- Which school-based interventions, or combination of school-based interventions, are effective and cost-effective in preventing children and young people from taking up smoking?
- What factors aid the delivery of effective school-based interventions to prevent the uptake of smoking? What are the barriers to successful delivery?

The four reports (cost-effectiveness review, effectiveness review, qualitative review and economic modelling report) that collectively form the evidence review undertaken by the WMHTAC aim to address these questions.

For this cost-effectiveness review, the primary question being addressed is:

Are any school-based interventions more cost-effective than usual practice, minimal or no intervention, or other school-based interventions in preventing children and young people from taking up smoking?

Studies that address the primary research question are reviewed to identify key determinants of cost-effectiveness of these interventions, for example:

- Does cost-effectiveness depend on whether the interventions were preventing rather than delaying the onset of smoking?
- Does cost-effectiveness depend on the status of the person (e.g., peer, teacher or external trainer/researcher) delivering it, or the intensity of the intervention (longer versus shorter duration programmes / booster sessions after programme completion versus no booster), or the site/setting where the intervention takes place?
- Does the age, sex, ethnicity or socio-economic status of the target audience influence cost-effectiveness?

2.2 Literature search

2.2.1 Overview

To address the question "Which school-based interventions are effective and cost-effective in preventing young people from taking up smoking?" the following types of literature were targeted:

- Primary studies located via searches of bibliographic databases and selected websites
- Primary studies identified from references in existing systematic reviews
- Studies suggested by experts/stakeholders.
- Studies obtained via public health and other appropriate websites

The searches of bibliographic databases involved an initial scoping search during which key references were identified and search strategies were refined; a main search using the agreed search strategies to identify potentially relevant studies for all four reports; and a cost-effectiveness search to facilitate the identification of studies specifically relevant to the cost-effectiveness review.

2.2.2 Search process and methods

Bibliographic database search strategies

Our initial scoping searches targeted systematic reviews, evidence briefings and guidelines as well as a brief search for primary studies. A search strategy was developed and tested using a number of significant studies retrieved during this scoping process. This strategy was then refined and expanded after discussion with information specialists at NICE. The key concepts of the search question are the intervention i.e. 'interventions used to prevent the uptake of smoking ' and the population 'children/young people in school/educational settings'.

The databases and websites that were searched are described in subsequent sections. The final, full search strategy for the main search is detailed in Appendix 1 and for the cost-effectiveness search is detailed in Appendix 2. The search process has been clearly documented (databases searched, date searched, time span searched, results of individual searches) to ensure it is transparent and repeatable. Search results have been saved as text files and also stored in a Reference Manager database managed by the reviewers.

Bibliographic databases

The following electronic databases were searched:

- Systematic reviews and primary studies: Cochrane Library (Wiley) (CDSR, DARE, HTA and CENTRAL) 2008 Issue 4 , York CRD database (DARE and HTA) October 2008, MEDLINE (Ovid) 1950 – November week 1 2008 , MEDLINE In Process at 12 November 2008, EMBASE (Ovid) 1980 – 2008 week 45, ERIC (CSA) at 12 November 2008, PsycINFO (Ovid) 1987 – November week 2 2008, ASSIA (CSA) at 14 November 2008, and HMIC (Ovid) October 2008

- Cost effectiveness studies: NHS EED database (Cochrane Library), EconLit (EBSCO) 19 November 2008 , MEDLINE (Ovid) 1950 – November week 1 2008, EMBASE (Ovid) 1980 – 2008 week 45

As the searches sought to retrieve both quantitative and qualitative studies, no study design filter was employed. Instead all studies retrieved were sifted by the reviewers and tagged according to type of study. For the MEDLINE and EMBASE searches for systematic reviews the Haynes optimized reviews filter (Montori et al, 2005) was used to target such reviews in the initial scoping searches. Reviews published in the intervening period were tagged by the reviewers during the sifting process of the main search.

Cost effectiveness studies in MEDLINE and EMBASE were pinpointed by using an economic study filter (Duffy and Christie, 2007) based on the CRD model combined with the parent subject search to locate more easily studies providing evidence on cost-effectiveness.

The searches used the following limits: English language only and a date range of 1990-2008.

Selected websites

The database searches were also supplemented by searches of the following websites:

- ARIF website and database http://www.arif.bham.ac.uk/
- TRIP database http://www.tripdatabase.com/index.html
- Clinical Evidence http://clinicalevidence.bmj.com/ceweb/conditions/index.jsp
- Bandolier http://www.medicine.ox.ac.uk/bandolier/index.html
- Cochrane Public Health Group http://www.ph.cochrane.org/en/index.html
- The Campbell Collaboration http://www.campbellcollaboration.org/
- The Evidence for Policy and Practice Information and Co-ordinating Centre (EPPI-Centre Social Science Research Unit Institute of Education, University of London) http://eppi.ioe.ac.uk/cms/
- The Trials Register of Promoting Health Interventions (TRoPHI) http://eppi.ioe.ac.uk/webdatabases/Intro.aspx?ID=5
- NICE public health guidance http://www.nice.org.uk/guidance/index.jsp?action=byType&type=5
- HDA publications via NICE website http://www.nice.org.uk/aboutnice/whoweare/aboutthehda/hdapublications/hda_publications.jsp
- UK Public Health Association http://www.ukpha.org.uk/
- Websites of Public Health Observatories
- Department for Children Schools and Families http://www.dcsf.gov.uk/index.htm
- National Service Framework for Children, Young People and Maternity Services Case studies Database http://www.childrensnsfcasestudies.dh.gov.uk/children/nsfcasestudies.nsf

- Every Child Matters : Change for Children http://www.everychildmatters.gov.uk/
- Action on Smoking and Health (ASH) http://www.ash.org.uk/
- Quit http://www.quit.org.uk
- Centre for UK Tobacco Control Research http://www.ctcr.stir.ac.uk
- ASH Scotland website http://www.ashscotland.org.uk/ash/
- ASH Wales website http://www.ashwales.co.uk/
- Health Scotland http://www.healthscotland.com/

2.3 Selection of studies for inclusion

Records retrieved from the main search of bibliographic databases were imported into a Reference Manager database, which detected and excluded some of the duplicated records during importing. Among 10625 records imported, a further 1601 duplicated citations were identified and deleted manually. The title/abstract of the remaining 9024 records were screened by one reviewer to identify potentially relevant studies (of any design) using a pre-designed checklist (see Appendix 3). Six-hundred records were considered potentially relevant and full papers for these records were ordered. Among these, eight papers that were considered potentially relevant to the cost-effectiveness review were passed on to the first author (MJ) for assessment of inclusion using the inclusion/exclusion criteria described in the following sections.

2.3.1 Populations

Groups that are included in this review:

Children and young people under 19 years of age attending educational institutions including, but not limited to:

- State-sector primary and secondary schools
- 'Extended schools' where nursery or other informal education is provided
- City technology colleges, academics, grammar schools, further education colleges, special and independent primary and secondary schools and alternative centres of education (such as learning centres, secure training and local authority secure units)
- Consideration was given to disadvantaged and vulnerable groups

Groups that are not included in this review:

- Children under the age of 5 who do not attend an educational institution
- Children and young people who are educated at home
- Children and young people who are excluded from school
- Young people aged over 16 who are not in education
- Young people aged 19 and older

2.3.2 Interventions

Activities/interventions that are included in this review:

Any form of educational interventions principally delivered in schools designed to prevent uptake of tobacco smoking. These include, but are not limited to:

• Information giving, social competence, social influence, combined social influence and competence, or multimodal programmes

• Peer-led, teacher-led, health care worker-led or researcher-led programmes

• Tobacco-focused or tobacco together with other substances such as drugs and alcohols

School-based programmes that had as one their goals deterring the uptake of tobacco smoking are included. Programmes that did not target tobacco smoking but included tobacco smoking as one of the outcome measures are excluded.

Activities/interventions that are not included in this review:

Interventions with no school component, including:

- Mass-media and point-of-sales measures
- Community-based interventions
- Family interventions
- Interventions that challenge the social acceptability of smoking (such as smoke-free homes or cars)
- Interventions to encourage or support children and young people to quit smoking
- Interventions to discourage or reduce the uptake of tobacco chewing and the use of smokeless tobacco by children
- Tobacco pricing policies (e.g. tax increases) or measures to control tobacco smuggling
- Interventions to alter the prevalence of smoking substances other than tobacco (e.g. cannabis, opium, heroin, and crack cocaine)

2.3.3 Comparators

Doing nothing, usual education, and other suitable comparators are considered in this review.

2.3.4 Location and time period

This review covers studies conducted in OECD-listed countries (see Appendix 3) and published from 1990 onwards and reported in English only. Studies conducted in non-OECD countries or published before 1990 are excluded.

2.3.5 Study types and outcomes

This review covers the following types of study:

- RCTs, longitudinal intervention studies and cross-sectional studies with cost-effectiveness, cost consequences, cost benefit analysis, cost utility, cost minimisation or net monetary (cost), and benefit data
- Any econometric study (including decision analytic models) and epidemiological models or both that contain relevant effectiveness or economic data

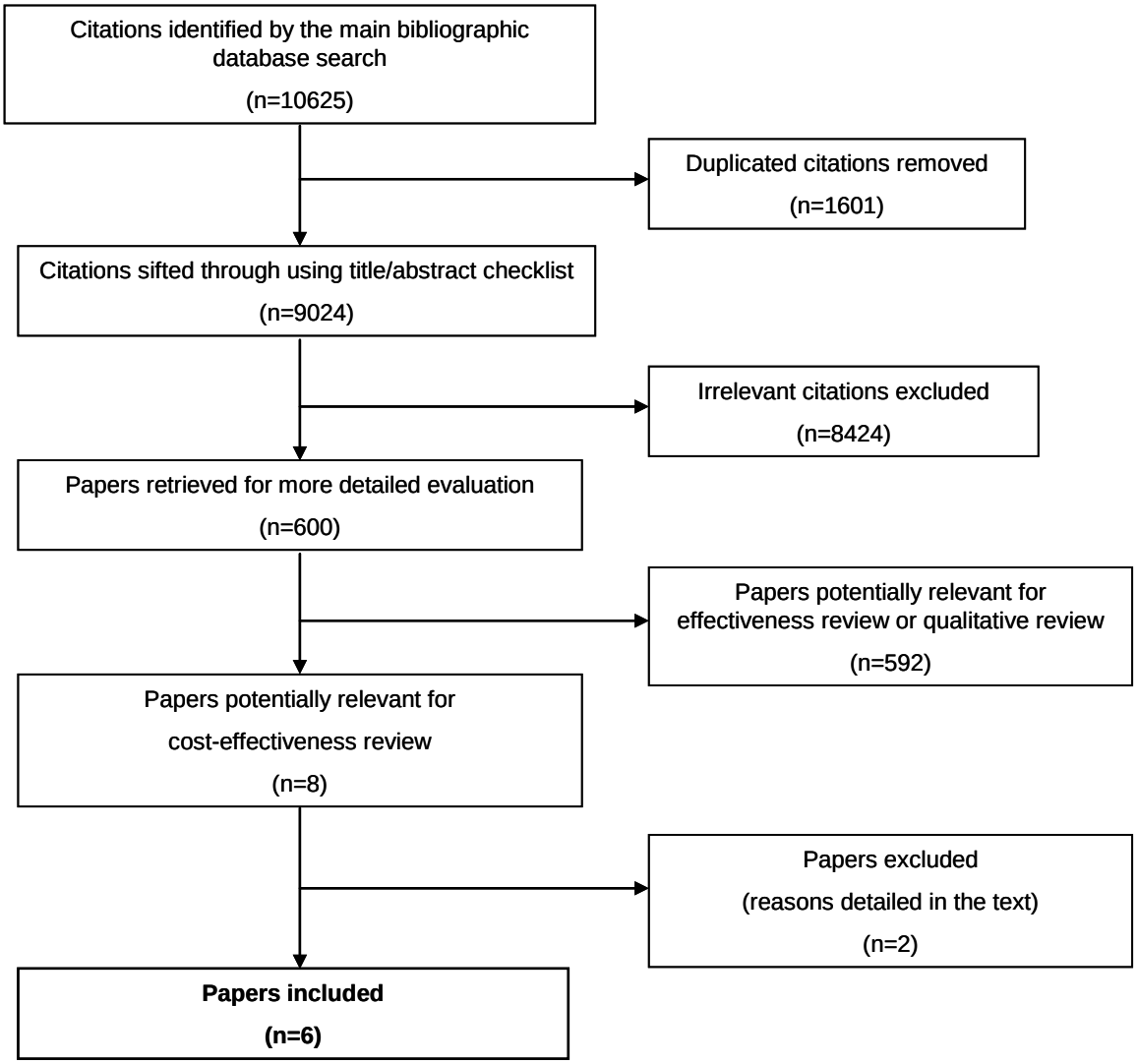
Studies that focus on effectiveness of interventions are considered in a separate effectiveness review, and those using qualitative research methods to investigate facilitators and barriers for the successful delivery of school-based interventions are considered in the qualitative review.

2.4 Summary of study selection process

Of the eight potentially relevant studies identified during initial sifting, six met the above inclusion criteria. The overall study selection process is shown in Figure 1.

Two papers that passed through the initial sifting did not meet the inclusion criteria. One (Gordon et al, 2007) was a review article and the interventions described were not school-based. The other (by Barnett et al, 2007) described the cost-benefit of a pre-school program with aims related to general educational and social development, and not smoking prevention in particular, hence it is considered beyond the scope of this review.

Figure 1 Flow chart (QUOROM diagram) for the study selection process of the cost-effectiveness review



In addition to the identification of potentially relevant studies from the main search described above, one reviewer (MJ) separately sifted through the 600 papers retrieved for more detailed evaluation in order to identify papers potentially relevant for the cost-effectiveness search. No additional relevant articles were found that were not already identified by the main sifting team.

2.5 Data extraction and quality appraisal

Each included study was assessed using the methodology checklist for economic evaluations based on the *Methods for development of NICE public health guidance* (National Institute for Health and Clinical Excellence, 06) and relevant data was extracted into an evidence table. These were undertaken by one reviewer (MJ) and were double-checked by a second reviewer (PB). Any doubtful points were resolved by discussion. An example of a completed quality assessment form is included in Appendix 4.

Studies were also assessed for applicability to the target population and setting in the scope. In this case, this is the current UK context. Applicability for economic evaluations was assessed on the basis of two dimensions:

- Whether or not the *population* being studied was comparable to the current UK population.
- Whether or not the *methodology* of the study was likely to yield results similar to a study based on the NICE reference case.

From the perspective of the population being studied, a study was only deemed to be *completely applicable* if the data used to parameterise the economic evaluation were obtained from a study population that was equivalent to the current UK population. Ideally this would involve a recent UK study based on a sample representative of the UK population in terms of demographics, socioeconomic status and access to health, social services and education.

None of the studies reviewed were based on a UK population. Consequently, the countries from which the source population of the studies was drawn (Canada, Germany, the Netherlands and the USA) were assessed for comparability with the UK population. The table below shows health, socioeconomic and educational statistics from the four countries compared to equivalent figures for the UK obtained from the OECD {Organisation for Economic Co-operation and Development, 2007 10685 /id}. Shaded boxes indicate statistics that differ from comparative figures for the UK by more than 25%.

Table 2.1. Comparative health, socioeconomic and educational statistics from the UK, USA, Canada Germany and the Netherlands. Shaded boxes indicate statistics that differ from comparative figures for the UK by more than 25%.

Statistic	Year	UK	USA	Canada	Germany	Netherlands
Health expenditure per capita (USD)	2005	2724	6041	3326	3287	3094
Public share of total health expenditure (%)	2005	87	45	70	77	66
GDP per capita (USD)	2005	32896	41827	34057	30776	35112
Income inequality (Gini coefficient)	2000	32.6	35.7	30.1	27.7	25.1
Years of compulsory schooling	1999	11	8-13 (varies)	10	12	13
Daily smoking prevalence in over 15s (%)	2005	24.0	16.9	17.3	24.3	31.0

Based on the similarity in relevant statistics in table above, studies representative of the Canadian, German or Dutch population are deemed to be *partially applicable* to the UK population, while studies representative of the American population are deemed to be *largely inapplicable* to the UK context. However, account will also be taken of whether the study population is actually representative of the country that the study is based on (in terms of features such as urban/rural mix, socioeconomic indicators, gender, ethnicity).

From a methodological viewpoint, a study was only deemed to be *completely applicable* if the economic evaluation was carried out using rules equivalent to the current NICE reference case, in particular with reference to the type of analysis (cost-utility), costing perspective (public sector) and discount rates (3.5% for both costs and benefits; figures between 3-4% are deemed to be admissible). A study that met one or two of the three criteria above was deemed to be *partially applicable*, while a study that met none of them was deemed to be *largely inapplicable* from a methodological viewpoint.

2.6 Synthesis and formulation of evidence statements

The results of the data extraction and quality assessment were described in a narrative summary for each included study. An overall summary of evidence and evidence statements were then presented, followed by the evidence tables for individual studies.

3 Economic Evaluation Findings

Six economic evaluation articles were included, as listed in Table 3.1. These articles can be grouped into two categories:

1) *Economic analyses alongside effectiveness studies*, which analysed the outcomes of effectiveness studies of school-based interventions, but used modelling to extrapolate smoking outcomes to lifetime cost and health benefit implications.

2) *Economic analyses of hypothetical interventions*, which derived effect estimates of interventions based on a synthesis of results from several effectiveness studies and other sources of data. This category includes one study (Tengs, Osgood, and Chen, 01) which used an effectiveness study as an exemplar for estimating intervention costs.

For the effectiveness study based articles, Table 3.1 shows the name of the effectiveness study used, as reported in the forthcoming effectiveness review. For hypothetical study based articles, the source of effectiveness information is summarised in that table. Information for each structured narrative was obtained from both the cost-effectiveness study as well as the corresponding effectiveness review (if any).

Monetary results are reported as given. If no value in sterling was quoted by the authors, we have converted the results into sterling using average exchange rates for the year of publication (or for 2008, the average exchange rate from 1 January to 31 March). Rates were obtained from HM Revenue & Customs (available at http://www.hmrc.gov.uk/exrate). Values were not inflated to any particular year due to the unavailability of health care price indices in the relevant countries.

Table 3.1. Articles included in the review of economic evaluations.

Articles	Study type	Source of effectiveness data
(Caulkins et al. 04)	Hypothetical intervention based	Based on a review of 12 effectiveness studies.
(Hoeflmayr and Hanewinkel, 08)	Effectiveness study based	(Wiborg, Hanewinkel, Wiborg, and Hanewinkel, 02)
(Stephens et al. 00)	Hypothetical intervention based	Unpublished CDC/Battelle study (Rothman et al. 96)
(Tengs et al. 01)	Hypothetical intervention based	Based on 7 published reviews and meta-analyses.
(Vijgen et al. 08a)	Effectiveness study based	(Dijkstra, Mesters, De, van, and Parcel, 99)
(Wang, Crossett, Lowry, Sussman, and Dent, 01)	Effectiveness study based	(Dent et al. 95)

The methodological quality of each study was rated by using the criteria in the Drummond checklist. An example is given of a completed evaluation is given in Appendix 4. Each study was given an overall rating of ++, + or – based on the following rules:

++	All or most of the criteria have been fulfilled. Where they have not been fulfilled the conclusions of the study or review are thought very unlikely to alter.
+	Some of the criteria have been fulfilled. Those criteria that have not been fulfilled or not adequately described are thought unlikely to alter the conclusions.
-	Few or no criteria fulfilled. The conclusions of the study are thought likely or very likely to alter.

None of the reviewed studies were rated ++ because they all had unfulfilled criteria that may have affected the study conclusions. Studies were rated + if these unfulfilled criteria concerned additional pieces of analysis or description (such as sensitivity analyses or descriptions of the generalisability of the study) that may not directly affect the conclusions of the base case analysis. Studies were rated – if these unfulfilled criteria concerned methodological issues or lack of justification for model assumptions and parameters that raised substantial questions about the reliability of conclusions of the base case analysis.

3.1 Effectiveness study based articles

Three of the included economic evaluations were based outcomes of effectiveness studies of school-based interventions, but used modelling to extrapolate smoking outcomes to lifetime cost and health benefit implications. None of the articles reported interventions conducted in the UK; the studies that the economic evaluations were based on were Germany (Hoeflmayr et al. 08), the Netherlands (Vijgen et al. 08a) and the United States (Wang et al. 01). The articles follow in alphabetical order.

3.1.1 'Do school-based tobacco prevention programme pay off? The cost-effectiveness of the 'Smoke-free Class Competition.' (Hoeflmayr et al. 08)

Overview

Hoeflmayr and Hanewinkel conducted a cost-benefit analysis of the 'Smoke-free Class Competition', a school-based smoking prevention programme, currently implemented in 20 European countries. The intervention, based on a social influence model with positive reinforcements for non-smoking behaviour, involved awarding prizes to classes which agreed to become smoke-free (have at least 90% of the class reporting not smoking in the past week) for at least six months. The aim of the programme was primarily preventative (that is, to discourage non-smokers from initiating smoking). The analysis was based on an effectiveness study of the programme in Germany, reported elsewhere (Wiborg et al. 02). This was a non-randomised experimental trial of the programme among 2,142 students in 131 classes in three German cities (Hamburg, Berlin and Hannover) in 1998-99. Classes were pre-selected from Hamburg and Berlin in the intervention group, and from Hanover in the control group (no intervention). The intervention group had a mean age of 12.9 years (standard deviation 0.98 years), was 53.4% female, and reported smoking prevalence of 15.2% for 4-week prevalence and 2.9% for daily prevalence. Costs and benefits were evaluated from a societal benefit, discounted at 5% a year, and using a lifetime time horizon.

Modelling method used

The difference between self-reported smoking proportions in the intervention and hypothetical control groups at follow-up of the effectiveness study was extrapolated to later life using a cohort progression model. This relied on evidence in the literature about the propensity of student smokers and non-smokers to smoke in later life, as well as smoking cessation rates later in life.

Benefits

The model estimated that 2.04% of programme participants would be prevented from becoming established smokers. The benefit of a prevented smoker was estimated to be €6,786 (£5,400), of which €2,068 (£1,700) were direct benefits, based on direct health care costs as well as indirect labour costs using the human capital method.

Costs

Costs included the costs to the central agency managing the programme, region and local government offices, schools and students participating in the programme. Indirect labour costs for teachers delivering the programme accounted for 86% of costs. The programme cost €5.87 million (£4.70 million), which amounted to €39 (£31) per student participant. Cost per prevented smoker was estimated to be €1909 (£1,500), of which €251 (£200) were direct costs.

Cost benefit

The direct benefit/cost ratio was 8.2 and the total benefit/cost ratio was 3.6. The overall conclusion that the intervention was of net benefit was not sensitive to univariable and multivariable changes in the variables, although a high discount rate would have a large effect on the result.

Limitations

Limitations of the experimental study identified by the authors are:

1) The study was not randomised.

2) There was a high loss to follow-up (53% and 45% in the intervention and control groups respectively after one year).

3) Smoking was positively correlated with attrition.

4) The follow-up time in the study was short (6 months after completion of the programme).

5) The intervention was limited to a single school year.

Limitations of the progression model identified by the authors are:

1) The future smoking outcomes of the cohort had to be extrapolated from other models since data was not available from the trial.

2) Estimates of the benefits of preventing smoking were based on two prevalence studies of the cost of cigarette smoking in Germany, which were felt to be crude. Furthermore, the use of prevalence cost data in an incidence study introduced unverifiable assumptions.

3) Gross, rather than net, smoking costs were applied.

4) Different time periods for programme cost and outcome evaluation were combined.

Limitations identified by the review team are:

1) The decrease in smoking uptake may have been predicated by extrinsic rewards (prizes) and may not be sustainable in the long-term.

2) The sources and shapes of the uncertainty distributions for probability sensitivity analysis were not described.

Comments

The article was rated +. The main methodological shortcomings were poor description of the sensitivity analysis, and a lack of discussion of the generalisability of results to other settings.

The results are partially applicable from a population viewpoint, because they are based on a study population (German) somewhat similar to the UK population. However, there are further issues because the analysis was based on studies conducted in urban settings only. The results are not applicable from a methodological viewpoint, because the economic evaluation uses a

type of analysis (cost-benefit), costing viewpoint (societal) and discount rate (5%) that does not conform to the NICE reference case.

3.1.2 'Cost-effectiveness analyses of health promotion programs: a case study of smoking prevention and cessation among Dutch students.' (Vijgen et al. 08a)

Overview

Vijgen and co-workers conducted a cost-effectiveness analysis of a school-based social influence programme with boosters in the Netherlands. The analysis was based on an experimental study (described in a separate publication (Dijkstra et al. 99)) carried out in 1990-92 with three arms: control (no intervention), social influence program and social influence program with boosters. The intervention consisted of five weekly 45-min lessons among grade 8 students (around 14 years old) in small groups of 4-5, each led by a peer leader (non-smoking student from the same class). Special magazines were used as boosters. The sample sizes were 1,992 students (20 schools) in the control group, 575 students (16 schools) in the social influence group and 526 students (16 schools) in the social influence with boosters group. Boys and girls were almost equally represented. Between 6.4% - 13.5% of the study cohorts self-reported smoking at least occasionally. The analysis was conducted from a health care provider perspective, using a discount rate of 4% and a 100 year time horizon in the base case.

Modelling method used

The difference in the number of self-reported experimental smokers (who self-report smoking in the last month) between the control and intervention arms of the effectiveness study was used. This was extrapolated to estimate the difference in the number of daily smokers in the two arms, and further extrapolated to lifetime effects using the RIVM Chronic Disease Model. This was a Markov model with multiple

disease endpoints that describes changes in morbidity and mortality in a hypothetical cohort. The use of a generic cohort model (rather than one with smoking-specific disease endpoints only) enabled competing causes to be taken into consideration (increases in the incidence of non-smoking related diseases due to longer survival of non-smokers). In the base case, it was assumed that the intervention was equally effective in discouraging daily smoking.

Effectiveness

The effectiveness study reported 7% fewer experimental smokers in intervention group, which was assumed to translate into 3.2% fewer daily smokers, based on an estimate that 45% of 14-year old Dutch experimental smokers were daily smokers. The benefit in a cohort of 1000 adolescents exposed to the intervention was estimated to be 58 LYs and 41 QALYs gained.

Costs

The intervention cost €75 (£60) per participant for the social influence programme with boosters. However, it saved €15.8 (£11) per participants in health care costs due to the reduced risk of them becoming smokers.

Cost effectiveness

The incremental cost-effectiveness ratio was €18,200 (£15,000) per LY gained and €19,900 (£16,000) per QALY gained. At a threshold for cost-effectiveness of €20,000 (£16,000) per QALY gained, the intervention would have to translate into 3% fewer daily smokers. The result was found to be highly sensitive to changes in the discount rate and time horizon, but less sensitive to changes in intervention costs within a ±10% range.

Limitations

Limitations identified by the authors are:

1) The authors assumed that the intervention would have the same proportionate effect on daily smoking as it did on experimental smoking. Note that our own review of the effectiveness literature suggested that studies using the prevalence of regular smoking (but not experimental smoking) as the primary outcome tend to produce a statistically significant programme effect.

2) The model was based on a single randomised trial (Dijkstra et al. 99) rather than a meta-analysis of studies, due to lack of suitable evidence relevant to the Dutch situation.

3) The results may not be valid in other schools and other settings.

Limitations identified by the review team are:

1) Smoking status was self-reported (evaluated by questioning the subjects), which may bias the results.

2) It was assumed that changes to smoking prevalence during the intervention would last throughout the lifetime of the subjects.

Comments

The article was rated +. The framework used for the economic analysis was appropriate and well justified. The main shortcoming was a lack of discussion about the assumption that changes to smoking prevalence lasted throughout the lifetime of the subjects.

The results are partially applicable from a population viewpoint, because they are based on a study population (Dutch) somewhat similar to the UK population. The results are applicable from a methodological viewpoint, because the economic evaluation uses the same type of analysis (cost-utility), costing viewpoint (health care provider) as the NICE reference case, as well as a similar discount rate (4%).

3.1.3 ‘Cost-effectiveness of a School-Based Tobacco-Use Prevention Program.’ (Wang et al. 01)

Overview

Wang and co-workers estimated the cost-effectiveness of Project Towards No Tobacco Use, a school-based smoking prevention programme conducted in 1989—91 described in a separate publication (Dent et al. 95). This consisted of 10-lesson curricula delivered to grade 7 students in the United States (normally 12-13 year olds), followed by a 2-lesson booster delivered at grade 8 (normally 13-14 year olds). Each lesson was about 40-50 minutes in length. The study population was reported to be 50% male; also 60% white, 27% Hispanic, 7% black and 6% Asian/other. Socio-economic status was controlled for at randomisation but not reported. Baseline smoking prevalence was 6% for weekly use and 40% for trial use. Classes using the curricula were compared to controls (receiving “usual care”). The combined strategy curricula arm of the study (which involved lessons on physical consequences, information social influence and normative social influence) was used since it had the best effectiveness profile at 2-year follow-up. Costs included intervention costs and lifetime medical costs, and a 3% discount rate was applied.

Modelling method used

The relative reduction in self-reported trial and weekly cigarette use at the end of the effectiveness study follow-up (age 14) was translated into the number of established smokers at age 26 using a decision tree model with nodes representing smoking status transitions (between non-smokers, experimenters and established smokers) at four ages (14, 18, 22 and 26).

Effectiveness

The intervention was estimated to prevent 34.9 students (range 19.7 – 51.0) from becoming smokers in a cohort of 770 (4.5% of the cohort).

Costs

Only medical cost savings (from all sources) were considered. Intervention cost was estimated at $13 (£9) per student. Average discounted lifetime medical costs saved by preventing someone from smoking was estimated at $8,638 (£6,900) for males and $10,119 (£8,100) for females.

Cost effectiveness

If medical costs saved are included, then the intervention was estimated to be cost saving. If they are excluded, then it was estimated to cost $703 (£560) per LY gained (range $481 - $2,770 or £390 - £2,200) and $448 (£360) per QALY gained (range $306 - $1,764 or £240 - £1,400). The ranges indicate the maximum and minimum values found during probabilistic sensitivity analysis, although the number of samples (1,024) was small. Univariable sensitivity analysis indicated that results were most sensitive to the prevalence of established smokers, although not by enough to change the overall conclusion that the intervention would be cost-effective.

Limitations

Limitations identified by authors are:

1) Costs were estimated rather than prospectively measured.
2) The number of established smokers prevented was modelled rather than directly measured.
3) The probability of smoking initiation was estimated from a single source of data.
4) The probability of experimenters becoming established smokers was assumed as no data were available.
5) The probability that non-smokers in the intervention group was assumed to be the same in the control and intervention group. This implied that the possibility of a non-smoker who was prevented from smoking by the intervention being more likely to smoke after the intervention ended was not considered.
6) Effectiveness of the intervention beyond 2 years was not considered.

7) Effectiveness of the intervention on smokeless tobacco use was not considered.

8) Costs due to passive smoking, smoking-related fires and maternal smoking on infants' health were not considered.

Limitations identified by review team are:

1) Estimates of staff time needed to deliver the intervention are very low - two health educators are able to deliver the intervention to a cohort of 1,234 students in 8 schools within 10 days (plus 2 for the booster). Although they are based on trial data, they are significantly lower than estimates in other studies, including a separate economic evaluation of the same intervention(Tengs et al. 01).

2) The cost of loss of work due to smoking-related morbidity or reduced life expectancy was not considered.

3) The cumulative life years and quality adjusted life years gained due to the intervention in Table 2 are reported as being discounted, but are likely to be undiscounted as they do not give the correct cost effectiveness ratio.

Since results were sensitive to the prevalence of established smokers, the authors suggest this warrants "further examination" in future studies. In addition, research was recommended into the stages of smoking establishment from adolescent to adulthood, medical costs of smoking and life expectancy changes due to smoking.

Comments

The study quality was rated +. The methodology was broadly acceptable and well-described. The viewpoint of the analysis (societal, but inclusion of medical costs only) is justifiable, but the excluded costs (work loss) were not described. The generalisability of the findings to other smoking prevention interventions was also not discussed.

The results are largely inapplicable from a population viewpoint, because they are based on a study population (American) that is dissimilar to the UK population. The results are applicable

from a methodological viewpoint, because the economic evaluation uses the same type of analysis (cost-utility) as the NICE reference case. There are also similarities in terms of costing viewpoint (medical costs only, although these include expenses that are out-of-pocket or covered by private insurance which the NICE reference case does not consider) and discount rate (3%).

3.2 Hypothetical intervention based articles

Three of the included economic evaluations were based on hypothetical interventions. Two of them were based in the United States (Caulkins et al. 04;Tengs et al. 01) while one was Canadian based (Stephens et al. 00), but used effect estimates from an American model (Rothman et al. 96). The articles follow in alphabetical order.

3.2.1 'What we can—and cannot—expect from school-based drug prevention.' (Caulkins et al. 04)

Overview

Caulkins and co-workers compare the social costs and benefits of school-based universal drug prevention programs in the United States using a spreadsheet-style model. Costs and benefits were evaluated from a societal perspective, using a discount rate of 4% and an implicit lifetime time horizon. Only the cigarette-related parameters and outcomes are presented here.

Modelling method used

A review of 12 effectiveness studies of universal drug prevention programmes was conducted (but not described) to extract reported reduction in cigarette initiation at first follow-up. In the base case, it was assumed that everyone whose initiation was prevented by the intervention initiated drug use at age 18 instead. NHSDA data were used to estimate the correlation between age of initiation and lifetime tobacco consumption. The relationship was attenuated by a correlation/causation ratio of 0.9 (range 0.5 – 1.0). It was further reduced by a scale-up factor of 30-50% to account for reduced effectiveness outside trial settings. The latter two parameters were derived from previous work by the authors (Caulkins, Everingham, Rydell, Chiesa, and Bushway, 99).

Costs

The cost of the intervention was estimated based on the opportunity cost of providing classroom lessons, and did not include programme materials or teacher training as these were regarded as small. This was estimated to be $150 (£82) per participant for a 30-hour curriculum.

Benefits

The intervention was assumed to reduce the uptake of smoking by 16.8% in the short term. The effect was assumed to dissipate by age 18 in the base case scenario, but lifetime tobacco use was assumed to be 14% lower for people who initiated smoking later, so that the overall reduction in lifetime use was 16.8% - 14%, or 2.4%, in the intervention cohort. The social benefit of this reduction was valued using a cost-of-illness approach, including health care expenditure (both government and private) as well as lost life-years valued using the human capital method. However, job-related productivity losses were not included. Total social benefit per participant due to prevention of cigarette smoking was $300 (£160), or $840 (£460) if all endpoints are included.

Cost benefit

Although not explicitly stated, the benefit-cost ratio of cigarette smoking-related prevention was 2.0 (5.6 if other endpoints are included). Monte Carlo simulations were performed, but the distributions used and quantitative results were not clearly described. However, the conclusion that the net benefit of the programme (including all endpoints) was positive was reported to be robust to changes in the parameter values. Univariable sensitivity analysis was not explicitly conducted, although productivity losses due to premature mortality were considered to be important.

Limitations

Limitations identified by authors are:

1) Reduction in heroin, LSD, ecstasy and date rape drugs were not considered.

2) Job-related productivity losses were not considered.

3) Benefits not directly related to drug use such as reduced sexual activity, increased school retention and graduation were not considered.

Limitations identified by review team are:

1) The analysis is based on number of packs smoked over a lifetime rather than the number of smokers. Hence it does not take into account variability (including possible skewness) in the distribution of number of packs smoked per person, and possible variability in intervention impact on smokers of different intensity.

2) Probabilistic sensitivity analysis was poorly described.

Recommendations

Drug prevention programmes should be evaluated not only in terms of behavioural outcomes but also in terms of their educational value, if any.

Comments

The article was rated -. The approach used to extrapolating intervention effects to lifetime outcomes is novel and potentially useful. However, there are a number of methodological issues, including the hypothetical nature of many of the parameter estimates and lack of detail about the probabilistic sensitivity analysis.

The results are largely inapplicable from a population viewpoint, because they are based on a study population (American) that is highly dissimilar to the UK population. Furthermore, results from a universal drug prevention programme may not be applicable to a smoking-specific prevention programme. The results are partially applicable from a methodological viewpoint, because they are based on a similar discount rate (4%) as the NICE reference case. However, they are based on a different type of analysis (cost-benefit) and costing viewpoint (societal).

3.2.2 'School-based Smoking Prevention: Economic Costs Versus Benefits.' (Stephens et al. 00)

Overview

Stephens and co-workers conducted a cost-benefit analysis of school-based prevention programmes in Canadian schools. Programme delivery costs were based on previously published recommendations about an effective programme (Glynn, 89), involving a four year education programme from grades 6 to 9 (about 10-13 years old) with a minimum of 10 teacher-led sessions. Effect estimates were modified from a CDC/Battelle model (Rothman et al. 96)[3]. The programme was compared to no intervention. Costs and benefits were valued using a societal perspective, with a discount rate of 4% and a lifetime time horizon.

Modelling method used

Based on a review of the literature (not described), the effect size (different in smoking prevalence between intervention and control groups) was assumed to be 6%, decaying to 4% after 4 years. The way in which smoking status at the end of the 4 years is then extrapolated to lifetime cigarette use was unclear[1]; however, it appears smoking status was directly extrapolated to lifetime cigarette use. The age of smoking initiation has no effect on smoking status later in life.

Costs

Costs were based on the cost for training teachers, classroom time and materials. Unit costs were based on documented costs for two Canadian programmes (Peer Assisted Learning and Improving the Odds). The cost of programme delivery was estimated at C$67 (£30) per student, or C$19.7 million (£8.8 million) if the programme was implemented on a national level.

Benefits

Benefits were evaluated using a cost-of-illness approach. Benefits considered were direct savings from reduced health care demand, indirect savings from reduced sick days and income loss due to premature death using the human capital approach. An alternative scenario tested this result using the friction cost approach, in which the cost was approximated by estimating that it takes three months to replace a deceased worker. The average benefit of preventing one person from becoming a smoker was estimated to be C$3,400 (£1,500) in direct costs and C$14,000 (£6,200) in indirect costs. Potential benefits on a national level were valued at C$639 million (£290 million).

Cost benefit

The overall benefit-cost ratio was estimated to be 15.4 (17.7 for males and 13.1 for females). If only direct costs were considered, then the benefit-cost ratio decreased to 2.9. Scenarios which

[1] A reference about this was made to an unpublished monograph (Rothman et al. 96) published by CDC/Battelle Institute. Enquiries to the Centers for Disease Control and Prevention revealed that the monograph is no longer available and additionally is out of date.

alter programme costs, discount rates, effect sizes or method for valuing benefits had an effect on the benefit-cost ratio but the programme would still be beneficial under each of the scenarios considered.

Limitations

Limitations identified by the authors were:

1) Some costs of smoking were ignored, such as health and property damage due to environmental tobacco smoke ETS, cost of creating separately ventilated public smoking areas, increased life insurance costs for smokers and work loss during smoking breaks. These costs have been estimated in the literature, but the methods of doing so are not widely accepted.

2) Deaths due to smoking were assumed to occur after the age of 45.

3) Indirect costs were estimated based on average wages; however premature deaths due to smoking are more likely to occur during workers' peak earning years later in life.

4) The cost-of-illness approach to benefits omits consideration of quality of life detriment due to smoking-related diseases.

5) The contribution of the tobacco industry in terms of taxation was not considered.

Limitations identified by the review team are:

1) Changes in prevalence during the programme were assumed to be sustained throughout the lifetime of subjects. This is less of a shortcoming than in some other economic evaluations discussed in the report, since the length of the programme was greater here (4 years).

2) The effect of the intervention was expressed in terms of a reduction in smoking prevalence, rather than a proportionate decrease in smoking uptake, so the model may not be valid in a setting where the risk of smoking uptake was very different from that in which the estimate was based.

3) Probabilistic sensitivity analysis was not performed.

4) Cost and effect estimates were derived from heterogeneous sources, so may not be compatible with each other.

Comments

The article was rated -. There are a number of methodological limitations including the lack of probabilistic sensitivity analysis, use of heterogeneous sources for establishing costs and benefits as well as a number of issues with the model that were not clear. It is not clear what form of intervention the authors propose will achieve the benefit-cost ratio they find.

The results are partially applicable from a population viewpoint, because they are based on a study population (Canadian) somewhat similar to the UK population. The results are partially applicable from a methodological viewpoint, because they are based on a similar discount rate (4%) as the NICE reference case. However, they are based on a different type of analysis (cost-benefit) and costing viewpoint (societal).

3.2.3 'The Cost-Effectiveness of Intensive National School-Based Anti-Tobacco Education: Results from the Tobacco Policy Model.' (Tengs et al. 01)

Overview

Tengs and co-workers conducted a cost-effectiveness (cost-utility) analysis of school-based smoking prevention programmes in the United States. They used as an exemplar for estimating intervention costs the Towards No Tobacco Use project, which uses an intensive social influences-based curriculum in the 7th grade (about 11-12 years old) with booster lessons in the 8th grade (about 12-13 years old). The intervention was compared to no intervention. The analysis was conducted from a societal perspective, using a discount rate of 3% and a time horizon of 25 or 50 years.

Modelling method used

Based on the results of seven published reviews and meta-analyses of the literature, the authors considered three possible estimates (5%, 30% and 56%) of the reduced uptake in smoking prevalence over the course of the 2-year intervention. The largest estimate was consistent with an analysis of the effectiveness of Project Towards No Tobacco Use (Sussman, Dent, Burton, Stacy, and Flay, 95). The effect was assumed to dissipate between 1-4 years after the end of the intervention. The expected cost savings and public health gains were estimated using the Tobacco Policy Model, a generic multiple cohort Markov model. The use of a generic cohort model with multiple disease endpoints enabled competing causes to be taken into consideration (increase in incidence of non-smoking related diseases due to longer survival of non-smokers). QALY differences between non-smokers and smokers were estimated using the Quality of Well Being (QWB) scale.

Effectiveness

The intervention was estimated to save between 6,600 to 130,000 QALYs nationwide, depending on the effect size and duration of effect.

Cost

Based on the costs of Project Towards No Tobacco Use, the intervention was estimated to cost $195 million (£140 million) for the whole country, or $50 (£35) per student in the first year. In subsequent years, cost per student would be $48 (£33) due to lower training costs. This included the cost of educating teachers, classroom time and materials. The difference in medical costs between smokers and non-smokers was also taken into account using an estimate by Hodgson (Hodgson, 92).

Cost effectiveness

Under base case assumptions of 30% effectiveness dissipating by 4 years and a 50-year time horizon, the incremental cost-effectiveness ratios were $19,000 (£14,000) per QALY gained and $710,000 (£520,000) per LY gained. However, these figures were very sensitive to assumptions about the size and duration of the intervention effect. With a 50-year time horizon, the QALYs gained ranged from 17,000 to 338,000; the incremental cost-effectiveness ratio ranged from $4,900 to $340,000 (£3,400 to £240,000) per QALY gained and $150,000 to $12 million (£100,000 to £8 million) per LY gained. With a 25-year time horizon, the QALYs gained ranged from 6,000 to 126,000; the incremental cost-effectiveness ratio ranged from $24,000 to $600,000 (£17,000 to £420,000) per QALY or $3.8 million to $170 million (£2.6 million to £120 million) per LY gained. In each case, the highest estimate of the ICER corresponds to the lowest estimate of QALYs gained, and vice versa. However, Monte Carlo sensitivity analysis showed that overall conclusions about cost effectiveness were fairly robust to a cost-effectiveness threshold of $50,000 (£35,000) per QALY gained, when changes were made to costs, quality of life effects and mortality parameters.

Limitations

Limitations identified by the authors are:

1) The model compares intensive educational programmes with the status quo. Results do not hold if less effective educational programmes are used, or if the status quo already includes excellent programmes.

2) Changes in smoking uptake, cessation or relapse rates in the future are not considered.

3) Dynamic effects such as peer influences (so that preventing one student from smoking may potentially affect his or her peers' risk of smoking) are not considered.

4) A decrease in environmental tobacco smoke as a result of lower smoking prevalence is not considered.

5) Race was not considered as a stratifying variable of effect.

6) The model does not consider the interaction of a school-based prevention programme together with other forms of prevention programmes such as mass media campaigns and smoking restrictions.

Limitations identified by the review team are:

1) Although the reduction in the increase in smoking prevalence is assumed to dissipate after 1-4 years, the people who are prevented from smoking are assumed to stay as non-smokers.

Comments

The article was rated +. The framework used for the economic analysis was appropriate and well justified. However, effectiveness estimates were based on a number of short-term studies only, with insufficient consideration of long-term outcomes.

The results are largely inapplicable from a population viewpoint, because they are based on a study population (American) that is highly dissimilar to the UK population. Furthermore, results from a universal drug prevention programme may not be applicable to a smoking-specific prevention programme. The results are partially applicable from a methodological viewpoint, because they are based on a similar discount rate (3%) and type of analysis (cost utility) as the NICE reference case. However, they are based on a different costing viewpoint (societal).

3.3 Summary of the evidence

3.3.1 Summary of the evidence for effectiveness study based articles

Economic framework

Two studies (Hoeflmayr et al. 08;Vijgen et al. 08a) were conducted in 2008, and one (Wang et al. 01) in 2001. Two studies (Hoeflmayr et al. 08;Wang et al. 01) were conducted from a societal perspective while the third (Vijgen et al. 08a) used a health care provider perspective. The discount rate (ranging from 3% to 5%) and time horizon (ranging from 100 years to lifetime) were reasonably comparable between studies. However, no study used the NICE recommended rate of 3.5%.

Population

It was not possible to draw conclusions about the interaction between social determinants of health (such as age, sex, ethnicity and socio-economic status) and the cost-effectiveness of the intervention. All three studies involved subjects with similar ages (12-14 years old) and genders (almost equal numbers of male and female). Only one study reported ethnicity, and none of the studies reported socio-economic indicators. Baseline smoking prevalence was not comparable between studies due to the different definitions used (occasional, daily, weekly and 4-weekly).

Interventions

The effectiveness studies on which two of the analyses were based (Vijgen et al. 08a;Wang et al. 01) were conducted in 1989-92, while the third (Hoeflmayr et al. 08) was conducted in 1998-99. All the three studies were classroom-based, delivered to

students around 12-14 years old. The intervention classes were compared to controls (who received no intervention). Interventions were based on a social influence model, on the grounds that other types of intervention showed limited efficacy against smoking uptake. However, the classic social influence model was modified. In one study, it was combined with boosters (Vijgen et al. 08a) while another (Wang et al. 01) combined it with information giving. A third study (Hoeflmayr et al. 08) was based on an intervention using positive reinforcement (prizes) rather than negative. The intensity of the intervention ranged from a six month-long competition (Hoeflmayr et al. 08) to either five (Vijgen et al. 08a) or twelve (Wang et al. 01) lessons of about 45 minutes in length each, but there was no obvious association between intensity and cost-effectiveness.

Effectiveness or benefit

All three studies collected data on the difference in smoking uptake between the control and intervention arms at the last follow-up. Effect size varied between 3.2% (Vijgen et al. 08a) and 4.5% (Wang et al. 01), with smoking prevalence determined based on self-reports. This was extrapolated to lifetime smoking prevalence using cohort models. One paper (Wang et al. 01) used a decision tree to do this while the other two (Hoeflmayr et al. 08;Vijgen et al. 08a) used previously developed cohort models. However, none of the models assumed that subjects prevented from becoming smokers by the intervention had a greater risk of becoming smokers after the intervention ceased. Two of the models (Vijgen et al. 08a;Wang et al. 01) made a distinction between experimental smoking and established (or regular) smoking at study follow-up.

Costs

All three studies considered the time taken for health educators to train teachers of participating classes, the time taken to deliver classroom lessons and the cost of promotional and educational material. In addition, the German study (Hoeflmayr et al. 08) also included the administrative costs of the programme born by national, regional and local government. However, the study reported that the labour costs for teachers amounted to 86% of the total. At $13 (£9) per student participant, intervention costs were particularly low for the analysis based on Project Towards No Tobacco Use (Wang et al. 01). This was mainly due to the assumption made that two health educators were able to deliver the intervention to the entire cohort of 1,234 students in eight schools within 10 days (plus 2 days for the booster session), while the other two studies made less optimistic assumptions about the number of staff and time taken to deliver the intervention.

The American study (Wang et al. 01) estimated that the increased lifetime medical costs of smokers were $9379 or £7500, based on a study by Hodgson (Hodgson, 92). However, the Dutch study (Vijgen et al. 08a) reported that the reduced cost of smoking-related diseases in the intervention cohort were not substantial and indeed were dwarfed by the additional health care costs imposed by the increased life expectancy of the cohort.

Cost-effectiveness or cost-benefit

The three studies reached very different conclusions about the efficiency of the intervention. Wang and co-workers (Wang et al. 01) reported that it would be cost saving if the saved medical care costs of smokers are included in the analysis. If they are excluded, then the cost-effectiveness ratio of $8,482 (£6,800) is comfortably below the threshold at which interventions are considered cost-effective in the UK.

However, Vijgen and co-workers (Vijgen et al. 08a) and reported an incremental cost-effectiveness ratio of €19,900 (£16,000). The difference was due to the larger estimated effect size used in the Wang study, as well as the far larger estimate of health care costs consumed by smokers. The third study (Hoeflmayr et al. 08) reported a benefit/cost ratio of 8.2; however this study also included the cost of lost labour productivity so is not comparable to the first two.

Two of the studies (Hoeflmayr et al. 08;Vijgen et al. 08a) reported that results were highly sensitive to the discount rate for costs used; the third study (Wang et al. 01) did not vary the discount rate. One study (Wang et al. 01) also reported that the prevalence of established smokers was an influential variable in univariable sensitivity analysis. Results were found to be insensitive to other parameters within the ranges they were varied in the three studies.

Limitations

The major limitation of all three economic analyses was that they were based on effectiveness studies where subjects were not followed up after leaving school. Hence it was not clear whether the reduction in smoking at the final follow-up would be maintained into adulthood, when the motivators against smoking (such as prizes and social influence) are removed.

The conclusions from the study are difficult to compare to each other because of the different economic frameworks used and also because the studies arrived at very different estimates of the lifetime health care costs of smokers compared to non-smokers.

3.3.2 Summary of evidence from hypothetical intervention based articles

Economic framework

The studies were carried out between 2000 and 2004. All three studies used a societal perspective, although two studies (Caulkins et al. 04;Stephens et al. 00) conducted a cost-benefit analysis while the third (Tengs et al. 01) was a cost-effectiveness analysis. The studies used comparable discount rates (ranging from 3% to 4%) although none used the NICE recommended rate of 3.5%. Two studies (Caulkins et al. 04;Stephens et al. 00) used lifetime time horizons but the third (Tengs et al. 01) may have missed some outcomes by using 25 and 50 year time horizons.

Population

It was not possible to draw conclusions about the interaction between social determinants of health (such as age, sex, ethnicity and socio-economic status) and the cost-effectiveness of the intervention. The studies assumed hypothetical interventions that would be applied across the entire country. Two of the studies assumed target school years that were very similar: US grade 6 to 9 (normally about age 11 to 15) (Stephens et al. 02) and US grade 8 (normally about age 13 to 14) (Tengs et al. 01); the third study (Caulkins et al. 04) simply assumed delivery of the intervention to school students under age 18. Sex, ethnicity and socio-economic status were not considered. Baseline smoking prevalence was not relevant since the models were not based on a single effectiveness study in a defined population.

Intervention

The types of interventions considered in all three studies were extremely general and did not conform to a particular model of smoking prevention. Two studies (Tengs et al. 01;Stephens et al. 00) assumed generic school-based smoking prevention programmes, although the paper by Tengs and co-workers used Project Towards No Tobacco use (Dent et al. 95) as an exemplar for estimating intervention costs while Stephens et al (Stephens et al. 00) based cost estimates on two Canadian programmes. Caulkins and co-workers (Caulkins et al. 04) analysed the benefits of universal drug prevention programmes in terms of reducing the use of alcohol, tobacco, marijuana and cocaine. In all studies, incremental costs and benefits were compared to not having any intervention.

Modelling method used

A range of approaches was used to extrapolate smoking status at the end of the intervention to lifetime health outcomes. The most sophisticated model was used by Tengs and co-workers (Tengs et al. 01), who used a multiple cohort Markov model with several disease endpoints to account for competing causes. Caulkins and co-workers (Caulkins et al. 04) used a simpler spreadsheet approach with coefficients to take into account the association between smoking status at the end of the intervention and lifetime reduction in tobacco use. In the model by Stephens and co-workers (Stephens et al. 00), the reduction in smoking at the end of the intervention was assumed to hold constant for the lifetime of the cohort.

Effectiveness or benefit

All three studies used different measures of effect (lifetime reduction in tobacco use, reduction in smoking uptake during the intervention and overall decrease in smoking prevalence after the intervention). The effect sizes reported, estimated from the literature, were a 2.4% reduction in lifetime tobacco use (Caulkins et al. 04), 5-

30% reduction in smoking uptake for 1-4 years of the intervention(Tengs et al. 01), and 4% decrease in smoking prevalence after 4 years (Stephens et al. 00).

Costs

The cost per student of the intervention was comparable in two of the studies ($48 or £33 for Tengs et al (Tengs et al. 01) and C$67 or £30 for Stephens et al (Stephens et al. 00)). Both of these studies included the cost of teacher training, delivering lessons and classroom materials. The third study by Caulkins and co-workers (Caulkins et al. 04) estimated much higher intervention costs ($150 or £82), despite the fact that teacher training and classroom materials were not costed as they were assumed to be small. Part of the reason is because of the large amount of teaching time (30 hours) assumed to be necessary in order to deliver an effective intervention.

Cost-effectiveness or cost-benefit

All three studies reported that the intervention being modelled is likely to be cost-effective or of net benefit. Of the two cost-benefit analyses, one (Caulkins et al. 04) reported the less favourable benefit-cost ratio of 2.0 compared to a ratio of 15.4 for the other (Stephens et al. 00). However, this is likely to be because Caulkins and co-workers were modelling general school-based drug prevention programmes, but only the smoking benefits were extracted for the purposes of this review. The cost-effectiveness study (Tengs et al. 01) reported a cost-effectiveness ratio of $20,000 (£14,000) per QALY gained in the base case of 30% effectiveness dissipating by 4 years and a 50-year time horizon, but found that changes to the effect size and duration of effect could increase this ratio to as much as $340,000 (£240,000). The time horizon was also found to be important – a time horizon of 25 years substantially increased the cost-effectiveness ratio. The overall conclusions were found to be robust to univariable and multivariable changes to other parameters (including medical costs, quality of life estimates and mortality) in sensitivity analysis in all three studies.

Limitations

In addition to the specific limitations identified for each study, the extension of modelling to a generic prevention programme raises questions of applicability. Even if a programme is found to be cost effective, it is not clear what the design, target population and intensity of such a programme should be. In contrast, trial-based models are able to present a particular intervention design, based on a model of drug prevention.

Two of the models (Stephens et al. 00;Tengs et al. 01) assumed that subjects who were prevented from smoking due to the intervention would not have a greater risk of reverting to smoking when the intervention was removed.

In addition, despite using a societal perspective, all of the models ignored considerations such as the cost of environmental tobacco smoke, productivity loss due to smoking breaks, increased life insurance premiums, tobacco taxes and the effect of smoking on educational achievement.

3.3.3 Overall summary and evidence statements

Six articles were identified which were economic evaluations of school-based smoking prevention programmes. Three analysed results from an experimental study (Hoeflmayr et al. 08;Vijgen, Van Baal, Hoogenveen, De Wit, and Feenstra, 08b;Wang et al. 01). Another three (Caulkins et al. 04;Stephens et al. 00;Tengs et al. 01) modelled a hypothetical programme, although in one case (Tengs et al. 01) an actual programme was used as an exemplar for estimating intervention costs.

Only one article (Vijgen et al. 08b) presented a cost-effectiveness study with a health care provider perspective, which is the closest to the framework recommended by NICE for public health interventions. The other articles presented either cost-benefit analyses (Hoeflmayr et al. 08;Stephens et al. 00;Caulkins et al. 04) or cost-effectiveness analyses with a societal perspective (Tengs et al. 01;Wang et al. 01). All articles compared the costs and benefits of the intervention to having no intervention.

Although the articles were published comparatively recently (between 2000 and 2008), they used effectiveness data from studies carried out in the 1980s or 1990s.

Indirect costs and benefits formed a large proportion of total costs and benefits in all studies conducted from a societal perspective.

The cost of the intervention ranged from $13 (£9) (Wang et al. 01) to $150 (£82) (Caulkins et al. 04) per participant. The lower figure ($13) comes from a study that made very optimistic assumptions about the number of staff needed to deliver the intervention, while the higher figure ($150) comes from an analysis of a generic drug prevention programme. The costs assumed for the four remaining studies lie in a narrower range of C$67 (£30) (Stephens et al. 02) to €75 (£60) (Vijgen et al. 08b).

Four articles represented the effect size in terms of reduction in smoking prevalence in the intervention group, ranging from 2.04% (Hoeflmayr et al. 08) to 4.5% (Wang et al. 01). Two articles represented the effect size in terms of reduction in smoking uptake in the intervention group, ranging from 16.8% until age 18 (Caulkins et al. 04) to 56% for 4 years (Tengs, Ahmad, Moore, and Gage, 04).

All three cost-effectiveness analyses suggested that under base case assumptions the modelled intervention was cost-effective under both a threshold of £20,000 per QALY gained and the relevant threshold applied in the country of the study. The cost per QALY gained ranged from $448 (£360)(Wang et al. 01) to €19,900 (£16,000)(Vijgen et al. 08b). Two analyses reported the cost per LY gained, ranging from $703 (£560)(Wang et al. 01) to €18,200 (£15,000)(Vijgen et al. 08b).

All three cost-benefit analyses suggested that the modelled intervention would be of net benefit, with the benefit/cost ratio ranging from 2.0 (Caulkins et al. 04) to 15.4 (Stephens et al. 00), although the smaller figure represented a generic drug prevention programme rather than a smoking prevention programme.

Overall conclusions about net benefit or cost-effectiveness were robust to univariable changes in the parameters except for the discount rate (Hoeflmayr et al. 08;Vijgen et al. 08b), time horizon (Vijgen et al. 08b;Tengs et al. 01), effect size and duration of effect (Tengs et al. 01).

Four studies(Hoeflmayr et al. 08;Wang et al. 01;Caulkins et al. 04;Tengs et al. 01) found that the conclusions were robust to changes in parameters (such as medical costs, quality of life estimates and mortality) when varied using probabilistic sensitivity analysis.

No conclusions could be drawn about the interaction between intensity of intervention, social determinants of health (age, sex, ethnicity and socio-economic status) and the cost-effectiveness of the modelled interventions.

Table 3.2 summarises the results of all the economic evaluations considered in this review. Evidence statements have been generated following the structure of this table.

Table 3.2 Economic evaluation results summary

First author	Hoeflmayer	Vijgen	Wang	Caulkins	Stephens	Tengs
Year	2008	2008	2001	2004	2000	2001
Type	Cost-benefit	Cost-effectiveness	Cost-effectiveness	Cost-benefit	Cost-benefit	Cost-effectiveness
Country	Germany	Netherlands	USA	USA	Canada	USA
Intervention cost per participant	€39 (£31)	€75 (£60)	$13 (£9)	$150 (£82)	C$67 (£30)	$48-50 (£33-35)
Effect size	2.04% reduction in smoking prevalence.	3.2% reduction in daily smoking prevalence.	4.5% reduction in smoking prevalence.	16.8% reduction in smoking uptake until age 18, 2.4% reduction in lifetime cigarette use.	6% reduction in smoking prevalence, decaying to 4% after 4 years.	56% reduction in smoking uptake for 4 years.

Cost-effectiveness or cost-benefit	Benefit/cost ratio: total 3.6, direct 8.2	€19,900 (£16,000) per QALY. €18,200 (£15,000) per LY.	$703 (£560) per LY gained, $448 (£360) per QALY gained.	Benefit/cost ratio: smoking only 2.0, all endpoints 5.6.	Benefit/cost ratio: total 15.4, no indirect costs 2.9.	$4,900 to $340,000 (£3,400 to £240,000) per QALY. $150,000 to $12 million (£100,000 to £8 million) per LY.
Univariable sensitivity	Only sensitive to discount rate.	Only sensitive to discount rate and time horizon.	Only sensitive to prevalence of established smokers.	Not explicitly conducted.	Not sensitive to parameters tested.	Sensitive to time horizon and effect size.
Multivariable sensitivity	Not sensitive to parameters tested.	Not shown.	Not sensitive to parameters tested.	Not sensitive to parameters tested.	Not shown.	Not sensitive to parameters tested.

Cost effectiveness evidence statements

Excluding two studies that appear to be unrepresentative outliers, the cost of the intervention ranged from C$67 (£30) to €75 (£60) per participant.

Indirect costs and benefits formed a large proportion of total costs and benefits in all studies conducted from a societal perspective.

Four articles represented the effect size in terms of reduction in smoking prevalence in the intervention group, ranging from 2.04% to 4.5%. Two articles represented the effect size in terms of reduction in smoking uptake in the intervention group, ranging from 16.8% until age 18 to 56% for 4 years.

The three cost-effectiveness analyses suggested that in the base case cost per QALY gained ranged from $448 (£360) to €19,900 (£16,000). Two of them reported the cost per LY gained ranged from $703 (£560) to €18,200 (£15,000). The wide range in these figures is largely due to the low estimate of intervention costs reported in the study with the lowest cost per LY/QALY gained.

All three cost-benefit analyses suggested that the modelled intervention would be of net benefit, with the benefit-cost ratio ranging from 2.0 to 15.4. However, the lower figure represents the ratio for a generic drug prevention programme and does not include indirect (productivity loss) costs of smoking, so is not directly comparable with the other two analyses.

Overall conclusions about net benefit or cost-effectiveness were robust to changes in single parameters except for the discount rate, time horizon, prevalence of smokers at baseline, effect size and duration of effect.

No conclusions could be drawn about the interaction between intensity of intervention, social determinants of health (age, sex, ethnicity and socio-economic status) and the cost-effectiveness of the modelled interventions.

Four studies found that the conclusions were robust to changes in cost and health impact parameters when varied using probabilistic sensitivity analysis, a technique in which the value of each parameter is sampled many times from a joint distribution representing the uncertainty in parameter values.

3.4 Evidence tables

3.4.1 'Do school-based tobacco prevention programme pay off? The cost-effectiveness of the 'Smoke-free Class Competition.' (Hoeflmayr et al. 08)

Study details	Population and setting	Intervention/comparator	Outcomes and methods of analysis	Results	Notes
Authors: Hoeflmayr and Hanewinkel **Year:** 2008 **Aim of study:** To assess the cost-benefit of the `Smoke-Free Class Competition' school-based tobacco prevention programme **Type of Economic Analysis:** Cost-benefit **Economic Perspective:** Societal **Study Quality:** +	**Source population/s:** Germany (developed, largely publicly funded health care). Urban (Hamburg, Berlin, Hannover). Intervention group: mean (SD) age 12.9 (0.98) years, female 53.4%, 4-week smoking prevalence 15.2%, daily smoking prevalence 2.9%. Control group: no significant difference in recorded demographic variables. **Setting:** Classroom based. **Data Sources:** Previously published	**Intervention/s description:** `Smoke-Free Class Competition', classes were awarded prizes for being smoke-free for 6 months. **Comparator/Control/s description:** Status quo. **Sample sizes:** Total = 131 classes (n=2142)	**Primary Outcomes** Direct and total discounted net benefit/cost ratio. Direct and total discounted net benefit/cost ratio. **Secondary outcomes** None. **Time Horizon:** Lifetime. **Discount Rates:** 5% costs and benefits in the base case. **Modelling Method:** Outcomes at effectiveness study follow-up directly extrapolated to lifetime use, adjusting for	**Primary analysis:** Benefit per prevented smoker: Direct: €2,068 (£1,600) Total: €6,786 (£5,400) Net benefit-cost ratio: Direct: 8.2 Total: 3.6 **Secondary analysis:** None.	**Limitations identified by authors:** Non-randomised experimental design. High loss to follow-up. Smoking positively correlated with being in attrition sample. Short follow-up time. Future smoking outcomes extrapolated. Crude cost of smoking estimates. Transfer from prevalence to incidence costs. Gross smoking costs applied. Time periods for programme cost and outcome evaluation different.

Study details	Population and setting	Intervention/comparator	Outcomes and methods of analysis	Results	Notes
Applicability: Population – partially applicable. Methodology – largely inapplicable.	effectiveness study(Wiborg et al. 02).		smoking cessation.		Intervention limited to single school year. **Limitations identified by review team**: Effect may diminish after extrinsic rewards (prizes) removed. Distributions for probabilistic sensitivity analysis not described. **Evidence gaps and/or recommendations for future research:** Long-term follow-up of study subjects. **Source of funding:** European Commission and medical charities.

3.4.2 'Cost-effectiveness analyses of health promotion programs: a case study of smoking prevention and cessation among Dutch students.' (Vijgen et al. 08a)

Study details	Population and setting	Intervention/comparator	Outcomes and methods of analysis	Results	Notes
Authors: Vijgen *et al*. **Year:** 2008 **Aim of study:** To assess the cost-effectiveness of a social influence smoking prevention programme. **Type of Economic Analysis:** Cost-effectiveness **Economic Perspective:** Health care provider. **Study Quality:** + **Applicability:**	**Source population/s:** Netherlands (developed country, publicly funded health care). Grade 8 students (~14 years old). Boys and girls almost equally represented. Pre-test smoking (at least occasional) prevalence 6.4% - 13.5%. **Setting:** Classroom based **Data Sources:** Previously published	**Intervention/s description:** Social influence (SI): Five weekly 45-min lessons in small groups of 4-5, each led by a peer leader (non-smoking student from the same class). Special magazines as boosters. **Comparator/Control/s description:** Status quo. **Sample sizes:** Control group: 1192 students (20 schools) SI group: 575 students (16 schools) SI + booster group: 526 students (16 schools) (data from (Dijkstra et al. 99)).	**Primary Outcomes** Discounted net cost per LY/QALY gained. **Secondary outcomes** Threshold number of smokers prevented for intervention to be cost effective (at €20000 per QALY gained). **Time Horizon:** 100 years. **Discount Rates:** 4%. **Modelling Method:** Markov model with multiple disease endpoints used to extrapolate effectiveness study outcomes.	**Primary analysis:** €18200 (£14,510) per LY gained. €19900 (£16,000) per QALY gained. **Secondary analysis:** Threshold is 30 out of 1000 smokers prevented.	**Limitations identified by authors:** 1. Experimental smoking assumed to be the same as daily smoking. 2. Based on a single trial. 3. Results may not be valid in other settings. **Limitations identified by review team**: 1. Self-reported smoking status. 2. LYs/QALYs gained reported in Table 2 may not have been discounted as reported. **Evidence gaps and/or recommendations for future research:** Need for more randomised clinical trials of smoking prevention.

Study details	Population and setting	Intervention/comparator	Outcomes and methods of analysis	Results	Notes
Population - partially applicable. Methodology – applicable.	effectiveness study (Dijkstra et al. 99).				**Source of funding:** RIVM.

3.4.3 'Cost-effectiveness of a School-Based Tobacco-Use Prevention Program.'(Wang et al. 01)

Study details	Population and setting	Intervention/comparator	Outcomes and methods of analysis	Results	Notes
Authors: Wang et al. **Year:** 2001 **Aim of study:** To determine the cost-effectiveness of the Project Towards No Tobacco Use. **Type of Economic Analysis:** Cost-effectiveness **Economic Perspective:** Medical costs only **Study Quality:** + **Applicability:** Population – largely inapplicable.	**Source population/s:** United States (developed country, mainly private health care). Grade 7-8 students (~12-13 years old). 50% male. 60% white, 27% Hispanic, 7% black, 6% Asian/other. Socio-economic status controlled for at randomisation but not reported. Baseline smoking prevalence: 6% (weekly), 40% (trial). **Setting:** Classroom based. **Data Sources:** Project Towards No Tobacco Use	**Intervention/s description:** 10-lesson curricula at grade 7, 2-lesson booster at grade 8. Combined curricula (physical consequences, information social influence and normative social influence). **Comparator/Control/s description:** Status quo **Sample sizes:** Combined intervention: 1234 at baseline, 770 at follow-up Control: 1956 at baseline, 1565 at follow-up Model cohort: 770.	**Primary Outcomes** Discounted cost per LY and QALY gained. **Secondary outcomes** None. **Time Horizon:** Lifetime (implicit). **Discount Rates:** **3%** **Modelling Method:** Decision tree model.	**Primary analysis:** Cost saving if medical costs are included. If medical costs are excluded, then $703 (£560) per LY gained and $448 (£360) per QALY gained. **Secondary analysis:** None.	**Limitations identified by authors:** 1. Costs estimated rather than prospectively measured. 2. Number of established smokers prevented was modelled rather than directly measured. 3. Probability of smoking uptake by non-smokers was estimated from a single source of data. 4. Probability of experimenters becoming established smokers was assumed. 5. Probability that non-smokers in the intervention group assumed to be the same in the control and intervention group. 6. Effectiveness of intervention beyond 2 years not considered.

Study details	Population and setting	Intervention/comparator	Outcomes and methods of analysis	Results	Notes
Methodology – applicable.	effectiveness study (Dent et al. 95). Data from the combined curricula were used.				7. Effectiveness of the intervention on smokeless tobacco use not considered. 8. Costs due to passive smoking, smoking-related fires and maternal smoking on infants' health not considered. **Limitations identified by review team**: 1. Assumption about staff numbers and time needed appear to be over-optimistic. 2. Cost of loss of work due to smoking-related morbidity or reduced life expectancy not considered. 3. Health outcomes in Table 2 do not appear to be discounted even though they are reported as discounted. **Evidence gaps and/or recommendations for future research:** Prevalence of established smokers needs to be examined in studies. Research into stages of

Study details	Population and setting	Intervention/comparator	Outcomes and methods of analysis	Results	Notes
					smoking establishment, medical costs of smoking and life expectancy changes due to smoking. Inclusion of intervention costs in published reports of effectiveness studies. **Source of funding:** Not stated.

3.4.4 'What we can—and cannot—expect from school-based drug prevention.' (Caulkins et al. 04)

Study details	Population and setting	Intervention/comparator	Outcomes and methods of analysis	Results	Notes
Authors: Caulkins **Year:** 2004 **Aim of study:** Compare costs and benefits of school-based universal drug prevention programmes. **Type of Economic Analysis:** Cost-benefit **Economic Perspective:** Societal **Study Quality:** -	**Source population/s:** United States (developed country, mainly private health care). School students under age 18. **Setting:** Classroom based. **Data Sources:** Review of literature.	**Intervention/s description:** Universal drug prevention programme with 30-hour curriculum. **Comparator/Control/s description:** Status quo. **Sample sizes:** Not applicable.	**Primary Outcomes** Costs and benefits of intervention **Secondary outcomes** None **Time Horizon:** Lifetime (implicit) **Discount Rates:** 4% **Modelling Method:** Simple spreadsheet model and linear regression.	**Primary analysis:** Costs: $150 (£82) per participant Benefits: $300 (£160) per participant for smoking prevention, $840 (£460) for prevention of all drugs considered. Benefit-cost ratio: 2.0 (5.6 if prevention of all drugs considered). **Secondary analysis:** None	**Limitations identified by authors:** 1. Reduction in heroin, LSD, ecstasy and date rape drugs not considered. 2. Job-related productivity losses not considered. 3. Benefits not directly related to drug use such as reduced sexual activity, increased school retention and graduation not considered. **Limitations identified by review team**: 1. Analysis based on total packs smoked over lifetime and not actual smokers. 2. Probabilistic sensitivity analysis poorly described. **Evidence gaps and/or recommendations for future**

Study details	Population and setting	Intervention/comparator	Outcomes and methods of analysis	Results	Notes
Applicability: Population – largely inapplicable. Methodology – partially applicable.					**research:** Evaluation of drug prevention programmes should include educational value. **Source of funding:** Robert Wood Johnson Foundation and Ford Foundation.

3.4.5 'School-based Smoking Prevention: Economic Costs Versus Benefits.' (Stephens et al. 00)

Study details	Population and setting	Intervention/comparator	Outcomes and methods of analysis	Results	Notes
Authors: Stephens *et al*. **Year:** 2000 **Aim of study:** To conduct a cost-benefit analysis of school-based smoking prevention programmes. **Type of Economic Analysis:** Cost-benefit **Economic Perspective:** Societal **Study Quality:** -	**Source population/s:** Canada (developed country, publicly funded health system). Grade 6-9 students (~10-13 years old). **Setting:** Classroom based **Data Sources:** Costs from previously published recommendations about an effective programme. Effects from CDC/Battelle model.	**Intervention/s description:** 10 teacher-led sessions of 30-45 minutes over 4 years. **Comparator/Control/s description:** Status quo. **Sample sizes:** Not applicable – the model assumes a nationwide programme.	**Primary Outcomes** Discounted benefit-cost ratio of intervention. **Secondary outcomes** None. **Time Horizon:** Lifetime (implicit). **Discount Rates:** 4% "inflation". **Modelling Method:** Not stated; probably direct extrapolation of results at the end of effectiveness study.	**Primary analysis:** Benefit-cost ratio of 15.4 (17.7 for males, 13.1 for females, 2.9 if only direct costs are considered). **Secondary analysis:** None.	**Limitations identified by authors:** 1. Costs of environmental tobacco smoke, separate smoking areas, life insurance and smoking breaks ignored. 2. Deaths due to smoking assumed to occur after 45 years. 3. Average rather than age-dependent figures for wages used. 4. Quality of life considerations ignored. 5. Contribution of tobacco taxes not considered. **Limitations identified by review team**: 1. Changes in smoking prevalence assumed to be sustainable.

Study details	Population and setting	Intervention/comparator	Outcomes and methods of analysis	Results	Notes
Applicability: Population – partially applicable. Methodology – partially applicable.					2. Effect size in terms of prevalence reduction rather than uptake reduction. 2. No probabilistic sensitivity analysis. 3. Costs and benefits derived from heterogeneous sources. **Evidence gaps and/or recommendations for future research:** Not stated. **Source of funding:** Canadian Association for School Health.

3.4.6 'The Cost-Effectiveness of Intensive National School-Based Anti-Tobacco Education: Results from the Tobacco Policy Model.' (Tengs et al. 01)

Study details	Population and setting	Intervention/comparator	Outcomes and methods of analysis	Results	Notes
Authors: Tengs *et al*. **Year:** 2001 **Aim of study:** To assess the cost-effectiveness of intensive school-based social influence smoking prevention programmes. **Type of Economic Analysis:** Cost-effectiveness **Economic Perspective:** Societal **Study Quality:**	**Source population/s:** United States (developed country, largely private health care system). Grade 8 and 9 students. **Setting:** Classroom based **Data Sources:** Previously published effectiveness study.	**Intervention/s description:** Intensive smoking prevention programme. Towards No Tobacco Use programme used as exemplar – this is a social influences-based curriculum in the 7th grade with booster lessons in the 8th grade. **Comparator/Control/s description:** Status quo. **Sample sizes:** The model assumes a nationwide education programme.	**Primary Outcomes** Discounted cost per QALY and LY gained. **Secondary outcomes** None. **Time Horizon:** 25 years, 50 years. **Discount Rates:** 3%. **Modelling Method:** Use of the Tobacco Policy Model, a generic	**Primary analysis:** Under base case assumptions of 30% effectiveness dissipating by 4 years and a 50-year time horizon, the incremental cost-effectiveness ratios were $19,000 (£14,000) per QALY gained and $710,000 (£520,000) per LY gained. Sensitive to changes in effect size but robust to changes in cost, quality of life and mortality parameters. **Secondary analysis:** Not applicable	**Limitations identified by authors:** 1. Results will not hold for less effective interventions. 2. Does not consider future changes in smoking uptake, cessation or relapse rates. 3. Does not consider knock-on effects (smokers may influence their peers to smoke). 4. Does not model environmental tobacco smoke. 5. Race not taken into account. 6. Does not consider marginal effect together with other smoking prevention programmes. **Limitations identified by review team**:

Study details	Population and setting	Intervention/comparator	Outcomes and methods of analysis	Results	Notes
+ **Applicability:** Population – largely inapplicable. Methodology – partially applicable.			multiple cohort Markov model.		Although the reduction in the increase in smoking prevalence is assumed to dissipate after 1-4 years, the people who are prevented from smoking are assumed to stay as non-smokers. **Evidence gaps and/or recommendations for future research:** Need to consider other factors besides mortality when evaluating public health interventions. **Source of funding:** California Tobacco-Related Disease Research Programme and National Institute of Drug Abuse.

4 Discussion

As noted at the beginning of this report, the National Institute for Health and Clinical Excellence has been asked by the Department of Health to develop guidance on school-based smoking prevention programmes.

If such a programme is to be supported and funded through a budget limited health service, then it must be cost-effective compared to other possible programmes, bearing in mind the competing demands on health service funding. The main question addressed by this review is the cost-effectiveness or net benefit of school-based programmes aimed at preventing the uptake of smoking.

The articles reviewed have been divided into two groups. The first group consists of economic analyses alongside effectiveness studies, which analysed the outcomes of effectiveness studies of school-based interventions, but used modelling to extrapolate smoking outcomes to lifetime cost and health benefit implications. The second group consists of economic analyses of hypothetical interventions, which derived effect estimates of interventions based on a synthesis of results from several effectiveness studies and other sources of data. This category includes one study (1) which used an effectiveness study as an exemplar.

None of the studies were based on results from the UK and hence they were not were directly applicable. However, the three studies from Canada, Germany and the

Netherlands were based on populations with some similarities to the UK population in terms of health care system, educational system and socioeconomic indicators. Only one study (Vijgen et al. 08b) used an economic framework similar to the NICE reference case: cost-utility analysis using QALYs as the outcome measure, costs measured from a public sector perspective, and similar discount rate (4%). Another study (Wang et al. 01) could also be considered similar methodologically since it was based on a cost-utility analysis with a 3% discount rate. Only medical costs were included, although this would have included out-of-pocket expenses and expenses covered by private insurance than are not considered in the NICE reference case. Overall, the study by Vijgen and co-workers (Vijgen et al. 08b) can be considered the most applicable from both population and methodological viewpoints.

Two studies (Caulkins et al. 04;Wang et al. 01) are highly unrepresentative outliers in terms of the cost of intervention. The former is a study that made very optimistic assumptions about the number of staff needed to deliver the intervention, while the latter is an analysis of a generic drug prevention programme. Excluding these two studies, the cost of the intervention appears to be fairly consistent between studies, ranging from C$67 (£30)(Stephens et al. 00) to €75 (£60)(Vijgen et al. 08b) per participant. However, even the models based on effectiveness studies relied on aggregated parameters in the published literature and assumptions, rather than obtaining primary data from the actual trials. For instance, one of the unrepresentative studies, by Wang and co-workers (Wang et al. 01), estimated the intervention cost of Project Towards No Tobacco Use to be only $13 (£9) per participant, assuming that two health educators could deliver the intervention to 1,234 participants in eight schools. However, Tengs and co-workers (Tengs et al. 01) costed the same project at $48-50 (£33-35) per participant, because they assumed that one health educator could only deliver the intervention to two classes.

All of the studies suggested that the modelled interventions would be an efficient use of resources. The three cost-benefit analyses suggested that the modelled intervention would be of net benefit, with the benefit/cost ratio ranging from 2.0 (Caulkins et al. 04) to 15.4 (Stephens et al. 00), although the smaller figure represented a generic drug prevention programme rather than a smoking prevention programme. The three cost-effectiveness analyses suggested that under base case assumptions the modelled intervention was cost-effective under both a threshold of £20,000 per QALY gained and the relevant threshold applied in the country of the study. However, the actual cost per QALY gained in the three studies varied widely. An American study (Wang et al. 01) suggested it may be as low as $448 (£360), due to optimistic findings about the staff time needed to deliver the intervention, while the other two studies (Vijgen et al. 08b) (Tengs et al. 01) estimated cost-effectiveness ratios of €19,900 (£16,000) and $19,000 (£14,000) respectively.

However, there are several issues that limit the applicability of these findings. Firstly, the studies that looked at indirect costs (such as lost productivity due to premature death and smoking related morbidity) found this to be the source of the majority of cost savings due to the intervention. These appear as benefits in a cost-benefit analysis and as cost savings in a cost-effectiveness analysis when costed from a societal perspective. One cost-benefit analysis (Hoeflmayr et al. 08) estimated that 86% of benefits were indirect. However, NICE recommends the use of cost-effectiveness analysis using a public sector perspective on costs for its reference case, and hence these benefits would be excluded.

There are also issues with the ways in which the effect of interventions were modelled. The analyses can be divided into two categories for this purpose. Most studies (Hoeflmayr et al. 08;Vijgen et al. 08b;Wang et al. 01;Stephens et al. 00) assumed that the intervention would reduce the prevalence of smoking in the intervention group by a constant percentage, compared to the control group. This method may be acceptable in an economic evaluation of an effectiveness study. However, it limits the validity of the model in settings where the baseline smoking prevalence and rate of smoking uptake in

the age groups affected by the intervention may differ from that in the study. Two of the studies (Caulkins et al. 04;Tengs et al. 01), both based on hypothetical interventions, took a different approach that arguably has greater validity to different settings. These two studies assumed that the intervention would decrease the rate of smoking uptake in the affected age groups; that is, that the annual increase in smoking prevalence in the intervention group would be a fixed proportion of that in the control group. Hence, if the models were used in a setting with a different pre-intervention rate of smoking uptake, the absolute difference in smoking prevalence between control and intervention groups would be greater, as might be expected.

Of the two studies that took the second approach of modelling a decrease in the rate of smoking uptake, the study by Caulkins and co-workers (Caulkins et al. 04) is arguably more realistic. This is because it assumed that the effect of the intervention only lasted until the age of 18, after which it dissipated. In other words, the participants who were prevented from smoking by the intervention were assumed to initiate smoking at age 18. However, the delayed age of smoking initiation was assumed to have an impact on lifetime use, as suggested by an American household survey on drug abuse. In contrast, the five other studies all assumed that the participants deterred from smoking by the intervention were no more likely to subsequently take up smoking than non-smokers in the control group. However, effectiveness studies with long-term follow up suggest that the effects of school-based smoking prevention programmes disappear after school leaving age (Wiehe et al. 05).

In conclusion, this review indicates that none of the six articles published since 1990 about economic evaluation of school-based smoking prevention is entirely valid for decision-making in the UK. Such a decision needs to be informed by a cost-effectiveness model that uses the discount rate, costing perspective, type of economic evaluation and baseline epidemiological features of the UK population. In order for the effect of an

intervention not to be overestimated, the model needs to admit the possibility that the intervention may simply delay the onset of smoking initiation without reducing the long-term risk of initiating smoking.

Appendix 1: Search strategies for the main searches

Cochrane Library (Wiley) 2008 Issue 4

#1	young next people*
#2	young next person*
#3	young next adult*
#4	adolescent*
#5	youth*
#6	teenage*
#7	girl*
#8	boy*
#9	MeSH descriptor Adolescent explode all trees
#10	child*
#11	(#1 OR #2 OR #3 OR #4 OR #5 OR #6 OR #7 OR #8 OR #9 OR #10)
#12	school*
#13	academy
#14	academies
#15	city next technology
#16	sixth next form*
#17	education next centre*
#18	secure next unit*

#19 training next unit*

#20 secure next training

#21 referral next unit*

#22 offender near/1 institute*

#23 further next education

#24 MeSH descriptor Schools explode all trees

#25 (#12 OR #13 OR #14 OR #15 OR #16 OR #17 OR #18 OR #19 OR #20 OR #21 OR #22 OR #23 OR #24)

#26 health next promotion

#27 health next education

#28 primary next prevention

#29 MeSH descriptor Health Education explode all trees

#30 MeSH descriptor Health Promotion explode all trees

#31 MeSH descriptor Primary Prevention explode all trees

#32 campaign* or teach* or advis* or counsel* or promot* or encourag*

#33 program* or lectur* or train* or workshop* or seminar* or lesson* or learn* or curricul* or course* or educat*

#34 (#26 OR #27 OR #28 OR #29 OR #30 OR #31 OR #32 OR #33)

#35 (#11 AND #25 AND #34)

#36 smoking

#37 MeSH descriptor Smoking explode all trees

#38 smok*

#39 tobacco*

#40 cigarette*

#41 nicotine*

#42 (prevent* or abstain* or abstin* or stop* or discourag* or anti* or no or non) near/2 (smok*)

#43 (#36 OR #37 OR #38 OR #39 OR #40 OR #41 OR #42)

#44 (#35 AND #43)

#45 <nothing>, from 1990 to 2008

#46 (#44 AND #45)

Database: Ovid MEDLINE(R) <1950 to November Week 1 2008>

Search Strategy:

---

1 young people.mp.

2 young person$.mp.

3 young adult$.mp.

4 adolescent$.mp.

5 youth$.mp.

6 teenage$.mp.

7 girl$.mp.

8 boy$.mp.

9 exp Adolescent/

10 Child/

11 child$.mp.

12 or/1-11

13 exp Schools/

14 academy.mp.

15 academies.mp.

16 city technology.mp.

17 sixth form$.mp.

18 education centre$.mp.

19 secure unit$.mp.

20 training unit$.mp.

21 secure training.mp.

22 referral unit$.mp.

23 school$.mp.

24 (offender$ adj institute$).mp.

25 further education.mp.

26 or/13-25

27 26 and 12

28 health promotion.mp. or exp Health Promotion/

29 health education.mp. or exp Health Education/

30 primary prevention.mp. or exp Primary Prevention/

31 (campaign or teach$ or advis$ or counsel$ or promot$ or encourag$).mp.

32 (program$ or lectur$ or train$ or workshop$ or seminar$ or lesson$ or learn$ or curricul$ or course$ or educat$).mp.

33 or/28-32

34 27 and 33

35 exp Smoking/ or smoking.mp.

36 smok$.mp.

37 tobacco$.mp.

38 cigarette$.mp.

39 nicotine$.mp.

40 ((prevent$ or abstain$ or abstin$ or stop$ or discourag$ or anti$ or no or non) adj2 smok$).mp.

41 or/35-40

42 34 and 41

43 limit 42 to (english language and yr="1990 - 2008")

Database: Ovid MEDLINE(R) In-Process & Other Non-Indexed Citations <November 12, 2008>

Search Strategy:

---

1 young people.mp.

2 young person$.mp.

3 young adult$.mp.

4 adolescent$.mp.

5 youth$.mp.

6 teenage$.mp.

7 girl$.mp.

8 boy$.mp.

9 child$.mp.

10 or/1-9

11 school$.mp.

12 academy.mp.

13 academies.mp.

14 city technology.mp.

15 sixth form$.mp.

16 education centre$.mp.

17 secure unit$.mp.

18 training unit$.mp.

19 secure training.mp.

20 referral unit$.mp.

21 (offender$ adj institute$).mp.

22 further education.mp.

23 or/11-22

24 health promotion.mp.

25 health education.mp.

26 primary prevention.mp.

27 (campaign or teach$ or advis$ or counsel$ or promot$ or encourag$).mp.

28 (program$ or lectur$ or train$ or workshop$ or seminar$ or lesson$ or learn$ or curricul$ or course$ or educat$).mp.

29 or/24-28

30 23 and 10 and 29

31 smoking.mp.

32 smok$.mp.

33 tobacco$.mp.

34 cigarette$.mp.

35 nicotine$.mp.

36 ((prevent$ or abstain$ or abstin$ or stop$ or discourag$ or anti$ or no or non) adj2 smok$).mp.

37 or/31-36

38 37 and 30

39 limit 38 to (english language and yr="1990 - 2008")

Database: EMBASE <1980 to 2008 Week 45>

Search Strategy:

---

1 young people.mp.

2 young person$.mp.

3 young adult$.mp.

4 Adolescent/

5 adolescent$.mp.

6 youth$.mp. or exp Juvenile/

7 teenage$.mp.

8 girl$.mp. or exp GIRL/

9 boy$.mp. or exp BOY/

10 Child/

11 child$.mp.

12 or/1-11

13 school$.mp.

14 academy.mp.

15 academies.mp.

16 city technology.mp.

17 sixth form$.mp.

18 education centre$.mp.

19 secure unit$.mp.

20 training unit$.mp.

21 secure training.mp.

22 referral unit$.mp.

23 (offender$ adj institute$).mp.

24 further education.mp.

25 or/13-24

26 health promotion.mp. or exp Health Promotion/

27 health education.mp. or exp Health Education/

28 primary prevention.mp. or exp Primary Prevention/

29 (campaign$ or teach$ or advis$ or counsel$ or promot$ or encourag$).mp.

30 (program$ or lectur$ or train$ or workshop$ or seminar$ or lesson$ or learn$ or curricul$ or course$ or educat$).mp.

31 or/26-30

32 25 and 31 and 12

33 exp SMOKING/ or smoking.mp.

34 smok$.mp.

35 tobacco$.mp.

36 cigarette$.mp.

37 nicotine$.mp.

38 ((prevent$ or abstain$ or abstin$ or stop$ or discourag$ or anti or no or non) adj2 smok$).mp.

39 or/33-38

40 32 and 39

41 limit 40 to (english language and yr="1990 - 2008")

Database: PsycINFO <1987 to November Week 2 2008>

Search Strategy:

---

1 young people$.mp.

2 young person$.mp.

3 young adult$.mp.

4 adolescent$.mp.

5 youth.mp.

6 teenage$.mp.

7 girl$.mp.

8 boy$.mp.

9 child$.mp.

10 or/1-9

11 school$.mp. or exp Schools/

12 academy.mp.

13 academies.mp.

14 city technology.mp.

15 sixth form$.mp.

16 education centre$.mp.

17 secure unit$.mp.

18 training unit$.mp.

19 secure training.mp.

20 referral unit$.mp.

21 or/11-20

22 21 and 10

23 health promotion.mp. or exp Health Promotion/

24 health education.mp. or exp Health Education/

25 primary prevention.mp.

26 (campaign$ or teach$ or advis$ or counsel$ or promot$ or encourag$).mp.

27 (program$ or lectur$ or train$ or workshop$ or seminar$ or lesson$ or learn$ or curricul$ or cours$ or educat$).mp.

28 or/23-27

29 22 and 28

30 smoking.mp. or exp Tobacco Smoking/

31 smok$.mp.

32 tobacco$.mp.

33 cigarette$.mp.

34 exp Nicotine/ or nicotine$.mp.

35 ((prevent$ or abstain$ or abstin$ or stop$ or discourag$ or anti or no or non) adj2 smok$).mp.

36 or/30-35

37 36 and 29

38 limit 37 to (english language and yr="1990 - 2008")

Database: HMIC Health Management Information Consortium < October 2008 >

Search Strategy:

---

1 young people$.mp. or exp YOUNG PEOPLE/

2 young person$.mp.

3 young adult$.mp. or exp YOUNG ADULTS/

4 adolescent$.mp.

5 youth.mp.

6 teenage$.mp.

7 girl$.mp. or exp GIRLS/

8 boy$.mp. or exp BOYS/

9 child$.mp.

10 or/1-9

11 exp schools/

12 school$.mp.

13 academy.mp.

14 academies.mp.

15 city technology.mp.

16 sixth form$.mp.

17 education centre$.mp.

18 secure unit$.mp.

19 training unit$.mp.

20 secure training.mp.

21 referral unit$.mp.

22 or/11-21

23 22 and 10

24 health promotion.mp. or exp HEALTH PROMOTION/

25 health education.mp. or exp HEALTH EDUCATION/

26 primary prevention.mp.

27 (campaign$ or teach$ or advis$ or counsel$ or promot$ or encourag$).mp.

28 (program$ or lectur$ or train$ or workshop$ or seminar$ or lesson$ or learn$ or curricul$ or course$ or educat$).mp.

29 or/24-28

30 22 and 29

31 exp ANTI SMOKING CAMPAIGNS/ or exp SMOKING/ or smoking.mp.

32 smok$.mp.

33 tobacco$.mp.

34 cigarette$.mp.

35 nicotine$.mp.

36 ((prevent$ or abstain$ or abstin$ or stop$ or discourag$ or anti or no or non) adj2 smok$).mp.

37 or/31-36

38 37 and 30

39 limit 38 to yr="1990 - 2008"

Wed Nov 12 6:21:52 EST 2008

CSA

Database: ERIC

Query: (young people or young person* or young adult* or adolescent* or youth or teenage* or girl* or boy* or child*) and (school* or academy or academies or city technology or sixth form* or education centre* or secure unit* or training unit* or secure training or training unit* or secure training or referral unit*) and (health promotion or health education or primary prevention or campaign* or teach* or advis* or counsel* or promot* or encourag* or program* or lecture* or train* or workshop* or seminar* or lesson* or learn* or curricul* or course* or educat*) and (smok* or smoking or tobaccco* or cigarette* or nicotine*) or (prevent* or abstin* or stop* or discourag* or anti or no or non) and (smok*)

Limit to : English language and yr= 1990-2008

Fri Nov 14 7:54:50 EST 2008

CSA

Database: ASSIA: Applied Social Sciences Index and Abstracts

Query: ((young people) or (young person*) or (young adult*) or adolescent* or youth or teenage* or girl* or boy* or child*) and (school* or academy or academies or (city technology) or (sixth form*) or (education centre*) or (secure unit*) or (training unit*) or (referral unit*)) and ((health promotion) or (health education) or (primary prevention) or campaign* or teach* or advis* or counsel* or promot* or encourag* or program* or lecture* or train* or workshop* or seminar* or lesson* or learn* or curricul* or course* or educat*) and (smok* or smoking or tobacco or

cigarette* or nicotine*) or (prevent* or abstin* or stop* or discourag*

or anti or no or non) and smok*

Limit to : English language and yr= 1990-2008

Appendix 2: Search strategies for cost-effectiveness searches

Database: Ovid MEDLINE(R) <1950 to November Week 1 2008>

Search Strategy:

---

1 young people.mp.

2 young person$.mp.

3 young adult$.mp.

4 adolescent$.mp.

5 youth$.mp.

6 teenage$.mp.

7 girl$.mp.

8 boy$.mp.

9 exp Adolescent/

10 Child/

11 child$.mp.

12 or/1-11

13 exp Schools/

14 academy.mp.

15 academies.mp.

16 city technology.mp.

17 sixth form$.mp.

18 education centre$.mp.

19 secure unit$.mp.

20 training unit$.mp.

21 secure training.mp.

22 referral unit$.mp.

23 school$.mp.

24 (offender$ adj institute$).mp.

25 further education.mp.

26 or/13-25

27 26 and 12

28 health promotion.mp. or exp Health Promotion/

29 health education.mp. or exp Health Education/

30 primary prevention.mp. or exp Primary Prevention/

31 (campaign or teach$ or advis$ or counsel$ or promot$ or encourag$).mp.

32 (program$ or lectur$ or train$ or workshop$ or seminar$ or lesson$ or learn$ or curricul$ or course$ or educat$).mp.

33 or/28-32

34 27 and 33

35 exp Smoking/ or smoking.mp.

36 smok$.mp.

37 tobacco$.mp.

38 cigarette$.mp.

39 nicotine$.mp.

40 ((prevent$ or abstain$ or abstin$ or stop$ or discourag$ or anti$ or no or non) adj2 smok$).mp.

41 or/35-40

42 34 and 41

43 limit 42 to (english language and yr="1990 - 2008")

44 economics/

45 exp "costs and cost analysis"/

46 cost of illness/

47 exp health care costs/

48 economic value of life/

49 exp economics medical/

50 exp economics hospital/

51 economics pharmaceutical/

52 exp "fees and charges"/

53 (econom$ or cost or costs or costly or costing or price or pricing or pharmacoeconomic$).tw.

54 (expenditure$ not energy).tw.

55 (value adj1 money).tw.

56 budget$.tw.

57 or/44-56

58 57 and 43

Database: Ovid MEDLINE(R) <1950 to November Week 1 2008>

Search Strategy:

---

1 young people.mp.

2 young person$.mp.

3 young adult$.mp.

4 adolescent$.mp.

5 youth$.mp.

6 teenage$.mp.

7 girl$.mp.

8 boy$.mp.

9 exp Adolescent/

10 Child/

11 child$.mp.

12 or/1-11

13 exp Schools/

14 academy.mp.

15 academies.mp.

16 city technology.mp.

17 sixth form$.mp.

18 education centre$.mp.

19 secure unit$.mp.

20 training unit$.mp.

21 secure training.mp.

22 referral unit$.mp.

23 school$.mp.

24 (offender$ adj institute$).mp.

25 further education.mp.

26 or/13-25

27 26 and 12

28 health promotion.mp. or exp Health Promotion/

29 health education.mp. or exp Health Education/

30 primary prevention.mp. or exp Primary Prevention/

31 (campaign or teach$ or advis$ or counsel$ or promot$ or encourag$).mp.

32 (program$ or lectur$ or train$ or workshop$ or seminar$ or lesson$ or learn$ or curricul$ or course$ or educat$).mp.

33 or/28-32

34 27 and 33

35 exp Smoking/ or smoking.mp.

36 smok$.mp.

37 tobacco$.mp.

38 cigarette$.mp.

39 nicotine$.mp.

40 ((prevent$ or abstain$ or abstin$ or stop$ or discourag$ or anti$ or no or non) adj2 smok$).mp.

41 or/35-40

42 34 and 41

43 limit 42 to (english language and yr="1990 - 2008")

44 decision support techniques/

45 markov.mp.

46 exp models economic/

47 decision analysis.mp.

48 cost benefit analysis/

49 or/44-48

50 49 and 43

Database: Ovid MEDLINE(R) <1950 to November Week 1 2008>

Search Strategy:

---

1 young people.mp.

2 young person$.mp.

3 young adult$.mp.

4 adolescent$.mp.

5 youth$.mp.

6 teenage$.mp.

7 girl$.mp.

8 boy$.mp.

9 exp Adolescent/

10 Child/

11 child$.mp.

12 or/1-11

13 exp Schools/

14 academy.mp.

15 academies.mp.

16 city technology.mp.

17 sixth form$.mp.

18 education centre$.mp.

19 secure unit$.mp.

20 training unit$.mp.

21 secure training.mp.

22 referral unit$.mp.

23 school$.mp.

24 (offender$ adj institute$).mp.

25 further education.mp.

26 or/13-25

27 26 and 12

28 health promotion.mp. or exp Health Promotion/

29 health education.mp. or exp Health Education/

30 primary prevention.mp. or exp Primary Prevention/

31 (campaign or teach$ or advis$ or counsel$ or promot$ or encourag$).mp.

32 (program$ or lectur$ or train$ or workshop$ or seminar$ or lesson$ or learn$ or curricul$ or course$ or educat$).mp.

33 or/28-32

34 27 and 33

35 exp Smoking/ or smoking.mp.

36 smok$.mp.

37 tobacco$.mp.

38 cigarette$.mp.

39 nicotine$.mp.

40 ((prevent$ or abstain$ or abstin$ or stop$ or discourag$ or anti$ or no or non) adj2 smok$).mp.

41 or/35-40

42 34 and 41

43 limit 42 to (english language and yr="1990 - 2008")

44 quality of life/

45 life style/

46 health status/

47 health status indicators/

48 quality-adjusted life years/

49 "Value of Life"/

50 SF$.mp.

51 EQ-5D.mp.

52 TTO.mp.

53 Time trade off.mp.

54 HUI$.mp.

55 health utilit$.tw.

56 or/44-55

57 56 and 43

Database: EMBASE <1980 to 2008 Week 46>

Search Strategy:

---

1 young people.mp.

2 young person$.mp.

3 young adult$.mp.

4 Adolescent/

5 adolescent$.mp.

6 youth$.mp. or exp Juvenile/

7 teenage$.mp.

8 girl$.mp. or exp GIRL/

9 boy$.mp. or exp BOY/

10 Child/

11 child$.mp.

12 or/1-11

13 school$.mp.

14 academy.mp.

15 academies.mp.

16 city technology.mp.

17 sixth form$.mp.

18 education centre$.mp.

19 secure unit$.mp.

20 training unit$.mp.

21 secure training.mp.

22 referral unit$.mp.

23 (offender$ adj institute$).mp.

24 further education.mp.

25 or/13-24

26 health promotion.mp. or exp Health Promotion/

27 health education.mp. or exp Health Education/

28 primary prevention.mp. or exp Primary Prevention/

29 (campaign$ or teach$ or advis$ or counsel$ or promot$ or encourag$).mp.

30 (program$ or lectur$ or train$ or workshop$ or seminar$ or lesson$ or learn$ or curricul$ or course$ or educat$).mp.

31 or/26-30

32 25 and 31 and 12

33 exp SMOKING/ or smoking.mp.

34 smok$.mp.

35 tobacco$.mp.

36 cigarette$.mp.

37 nicotine$.mp.

38 ((prevent$ or abstain$ or abstin$ or stop$ or discourag$ or anti or no or non) adj2 smok$).mp.

39 or/33-38

40 32 and 39

41 limit 40 to (english language and yr="1990 - 2008")

42 cost benefit analysis/

43 cost effectiveness analysis/

44 cost minimization analysis/

45 cost utility analysis/

46 economic evaluation/

47 (cost or costs or costed or costly or costing).tw.

48 (economic$ or pharmacoeconomic$ or price$ or pricing).tw.

49 (technology adj assessment$).tw.

50 or/42-49

51 50 and 41

Database: EMBASE <1980 to 2008 Week 46>

Search Strategy:

---

1 young people.mp.

2 young person$.mp.

3 young adult$.mp.

4 Adolescent/

5 adolescent$.mp.

6 youth$.mp. or exp Juvenile/

7 teenage$.mp.

8 girl$.mp. or exp GIRL/

9 boy$.mp. or exp BOY/

10 Child/

11 child$.mp.

12 or/1-11

13 school$.mp.

14 academy.mp.

15 academies.mp.

16 city technology.mp.

17 sixth form$.mp.

18 education centre$.mp.

19 secure unit$.mp.

20 training unit$.mp.

21 secure training.mp.

22 referral unit$.mp.

23 (offender$ adj institute$).mp.

24 further education.mp.

25 or/13-24

26 health promotion.mp. or exp Health Promotion/

27 health education.mp. or exp Health Education/

28 primary prevention.mp. or exp Primary Prevention/

29 (campaign$ or teach$ or advis$ or counsel$ or promot$ or encourag$).mp.

30 (program$ or lectur$ or train$ or workshop$ or seminar$ or lesson$ or learn$ or curricul$ or course$ or educat$).mp.

31 or/26-30

32 25 and 31 and 12

33 exp SMOKING/ or smoking.mp.

34 smok$.mp.

35 tobacco$.mp.

36 cigarette$.mp.

37 nicotine$.mp.

38 ((prevent$ or abstain$ or abstin$ or stop$ or discourag$ or anti or no or non) adj2 smok$).mp.

39 or/33-38

40 32 and 39

41 limit 40 to (english language and yr="1990 - 2008")

42 quality adjusted life.ti,ab.

43 (qaly$ or qald$ or qale$).mp. or qtime$.ti,ab.

44 health status indicators/

45 health utili$.tw.

46 time trade off.tw.

47 time tradeoff.tw.

48 tto.tw.

49 "Quality of Life"/

50 value of life.mp.

51 cost utilit$.tw.

52 exp Lifestyle/

53 sf$.tw.

54 hui$.tw.

55 eq5d.tw.

56 or/42-55

57 56 and 41

EconLit strategy schoolsmoking EconLit 19/11/2008

(young person*) or (young people*) or (young adult*) or (adolescent*) or (youth*) or (teenage*) or (girl*) or (boy*) or (child*)

AND

(school*) or (academies) or (academy) or (city technology) or (sixth form*) or (education centre*) or (secure unit*) or (training unit*) or (secure training) or (referral unit*) or (offender* institut*) or (further education)

AND

(health promotion) or (health education) or (primary prevention) or (campaign*)or (teach*) or (advis*) or (counsel*) or (promot*) or (encourag*) or (program*) or (lectur*) or (train*) or (workshop*) or (seminar*) or (lesson*) or (learn*) or (curricul*) or (course*) or (educat*)

AND

(smoking) or (smok*) or (tobacco*) or (cigarette*) or (nicotine*) or (prevent* or abstain* or abstin* or stop* or discourag* or anti or no or non) and (smok*)

Appendix 3: Sifting checklist – criteria for identifying potentially relevant articles using title/abstract

School-based intervention to prevent smoking sifting criteria – applied to title and abstract of search results

Q1	Is the full paper in English and published from 1990 onwards?	YES / UNCLEAR	Go to Q2	**Reference Manager labelling**
		NO	Exclude	
Q2	Does the study address prevention of uptake of smoking in children?	YES / UNCLEAR	Go to Q3	
		NO	Exclude	
Q3	Was the study carried out in an OECD country?	YES / UNCLEAR	Go to Q4	
		NO	Exclude	
Q4	Is it a school-based intervention or is there a school-based component within a combined intervention?	YES / UNCLEAR	Go to Q5	
		NO	Exclude	
Q5	Is there reporting of outcomes (quantitative or qualitative)?	YES / UNCLEAR	RELEVANT (TAG)	USER DEF 2= get paper

		NO	Exclude	

Member countries of the Organisation for Economic Co-operation and Development (OECD):

Australia	Austria
Belgium	Canada
Czech Republic	Denmark
Finland	France
Germany	Greece
Hungary	Iceland
Ireland	Italy
Japan	Korea
Luxembourg	Mexico
Netherlands	New Zealand
Norway	Poland
Portugal	Slovak Republic
Spain	Sweden
Switzerland	Turkey
United Kingdom	United States

Source: http://www.oecd.org/

Appendix 4: Example Completed Quality Assessment Checklist

Methodology checklist for economic evaluations (Hoeflmayr and Hanewinkel, 2008)

The criteria used in this checklist are extracted from Drummond MF et al. (1997) Critical assessment of economic evaluation. In: Methods for the Economic Evaluation of Health Care Programmes 2nd edition. Oxford: Oxford Medical Publications. Explanatory notes on these criteria are available from the publication.

Study identification:		
Evaluation criterion		**Comments**
1	**Was a well-defined question posed in answerable form?**	
1.1	Did the study examine both costs and effects of the service(s) or programme(s)?	Yes
1.2	Did the study involve a comparison of alternatives?	Yes
1.3	Was a viewpoint for the analysis stated and was the study placed in any particular decision-making context?	Yes
2	**Was a comprehensive description of the competing alternatives given (that is, can you tell who? did what? to whom? where? and how often?)?**	
2.1	Were any important alternatives omitted?	No
2.2	Was (should) a do-nothing alternative (be)	Yes

	considered?	
3	**Was the effectiveness of the programmes or services established?**	
3.1	Was this done through a randomised, controlled clinical trial? If so, did the trial protocol reflect what would happen in regular practice?	No (non-randomised controlled trial) Yes
3.2	Was effectiveness established through an overview of clinical studies?	No
3.3	Were observational data or assumptions used to established effectiveness? If so, what are the potential biases in results?	No – an experimental study was used. However, results were extrapolated beyond the follow-up period.

4	**Were all the important and relevant costs and consequences for each alternative identified?**	
4.1	Was the range wide enough for the research question at hand?	Yes – it included costs to the central agency managing the programme, region and local government offices, schools and students participating in the programme.
4.2	Did it cover all relevant viewpoints? (Possible viewpoints include the community or social viewpoint, and those of patients and third-party payers.)	Yes – a societal viewpoint was taken as appropriate to a cost-benefit analysis.
4.3	Were capital costs, as well as operating costs, included?	Yes
5	**Were costs and consequences measured accurately in appropriate physical units (for example, hours of nursing time, number of physician visits, lost work-days, gained life-years)?**	
5.1	Were any of the identified items omitted from measurement? If so, does this mean that they carried no weight in the subsequent analysis?	No
5.2	Were there any special circumstances (for example, joint use of resources) that made measurement difficult? Were these circumstances handled appropriately?	No
6	**Were costs and consequences valued credibly?**	

6.1	Were the sources of all values clearly identified? (Possible sources include market values, patient or client preferences and views, policy-makers' views and health professionals' judgements.)	Yes
6.2	Were market values employed for changes involving resources gained or depleted?	Yes
6.3	Where market values were absent (for example, volunteer labour), or did not reflect actual values (for example, clinic space donated at reduced rate), were adjustments made to approximate market values?	Not applicable
6.4	Was the valuation of consequences appropriate for the question posed (that is, has the appropriate type or types of analysis – cost-effectiveness, cost-benefit, cost-utility – been selected)?	Yes
7	**Were costs and consequences adjusted for differential timing?**	
7.1	Were costs and consequences which occur in the future 'discounted' to their present values?	Yes
7.2	Was any justification given for the discount rate used?	No
8	**Was an incremental analysis of costs and consequences of alternatives performed?**	
8.1	Were the additional (incremental) costs generated by one alternative over another compared to the additional effects, benefits or utilities generated?	Yes
9	**Was allowance made for uncertainty in the estimates of costs and consequences?**	
9.1	If data on costs or consequences were stochastic, were appropriate statistical analyses performed?	Unclear (poorly described)
9.2	Were study results sensitive to changes in the values (within the assumed range for sensitivity analysis, or within the confidence interval around the ratio of costs to consequences)?	No

10	**Did the presentation and discussion of study results include all issues of concern to users?**	
10.1	Were the conclusions of the analysis based on some overall index or ratio of costs to consequences (for example, cost-effectiveness ratio)? If so, was the index interpreted intelligently or in a mechanistic fashion?	Yes
10.2	Were the results compared with those of others who have investigated the same question? If so, were allowances made for potential differences in study methodology?	Yes/Yes
10.3	Did the study discuss the generalisability of the results to other settings and patient/client groups?	No
10.4	Did the study allude to, or take account of, other important factors in the choice or decision under consideration (for example, distribution of costs and consequences, or relevant ethical issues)?	No
10.5	Did the study discuss issues of implementation, such as the feasibility of adopting the 'preferred' programme given existing financial or other constraints, and whether any freed resources could be redeployed to other worthwhile programmes?	No
OVERALL ASSESSMENT OF THE STUDY		
How well was the study conducted? *Code ++, + or –*		+
Are the results of this study directly applicable to the patient group targeted by this guideline?		Not applicable

++	All or most of the criteria have been fulfilled. Where they have not been fulfilled the conclusions of the study or review are thought very unlikely to alter.
+	Some of the criteria have been fulfilled. Those criteria that have not been fulfilled or not adequately described are thought unlikely to alter the conclusions.
–	Few or no criteria fulfilled The conclusions of the study are thought likely or very likely to alter.

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4. Caulkins,J.P., Pacula,R.L., Paddock,S., Chiesa,J., Caulkins,J.P., Pacula,R.L., Paddock,S., and Chiesa,J. 2004. What we can--and cannot--expect from school-based drug prevention. ***Drug & Alcohol Review,*** 23(1): 79-87.

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